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- See Reports -

SUBJECT: Forwards marked-up draft revised pages for FSAR Section 8.3, re rewrite,per 810722 request for addl info.Responses to Remaining Power Sys Branch questions will be submitted by 820131,per 811216-18 commitment.

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January 13, 1982
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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
SECTION 8.3 REWRITE

Reference: Letter, R. L. Tedesco to R. L. Ferguson, "WNP-2 - Request for Additional Information", dated July 22, 1981

Enclosed are sixty (60) copies of the draft revised pages for the WNP-2 FSAR Section 8.3 rewrite. Included in this enclosure is the response to NRC Question 040.088 which was transmitted to the Supply System by the reference letter.

Responses to the remaining Power Systems Branch Questions will be submitted to the NRC prior to January 31, 1982 as committed to in the PSB meeting December 16-18, 1981. Both the Section 8.3 rewrite and the NRC question will be included in Amendment 23.

Very truly yours,

GD Bouchey

G. D. Bouchey, Deputy Director
Safety & Security

CDT/ct
Enclosure

cc: R. Auluck - NRC
WS Chin - BPA
R. Feil - NRC-Site

B001
S 1/60

Q. 040.088
(9.5.7)
RSP

An emergency diesel generator unit in a nuclear power plant is normally in the ready standby mode unless there is a loss of offsite power, an accident, or the diesel generator is under test. Long periods on standby have a tendency to drain or nearly empty the engine lube oil piping system. On an emergency start of the engine as much as 5 to 14 or more seconds may elapse from the start of cranking until full lube oil pressure is attained even though full engine speed is generally reached in about five seconds. With an essentially dry engine, the momentary lack of lubrication at the various moving parts may damage bearing surfaces producing incipient or actual component failure with resultant equipment unavailability.

The emergency condition of readiness requires this equipment to attain full rated speed and enable automatic sequencing of electric load within ten seconds. For this reason, and to improve upon the availability of this equipment on demand, it is necessary to establish as quickly as possible an oil film in the wearing parts of the diesel engine. Lubricating oil is normally delivered to the engine wearing parts by one or more engine driven pump(s). During the starting cycle the pump(s) accelerates slowly with the engine and may not supply the required quantity of lubricating oil where needed fast enough. To remedy this condition, as a minimum, an electrically driven lubricating oil pump, powered from a reliable DC power supply, should be installed in the lube oil system to operate in parallel with the engine driven main lube pump. The electric driven prelube pump should operate only during the engine cranking cycle or until satisfactory lube oil pressure is established in the engine main lube distribution header. The installation of this prelube pump should be coordinated with the respective engine manufacturer. Some diesel engines include a lube oil circulating pump as an intregal part of the lube oil preheating system which is in use while the diesel engine is in the standby mode. In this case an additional prelube oil pump may not be needed.

Confirm your compliance with the above requirements or provide your justification for not installing an electric prelube oil pump.

Response:

The lube oil system for each diesel generator unit is provided with an independent AC motor driven circulating pump which is utilized to insure lubrication of the turbocharger bearings prior to engine start and the removal of residual heat from the turbocharger after engine shutdown, and in addition, this pump circulates the preheated oil through the oil system to keep the engine in a constant state of readiness. Each diesel generator unit (Division 1 and 2) is also provided with a standby DC motor driven soak-back pump redundant to the AC driven pump above.

However, the lube oil system for all the diesel generator units will be modified to improve its reliability during repeat start conditions and hence, will be in conformance with NUREG/CR-0660 recommendations.

no change

CHAPTER 8

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E 8.1-1

DIVISION 1 LOADS

Item Description	No. On Bus	Total hp/kW (3) Connected To Bus	Normal Operation	Forced (2) Shutdown
1) Motor-Operated Valves (5)	Set	200kW	-	-
2) Emergency Lighting and Power	Set	124kW	-	-
3) Diesel Auxiliaries and HVAC	Set	200kW	140kW	140kW
4) LPCS Water Leg Pump	1	15/12kW	12kW	12kW
5) Standby Liquid Control Pump (4)	1	40/33kW	33kW	-
6) RCIC Water Leg Pump	1	15/12kW	12kW	12kW
7) Fuel Pool Recirculation Pump (4)	1	50/40kW	40kW	40kW
8) Plant Service Water Pump A (4)	1	1500/1197kW	1197kW	1197kW
9) LPCS Pump	1	1500/1197kW	-	-
10) RHR Pump A	1	800/642kW	-	642kW
11) Standby Service Water Pump A	1	1750/1377kW	-	1377kW
12) Cooling Tower Makeup Water Pump (4)	2	1600/1270kW	635kW	635kW
13) Control Rod Drive Pump (4)	1	250/205kW	205kW	205kW
14) Reactor Closed Cooling Pump (4)	1	200/160kW	160kW	160kW
15) Load Center Transformer Losses	2	45kW	40kW	33kW
16) 250V Battery Charger (4)	1	165kW	165kW	165kW
17) 125V Battery Charger (4)	1	43kW	43kW	43kW
18) Uninterruptible Power Supply (4)	1	30kW	30kW	30kW
19) Standby Gas Treatment Fans and Heater Coils	2	50/93kW	-	-
20) RPS MG Set (4)	1	25/20kW	20kW	20kW
21) Hydrogen Recombiner	1	25/57kW	-	-
22) Drywell Cooling and Fans (4)	Set	184kW	184kW	184kW
23) Control Air Compressor (4)	1	100/82kW	82kW	82kW
24) Containment Instrument Air Compressor (4)	1	15/12kW	12kW	12kW
25) Nuclear Boiler Recirc. System Hydraulic Actuator Power Unit (4)	2	30/48kW	48kW	48kW
26) Reactor Bldg. Elec. Equip. HVAC	Set	368kW	368kW	368kW
27) Control Bldg. Elec. Equip. HVAC	Set	283kW	283kW	283kW
28) Radwaste Bldg. Elec. Equip. HVAC (4)	Set	150kW	150kW	150kW
29) Makeup Water Pumphouse Elec. Equip HVAC (4)	Set	90kW	90kW	90kW
30) Standby Service Water Pumphouse Electric Equipment HVAC	Set	38kW	38kW	38kW
		TOTAL	3987kW	5761kW

NOTE:
1. Division 1 and 2 together provide functional redundancy to the HPCS (Div. 3) system and are also redundant to each other.
2. Forced shutdown is defined as nonaccident force shutdown with offsite power available.
3. Motor horsepower indicated is nameplate HP, and kW is the equivalent kW.
4. Components are not required for a safe shutdown (non-ESF components).
5. Intermittent loads. Not included as long term loading.

TABLE 8.1-2

DIVISION 2 LOADS

Item Description	No. On Bus	Total hp/kW (3) Connected To Bus	Normal Operation	Forced (2) Shutdown
1) Motor-Operated Valves (5)	Set	200kW	-	-
2) Emergency Lighting and Power	Set	122kW	-	-
3) Diesel Auxiliaries and HVAC	Set	185kW	97kW	97kW
4) RHR Water Leg Pump	1	15/12kW	12kW	12kW
5) Standby Liquid Control Pump & Heaters (4)	1	40/88kW	44kW	-
6) Reactor Water Cleanup System	2	100/82kW	82kW	82kW
7) Fuel Pool Cooling & Cleanup System (4)	Set	50/90kW	90kW	90kW
8) Plant Service Water Pump B (4)	1	1500/1197kW	-	-
9) RHR Pumps B & C	2	1600/1284kW	-	642kW
10) Standby Service Water Pump B	1	1750/1377kW	-	1377kW
11) Cooling Tower Makeup Water Pump (4)	2	1600/1270kW	635kW	-
12) Control Rod Drive Pump B (4)	1	250/205kW	205kW	205kW
13) Reactor Closed Cooling Pump (4)	2	400/320kW	160kW	160kW
14) Load Center Transformer Losses	2	45kW	40kW	33kW
15) 125V Battery Charger (4)	1	43kW	43kW	43kW
16) Standby Gas Treatment Fans and Heater Coils	2	50/93kW	-	-
17) RPS MG Set (4)	1	25/20kW	20kW	20kW
18) Hydrogen Recombiner	1	25/57kW	-	-
19) Drywell Cooling and Fans (4)	Set	186kW	186kW	186kW
20) Control Air Compressor & Dryers (4)	1	100/126kW	126kW	126kW
21) Containment Instrument Air Compressor (4)	1	15/12kW	12kW	12kW
22) Nuclear Boiler Recirc. System Hydraulic Actuator Power Unit (4)	2	30/48kW	48kW	48kW
23) Radwaste System Condensate Demineralized Hold Pumps	Set	18/15kW	15kW	15kW
24) Reactor Bldg. Elec. Equip. HVAC				
25) Control Bldg. Elec. Equip. HVAC	Set	371kW	371kW	371kW
26) Radwaste Bldg. Elec. Equip. HVAC (4)	Set	331kW	331kW	331kW
27) Makeup Water Pumphouse Elec. Equip	Set	145kW	145kW	145kW
HVAC	Set	90kW	90kW	90kW
28) Standby Service Water Pumphouse Electric Equipment HVAC	Set	40kW	40kW	40kW
		TOTAL	2587kW	4555kW

For notes, see bottom of Table 8.1-1

Table 8.1-3

DIVISION 3 (HPCS) LOADS

	Item Description	No. On Bus	Total hp/kW Connect to Bus	Normal Operation	Forced (2) Shutdown
1)	HPCS Pump	1	3000/2380	-	-
2)	Motor-Operated Valves (5)	Set	77/62	-	-
3)	HPCS Waterleg Pump	1	15/12	-	-
4)	HPCS Service Water Pump	1	60/50	-	-
5)	Auxiliary Panel	1	24	24 kW	24 kW
6)	D-G Rm Exhaust Fan	1	50/40	-	-
7)	Supply Fans	2	45/36	-	-
8)	Fan Coil Unit	1	10/8	5 kW	5 kW
9)	Instrument and Control Power	Pnl	6	2 kW	2 kW
10)	Lighting	Pnl	12	2 kW	2 kW
11)	Misc. Aux.	Set	3	2 kW	2 kW
12)	HPCS Batt. Chgr.	1	5	5 kW	5 kW
			TOTAL	40 kW	40 kW

For Notes see bottom of Table 8.1-1.

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 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 start-up 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, ~~are~~ is accomplished through the use of electromechanical time delay relays. ~~Due to voltage drop limitations, the same loading sequence is used when buses SM-7 and SM-8 are powered from either of the off-site power sources~~. 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 ~~latter~~ following ~~from~~ a total loss. Synchronizing of any diesel generator with the normal auxiliary transformer is ~~prohibited~~. Administrative procedures are implemented ~~to ensure that this requirement is followed~~.

add

The primary undervoltage sensing scheme for the 4.16 kV Class 1E distribution system utilizes instantaneous under-voltage relays to start the Divisionn 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 ~~cannot be supplied by~~ 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 voltage for continuous operation. (See Table 8.3-13.) For this reason, Class 1E bus 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.

starting the diesel generators,

In the event of sustained bus undervoltage (87.3% of ~~rated~~ nominal bus voltage lasting more than 8 seconds), the second level of undervoltage protection automatically ~~isolates~~ trips the feeder breaker connecting the normal/startup sources to their respective 4.16 kV Class 1E buses. This action results in loss of bus voltage, thereby 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 breaker timer permits closing of the diesel generator ~~breker~~ 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. For Division 1 and 2,

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.

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.

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 siwtch 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.

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).

The system consists of non-Class 1E 120/208 V distribution panels supplied from the 480 V Class 1E MCCs via 480-120/208 V stepdown transformers.

8.3.1.1.5 Division 1 and Division 2 120/240 Volt Critical (Class 1E) Instrumentation Power System

Power is supplied to critical plant instrumentation at 120/240 V AC via two single phase, three wire, grounded neutral distribution systems as shown in Figure 8.3-2. AC power is normally fed into the systems from 15 kVA static inverter-static switch arrangements supplied from both the 125 V DC battery systems (primary sources) and the critical AC distribution panels (alternate sources). The static switches immediately transfer from the inverter sources to separate AC sources upon loss of inverter output. The system is divided into Division 1 and 2 redundant circuits, with separate inverters and static switches feeding into separate distribution panels (7A-A and 8A-A) in the main control room for service to ESF circuits in the nuclear steam supply system. This system maintains critical instrumentation power sources even during the short interval when offsite power has been lost and standby power has not yet been applied to the Class 1E AC buses.

8.3.1.1.6 Reactor Protection System Power System

The RPS power system is designed to provide 120 V AC power to the logic and/or system components that are part of the reactor protection system, the containment isolation system, the neutron monitoring system, and the process radiation monitoring system. It is designed to prevent inadvertent reactor trip or isolation due to a transient loss of power to the trip logic. Refer also to discussions in 7.2.1.1.b and 7.2.1.2.f.

The principal elements of the reactor protection system power system are shown in Figure 8.3-2. The system consists of two high inertia, alternating current, motor generator sets.

Each of these high inertia MG sets has a voltage regulator which is designed to respond to a step load change of 50% of rated load with an output voltage change of not more than 15% and keep the normal voltage limits to within ±10% of rated. The MG sets do not require manual operation or adjustment during coastdown or acceleration.

High inertia is provided by a flywheel. The inertia is sufficient to maintain the voltage and frequency of generated voltage within -5% of the rated values for ~~approximately 15~~ at least ½ seconds following a loss of power to the drive motor.

120 V AC power is supplied from two sources. The primary source of power is the motor generator sets previously described. The alternate source is from a non-Class 1E distribution panel which is powered from the main generator or the startup transformer. The motor generator sets themselves are supplied from separate Class 1E 480 V (Division 1 and 2) motor control centers. Indiciating lights are provided in the main control room to monitor the status of both the motor generator sets and the alternate feed.

In order to protect the RPS trip system from the unacceptable effects of sustained over/under voltage or under frequency from the non-Class 1E power sources, to redundant Class 1E circuit breakers are provided between the RPS distribution panel and each of the non-Class 1E power sources, namely, the two RPS MG sets and the common alternate source. Each circuit breaker is provided an independent set of Class 1E over/under voltage and under frequency sensing relays.

During operation, the reactor protection system buses are energized by their respective motor generator sets. Either MG set can be taken out of service by manually operating the RPS transfer contactor which takes one MG set out and connects that RPS bus to the alternate power source. Provision is made to prevent connection of both RPS buses to the alternate source at the same time. A loss of power to either MG set is monitored in the main control room where the operator, on detecting such a condition, can switch to the alternate source. A complete, sustained loss of electrical power to both buses is required to cause a scram and containment isolation.

Equipment associated with the RPS power system is located in separate rooms where routine maintenance can be conducted. Motor generator sets can be inspected, serviced, and tested individually while using the alternate feed from the aforementioned distribution panel.

8.3.1.1.7 Supervisory System

A non-Class 1E supervisory control (multiplexing) system is provided between the main plant area and the makeup water pumphouses, circulating water pumphouses, cooling towers and meteorological tower to monitor and control operation of locally mounted equipment.

A Class 1E supervisory control system is provided between the main control room and the standby service water pumphouses to monitor and control operation of Class 1E standby service water equipment. The system is divided into three separate and independent divisions (Division 1, 2, and 3) corresponding to the three service water system equipment divisions. Separate equipment is provided for supervision of electrical equipment of each division; there is no sharing of equipment or connections between divisions. Failure of equipment in one supervisory division does not affect supervisory equipment of other divisions.

Each supervisory control division is a two-way type, incorporating multiplexing line sharing, continuous scanning modules (with solid state logic) and output relays.

8.3.1.1.8 Standby AC Power System

The standby AC power source for the plant consists of three diesel generator sets, each one serving ESF loads in its associated Division (1, 2, 3), their attendant air starting and fuel supply systems, and automatic control circuitry. The diesel generator sets supply power to those electrical loads which are required to achieve safe cold shutdown of the plant and/or mitigate the consequences of a design basis event coincident with a loss of all offsite AC power. Tables 8.3-1, 8.3-2, and 8.3-3 list the equipment and loads supplied by each generator for both cases. The individual loads are determined on the basis of nameplate rating of the motors used.

Each diesel generator (with its auxiliaries) is housed in a separate room as shown in Figure 8.3-15. The separating walls are designed as four-hour NFPA fire barriers and will provide missile protection in the event of explosion or failure of rotating equipment. Each room is provided with its own ventilation and lighting systems. Design provisions ensure that flooding in one diesel generator room does not jeopardize the operation of the other diesel generators. The power, instrumentation, and control cabling associated with the diesel generators is contained in cable trays and conduits which meet the separation criteria detailed in 8.3.1.4. All equipment for these systems is identified as indicated in 8.3.1.3.

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

8.3.1.1.8.1.1 General

The dual drive diesel generators comprising the Division 1 and Division 2 standby AC power supplies are designed to quickly restore onsite power to their respective Class 1E distribution system divisions in the event of coincident loss of all offsite AC power. Figures 8.1-9a and 8.1-9b show the interconnections between the preferred power system and the Division 1 and Division 2 standby diesel generating units.

The dual drive engines utilized are medium weight, fabricated, main frame engines capable of rapid starting due to a unique lubrication system that provides immediate, full pressure lubrication to highly stressed and loaded areas.

Selection of the type of diesel engine utilized is based upon the advantages offered by this class of unit: the ability to start and accept rated load rapidly and repeatedly with enough dead load pickup capability to assume substantial incremental motor load additions. Having selected the generic type, dual drive is dictated by equipment availability. Single drive units are not available in capacities greater than 3000 kW, which leads to the use of dual drive units to meet larger load requirements.

8.3.1.1.8.1.2 Unit Ratings and Capability

The diesel generator sets for Division 1 and Division 2 each have a continuous service rating of 4400 kW, which is larger than the sum of the automatically connected loads shown in Tables 8.3-1 and 8.3-2. Diesel generator set short-term ratings are 4650 kW for 2000 hours, 4900 kW for seven days, and 5150 kW for 30 minutes. The continuous rating of ~~the~~ diesel generator is based upon an accident condition load which is larger than that required for a safe plant shutdown. The generators are rated 5812 kVA at 0.8 pf, which is sufficient to carry the 4650 kW short-term ratings at 0.8 pf. At higher kW outputs, the diesel generator sets would have to operate at a higher power factor.

The size of each of the diesel generators serving Divisions 1 and 2 satisfies the requirements of NRC Regulatory Guide 1.9, Revision 0, and conforms to the following criteria:

a. The continuous (8000 hr) nameplate rating of each set exceeds the maximum required load indicated in Tables 8.3-1 and 8.3-2.

b. Each diesel generator is capable of starting, accelerating, and supplying its loads in the sequence shown on Tables 8.3-1 and 8.3-2 without exceeding 5 percent frequency drop (maximum). The units are capable of recovery to 98 percent of normal frequency in less than 2 seconds.

c. Each diesel generator is capable of starting, accelerating, and supplying its load in their proper sequence without exceeding 20 percent voltage drop at its terminals (maximum). The units are capable of recovery to 90 percent of normal voltage is less than 2 seconds.

d. Each diesel generator is capable of starting, accelerating, and running its largest motor at any time after the automatic loading sequence is completed, assuming that the motor had failed to start immediately.

e. Each diesel generator is capable of reaching full speed and voltage within 10 seconds after receiving a signal to start, and can be fully loaded within 30 seconds following the start signal.

f. The speed of each diesel generator does not exceed 75 percent of the difference between nominal speed and the overspeed trip setpoint, or 115 percent of nominal speed, whichever is lower, during recovery from transients caused by disconnection of the largest single load.

8.3.1.1.8.1.3 Cooling Water Systems

Each engine in each diesel generator set has a closed cooling system consisting of a forced circulation cooling water system which cools the engine directly and a heat exchanger connected to the respective standby service water system. The cooling water pump is driven directly from the engine crankshaft. The engine cooling water system incorporates provision for heat to maintain the engine jacket at a steady temperature when the engine is not running to assure quick starts. Initial air intake is warm. The diesel generator cooling water systems are discussed in 9.5.5.

8.3.1.1.8.1.4 Lubrication Systems

The engines of each diesel generator set have self-contained lubrication oil systems consisting of lubrication sumps located at the base of each engine, lubrication oil pumps, piping and heat exchangers. The lube oil heat exchanger is served by the diesel generator cooling water system. When the engine is not running, the temperature of the lube oil is maintained at a steady level with heaters and temperature controls to ensure quick starts. The diesel generator lubrication systems are discussed in 9.5.7.

8.3.1.1.8.1.5 Air Starting Systems

Each diesel generator set has independent redundant air starting systems as discussed in 9.5.6.

8.3.1.1.8.1.6 Fuel Oil Systems

The diesel generator fuel oil storage and transfer systems are discussed in 9.5.4.

8.3.1.1.8.1.7 Automatic Starting and Loading Systems

In the event of loss of offsite sources of power to the onsite power bus, each diesel generator set is automatically started and loaded by independent control and circuitry. The starting circuitry and control power is provided by separate 125 volt DC station batteries for Divisions 1 and 2 (see 8.3.2.1.1). The diesel generator starting logic and starting signals (shown on Figures 8.3-16a through 8.3-17b) are described as follows:

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[illegible] 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.

Administrative procedures are used to prevent paralleling of the diesel generator with the normal auxiliary transformer so that the switchgear short circuit capability is not exceeded.

g. If offsite power is still present, and the diesel generator is started by a loss-of-coolant accident (LOCA) signal, the diesel generator breaker will not close. However, the unit will continue to run at rated frequency and voltage until manually shut down.

h. Means are provided for periodic exercising of each diesel generator under load. To accomplish this, supply of the 4.16 kV Class 1E bus associated with the diesel generator to be tested is transferred to the startup source. Under this condition the diesel generator to be tested is synchronized to the 230 kV startup source and loaded via manual adjustment of the unit speed controls. ~~Switchgear design does not allow synchronization of the diesel generator to the normal auxiliary transformer. Administrative procedures are provided to ensure compliance with this requirement.~~

The control circuits for automatic start are provided with means for manual testing during normal plant operation and conform to criteria detailed in IEEE Standard 279-1971. Means are provided to permit applying selected non-ESF loads in the plant to the diesel generator sets within their capabilities. However, this is a manual operation under the operator's full control. Under LOCA conditions, application of the non-ESF loads can only be accomplished after the LOCA parameters have been reduced below LOCA sensing instrumentation setpoints.

8.3.1.1.8.1.8 Protective Trips

The diesel generator protection system is designed such that upon accident signal (low reactor water level, high drywell pressure) only the following diesel generator trips are effective:

a. Engine overspeed

b. Generator differential relay action

c. Incomplete sequence

d. Emergency stop pushbutton

During nonemergency operation of the diesel generator sets (such as testing) the engine is shut down and the generator breaker tripped under the following conditions:

a. Engine overspeed

b. Generator differential relay action

c. Incomplete sequence

d. Emergency stop pushbutton

e. Generator loss of excitation

f. Reverse current

g. Generator overcurrent

h. Generator over~~excitation~~ Voltage

i. High jacket water temperature

j. Low lube oil pressure

During a synchronizing test, the diesel generator is protected from overcurrent ~~supplied to~~ the non-Class 1E loads ~~at~~ 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 genrating 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. 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 deisel 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:

a. Voltmeter

b. Ammeter

c. Wattmeter

d. Varmeter

e. Field ammeter

f. Annunciator panel

g. Synchroscope, synchronizing switches and lights

h. Frequency meter

i. Elapsed time meter

j. Generator breaker status lights

k. Bus-tie breaker status lights

The diesel generator sets are capable of being started or stopped manually from the main control room or from local control panels, and all Class 1E instrumentation is capable of being monitored both in the main control room and locally.

8.3.1.1.8.1.11 Light Load Operation

The Division 1 and 2 diesel generating units are capable of running for four (4) hours in the lightly loaded condition. Subsequent to the four-hour period, the units must be either shut down or loaded to a minimum of 50 percent of nameplate rating for a period of at least 30 minutes. Operation of the units at loading less than 50 percent of nameplate rating for periods of more than four (4) hours, may lead to accumulation of oil in the exhaust systems, and to the potential for a fire to occur.

The diesel generators are automatically started, and run unloaded during LOCA conditions when offsite power is available to the unit 4.16 kV Class 1E buses. During unit testing and maintenance/repair, periods of unloaded operation are also expected to occur.

Administrative procedures are employed to periodically load the diesel generators or manually shut the units down in less than the prescribed four (4) hour time limit, whenever unit loading is less than 50 percent of nameplate rating. During

unit testing, running at less than 50 percent load is ~~made~~ ~~only for~~ a minimum period while preparing for the application ~~of the~~ scheduled test load. Light load operating time is ~~totalized~~ ~~so/as~~ not ~~to~~ exceed the manuacturer's recommendations. (does)

to ensure that the accumulated time

8.3.1.1.8.2 HPCS (Division 3) Standby AC Power Supply

8.3.1.1.8.2.1 General

The single drive HPCS standby diesel generator is used to supply power exclusively to the HPCS system in the absence of the normal/startup power sources. Figures 8.1-9a and 8.1-9b show the interconnections between the preferred power system, the HPCS diesel generator unit, and the HPCS pump and 225 kVA auxiliary transformer. HPCS auxiliary loads appear on Figure 8.3-1d.

The HPCS system is self-contained except for connection to LOCA start signals and for access to the preferred source of offsite power through the plant AC power distribution system. It is operable as an isolated system independent of electrical connection to any other system through its use of the dedicated HPCS diesel generator. The standby auxiliary equipment such as heaters, air compressor, and battery charger are supplied from the same power source as the HPCS motor when the diesel generator is not running.

The HPCS diesel generator has the capability to quickly restore onsite power to the HPCS pump motor in the event offsite power is unavailable and to provide all required power for the startup and operation of the HPCS pump motor in a manner compatible with safe shutdown of the plant. The HPCS diesel generator starts automatically on a signal from the plant protection system; the unit is both started and connected to the bus automatically upon receipt of a bus undervoltage signal. The failure of this unit does not negate the capability of other power sources.

There is no sharing of the HPCS power system with other units.

8.3.1.1.8.2.2 Unit Rating and Capability

The diesel generator set for Division 3 (HPCS) has a continuous service rating of 2600 kW, which is larger than the sum of the automatically connected loads shown in Table 8.3-3. Diesel generator set short-term ratings are 2850 kW for 2000 hours, and 3030 kW for 30 minutes. The generator is rated 3580 kVA at 0.8 pf, which is sufficient to carry the 2850 kW short-term rating at 0.8 pf. At higher kW outputs, the diesel generator set would have to operate at a higher power factor.

The generator is rated to have sufficient capacity to start and supply the HPCS induction motor for the HPCS pump and (via stepdown auxiliary transformer) 460 V induction motors which drive the engine cooling water pump, valve operator motors, and miscellaneous HPCS auxiliaries. The valve motors operate for short times and do not impose a significant load on the generator. The HPCS pump motor has a nameplate rating of 3000 hp at 4000 volts. Table 8.1-3 lists the principal loads on Division 3 (HPCS). The diesel generator unit has the capacity to start and supply the loads required by the HPCS system within the time requirements described in Chapter 6. Table 8.3-3 lists the sequence of starting loads for the HPCS system.

The size of the diesel generator serving Division 3 (HPCS) satisfies the requirements of NRC Regulatory Guide 1.9, Revision 0, except for voltage and frequency limitations, and conforms to the following criteria:

a. The continuous (8000 hr) nameplate rating of the unit exceeds the maximum required load indicated in Table 8.3-3.

b. The unit is capable of starting, accelerating and running its largest motor at any time.

c. The unit is capable of reaching full speed and voltage within 10 seconds after receiving a signal to start, and can be fully loaded within 30 seconds following the start signal.

d. The unit demonstrates a torque margin in excess of the starting period requirements.

Refer to 8.3.1.2.1.4.5 for a discussion of the nonconformance to Regulatory Guide 1.9, Revision 0 voltage and frequency limitations.

HPCS power system electrical apparatus is sized on the basis of the most severe conditions it will be subjected to in either a continuous or intermittent basis in any mode of operation. Intermittent loads are factored in on the basis of heating (e.g., short time peaks are not added directly to determine total continuous load imposed). Adverse environmental conditions have been taken into consideration (e.g., derating of cable for temperatures higher than the basic rated values and use of multipliers on actual service hours for motors operated at higher than normal rated temperatures).

8.3.1.1.8.2.3 Cooling Water System

The HPCS diesel engine is provided with a closed cooling system containing immersion heaters to maintain the engine coolant temperature, an expansion tank, a temperature regulating valve, and a lube oil cooler. The immersion heater is thermostatically controlled and, in conjunction with the temperature regulating valve, will maintain the jacket water at a steady temperature. During engine shutdown condition, jacket water heated by the immersion heater will circulate through the lube oil cooler by thermosyphon action to warm the lubricating oil circulated by an AC motor-driven pump. This "keep warm" feature will provide the engine with the capability of quick start and load acceptance after a shutdown. The engine low temperature condition will be annunciated in the main control room. Refer to 9.5.5 for additional details of the cooling water system.

8.3.1.1.8.2.4 Lubrication System

Shown in Figure 8.3-20 is the lubricating oil system schematic. The lube oil system is provided with a suction-strainer full-flow filter with bypass relief valves, a lube oil cooler/heater, and a lube oil sump pan of sufficient capacity to hold usable lube oil for 7 days operating without adding makeup lube oil. No external cooling is required for the lube oil system. High crankcase pressure is annunciated for operator action. In view of the low probability of this event, no blowout panel is provided. Refer to 9.5.7 for additional details of the lubrication system.

8.3.1.1.8.2.5 Air Starting System

There are two independent air starting systems. The air starting system is shown in Figure 8.3-21. Each air starting system has two rotary vane motors. On receipt of the engine start signal, a normally closed solenoid valve opens and air flows to the piston for the pinion gear of the lower motor. The entry of air moves the pinion gear forward to engage with the engine ring gear. Movement of the pinion gear uncovers a port, allowing air pressure to be released to the upper motor pinion gear piston which, in turn, engages its pinion gear with the engine ring gear. Full engagement of the upper pinion gear permits air flow to the air valve which, in turn, opens the air starting valve and releases the main starting air supply. Starting air passes through the air line lubricator, releasing an oil air mist into the starting motor. The motors drive the pinion gears, rotating the ring gear and cranking the engine. The engine will normally start with one bank of dual air starting motors.

no change

However, to ensure positive starting, both solenoids are energized simultaneously and both banks of dual starting motors crank the engine. The air supply system contains two receivers. One air compressor is provided for charging air into each air receiver. One of the air compressors is electric-motor driven and the other is diesel-engine driven. The motor-driven air compressor is powered from the HPCS bus. The air compressors are automatically started when the air pressure in the receivers drops below 200 psig and shuts off when the air pressure reaches 250 psig. The air receivers are equipped with safety relief valves which operate at 275 psig. Each air start system has adequate air capacity to start the engine five consecutive times without recharging, as demonstrated by test.

System design is such as to preclude fouling of the starting air valve or filter with contaminants. The air for the HPCS diesel is delivered to the air receiver by the air compressors where it is stored at rated pressure (200-250 psi) until required to start the diesel engine. The volume of the receiver allows sufficient time for moisture and oil to precipitate in the bottom of the tank. The connection to the engine start system is located far enough above the bottom so that the moisture in the bottom will not get carried in the air being supplied to the air start motors. Blowdown valves are provided in the bottom of the air receivers to drain any moisture that might have collected in the bottom. The blowdown valves are opened periodically on a maintenance schedule to blow moisture out of the tank.

The air start system is completely redundant. Failure of one system will not prevent the other system from starting.

Wye strainers are provided in the air start system piping to filter any particulate carryover. Inspection and cleaning of the system components are made after the initial trial runs during installation. It is expected, that after the initial trial runs, all loose particles will either collect or get blown out.

Refer to 9.5.6 for additional details of the air starting system.

8.3.1.1.8.2.6 Fuel Oil System

Figure 8.3-22 shows the fuel oil system. The fuel oil system consists of two mutually redundant fuel oil systems external to the engine fuel manifolds, either of which is capable of supplying fuel oil to the engine. Each system, from the day tank to the fuel manifolds, contains a fuel supply line, a strainer, a fuel oil pump, a duplex filter, a pressure gage, and relief and check valves. One of the fuel pumps is mechanically driven by the engine and the other by a 120 V DC motor. The system has a common return to the day tank.

Refer to 9.5.4 for additional details of the fuel oil system.

8.3.1.1.8.2.7 Automatic Starting and Loading System

In the event of loss of offsite sources of power to the onsite power system, the HPCS diesel generator set is automatically started and loaded by controls and circuitry which are independent of those used to start and load the Division 1 and Division 2 units. Control power for the diesel generator unit is supplied from its own 125 V DC system which consists of a battery with its own battery charger (see 8.3.2.1.2).

The diesel generator starting logic and starting signals (shown on Figures 8.3-18a and 8.3-18b) are described as follows:

a. The diesel generator starts immediately upon receipt of 4.16 kV Class 1E bus (SM-4) undervoltage signals or LOCA signals (reactor low water level and/or high drywell pressure).

b. Upon sustained loss of bus SM-4 voltage the bus is automatically isolated from the upstream non-Class 1E system.

c. After the diesel generator has attained approximately normal frequency and voltage, its breaker automatically closes (if unit start was initiated by bus SM-4 undervoltage), picking up loads as indicated in Table 8.3-3. LOCA signals do not initiate automatic breaker closure.

d. Diesel generator capacity (2600 kW) is such that the unit is capable of supplying the entire Division 3 load (2563 kW) on a continuous basis. There is no load shedding in Division 3.

e. If offsite power is still present, and the unit is started by a LOCA signal, the diesel generator breaker will not close. However, the unit will continue to run at ~~full~~ rated frequency and voltage until manually shut down.

f. Means are provided for periodic exercising of the diesel generator under load. To accomplish this, supply of 4.16 kV Class 1E bus SM-4 is transferred to the startup source. Under this condition, the diesel generator is synchronized to the 230 kV startup source and loaded via manual adjustment of the unit speed controls. ~~The switchgear design does not allow synchronizing of the diesel generator to the normal auxiliary transformer.~~ Administrative procedures are ~~exercised to ensure that this requirement is~~ followed.

Means are also provided to periodically test the entire chain of HPCS system elements from sensing devices through driven equipment to assure that equipment is functioning in accordance with design requirements. The drawout feature of protective relays allows a replacement relay to be installed while the relay that was removed can be bench tested and calibrated. Startup of the diesel generator can be effected by simulation of signals for LOCA or bus SM-4 undervoltage.

8.3.1.1.8.2.8 Protective Trips

When the HPCS diesel generator is called upon to operate under accident conditions or upon loss of normal voltage to 4.16 kV bus SM-4, only the emergency protective devices are used. These are the generator differential overcurrent relays and engine overspeed trip device. The trips are annunciated in the main control room. Other normal protective relays and devices such as loss of excitation, antimotoring (reverse power), overcurrent (with voltage restraint), high jacket water temperature, high crankcase pressure and low lube oil pressures are used to protect the machine when it is operating during periodic tests. These relays are automatically blocked from the tripping circuits under accident conditions.

In addition to these protective relays, a normal time delay differential overcurrent relay senses a generator overload and causes an alarm in the main control room. The generator differential relays and overspeed trip device are retained under emergency conditions to protect against what could be major faults which would cause immediate system failure and major damage. All the necessary bypassed trip devices alarm in the control room and provide the operator with sufficient information to take the necessary corrective action. Since the diesel generator is performing a safety-related core cooling function during accident conditions, these trip devices cannot be permitted to interrupt the diesel generator's operation. The capability of the diesel to operate under these abnormal conditions is left to the operator.

8.3.1.1.8.2.9 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, manufacture, installation, testing, and maintenance of the diesel generator. 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. Annunciation is provided both locally (diesel generator panel) and in the main control room.

An alarm "HPCS not ready for auto start", which operates during one of the following conditions, is provided in the control room.

a. Exciter not in auto position

b. Engine lockout operated

c. Generator lockout operated

d. Engine in maintenance position

e. Diesel generator breaker in low position

f. HPCS pump motor breaker in lower position

g. Control power not available

In addition, the following alarms in the control room pertaining to the diesel generator aid the operator in determining the status of the unit.

a. Diesel engine in maintenance or test position

b. Generator trip lockout

c. 125 V DC system trouble

d. Diesel engine overspeed

e. Diesel engine running

f. Diesel engine trouble

The "diesel engine trouble" alarm indicated above is actuated by any one of the following alarms (which are annunciated locally in the diesel generator panel).

a. Low lube oil pressure

b. High lube oil temperature

c. Low air pressure

d. Overspeed trip

e. Low jacket water temperature

no change

f. High jacket water temperature

g. Low water pressure

h. Unit lockout

i. Blown fuse

j. Lube oil relief valve open (lube oil system fault)

k. Fuel oil system fault

l. Fail to start

m. Fail to run

When the engine selector switch is in the "local manual" position, the air compressor switch is in the "not in auto" position, or the voltage regulator switch is in the "off" position, the engine will not be prevented from starting automatically.

A manual stop signal does not prevent the engine from starting in the automatic mode; however, the emergency manual stop signal prevents the engine from starting unless reset. In this case, it is annunciated in the control room as "HPCS not ready for automatic start".

8.3.1.1.8.2.10 Instrumentation and Control System

The power supply source for Division 3 controls and instrumentation is independent of the power sources for controls and instrumentation of other divisions, in accordance with the separation criteria detailed in 8.3.1.4 and 8.3.2.4.

The diesel generator set includes the following instrumentation:

a. Voltmeter

b. Ammeter

c. Wattmeter

d. Watthour meter

e. Varmeter

f. Field voltmeter

g. Field ammeter

h. Synchroscope, synchronizing switches and lights

i. Frequency meter

j. Generator breaker status lights

Refer to Figure 8.1-9b for protection and surveillance devices for the HPCS power system. Figures 8.3-24a through 8.3-24c show the functional control diagrams for the system.

Additional information is provided in 7.3.1.1.1.1.

8.3.1.1.8.2.11 Light Load Operation

Light load operating capability of the HPCS (Division 3) diesel generating unit, and administratively controlled operating procedures for this operating mode, are identical to those described for the Division 1 and 2 diesel generating units. See 8.3.1.1.8.1.11.

8.3.1.1.9 Electrical Equipment Tests

Components of the onsite AC power system are factory tested in accordance with industry and manufacturer's standards. For Seismic Category I components, the manufacturer submits dynamic tests, analysis, or combination of both which substantiate the ability of the equipment to function under SSE loads (see 3.10). Tests and inspection of the onsite AC power system are discussed further in 8.3.1.2.2.

The standby diesel generators for Division 1 and 2 are of a type not previously used nor qualified for standby power service at a nuclear plant. Therefore, the diesel generators are shop tested to demonstrate starting reliability. The starting test requirements include:

a. Shop tests, the objective of which is to establish a starting reliability of 0.99 with a confidence level of 0.95. As a minimum requirement, the diesel generator will be started 300 times with a failure rate not in excess of one per 100 starts.

b. Bringing the set to full speed and voltage automatically within 10 seconds.

c. Loading of the generator to at least 95% of continuous rating in four steps at five-second intervals immediately after each successful start and maintaining this load until thermal equilibrium is attained.

d. 90% "cold" starts and 10% "hot" starts.

e. Monitoring of operating conditions throughout the duration of test with significant parameters such as voltage, frequency, operating temperature, acceleration times, and other pertinent functions being recorded.

Failures considered are limited to those caused by malfunctions of the diesel generator set only. Failures caused by malfunctions in the test equipment, external circuitry or loads are not considered attributable to the reliability of

the diesel generator set. Provisions are made in the testing procedure to determine the cause of any malfunction or excess wear and to classify it as a valid failure of the equipment being tested or an external nonvalid failure. Such determination of cause and classification of failure or excess wear is fully supported by documentation.

At the completion of the tests, a thorough inspection is performed on the diesel generator unit.

A prototype test has been made for the standby diesel generator selected for Division 3 (HPCS) to establish the adequacy of the diesel generator unit to successfully accelerate the bulk HPCS pump loads. The test consisted of starting the actual HPCS pump motor depicting as closely as possible the actual HPCS pump loop (HPCS system in condensate to condensate test mode) and auxiliary loads, ~~several times within the design time requirement~~. A topical report on HPCS power system unit (NEDO-10905-3) describes and shows theoretical and experimental evidence as to the adequacy of the design.

8.3.1.1.10 Equipment Criteria

Motor Size

The criterion for Class 1E motor size is that the safety-related motor develop sufficient horsepower to drive the mechanical load under runout or maximum expected flow and pressure, whichever is greater. Class 1E motors are sized in accordance with NEMA standards and manufacturers ratings to be at least large enough to produce the starting, pull-up, and breakdown torque calculated to be needed for the particular application, and permit the driven equipment to develop its specified capacity without exceeding the temperature rise rating of the motor when operated at the duty cycle of the driven equipment.

Motors are initially tested in accordance with NEMA-MG-1.

The motor and driven equipment are preoperationally tested to verify that the system requirements are met.

Motor Thermal Overloads

Motor thermal overloads for miscellaneous Class 1E motors having a 1.15 service factor are selected to protect 125% of

motor full load current. Miscellaneous Class 1E motors having a 1.0 service factor are provided with overloads rated one size lower.

Motor thermal overloads for Class 1E motor-operated valves (MOVs) are selected two sizes larger than the normally selected thermal overload. (This approximates 140% of motor FLA.) Selection of overloads in this range permits Class 1E MOVs to operate for extended periods of time at moderate overloads; tripping occurs just prior to motor damage. Class 1E motor control centers are located in environmentally controlled rooms such that overload ambient temperature variation is not a significant factor. Periodic surveillance procedures are provided to check setpoint drift of the thermal overload devices.

no change

Minimum Voltage

All Class 1E motors, as a minimum, have torque characteristics suitable for the driven load to accelerate their connected loads to rated speed with only 80% of motor rated voltage at the terminals.

The HPCS pump motor is designed to accelerate its load with only 75% voltage applied to the motor terminals.

Motor Starting Torque

Class 1E motors are designed for full voltage starting and to be capable of accelerating the driven equipment to its rated speed without exceeding the thermal capability of the motor under all expected conditions of ambient temperature, voltage, and frequency.

Minimum Torque

The minimum motor torque through the accelerating period is based on the following criteria:

a. The brake horsepower does not exceed the guaranteed motor rating over the entire range of the driven equipment.

b. The driven equipment is capable of attaining rated speed under all design conditions within 5 seconds.

In general, motors are sized such that no portion of a motor's service factor above 1.0 is used in continuous operation of the motor. Specified minimum values of motor torque over equipment torque are, therefore, not required.

For the HPCS pump motor, the minimum difference between the motor torque and the pump torque at any given speed during acceleration is 10% of motor rated torque.

no change

Motor Insulation

The criteria for determining insulation for Class 1E motors are as follows:

a. The insulation for continuous rated motors has a 40-year life expectancy for the duty cycle and the ambient conditions of temperature and radiation at which they are required to operate. Intermittent duty motors are similarly rated for the number of duty cycles expected over the 40-year life of the plant.

b. For Class 1E motors, which are required to operate during or subsequent to accidents, insulation is provided to withstand the expected environmental conditions of ambient pressure, temperature, and radiation dosage.

The HPCS, LPCS, RHR and standby service water pump motors have Class B insulation. All other motors are provided with either Class B, F or H insulation. The insulation temperature ratings are greater than the sum of the motor temperature rise, the ambient temperature at the motor location, and the hot spot temperature allowance.

Temperature Monitoring Devices

Motors 300HP in size and larger are provided with one or more copper-constantan thermocouples in each bearing.

The HPCS, LPCS, RHR and standby service water pump motors are provided with six single element copper-constantan thermocouples imbedded in stator windings, two per phase, where the highest operating temperatures are expected.

The output from the thermocouples is wired to the station computer for scanning and alarm in the main control room.

Interrupting Capacity

Class 1E switchgear, load centers, control centers, and distribution panels are sized for interrupting capacity based on maximum short circuit availability at their location. Switchgear is applied within its interrupting close and latch ratings in accordance with ANSI C37.010-1972, "Application Guide for AC High Voltage Circuit Breakers".

no change

The calculations to document this application take into account the fault contributions of all rotating machines and source transformers and make proper allowance for system X/R ratio at the point of fault. Transformer impedance is selected to limit short circuit currents at 4.16 kV switchgear. Low voltage metal enclosed breakers at load centers and molded case breakers at motor control centers are adequately sized for the maximum available short circuit currents.

Electric Circuit Protection

Equipment and settings are provided to carry out relaying as listed below. The basic coordination for the 4.16 kV and 480 V systems is as follows:

a. A faulted piece of equipment is cleared by isolating the smallest possible portion of the system.

b. A faulted piece of equipment is cleared as quickly as possible to minimize damage to that equipment and the effects on the remainder of the system.

c. In the event that the primary protective device fails to clear the fault, a backup device operates to clear it after a suitable coordination interval. Operation of a backup device usually results in de-energizing a larger portion of this system than the operation of a primary device.

The one line diagrams, Figures 8.1-9a, 9b, 9c and 9d, show the relay protection schemes.

The incoming supply feeders are included in the differential zone of the normal auxiliary, startup and backup transformers; hence the primary protection for these feeders consists of harmonically restrained differential relays. The overcurrent relays on the incoming supply breaker are coordinated with the maximum feeder setting on the bus.

The 6.9 kV and 4.16 kV systems are high resistance grounded to minimize damages by limiting ground fault currents to 12.5 amps (maximum). An overcurrent relay is connected to a current transformer in the neutral of the resistance grounded, wye-connected secondary of the supply transformer for ground indication, and each feeder is equipped with a ground sensor.

The 480 V system is also high resistance grounded to limit ground fault currents to 10 amperes (maximum). Ground faults are detected at all diesel generator neutrals, transformer secondary neutrals, or 480 V switchgear feeders.

Circuit protection of the NSSS vendor supplied HPCS bus is coordinated with the design of the overall protection system for the plant auxiliary system. Simplicity in load grouping is employed to achieve simplicity in conventional protective relaying practice for isolation of fault. There is no load shedding or sequencing in the HPCS power system. Emphasis is given in preserving function and limiting loss of Class 1E equipment function in situations of power loss and equipment failure. Normal overload relays for the HPCS pump motor and diesel generator give alarm indication only. Faults are isolated by instantaneous relaying.

4.16 kV Motor Feeder

Each Class 1E 4.16 kV motor feeder is protected by two relays, each having a long time overcurrent unit, a high dropout instantaneous unit and an indicating instantaneous trip unit. The relays are set for (a) 115% to overload alarm, (b) locked rotor trip just short of safe stall time, and (c) instantaneous trip on short circuit based on nearly twice the locked rotor current. The motor relays are coordinated with the three sets of incoming bus breaker time overcurrent relays. Ground fault indication is provided by a ground sensor relay activated by a doughnut current transformer. The 4.16 kV HPCS pump motor feeder is also tripped on motor feeder over frequency.

Transformer Feeders

Each 480 V load center unit substation or motor control center transformer feeder on the 4.16 kV Class 1E buses has two time overcurrent relays for phase fault protection. These relays are coordinated with the maximum protective device settings on the 480 V Class 1E equipment buses fed by the transformers. Ground fault indication is provided by the ground sensor system.

Diesel Generator

The primary protection for the diesel generator connected to each 4.16 kV Class 1E bus consists of differential relaying and overspeed trip (see 8.3.1.1.8.1.8 and 8.3.1.1.8.2.8).

480 V Motor Feeder Fed From Switchgear Bus

The overcurrent fault protection on each 480 V motor feeder is a low voltage power circuit breaker, containing a solid state trip device with adjustable long time delay and instantaneous trips. Ground sensors provide ground fault detection.

Motor Control Center Feeder Fed From 480 V Switchgear Bus

The overcurrent fault protection for each 480 V motor control center feeder (except HPCS motor control center MC-4A) is a low voltage power circuit breaker with a solid state trip device having both adjustable long time and adjustable short time trips. The long time device is coordinated with the maximum overload device setting in the motor control center. The short time device is coordinated with the maximum instantaneous device setting in the motor control center. Motor control center MC-4A is protected by the 4.16 kV feeder circuit breaker. Ground sensors provide ground fault detection.

Feeders From 480 V Motor Control Centers

Motors fed from the 480 V Class 1E motor control centers are generally 100 hp or less. Except for MC-4A, which uses molded case circuit breakers, short circuit protection is provided by dual element time delay fuses which combine high interrupting capacity with long time delay for safe motor starting. Running overcurrent protection is provided by three overload relays in each motor starter. Other loads fed from the control centers are protected against short circuits and overcurrent by dual element time delay fuses. Subfeeders to other motor control centers are protected by molded case thermal magnetic circuit breakers.

Raceway Systems

The cable tray system utilizes open ladder type trays, with the exception of reactor protection system and instrumentation trays which are totally enclosed type. All cable trays are constructed of galvanized steel.

All conduit, except for conduits for lighting, communication, security, and fire detection systems which may utilize EMT thinwall, are full weight rigid galvanized steel. Sleeves also utilize full weight conduit.

Conduit and sleeve fill is generally in accordance with National Electric Code criteria. For tray fill see 8.3.1.4.

Flexible metallic conduit is utilized for final connections to vibrating or rotating equipment, cabling within the area below the reactor pressure vessel, cabling within the power generation control room complex (PGCC) perifery, fail safe, fire protection and control/utility power cabling within the PGCC, short extensions of rigid conduit which require numerous direction changes, short connections between cable tray and panels or devices, and between different structures or buildings which experience differential movement.

For discussion of underground ducts, refer to 8.3.1.4.3.8.2.4.

Grounding Requirements

The design criteria for grounding are:

a. Equipment hardware, exposed surfaces, and potential induced voltage hazards are adequately grounded to ensure that no danger exists for plant personnel.

b. A high resistance ground return path is provided to facilitate the operation of ground fault detection devices in the event of ground fault or insulation failure on any electrical load or current. Ground fault currents are thereby limited to 12.5 amperes (maximum) in the 6.9 kV and 4.16 kV systems, and to 10 amperes (maximum) in the 480 V system. The 120/208 V system is solidly grounded.

c. A separate and independent grounding system for instruments and instrument wire shield is provided.

The design basis for grounding requirements is:

All major electrical equipment is connected directly to the grounding grid by cable ties. A fault current return path is provided for 6.9 kV and 4.16 kV switchgear, 480 V switchgear, motor control centers and other equipment. This fault return path consists of bare #4/0 copper cables installed on all power cable trays, in duct banks and in loops along the

building walls. Motors and electrical equipment operating at 150 volts (to ground) and above, or carrying currents of 60 amperes or more, have direct cable or strap connections to the ground grid. Alternately, the #4/0 AWG grounding cable alongside the trays may be tapped for grounding motors, panels, and other equipment, if the distance is not greater than from the grounding loop indicated on contract drawings, and the equipment does not require larger cable than #4/0. Motors and electrical equipment operating at less than 150 volts (to ground) or carrying currents less than 60 amperes are grounded via the connecting conduit system and the ground cable in trays.

The cable trays are solidly grounded to the station grounding grid or building steel work. Electrical connections between individual tray sections are made by mechanical connector plates. In addition, a bare ground cable is attached to trays supporting power cables and to flexible conduits external to the power generation control complex (PGCC). ~~Within the PGCC modular floor,~~ All flexible conduits containing failsafe circuits which are routed in the PGCC modular floor are grounded.

The station ground grid is routed into primary containment via two penetrations suitable for the purpose.

The station grounding grid is designed to maintain the station area at an effective ground potential during a worst-case ground fault of any installed electrical equipment, including transmission facilities and unit main generator, as well as lightning effects. An effective ground is considered to be the maintenance of voltage potentials below "safe touch-and-step potential" levels for plant personnel.

8.3.1.1.11 Class 1E Electrical Equipment Arrangement

The Class 1E electrical equipment arrangement for major components of the three separate power divisions is shown on Figure 8.1-7.

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 ~~HPCS~~ system is a separate and independent safety-related (Class 1E) system ~~comprising~~ Division 3.

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.

The electrical separation and independence of redundant (Division 1 and 2) portions of the safety-related auxiliary power systems conform to IEEE Standard 308-1974, General Design Criterion 17 and Regulatory Guide 1.6, Revision 0, except that these diesel generators have tandem diesel engines. Reliability equivalent to a single diesel engine generator set is achieved, as shown by prototype testing (discussed in 8.3.1.1.9).

Division 1, 2 and 3 4.16 kV Class 1E buses (SM-7, 8, and 4 respectively) are normally supplied from separate 4.16 kV non-Class 1E buses (SM-1, 3 and 2 respectively) as indicated in Figures 8.1-9a through 8.1-9d. Class 1E circuit breakers which automatically open on a loss of offsite power are provided on the 4.16 kV tie lines between the Class 1E and non-Class 1E buses.

As protection against failures of the redundant standby AC power sources due to a single event, there are no electrical interconnections between the circuits needed to start, load, and maintain operation of each standby diesel generator.

All principal power circuits have both overload and short circuit protection provided by protective relays circuit breakers or by fuses.

Physical separation is provided between the independent electrical divisions as described in 8.3.1.4.

Design of the onsite power systems is not in strict accordance with NRC Regulatory Guide 1.75, Revision 0, ~~is not required~~, since the WNP-2 CP issue date precedes the regulatory guide issue date. However, WNP-2 design does provide independence between equipment and circuits of redundant Class 1E electrical divisions, and between Class 1E and non-Class 1E equipment and circuits where practicable in satisfaction of 10 CFR Part 50 requirements.

Connection of non-Class 1E loads to the Class 1E power supplies ~~is permitted, and~~ does not degrade the Class 1E power supplies, based on the following:

a. Connection of non-Class 1E loads to Class 1E power supply is via Class 1E isolation devices. These devices are either a circuit breaker shunt tripped on LOCA or ~~a set of~~ one or two overcurrent devices such as fuses or circuit breakers. ~~The overcurrent devices trip on overload currents (except for 4 kV motor~~

circuits), line-to-line and three-phase faults and line to ground faults for grounded systems.

b. The Class 1E power supplies are adequately sized to handle all the Class 1E and non-Class 1E loads.

c. Periodic surveillance of isolation devices ensure maintenance of the trip setpoints within the limits for proper coordination with the main supply circuit protective devices.

Refer to 8.3.1.3 and 8.3.2.3 for specific details of equipment and circuit identification for plant AC and DC systems respectively.

Refer to 8.3.1.4 and 8.3.2.4 for specific details of equipment and circuit separation for plant AC and DC systems respectively.

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 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, trippiing 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, especaially 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

tests during the refueling outage, the latter based on simulation of actual accident conditions. These tests demonstrate the operability of diesel generator, batter system components, and logic systems and thereby verify the continuity of the systems and the operation of the components.

Because the diesel generator is a standby unit, readiness is of prime importance. Readiness is demonstrated by periodic testing. The testing program is designed to test the ability to start the HPCS loads as well as to run under load long enough to bring all components of the system into equilibrium conditions. This ensures that cooling and lubrication are adequate for extended periods of operation. Full functional tests of the automatic control circuitry will be conducted on a periodic basis to demonstrate correct operation.

8.3.1.2.1.4.3 DELETED

8.3.1.2.1.4.4 Conformance With Regulatory Guide 1.6 (Revision 0)

The HPCS diesel generator unit supplies power only for the HPCS pump and its auxiliaries; therefore, failure of any single component of the HPCS diesel generator does not prevent the startup and operation of any other standby power supply and thus meets the requirements of Regulatory Guide 1.6 (Revision 0).

The system conforms to Position 1 of the guide in that each Class 1E load is assigned to a division of the load groups. The assignment is determined by the nuclear safety functional redundancy of the load such that the loss of any one division of the load group does not prevent the minimum safety functions from being performed.

The system conforms to Position 2 of the guide in that the HPCS AC loads have a supply from the startup auxiliary transformer as the preferred (offsite) power source, as well as from the HPCS diesel generator as the standby (onsite)power source (See Figures 8.1-9a and 8.1-9b).

The HPCS diesel generator breaker ~~can be~~ will close~~d~~ automatically ~~only~~ if the normal source breaker to HPCS bus SM-4 is open and the diesel generator has reached rated voltage and frequency. The system conforms to Position 3 of the guide in that there is no automatic or manual connection of the HPCS system to any other load group.

The system conforms to Position 4 of the guide as follows:

a. The diesel generator is connected to a divisional load group that is physically and electrically independent of other divisional load groups. The diesel generator connected to any division of a load group cannot be automatically paralleled with a diesel generator that is connected to another division of the load group.

b. Each of the diesel generators is connected to one independent division of load group. No means exist for connecting different load groups with each other.

c. Each of the load groups is fed from only one diesel generator, as shown in Figures 8.1-9a and 8.1-9b. No means are provided for transferring loads between the diesel generators.

d. No means exist for manually connecting the different load groups together. All divisions of load groups are physically and electrically independent of each other.

In order to comply with the requirements of Position 5 of the guide, the following start and load reliability test as described in NEDO-10905-3 was successfully performed.

a. A series of tests ~~was~~ were conducted to establish the capability of a prototype HPCS diesel generator unit to consistently start and load within the required time.

b. The prototype diesel generator is of the same model as the unit used for WNP-2 except for the generator. Generator data, however, show equivalence with the prototype unit. Generator characteristics. The comparison data shown in Table 8.3-25 indicates that the WNP-2 ~~[illegible]~~ generator is at least equivalent to the prototype unit.

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 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 conisting 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 ~~is~~ 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 jacet 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 $\pm$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 categoires 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 ~~have~~-been verified by ~~prototype~~ 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 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 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. ~~In addition, a prototype test described in 8.3.1.1.9 will be performed.~~

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.

8.3.1.2.1.4.10 Conformance With IEEE Standard 279-1971

See 7.3.2.1.2 for a discussion of compliance of the HPCS with IEEE Standard 279-1971.

8.3.1.2.1.4.11 Conformance With IEEE Standard 308-1971

The HPCS electrical system components supplying power to the Class 1E electrical equipment are designed to meet their functional requirements under the conditions produced by the design basis events. Equipment of different divisions is physically separated to maintain independence and to minimize the possibility of a common mode failure. HPCS Class 1E equipment is located in Seismic Category I structures.

Surveillance of the HPCS Class 1E electrical system is in compliance with the standard.

8.3.1.2.1.4.12 Conformance with IEEE Standard 344-1971

The HPCS power supply unit components are seismically qualified to IEEE Standard 344-1971. Refer to 3.10.

8.3.1.2.1.4.13 Conformance to IEEE Standard 387-1972

The HPCS power supply unit is completely independent from other standby power supply units and meets the applicable requirements of IEEE Standard 387-1972.

The HPCS diesel generator unit is designed to:

a. Operate in its service environment during and after any design basis event without support from the preferred power supply;

b. Start, accelerate, and be loaded with the design load within an acceptable time:

   1. from the normal standby condition,

   2. with no cooling available, for a time equivalent to that required to bring the cooling equipment into service with energy from the diesel generator unit, and

3. on a restart with an initial engine temperature equal to the continuous rating, full load engine temperature;

c. Carry the design load for 2000 hours;

d. Maintain voltage and frequency within limits that will not degrade the performance of any of the loads composing the design load below their minimum requirements, including the duration of transients caused by load application or load removal;

e. Withstand any anticipated vibration and overspeed conditions. There is no flywheel coupled with the HPCS diesel generator. The generator and exciter are designed to withstand 25% overspeed without damage.

The HPCS diesel generator has continuous and short-term ratings consistent with the requirements of Section 5.1 of the standard.

Mechanical and electrical system interactions between the HPCS diesel generator unit and other units of the standby power supply, the nuclear plant, the conventional plant, and the Class 1E electrical systems are coordinated so that the HPCS diesel generator units' design function and capability are realized for any design basis event except failure of the HPCS diesel generator unit.

The qualification requirements of IEEE Standard 323-1971 are met by test and on operating experience on similar equipment in similar environment in other plants.

8.3.1.2.2 Tests and Inspection

The auxiliary AC power system is designed to permit periodic testing and inspection of the system as a whole and of the operability and functional performance of the components in accordance with General Design Criterion 18. Preoperational testing, as described in Chapter 14, will be performed to verify that all components, automatic and manual controls, and sequences of operation of the standby power system function as required. Preoperational testing of redundant portions of the onsite electrical power system to verify proper load group assignments is performed in accordance with NRC Regulatory Guide 1.41, Revision 0.

Prior to plant startup, and at periodic intervals when the reactor is not at power operation, tests simulating Class 1E bus undervoltage or LOCA will be performed to demonstrate the capability of the power sources to meet the starting and loading sequencing requirements. Testing procedures during these times are described in the Technical Specifications.

Periodically during plant operation each diesel generator will be manually started and loaded. Each (Division 1, 2 and 3) unit will be separately synchronized to the 230 kV startup offsite power source and loaded.

The testing program is designed to test the ability of each diesel generator to start as well as to run under load long enough to bring all components of the system into equilibrium condition. This ensures that cooling and lubrication are adequate for extended periods of operation. Functional testing of the automatic control circuitry is conducted on a periodic basis to demonstrate proper operation.

Sufficient testability, alarms and fault detection equipment are provided to comply with the criteria indicated above. Thus assurance is given that the standby power sources are capable of performing their safety functions with adequate reliability at all times.

8.3.1.2.3 Service Environment

In addition to the effects of operation in normal service environment, all components of the emergency portion of the auxiliary AC power system essential to limiting the consequences of a LOCA, are designed to operate in the post-accident environment expected in the area in which they are located. Refer to 3.11 for discussion of environmental design and analysis of safety related (Class 1E) electrical components for post-accident conditions. Section 3.11 also identifies safety-related equipment that must operate in a hostile environment, and contains a tabulation of the conditions under which the equipment must operate. 3.10 identifies Seismic Category I electrical equipment and describes the criteria, design and testing of electrical equipment in compliance with IEEE Std. 344-1971 for seismic qualification.

[illegible]

All cable for Class 1E systems and associated circuits ~~is~~ moisture and radiation resistant, ~~is~~ highly flame ~~resistant~~ and ~~evidences little~~ corrosive ~~effect~~ when subject to heat or flame, ~~or both~~. Certified proof tests are performed on cable samples to certify 40-year life by thermal aging, to prove radiation resistance by exposure of aged specimen to integrated dosage of 5×10^7 rads, mechanical/electrical tests of previously exposed cable to 340°F and 45 psig steam, to prove flame resistance by the vertical tray, 70,000 Btu/hr flame test for eight minutes, minimum, and finally, to show acceptable levels of gas by an acid gas generation test. See 8.3.3.1.

8.3.1.2.4 Offsite Power System Degradation

8.3.1.2.4.1 General

The WNP-2 auxiliary AC power system is normally supplied by the 25 kV plant main generator (via the normal auxiliary transformers TR-N1 and TR-N2). During this time, the main generating unit is generally synchronized with and furnishes power to the 500 kV BPA grid via the plant main transformer.

During plant startup, shutdown, or sudden loss of the main generating unit, the 230 kV startup offsite power source is capable of supplying all plant auxiliary AC power system loads (both Class 1E and non-Class 1E) via the startup auxiliary transformer TR-S.

In the event that both the 25 kV normal source and the 230 kV startup source are unavailable, the 115 kV backup offsite power source supplies (via the backup auxiliary transformer TR-B) the Division 1 and 2 Class 1E loads required for safe shutdown.

Refer to 8.2 for a detailed description of the WNP-2 offsite power sources. Refer to 8.3.1 for a detailed description of the auxiliary AC power system.

Based upon previous industry operating experience with boiling water reactors of a similar type, it is estimated that WNP-2 plant availability will be approximately 0.75. As a result, supply of auxiliary AC power system loads via either the 230 kV startup or 115 kV backup offsite power sources will occur approximately 25 percent of plant operating life.

8.3.1.2.4.2 Class 1E Auxiliary AC Distribution System Voltages

8.3.1.2.4.2.1 Voltage Criteria

The auxiliary AC distribution system is designed to maintain system voltages within acceptable ranges at all levels of the plant distribution system, whether incoming supply is from the plant main generator or from the BPA grid system. Table 8.3-12 indicates the acceptable voltage ranges for the major Class 1E portions of the system, based upon consideration of motor-operating voltage ranges as determining system voltage acceptability. Table 8.3-13 indicates the voltage range over which Class 1E and non-Class 1E motors and motor starters are capable of operating.

Load tap changing capability is not provided on the power transformers utilized at WNP-2. All power transformers are furnished with no-load type tap changers on the primary side only; all taps are set as shown on Table 8.3-23.

8.3.1.2.4.2.2 Expected Voltages - 25 kV Main Generating Unit Supply

Table 8.3-14 indicates the minimum and maximum voltages expected at the major levels of the Class 1E portions of the auxiliary AC distribution system when supplied from the 25 kV main generating unit. Main generating unit output voltage range is assumed to range from 23.8 kV to 26.3 kV, corresponding to an output voltage variation of $\pm$5 percent of generator nameplate voltage. This range is based upon the use of a unit automatic voltage regulator designed to maintain generator output voltage between 0.95 pu and 1.05 pu.

A comparison of the acceptable and required voltage ranges indicated in Tables 8.3-12 and 8.3-13 (respectively), and the expected voltages indicated in Table 8.3-14, indicates that expected voltages in the Class 1E portions of the auxiliary AC distribution system are acceptable when supplied from the 25 kV plant main generating unit.

8.3.1.2.4.2.3 Expected Voltages - 230 kV Grid Supply

The preferred offsite power source grid system voltage has a nominal rating of 230 kV. Minimum and maximum values of grid voltage are 230 kV and 240 kV respectively.

Table 8.3-15 indicates the minimum and maximum voltages expected at the major levels of the Class 1E portions of the auxiliary AC distribution system over the range of 230 kV grid supply.

A comparison of the acceptable and required voltage levels indicated in Tables 8.3-12 and 8.3-13 (respectively) and the expected voltages indicated in Table 8.3-15 indicates that the expected voltages in the Class 1E portions of the auxiliary AC distribution system are acceptable when supply is from the 230 kV grid system.

8.3.1.2.4.2.4 Expected Voltages - 115 kV Grid Supply

The backup offsite power source grid voltage has a nominal rating of 115 kV. Minimum and maximum values of grid voltage are 113 kV and 122 kV, respectively.

Table 8.3-16 indicates the minimum and maximum voltages expected at the major levels of the Class 1E portions of the auxiliary AC distribution system over the range of 115 kV grid supply.

A comparison of the acceptable and required voltage levels indicated in Tables 8.3-12 and 8.3-13 (respectively) and the expected voltages indicated in Table 8.3-16 indicates that expected voltages in the Class 1E portions of the auxiliary AC distribution system are acceptable when supply is from the 115 kV grid system.

8.3.1.2.4.3 Class 1E Auxiliary AC Distribution System Voltage Sensing

8.3.1.2.4.3.1 Primary Undervoltage Sensing

High speed, instantaneous undervoltage relays located in each of the 4.16 kV Class 1E switchgear units are utilized for detection of undervoltage at the switchgear buses.

The trip setpoint of each relay is set at 2870 volts, corresponding to 69% of nominal bus voltage. Trip setpoint selection is based upon overriding minimum bus voltage during motor starting, with an allowance (10% below minimum motor starting voltage) to compensate for relay setting tolerances.

8.3.1.2.4.3.2 Secondary Undervoltage Sensing

Static Class 1E undervoltage relays with definite time delay located in each of the redundant Division 1 and Division 2 4.16 kV Class 1E switchgear units are utilized for detection of sustained degraded voltage in the offsite power system. This protection scheme is designed to compliment the primary undervoltage scheme described above.

The trip setpoint of each relay is ~~set at~~ 3631 volts, corresponding to 87.3 percent of nominal bus voltage and 90.8 percent of nominal motor voltage. Trip setpoint selection is based upon insuring 90 percent of motor nominal voltage at the motor terminals, including allowance for feeder voltage drop. The relay automatically resets when the bus voltage exceeds 89.9% of nominal rating. Eight seconds of time delay is provided to permit override of motor starting dip. The duration of motor starting voltage dip is very short lived - in the order of 2 to 5 seconds. The second level of undervoltage relays will not, therefore, initiate actions for this condition.

The relays operate to isolate the degraded source and initiate the sequence of event to select the next available source. Circuit design precludes spurious voltage loss signal and allows for testing of the individual relay, one at a time, without disrupting the protective function.

During loss-of-coolant accident, diesel generator power is available to the emergency loads 13 seconds after the sustained degraded grid voltage condition is sensed at the emergency bus. The above time delay is acceptable since during a concurrent loss-of-coolant accident ~~(LOCA)~~, the emergency core cooling system (ECCS) coolant injection time requirements as specified in Table 6.3-1 are met.

This time delay is equal to the 8 second delay prior to the offsite breaker trip plus a 5 second delay prior to the diesel generator breaker closure.

See Figures 8.3-16c and 8.3-17c for the logic diagrams of Divisions 1 and 2 secondary undervoltage protection.

Assume that, while the emergency motor loads are running, the grid voltage is degraded to anywhere between 69% and 87.3% of the bus nominal voltage. The corresponding motor terminal voltage would be between 72% and 90% approximately of nameplate value. For motor terminal voltages between 80% (75% for the HPCS pump motor) and 90%, the motor will continue to run at overcurrents up to 125% of motor rated current (133% for the HPCS pump motor). The motors can safely carry this overload for 8 sec. For motor voltages less than 80% (75% for the HPCS pump motor) the motor torque would be less than the load torque, thus resulting in deceleration and eventual stalling. The safe motor stall time exceeds 10 seconds at which the motor locked-rotor protective relay is set to trip and lock out. In as much as the secondary undervoltage relaying is set to operate in 8 seconds, the motor locked-rotor protective relay will not trip. Hence, the motor will not be locked out. At the end of the 8-second period the motors will be shed and will remain available for a restart after the bus voltage has been restored.

If, on the other hand, the motor start signal comes after the grid voltage is degraded the emergency motor loads are prevented from starting by interlocks from the secondary undervoltage auxiliary relays to the motor start logic and by appropriate time delay relays.

Table 8.3-19 indicates the voltage values expected at the various levels of the Class 1E portions of the auxiliary AC distribution system under a degraded (69% of nominal, based upon 4.16 kV voltage sensors) value of input voltage (2870 V).

It should be noted that critical (Class 1E) plant controls and vital instrumentation are supplied by redundant (Division 1 and 2) divisions of the 120/240 V AC Class 1E uninterruptible power supply system. This system supplies loads via inverters, with static transfer to an alternate AC supply in case of circuit faults or loss of inverter voltage. The alternate supply line voltage is regulated within ±10% of normal in accordance with the NSSS vendor's requirements. A manual bypass switch is provided for maintenance of the inverter or static switch.

Table 8.3-17 indicates the various monitors and alarms (annunciators/computer) provided to monitor system voltages.

8.3.1.3 Physical Identification of Safety-Related (Class 1E) Equipment

Each safety-related electrical equipment or cable is tagged with an equipment number. In addition, a division identification marker is provided along with the equipment number which indicates the assignment to one of seven divisions (Divisions 1, 2, 3, 4, 5, 6, and 7). This division marker is inscribed with color coded characters on a color coded background as shown in Tables 8.3-25 and 8.3-26. Assignment of equipment to the seven divisions is given in Table 8.3-7.

All Class 1E cables external 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). In addition, division marking characters are provided as shown on Table 8.3-25. Non-Class 1E cables, including associated cables, are identified with a unique cable number at their terminations, pullpoints, entrance and exit to raceways, and every 100 feet. In addition, division marking characters which are provided as shown in Table 8.3-25. Non-Class 1E cables that are powered from Class 1E are identified every 15 feet (except in conduit), with a checkered divisional marker, as shown in Table 8.3-25.
to the cable numbers, color coded division identifiers are provided either

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 ~~or~~ and/or equipment (see 8.3.1.4.1.1 for definition) is provided to facilitate identification of safety-related components and their circuits. ~~to which they belong~~.

Class 1E circuits and associated circuits within equipment enclosures are not uniquely identified, ~~but assume the division identified~~ on the equipment except that all intruding divisional circuits and prime circuits (Class 1E powered non-Class 1E circuits) are identified by striped markers as shown in Tables 8.3-25 and 8.3-26.

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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 necesary for the systems listed in Table 7.1-1 to perform their safety function, and include the reactor protection system, the nuclear steam supply 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

of an unsafe condition. The ~~complete~~ RPS is a Class 1E safety-related system.

The reactor protection system power system, consisting of MG sets, distribution panels, etc., is a separate, nonsafety-related system which supplies power to the RPS itself.

8.3.1.4.1.4 Engineered Safeguards System (ESS)

This includes that combination of subsystems which take automatic action to provide the cooling necessary to limit or prevent the effects of fuel cladding melting, maintain the integrity of the conntainment, and insure that the exposure of the public to radiation will be below the limits of 10CFR100 in the event of a design basis reactor accident. The ESS includes emergency core cooling systems (ECCS) as follows:

a. low pressure core spray (LPCS)
b. automatic depressurization system (ADS)
c. high pressure core spray (HPCS)
d. residual heat removal (RHR)

ESS also includes other systems as shown in Table 8.3-21.

8.3.1.4.1.5 Nuclear Steam Supply Shutoff System (NSSSS)

The NSSSS consists of instrument channels (except those common to RPS), power supplies, trip systems, manual controls, and interconnecting wiring involved in generating a containment isolation trip function, part of primary containment and reactor vessel isolation control system (PCRVICS). Instrument channels for the isolation functions which are shared with the reactor protection system are considered a part of the RPS as far as separation is concerned.

8.3.1.4.1.6 Instrument Channel

The instrument channel is an arrangement of sensory and intermediate components as required to generate a single trip signal related to a particular plant parameter and introduce this trip signal into a trip system. The channel loses its identity upon combination of its trip signal with others.

8.3.1.4.1.7 Trip System

The trip system is an interconnected arrangement of components making use of instrument channel outputs in the generation of a trip function when appropriate logic is satisfied.

8.3.1.4.1.8 Trip Actuator

The trip actuator is the mechanism which carries out the final action of the protection system.

8.3.1.4.1.9 Redundant System

The redundant system is a system or subsystem whose function can be provided by another system or subsystem.

8.3.1.4.1.10 Standby Power Sources

Standby "onsite" power sources are those designed for use when offsite power is not available. These include engine-driven generators and station batteries.

8.3.1.4.1.11 Single Failure

A single failure is an occurrence which results in the loss of capability of a component to perform its intended safety functions. Multiple failures resulting from a single occurrence are considered to be part of the single failure. Systems providing safety functions are considered to be designed against an assumed single failure, if a single failure of any component does not result in a loss of capability of the systems to perform their safety function. Single failures are defined as follows:

a. Active Failure: An active failure is defined as the malfunction or loss of function of a component of electrical, mechanical, or fluid systems. Component function is ~~its designed function~~ to transmit signal, perform logic, and control, convert, or generate power.

b. Passive Failure: A passive failure refers to the failure of passive electrical equipment, such as insulation in cables or pump or valve seals for long-term cooling requirements.

8.3.1.4.1.12 Isolation Device

An isolation device is a device in a circuit which ~~limits~~ the effects of events in one section of a circuit from causing unacceptable consequences in other sections of the circuits or other circuits. Some examples of isolation devices are relays (coil to contact separation), buffer amplifiers, isolation transformers, fuses, circuit breakers, ~~and fire stops~~.

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 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 structure 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).

8.3.1.4.2 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 Segragation 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 tne 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 feeds to switchgear, panel and local panel control buses. Wire types are to be power cable, type G2.

b. 125 V DC or 120 V AC 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 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 383-1971 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. ~~Associated cables are installed to the same installation parameters as Class 1E cables except for sidewall pressure.~~ These circuits are defined in accordance with the three part definition in 8.3.1.4.1.4.13 and comply with at least one of the following requirements:

a. For cable trays, raceways, and PGCC floor ducts (associated circuit definition (a)), see 8.3.1.4.1.13)

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

2. They are 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. For cabinets, cable end points, equipment, internals (external to item (a) above) (associated circuit definitions b and c), see 8.3.1.4.1.13.

1. Associated Circuit Definition b - Associated circuits which become associated due to sharing of enclosures with Class 1E circuits do not require separation, but are analyzed to show that the Class 1E circuits are not degraded below an acceptable level.

2. Associated Circuit Definition c (prime circuits) - Associated 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 power source origin is a Division 1 critical bus and separated from a Division 2 Class 1E circuit and Division B non-Class 1E circuit whose power source origin is a Division 2 critical bus.

8.3.1.4.2.1.3.3 Non-Class 1E Cables

Non-Class 1E (nonassociated) cable numbers are prefixed by "A" or "B" are routed in non-Class 1E raceways. They are, however, 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.

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.

8.3.1.4.2.1.4 Cable Segregation by Routing

The physical separaton distances required between ~~non-~~PGCC raceways 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 Division A and Division 1 raceways and similarly between Division B and Division 2 raceways. For cables external to the PGCC, cable numbers listed in the computerized cable schedule are assigned a compatibility that corresponds to a raceway. The compatibility number is identical to the cable number prefix and the divisional assignment of the raceway except for the following: Division A prefixed cables are assigned a compatibility of 1 if routing in Division 1 raceways is required and Division B prefixed cables are assigned a compatibility of 2 if routing in Division 2 raceways is required (see Table 8.3-8); within the PGCC isolated floor ducts for Divisions 1, 2, 3, and nondivisional are provided for cable routing in accordance with Tables 8.3-20, 8.3-21 and 8.3-22. The routing of cables in raceways is in accordance with the following:

a. Cable splices are not normally designed into the cable system (except for cables entering containment at electrical penetrations). If required they are not permitted in cable trays, but are made in conduit fittings or metallic electrical boxes.

b. All cabling for use in Class 1E systems, and for associated circuits, is designed to resist combustion as described in 8.3.3. Cable flame retardance characteristics and routing arrangement eliminate (insofar as practical) the potential for fire damage to cables and the spread of fire between redundant divisions.

c. Power cable ampacities are based on NEMA WC 51-1972 using a tray fill of 2 in. out of a 3 in. usable depth and corrected for ambient temperature. A further group derating factor is applied to account for unforseen as-built conditions. The above tray fill of 2 in. is approximately 50% of the usable tray crossectional area.

d. Hazardous areas are avoided ~~such that circuit failures are~~ limited to ~~failures or~~ faults internal to the electric equipment or cables, ~~or else~~ analysis is provided (See 8.3.1.4.2.2).

e. In the cable spreading and main control room areas, 120 V AC (or below) and 125 V DC (or below) branch circuits from distribution panels to the control boards and terminal cabinets are

routed in conduit (see Table 8.3-24). The only power cables in these areas are the 460 V AC feeders to the control room emergency lighting panel step-down transformers; these cables are routed in conduit.

f. The underground cables for Class 1E systems complies with NRC General Design Criteria 1, 2, 3, 4, and 17, as well as IEEE Standard 308-1974 and the following:

1. Underground cables between manholes are run in concrete encased plastic ducts which serve non-Class 1E systems, and in reinforced concrete encased steel ducts to Class 1E systems.

2. The minimum horizontal separation at the peripheries of redundant underground ducts is 18 inches. There is no underground cross-overs of these duct banks.

3. Underground ducts for Class 1E cables are Quality Class 1 and Seismic Class 1. Cables are fire retardant type, and where splices are necessary in manholes because of the length of pull, waterproofing is utilized.

In limited access areas such as the switchyard, a single conduit may contain non-Class 1E cables of both non-Class 1E divisions provided they are not both prime circuits. Where access to a local device is via a single conduit, the conduit is considered as an extension of the device enclosure, and cable separation by service is not maintained.

8.3.1.4.2.2 Physical Separation Criteria

Physical separation as a protection against single failures of redundant Class 1E power control and instrumentation systems (Divisions 1 to 7) is provided. Where the use of separate safety class structures is not feasible, spatial separation is the preferred method of achieving separation. Methods of maintaining physical separation are as follows:

a. Non-safety equipment, components or piping are not run above safety equipment unless they are adequately restrained or it can be demonstrated that failure will not impair the overall function of the safety system.

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, an adequate protective barrier is constructed, or 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 can not occur.

c. Fire rated fire stops and/or 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 resistant material. Refer to Appendix F for the fire analysis provided in accordance 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 compliance, 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.

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

protection system cabinets is run in rigid or flexible conduits and/or totally enclosd trays used for no other wiring and are conspicuously identified at all junction or pull boxes. IRM, LPRM input, and RPS scram group output cables are combined in the same wireway provided that the four divisional separation (Divisions 4, 5, 6, and 7) are maintained (see Table 8.3-22).

8.3.1.4.2.4.2 Scram Solenoid Cabling

Wires from both RPS trip system trip actuators to a single group of scram solenoids are run in a single conduit; however, a single conduit does not contain wires to more than one group of scram solenoids. Wiring for two solenoids on the same control rod is run in the same conduit (see Figure 8.3-41).

8.3.1.4.2.4.3 NMS and Inboard Isolation Valve Cabling

Cables through the primary containment penetrations are so grouped that failure of all cabling in a single penetration cannot prevent a scram. (This applies specifically to the neutron monitoring cables and the main steam isolation valves position switches cables, see Figures 8.3-41 and 8.3-42.)

8.3.1.4.2.4.4 RPS Power Supplies

Power supplies to systems which de-energize to operate (so call "fail-safe" power supplies) require only that separation which is deemed prudent to give reliability (continuity of operation). Therefore, the protection system flywheel motor generator (MG) sets and load circuit breakers are not required to comply with Class 1E separation requirements.

8.3.1.4.2.4.5 Four Division Separation

Wiring for the four RPS scram group outputs and the NMS LPRM inputs is routed as four separate divisions (see Tables 8.3-20, 8.3-21, and 8.3-22 and Figures 8.3-41 and 8.3-42).

8.3.1.4.2.5 Equipment and Circuits Requiring Separation

Equipment and circuits are identified on documents and drawings in a distinctive manner.

8.3.1.4.2.6 Compliance to Regulatory Guide 1.75, Revision 1

This regulatory guide is not applicable to WNP-2 since the WNP-2 construction permit date precedes the regulatory guide issue date. However, the actual plant design does provide a technically acceptable alternative to the requirements of the

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 Reg. Guide 1.75 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 Reg. 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.

c. Paragraphs 4.6.1 and 4.6.2 Appendix (1) to Reg. 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 for item (b).

d. Sections 5.1.3 and 5.1.4 Appendix (1) to Reg. Guide 1.75 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. 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. Section 5.6.3 Appendix (1) to Reg. Guide 1.75 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.

8.3.1.4.3 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, batteries, charges, and associated equipment, ~~are~~ located ~~by redundant division~~ in separate rooms, and ~~are~~ further ~~described in~~ 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.

8.3.1.4.3.5 Containment Electrical Penetrations

There are twenty-four electrical penetrations which provide electrical power to equipment inside the primary containment as detailed in Table 3.8-6 and described in 3.8.6.1.4. Redundant Class 1E circuits for loads located inside primary containment are routed through separate penetrations and in accordance with Figures 8.3-41 and 8.3-42 with the exception of HPCS cabling. HPCS (Division 3) cabling is routed through a Division 2 penetration through a separate~~d and barriered~~ sleeve. ~~Containment penetrations are provided with bolt-on terminal boxes which qualify as electrical barriers. Cabling enters and exits penetrations terminal boxes via conduit.~~

8.3.1.4.3.6 Power Generation Control Complex (PGCC)

PGCC is defined in 8.3.1.4.1.15.

PGCC is a modular design concept which allows the fabrication installation, and testing in a quality controlled environment in accordance with the requirements of 10CFR50, Appendix B (see Figures 8.3-30 and 8.3-31). The PGCC forms an interface between the field cables and the control panels and consists of three different subassemblies: termination cabinets, modular floor sections, and cable assemblies.

8.3.1.4.3.6.1 Termination Cabinets

Termination cabinets (T/C) provide the interface with the field cables (see Figures 8.3-32 and 8.3-33) and consists of three different subassemblies: termination modules, connector plates (including connectors), and junction boxes for flexible conduit terminations (see Figure 8.3-34). The T/C enclosures are constructed of 3/16" steel plate welded to 3/8" steel corner angles and utilize swing and stationary steel barriers for fire separation between redundant system cables. Seismic and fire tests have been conducted on these units as reported in the licensing report NEDO-10466A. The fire tests demonstrated the adequacy of the stationary steel barriers. In addition to the overall structural fire protection design of the PGCC (see Figure 8.3-39), products of combustion detectors are located at the top of each termination cabinet. These detectors are monitored on the main control room fire control panel. Additional defense in depth measures include the installation of fire stops at all cable entrances to the cabinet, ~~and~~ the use of fire retardant materials, and the use of unlocked ~~termination~~ cabinet doors to allow rapid use of hand-held extinguishers.

(and penetration seals)

8.3.1.4.3.6.2 Modular Floor Sections

The modular floor section is a latticed floor constructed of steel "I" beams and rectangular steel tubes forming longitudinal and lateral ducts. These ducts interconnect the control panel modules (which are bolted on the modular floor section) and the termination cabinet (see Figures 8.3-31 and 8.3-35). The network, including transition and extension ducts, provides divisional separation with the use of vertial and/or horizontal barriers and fire stops. Miniducts (Figure 8.3-40) are of similar construction to the floor ducts and are utilized for divisional separation with the longitudinal ducts. Cables in the miniducts are routed in flexible metallic conduit. Insert from attached

The fire detection equipment in the floor modules consist of two thermal detectors and one product of combustion detector mounted in each of the longitudinal raceways (see Figure 8.3-36). Products of combustion dectectors respond to 0.006 grams of product per cubic foot of air while the thermal detectors respond to a temperature rise of 15°F per minute or an ambient temperature of 140°F. The fire detection system meets the requirements of a Class A system as defined in NFPA-72D and Class 1 circuits as defined in NFPA-70. The detectors and operational functions are wired out to the termination cabinet associated with each floor section. Fire protection cabling within the PGCC is routed in flexible steel conduit to the fire protection terminal box in each termination cabinet. Fire protection cabling external to the PGCC is routed in rigid steel conduit to the fire control panel for audible and visual alarms that are zoned to the individual floor sections. Primary and secondary power is supplied to the detection system. The primary system is 120 V and the secondary system 24 VDC. In Appendix F of the General Electric Licensing Report NEDO-10466-A, fire tests on the PGCC floor section showed that a fire could not be established. However, in order to enhance the safety features of the PGCC, a fixed automated halon 1301 suppression system has been installed. The equipment consists of four nozzles attached to a manifold located at the termination cabinet end of the floor section. Each nozzle is designed to flood each longitudinal raceway. If fire stops, barriers or miniducts create isolated longitudinal raceway sections, provisions are made so that suppressant material will reach these areas or the isolated section is protected with fire retardant material. Fire stops are located in the ducts that access the termination cabling and in the ducts that access the control panels (see Figure 8.3-37). Floor plates consist of an aluminum honeycomb core, 1-1/16" thick. A final floor covering of fire retardant vinyl-asbestos floor tile that meets federal specification SS-T-312 is provided for the finished PGCC floor.

and penetration seals

Insert to page 8.3-58b as marked

Fire protection is provided in accordance with the PGCC Licensing Topical Report, NEDO 10466A and Amendment No. 19 Fire Protection Evaluation, to the FSAR. Products of combustion and thermal detectors are provided in the floor section longitudinal ducts. These detectors are monitored on the respective PGCC module fire control panel and on the main control room fire control panel where zoned alarms are grouped by floor section. Products of combustion detectors will pre-alarm, to allow a manual response through quickly removable floor plates. Thermal detectors will automatically release Halon 1301 through a distribution system into each of the floor sections longitudinal cable ducts.

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 Raychem Flamtrol, General Electric Vulkene/Geoprene and 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 categoires: 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.

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 of 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.

8.3.1.4.3.8.2 Specific Areas

8.3.1.4.3.8.2.1 Cable Spreading Room

Within the cable spreading room, the minimum separation distance between open trays of redundant divisions is one foot between trays separated horizontally and three feet between trays separated vertically. A fire detection and extinguishing system is present. Where these distances cannot be maintained, fire barriers are installed.

Within the cable spreading room, the minimum separation clearance between conduits and open trays of redundant divisions is one-inch free air space when the conduit is below or to the side of the open tray and three-feet free air space when the conduit is located above the open trays.

8.3.1.4.3.8.2.2 Power Generation Control Complex (PGCC)

The physical configuration of the PGCC control room assembly does not allow for general area raceway spatial separation in accordance with 8.3.1.4.3.8.1. Structural and spatial separation has been provided in the PGCC as described in 8.3.1.4.3.6.2 for divisionally redundant raceways. The PGCC raceways are also provided with an automatic fire suppression system.

8.3.1.4.3.8.2.3 Cable Chase And Other Areas Of Cable Congestion

The use of fire retardant cabling and automatic sprinkler systems permit opposite sides of the cable chase to be utilized to route cabling of redundant divisions.

Fire protection, as described in 9.5.1 and 8.3.3, is installed in areas of large concentrations of cables and other areas to alarm if a fire occurs. Wherever an open wireway penetrates a firewall or fire floor slab, a fire retardant self-extinguishing silicone foam fire stop is provided to prevent the spread of fire through the wall or floor. All vertical runs have solid tray covers on the outermost tray at floor or slab penetrations. The fire stops are rated for 3 hours, or are rated equivalent to the wall or floor slab rating, whichever is less.

Fire stops are used where any raceway penetrates the slab into the control room, where any raceway penetrates designated fire zones, or where any raceway penetrates areas where an ambient pressure difference exists. In addition, fire stops are provided where any open vertical raceway penetrates floor or ceiling slabs. Both the penetration and the trays themselves are sealed with fire resistant material.

8.3.1.4.3.8.2.4 Class 1E Underground Duct System

Class 1E equipment located remotely from the plant (e.g., equipment located at the ultimate heat sink) is serviced by divisionally separated Class 1E underground duct systems and manholes. See 8.3.1.4.2.1.4.f. Separation distances between redundant divisions within manholes is similar to enclosures. See 8.3.1.4.3.7.

8.3.1.4.3.8.2.5 NMS Cabling Under Reactor

The neutron monitoring system cabling in the area immediately underneath the reactor is not completely routed in totally enclosed raceway nor separated in accordance with Figures 8.3-29a through 8.3-29d due to space limitations and the need for cable flexibility.

8.3.1.4.3.8.2.6 Class 1E Cabling In Turbine Generator Building

a. Class 1E main steam turbine sensing and turbine generator building leak detection instrumentation, instrument racks, cabling and raceways are located in the turbine generator building, a non-Category I structure. This equipment provides trip signal input to the RPS system in the event of a turbine trip or generator load rejection. Sufficient diverse backup signals exist within the RPS such that scram is not prevented because of the loss of these turbine generator building signals. Refer to 7.2.

b. Main steam tunnel high radiation sensing instrumentation and associated cabling and raceways are located in the turbine generator building, a non-Category I structure. This equipment provides RPS trip and containment isolation signals in the event of main steam line high radiation. Routing has been analyzed and supports designed such that equipment remains functional during SSE loading.

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 ~~and which~~ 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 non-Class 1E cables 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 Non-Class 1E ~~Circuits~~ Categories ~~Requiring Analysis~~

The following categories of circuits ~~are justified~~ by analysis such that they are treated as non-Class 1E circuits~~, as~~ defined by Regulatory Guide 1.75, Revision 1. ~~These are~~ illustrated in Figures 8.3-43a through 8.3-43c except for Categories 3B and 3C which are self explanatory.

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.

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.

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.

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.

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.

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

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.

Category 3C: Non-Class 1E power cables/wires that are supplied Class 1E power through an inverter.

8.3.1.4.4.1.1 Analysis for Category 1A ~~Non-Class 1E~~ 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.

c. Fire stops are provided at or near penetration of all fire-rated barriers, seismic gaps, pressure

boundries, and entrance to PGCC panels (including termination cabinets).

d. Overcurrent protective devices (including current limiting) are provided to isolate the cables or wires carrying abnormal currents and limit the effects on the Class 1E cables with which the continuing sections are routed.

e. Equipment affected by exposure fires is delineated in the Fire Hazard Analysis, Appendix F.

f. Pipewhip/jet impingement and missile study provides structural barriers and/or restraints where required to prevent impact on redundant engineered safety features required to mitigate the consequences of these events and safely shut down the plant.

g. Non-Class 1E cables ~~contained in a non-Class 1E~~ of a given division raceway can only be routed into ~~a compatible~~ one division Class 1E raceway. This prevents cridding between two redundant divisions.

8.3.1.4.4.1.2 Analysis for Category 1B Non-Class 1E Circuits

This category of non-Class 1E circuits are instrumentation and control cables/wires that are supplied Class 1E power and their continuing sections and routed in Class 1E raceways. The postulated failures are similar to those of Category 1A. Failures that affect non-Class 1E raceways or equipment containinng these associated circuits could result in circuit overcurrents. However, since these circuits are all protected by overcurrent protective devices, the ability of these faults to generate sufficient energy to propagate the failure to the Class 1E cables is mitigated.

The following design features are provided to minimize the occurance of this hazard.

a. Those justifications listed under Category 1A-a, b, c, d, e, f, and g.

b. Class 1E coordinated overcurrent protective devices have been provided to protect Class 1E buses from failures in non-Class 1E loads. These devices may be current-limiting fuses or circuit breakers. See 8.3.1.2.1.1 and 8.3.2.2.1.1.

c. These circuits have been designated prime and adhere to the physical separaton requirements imposed on Class 1E circuits. Barriers are provided between Division A and Division B trays that contain prime cables and trays not separated to the Class 1E requirements.

d. Prime cables are separated the same as Class 1E cables within enclosures. An A prime 1 (A'1) cable is treated like Division 1 cable and a B'2 cable is treated like a Division 2 cable. No other variation of prime cables is permitted.

8.3.1.4.4.1.3 Analysis for Category 1C Non-Class 1E Circuits

These associated circuits are non-Class 1E powered instrumentation and control circuits that become associated by proximity to Class 1E cables inside enclosures. The analysis for Category 1C is identical to Category 1A. Refer to 8.3.1.4.4.1.1.

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 ~~per~~ and cable ampacities are ~~determined~~ taken from NEMAWC51-1972. Ambient temperature correction is made for temperature above 40C. In addition, a group derating factor is applied to ~~the cables which prevent cable overheating and insulation failures~~. further guarrantee 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. ~~The analysis for these circuits is similar to the analysis provided for Category 2A. Refer to 8.3.1.4.4.1.4.~~ 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 Associated Circuits ~~Categories~~ of Treated as Class IE

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 ~~may~~ have a continuing section in a non-Class 1E raceway (Category 2B).

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.

8.3.1.4.4.3.2 Single RCIC Input is Utilized for Redundant RHR Output

The analog loop for the RHR steam inlet pressure transmitter E12-N028 is powered from an RHR signal resistor unit, which in turn provides a second input signal for level control valves RHR-V-65A and RHR-V-65B. These valves control the condensate flow to the RCIC system, thereby controlling the level in the RHR heat exchangers during a steam condensing mode (a non-safety-related function). ~~The signals from E12-N028 are therefor not Class 1E and are isolated by the signal resistor unit.~~ ~~The potential for damage to the Class 1E system is remote due to the low energy of the circuits involved~~, ~~and the design~~

8.3.1.4.4.3.3 Standby Liquid Control System

The standby liquid control system does not meet the divisional separation requirements; however, an analysis is provided by General Electric.

The signal resistor unit serves to isolate the non-Class IE from the Class IE circuit ~~such that under~~ during a postulated electrical fault in the non-Class IE circuit.

8.3.2 DC POWER SYSTEMs

8.3.2.1 Description

The principal elements of the WNP-2 Class 1E DC power systems are shown in Figure 8.3-19. The systems consist of three electrically independent and separate 125 V batteries (Division 1, 2, and 3), two ± 24 V batteries (Divisions 1 and 2), one 250 V battery (Division 1) and associated auxiliary equipment.

All non-Class 1E loads supplied by the Class 1E DC power systems are connected to the Class 1E DC power system via prime cables in a manner identical to that described for the AC power system (see 8.3.1.4).

Table 8.3-18 indicates the switchgear and motor control centers which are supplied with DC control power by the various DC power systems.

Two non-Class 1E 125 V DC (Divisions A & B) power supply systems are located at the makeup water pump house to provide local control power.

One non-Class 1E ~~125~~ 450 V DC power supply system is provided at the main guardhouse for the security system.

One non-Class 1E 125 V DC power supply system is provided in the radwaste building to supply non-Class 1E power, control, and instrumentation loads.

8.3.2.1.1 125 Volt DC Division 1 and 2 Systems

8.3.2.1.1.1 General

Two separate and independent Class 1E, 125 V DC systems are provided to power the safety-related (ESF) load groups of Division 1 and 2. Each of the batteries has a solid state battery charger sized to carry normal and post-accident steady DC loads, while simultaneously recharging the battery from 1.81 volts per cell to rated voltage within 24 hours. The battery chargers receive 480 V AC input power from their respective Division 1 and 2 480 V motor control centers. A spare unconnected charger of the same rating is provided.

The Division 2, 125 V DC distribution system also provides control power as required to all transformer yard equipment via a 125 V DC distribution panel (DP-S1-2C-3) located in the southwest section of the yard. This panel is fed from the 125 V DC turbine generator building distribution panel DP-S1-2C which appears on Figure 8.3-19. Since switchyard and turbine generator building loads served by the 125 V DC system are not safety-related, these panels are classified as non-Class 1E Division B equipment. The supply feeder from the Division 2, 125 V DC distribution system to the Division B, 125 V DC distribution panel DP-S1-2C is a prime circuit.

8.3.2.1.1.2 Batteries

In the event of a loss or interruption of charger 125 V DC output, the station batteries will maintain power to their respective DC systems. The ampere-hour capacity and short time rating of all batteries are in accordance with IEEE Standard 308-1974. They are capable of supplying for at least two hours, all DC power required to safely shut down the plant and/or to limit the consequences of a design basis accident without use of battery chargers.

Tables 8.3-4a and 8.3-4b indicate the load requirements of the 125 V Division 1 and 2 DC load groups following a LOCA. The batteries are sized as follows:

125 V ESF Station Batteries B1-1 & B1-2 (Division 1 & 2)	No. of Cells:	58
	Capacity:	1110 ampere-hour
	Discharge Rate:	8 hrs at 25°C
	Float Voltage:	2.17 volts/cell
	Final Voltage:	1.81 volts/cell

8.3.2.1.1.3 Chargers

The chargers for each ESF (Division 1 and 2) 125 V DC load group are supplied from separate 480 V AC MCCs associated

with each division. Each charger is capable of carrying the largest combined demand of the various steady state DC loads for its division while simultaneously recharging the battery from 1.81 Volts per cell to rated voltage in 24 hours. The charger size and instrumentation conform to the requirements of IEEE Standard 308-1974 and NRC Regulatory Guide 1.32, Revision 2. The chargers are capable of supplying the 125 V DC power requirements during all modes of plant operation. The Division 1 and 2 battery chargers (chargers C1-1 and C1-2 respectively) and the spare charger (C1-5) are rated 200 amperes DC output.

8.3.2.1.2 HPCS (Division 3) 125 Volt DC System

8.3.2.1.2.1 General

The objective of the 125 V DC Division 3 system is to provide a reliable, continuous and independent 125 V DC power source of control and motive power as required for the HPCS system logic, HPCS diesel generator set control and protection, and all Division 3 related control. Figure 8.3-19 shows 125 V DC one line diagram. A battery charger is provided for the battery. The system is classified as Class 1E. The Division 3 125 V DC system is independent of all other divisional batteries and there is no manual or automatic connection to any other battery. The battery is not shared with any other unit.

The 125 V DC power is required for HPCS diesel generator field flashing, control logic, control and switching function of 4.16 kV breakers. Table 8.3-6 lists all 125 V DC loads required for Division 3.

8.3.2.1.2.2 Battery and Charger

The 125 V DC system for the HPCS power supply has a 60-cell 125 V DC battery, one battery charger, and a distribution panel with molded case circuit breakers.

The 125 V DC system is designed as Class 1E equipment in accordance with applicable clauses of IEEE Standard 308. It is designed so that no single failure in the 125 V DC system will result in conditions that prevent safe shutdown of the plant. The plant design and circuit layout from these DC systems provide physical separation of the equipment, cabling, and instrumentation essential to plant safety.

The 125 V DC battery and its charger and distribution panel are shown in Figure 8.3-19. All components of the system are located in the HPCS diesel generating area of the diesel generator building.

8.3.2.1.2.3 Battery Capacity

The ampere-hour capacity (100 AH at 8 hours) and short time rating of the battery are in accordance with criteria given in IEEE Standard 308, and are adequate to supply all electrical loads required until AC power is restored for the operation of the battery chargers. This battery has sufficient stored energy to operate required connected essential loads for at least two (2) hours without any aid from the charger. Capacity is large enough to cope with LOCA conditions or any other emergency shutdown. Each distribution circuit is capable of transmitting sufficient energy to start and operate all required loads in that circuit. The 125 V battery is sized in accordance with the principles set out in IEEE Standard 308-1972.

8.3.2.1.2.4 Charger

The charger for the 125 V DC system is supplied by the 480 V HPCS motor control center (via the engine generator control panel). It is rated 50 amp DC and is capable of carrying the largest combined demand of the various direct current system loads while simultaneously recharging the battery from 1.75 volts per cell to full charge within 24 hours.

8.3.2.1.3 ± 24 Volt DC (Division 1 and 2) Systems

8.3.2.1.3.1 General

Two separate and independent Class 1E, ± 24 V DC systems are provided to power the Division 1 and 2 main control room equipment as indicated in Figure 8.3-19. Each ±24 V battery has two 12-cell 24 V banks connected in series with common point grounded. Each bank is provided with a solid state battery charger which receives 120 V AC input power from its respective Division 1 or 2 120 V AC vital power panel.

8.3.2.1.3.2 Batteries

In the event of a loss or interruption of charger 24 V DC (plus or minus) output, the batteries will maintain power to their respective DC systems. The ampere-hour capacity of

no change

each battery is 150 AH at 8 hours. This exceeds the NSSS vendor's requirements for units sized 60 AH at 4 hours.

Maximum concurrent circuit loads are indicated in Figure 8.3-19. Total loads are 15 amperes (Div. 1) and 17 amperes (Div. 2).

8.3.2.1.3.3 Chargers

The chargers for each $\pm$ 24 V DC load group (four chargers total) are supplied from 120 V AC vital power panels associated with each division. Each charger is capable of carrying the largest combined demand of the various steady state DC loads while simultaneously restoring the battery from 1.75 volts per cell to its rated voltage in 24 hours. The charger size and instrumentation conform to the requirements of IEEE Standard 308-1974 and NRC Regulatory Guide 1.32, (Revision 2). The $\pm$ 24 V DC Division 1 (CO-1A, CO-1B) and Division 2 (CO-2A, CO-2B) chargers are rated 25 amperes DC output.

8.3.2.1.4 250 Volt DC (Division 1) System

8.3.2.1.4.1 General

One Class 1E 250 V DC system is provided to supply 120/240 V AC power on an uninterruptible basis to plant controls, instrumentation, computer and communication equipment via a solid state inverter. It also supplies 250 V DC power directly to RCIC, selected RHR and RWCU system motor-operated valves and the turbine auxiliary oil pumps. See Figures 8.3-2 and 8.3-19.

Plant 120/240 V AC loads and turbine oil pump loads are classified as nonessential (Division A). However, because of their importance to plant operations and equipment, they are served from the Class 1E power source via the Division A inverter utilizing prime cables.

The cabling to the main 250 V DC distribution panel, including the panel, battery, charger, and incoming 480 V AC normal source are Class 1E (Division 1).

A spare, unconnected charger of the same rating is provided.

8.3.2.1.4.2 Battery

In the event of a loss or interruption of charger 250 V DC output, the battery will maintain power to its DC system loads. The ampere rating and short time rating of the battery is in accordance with IEEE Standard 308-1974. The battery is capable of supplying, for a period of at least two hours, all DC power required to safely shut down the plant and/or to limit the consequences of a design basis accident.

Table 8.3-5 indicates the load requirements on the system. The battery consists of 116 cells and has a discharge capacity of 2110 AH at 8 hours to 1.81 volts/cell.

8.3.2.1.4.3 Charger

The charger for the 250 V DC system is supplied from a Class 1E 480 V AC MCC and is capable of carrying the largest combined demand of the various steady state loads while simultaneously restoring the battery from its discharged state (1.81 volts per cell) to its fully charged state in 24 hours. The charger size and instrumentation conform to the requirements of IEEE Standard 308-1974 and NRC Regulatory Guide 1.32, Revision 2. The active charger (C2-1) and the spare charger (C2-2) are each rated 400 amperes output.

8.3.2.1.5 Non-Class 1E DC Systems

8.3.2.1.5.1 Main Plant 125 Volt DC (Non-Class 1E) System

8.3.2.1.5.1.2 General

The main plant non-Class 1E 125 V DC system is designd to supply the majority of the plant non-Class 1E 125 V DC loads. Other 125 V DC non-Class 1E loads are supplied by the Class 1E 125 V DC batteries through isolation devices and the makeup water pumphouse batteries. The battery is provided a solid state battery charger which is fed from non-Class 1E 480 volts.

8.3.2.1.5.1.2.1 Battery (B1-7)

The battery has 58 cells which are floated to 2.17 volts per cell. It is rated at 1110 ampere hours at an 8-hour discharge rate down to 1.81 volts per cell.

8.3.2.1.5.1.2.2 Charger (C1-7)

The battery charger is similar to the Class 1E battery chargers C1-1 and C1-2 as discussed in 8.3.2.1.1.3.

8.3.2.1.5.2 Makeup Pumphouse 125 Volt DC (Non-Class 1E) System

8.3.2.1.5.2.1 General

The Division A and B 125 V DC non-Class 1E loads of the makeup water pumphouse are fed from two non-Clas 1E batteries B1-3 and B1-4. Each battery is provided a battery charger which is fed from a 480/120 V transformer connected to an MCC of a compatible division.

8.3.2.1.5.2.2 Batteries (B1-3 and B1-4)

The batteries are rated fro 100 amper-hours on an 8-hour discharge rate.

8.3.2.1.5.2.3 Chargers (C1-3 and C1-4)

The battery chargers are each sized 25 amperes at 125 V DC.

8.3.2.1.5.3 405 Volt DC (Non-Class 1E) System

8.3.2.1.5.3.1 General

The 450 V DC system is located in the security building and serves all the DC loads of the security system. It is provided a battery charger which is supplied from a non-Class 1E AC source.

8.3.2.1.5.3.2 Battery (B1-6)

The battery is made up of 180 cells in series and floated at 2.25 volts per cell. Its 1-hour discharge rate is 620 amps down to a minimum voltage of 1.75 volts per cell. The 1-hour emergency load cycle consists of 366 amps for the first minute, 593 amps during the second minute, and 406 amps from the 3rd to the 60th minute.

8.3.2.1.5.3.3 Charger (C1-6)

The battery charger is sized to supply the emergency and normal loads and at the same time charge the battery from its minimum charge of 1.75 volts per cell to its fully charged state in 24 hours.

8.3.2.1.6 Ventilation

Batteries for Division 1 and 2 are located in separate rooms within the radwaste/control building. The battery for Division 3 is located in the diesel generator building. Each room is ventilated by separate exhaust fans to remove gases produced during the battery charging cycle. Battery rooms have no common ventilation ducts. Failure of the HVAC system of each battery room is annunciated. A portable exhaust fan is provided to service a battery room with a failed ventilation system.

8.3.2.1.7 Testing and Maintenance

Period maintenance tests will be performed in accordance with IEEE Standard 308-1974, 450-1975 and Regulatory Guide 1.32,

Revision 2, on all components of the DC systems to determine the condition of each individual subsystem. Battery and battery chargers will be tested and inspected as follows:

a. Visual inspection of system and electrical connections will be made weekly.

b. Liquid level of each cell will be checked monthly.

c. Specific gravity, voltage and temperature of the pilot cell of each battery will be measured and logged weekly.

d. The voltage and specific gravity of each cell, and the temperature of every fifth cell, will be measured and logged monthly.

e. Performance discharge and service tests will be performed in accordance with Sections 4 and 5 of IEEE Standard 450-1975. The specific gravity and voltage of each cell will be taken after discharge and logged.

f. Battery charger voltage and current will be measured and logged on a monthly basis.

For Class 1E DC system components, the manufacturer has performed operational tests or calculated data which substantiates the capability of the equipment to carry their DC post-accident (worst case) loads. Seismic and environmental qualification is discussed in 3.10 and 3.11.

Preoperational testing, as described in Chapter 14, is performed to verify that all components, automatic and manual controls, and functions of the DC power systems perform as required.

8.3.2.2 Analysis

8.3.2.2.1 Compliance to Criteria

8.3.2.2.1.1 General

In accordance with General Design Criterion 17, IEEE Standard 308-1974 and NRC Regulatory Guide 1.6, Revision 0, redundancy and independence of DC power sources and distribution equipment is provided by the separate (Division 1 and 2) battery systems. Each DC system has sufficient capacity to supply the DC power requirements of the redundant (Division 1 and 2) load groups for at least two hours following loss of power to the charger coincident with a design basis accident. This redundancy extends from the batteries and battery chargers through distribution panels, cabling, switchgear, and protective devices.

The HPCS DC power system is a separate and independent safety-related (Class 1E) system comprising Division 3. The Division 3 DC loads serve a separate safety function not provided by Division 1 or 2 directly. However, the ADS systems supplied via Division 1 and 2 can compensate for the loss of the entire Division 3 system.

There are no electrical connections between the DC buses for Division 1, 2, and 3, and there is no automatic or manual transfer of load between divisions. The elimination of ties between DC systems prevents a single failure from affecting more than one division.

~~Connection of~~ non-Class 1E loads to the Class 1E power supplies ~~is permitted, and~~ does not degrade the Class 1E power supplies, based upon the following:

a. All non-Class 1E loads are connected to Class 1E power supplies ~~by~~ Class 1E isolation. Any over-current condition that could occur in the non-

Class 1E portions of the system are isolated by these Class 1E devices without affecting the availability of the power supply. These Class 1E protective devices are either a circuit breaker shunt tripped on a LOCA signal or a set of one or two overcurrent devices such as fuses or circuit breakers. The overcurrent devices trip on overloads, line-to-line faults on ungrounded and line-to-line faults on grounded DC systems.

d. The Class 1E power supplies are sized adequately to supply all Class 1E and non-Class 1E loads connected to them.

e. Wiring to the non-Class 1E loads from the Class 1E power supplies are designated as prime circuits, and are routed in accordance with separation criteria defined in 8.3.1.4.

d. Periodic surveillance procedures ensure protective device trip setpoints to be within acceptable limits for proper coordination with the main circuit protective device.

8.3.2.2.1.2 Division 1 and Division 2 125 Volt, ±24 Volt, and 250 Volt DC Systems

The Division 1 and Division 2 DC power systems have been designed in compliance with IEEE Standard 308-1974. Components of the systems are located in the radwaste/control building, a Seismic Category I structure. This ensures that any design basis event as listed in IEEE Standard 308-1974, Table I will not cause loss of DC power and jeopardize the safety of the reactor or cause damage to the reactor coolant system. The DC buses and the associated equipment are located such that redundant counterparts are physically separated from each other.

There are no DC ties between redundant engineered safety feature equipment such as switchgear or motors. Therefore, no single failure of any DC component can adversely affect the operation of the redundant DC systems.

The chargers are on diesel generator supplied buses so that during loss of offsite power, with diesel generators operating, the batteries will be required to carry their loads for short periods only. Alarms are provided in the main control room for low DC bus voltage on the 125 V and 250 V buses.

Low $\pm$24 volt DC alarms are communicated via the main control room computer.

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

a. The battery chargers are sized as described in 8.3.2.1 to meet load and recharging requirements.

b. Battery performance discharge tests and battery service tests are scheduled in accordance with Section 4 of IEEE Standard 450-1975.

The DC power systems are designed to permit periodic inspection and test of important areas such as wiring, insulation, connections, and switchboards, and thus comply with General Design Criterion 18.

Control room instrumentation and alarms are provided for each battery and battery charger to monitor the status of each power supply in accordance with IEEE Standard 308-1974 and Regulatory Guide 1.47. This instrumentation includes indication of the main bus voltage, battery current (charge and discharge), and battery charger discharge current. Alarms through the control room annunciator and computer are provided for the following abnormal conditions: Bus undervoltage, DC system ground fault (for ungrounded systems), battery fuse blown, battery charger fuse blown, battery charger over/undervoltage, battery charger output breaker tripped, and battery charger AC failure. Charger and battery disconnect switches are provided with position indication and group alarm in the control room.

Battery high discharge rate is not separately alarmed. In the absence of an electrical fault and with battery charger available, all normal and emergency steady state loads are carried by the battery charger. At 125% of its full load rating, the battery charger operates in a current-limiting mode and any overcurrent in excess is supplied by the battery. However, the feeder circuit fuses are sized to trip on overcurrents of this magnitude, thereby preventing battery high discharge current to continue to the point of degrading the system. Annunciation of the isolated Class 1E circuit is made for each connected load. Failure of the battery charger also causes a battery high discharge, but this condition is monitored as discussed above.

8.3.2.2.1.3 HPCS (Division 3) 125 Volt DC System

The 480 V AC feed to the HPCS battery charger is from the HPCS motor control center via the engine generator control panel.

Separation between Division 3 and other independent systems is maintained and the power provided to the chargers can be from either offsite or onsite sources. The HPCS DC system is arranged so that the probability of a system failure resulting in loss of DC power is extremely low. Important system components are either self-alarming on failure or capable of being tested during service to detect faults. All abnormal conditions of selected system parameters important to surveillance of the system annunciate in the main control room. Cross connections with other independent 125 V DC systems do not exist.

Control room instrumentation and alarms for the HPCS are similar to those of the Divisions 1 and 2 DC systems as discussed in 8.3.2.2.1.2.

Components of the system are located in the diesel generator building, a Seismic Category I structure.

The DC power supply to switchgear circuit breakers in the Division 3 load group is from the Division 3 battery. There are no connections between DC systems of different divisions, thereby insuring that no single failure in one DC system can affect power systems of other divisions.

8.3.2.2.1.4 Non-Class 1E DC Systems

There are no specific design requirements for the non-Class 1E DC systems other than those required for a reliable operation and for good system operability and maintainability.

8.3.2.2.2 Service Environment

All components of Class 1E DC systems, with the exception of some distribution and control cables and control devices, are located outside of primary containment.

Components located in normally air conditioned areas are either designed to continue operating in the event of loss of air conditioning, or a Class 1E air conditioning system is provided (See 3.11.4).

Refer to 3.11 for discussion of environmental design and analysis of Class 1E electrical components for post-accident conditions, and to 3.10 for seismic conditions.

8.3.2.3 Physical Identification of Safety-Related (Class 1E) Equipment

The safety-related equipment for each division of the Class 1E DC power system is identified in 8.3.1.3 for the standby AC power system.

8.3.2.4 Independence of Electrical Divisions

Spatial separation and/or placement of physical barriers between different divisions of the DC power system is used as a protection against loss of the redundant DC load groups from a single event. Electrical separation is provided as described in 8.3.1.4 for the standby AC power system.

The Class 1E batteries and battery chargers of redundant divisions are located separately from one another in Seismic Category I rooms with no common ventilation connections. Redundant DC distribution panels and 480 V MCCs are located at as sufficient distance apart to prevent any single credible event from causing the loss of more than one panel or MCC. Cable trays, cables, and control circuitry for the three divisions (1, 2 and 3) are also separated as described in 8.3.1.4.

8.3.3 FIRE PROTECTION FOR CABLE SYSTEMS

8.3.3.1 Resistance of Cables to Combustion

The electrical cable installation for Divisions 1 through 7 and A & B is designed to resist the onset of combustion by limiting cable loading to levels which prevent overheating and insulation failures (and the resultant possibility of fire) and by the choice of insulation and jacket materials which have flame resistance and self-extinguishing characteristics.

Each type of cable (except that used in direct burial) is subjected to vertical tray flame resistance and oxygen index testing to verify that it does not propagate a fire, and exhibits self-extinguishing characteristics. The vertical tray flame resistance test for cables satisfies the requirements of IEEE Standard 383-1974, and demonstrates the cable's basic resistance to flammability. It is more rigorous than the IPCEA Standard 61-402 vertical flame resistance test (with which all cables also comply), having been performed as a minimum with a 70,000 Btu/hr flame source applied for eight minutes. The oxygen index test is performed in accordance with ASTM Standard D-2863, and measures the relative flammability of plastics in the cable insulation and jacket.

Documentation of a cable's ability to successfully complete all tests was provided prior to acceptance of that cable for installation. Test results are included in Table 8.3-10.

8.3.3.2 Localization of Fires

In the event a fire should occur, the installation design localizes the physical effects of the fire by preventing its spread to adjacent areas or to adjacent cable trays of a different division. Localization of the effects of fires on the electrical system is accomplished by separation of redundant cable systems and equipment as described in 8.3.1.4 and 8.3.2.4.

Spatial separation is the primary method of preventing the spread of fire between adjacent cable trays of redundant divisions. Where minimum separation cannot be maintained (such as in the cable spreading room or in terminal boxes), barriers are provided between the trays. Minimum tray separations and barrier locations are described in 8.3.1.4.b.

Spread of fire between adjacent areas is prevented by the use of fire-rated construction materials, and doors, ventilation system fire dampers and fireproof penetrations seals. With the exception of the cable spreading room to main control room interface, all electrical penetrations are made via conduits, either directly embedded, or located within sleeves embedded in floor slabs and walls. Where required, penetrations are offset and are located 6 feet above finished floor to prevent the passage of, and exposure to, radiation.

Penetration seals are formed of a highly flame resistant, airtight silicon foam material designed to prevent the passage of flame and smoke. Documentation confirming the ability of the sealing compound to withstand a three (3) hour fire test performed in accordance with ASTM Standard E-119-73, is provided prior to installation.

Seals are poured both between the conduits and sleeves (where applicable) and within the conduits themselves. Seals are poured to a depth of twelve (12) inches, or full wall thickness, whichever is smaller. Tray penetrations have sealing material poured both around and within the trays. Spare penetration sleeves and conduits are filled or capped.

8.3.3.3 Detection and Protection Systems

Fire detection and protection systems are provided in all critical plant areas. Automatic detection systems incorporate ionization, thermal, and/or smoke detectors, as dictated by the area requirements. Manual, non-coded pull boxes for operator initiation of fire signals are also provided. Protection systems include wet pipe and preaction sprinkler systems, deluge water spray, low pressure CO_2, Type 1301 halon systems, and portable extinguishers (dry chemical, halon, and pressurized water types).

no change

Actuation of any manual fire alarm station will automatically energize audible and visible alarms in the main control room, cause a coded signal to be sent to the DOE 300 Fire Station via a radio system and initiate an audible siren tone over the plant public address systems.

Ionization detectors in the cable spreading room are designed to energize the preaction sprinkler system in addition to the sequence of events described above for manual pullboxes (See 9.5.1 for additional details).

TABLE 8.3-1

DIVISION 1 DIESEL GENERATOR LOADING SEQUENCE
AUTOMATIC AND MANUAL LOADING OF ENGINEERED SAFETY SYSTEMS BUS

Item Description	No. On Bus	Total hp/kW Connected To Bus	SHUTDOWN WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW	LOCA WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW
1) Motor-Operated Valves (5)	Set	200kW	Set	0 Sec	(2)	-	Set	0 Sec	(2)	-
2) Emergency Lighting and Power	Set	124kW	Set	0 Sec	(4)	124	Set	0 Sec	(4)	124
3) Diesel Auxiliaries and HVAC	Set	200kW	Set	0 Sec (3)	(3)	124	Set	0 Sec (3)	(3)	94
4) LPCS Water Leg Pump	1	15/12kW	1	0 Sec (3)	(3)	12	1	0 Sec (3)	(3)	12
5) Standby Liquid Control Pump	1	40/33kW	-	-	-	-	-	-	-	-
6) RCIC Water Leg Pump	1	15/12kW	1	0 Sec (3)	(3)	12	1	0 Sec (3)	(3)	12
7) Fuel Pool Recirculation Pump	1	50/40kW	1	10 Hrs (4)	(4)	(40)	-	-	-	-
8) Plant Service Water Pump A	1	1500/1197kW	1	10 Sec	(4)	1197	-	-	-	-
9) LPCS Pump	1	1500/1197kW	-	-	-	-	1	0 Sec	(4)	1197
10) RHR Pump A	1	800/642kW	1	10 Min (4)	(4)	(642)	1	5 Sec	(4)	642
11) Standby Service Water Pump	1	1750/1377kW	1	20 Sec	(4)	1377	1	20 Sec	(4)	1377
12) Cooling Tower Makeup Water Pump	* 2	1600/1270kW	1	Note 6 (4)	(4)	(635)	-	-	-	-
13) Control Rod Drive Pump	** 1	250/205kW	1	(4)	(4)	(205)	-	-	-	-
14) Reactor Closed Cooling Pump	1	200/160kW	1	0 Sec	(4)	160	-	-	-	-
15) Load Center Transformer Losses TR-7-71 & 7-73	2	45kW	2	0 Sec	Cont.	33	2	0 Sec	Cont.	33
16) 250 V Battery Charger	1	165kW	1	0 Sec	(4)	135	1	0 Sec	(4)	135
17) 125 V Battery Charger	1	43kW	1	0 Sec	(4)	43	1	0 Sec	(4)	43
18) Uninterruptible Power Supply	1	30kW	1	0 Sec	(4)	30	1	0 Sec	(4)	30
19) Standby Gas Treatment Fans and	2	50/40kW	1	10 Min (4)	(4)	(20)	1	30 Sec	(4)	20
and Heater Coils	2	45kW	-	-	-	-	2	20 Sec	(3)	45
20) RPS MG Set	1	25/20kW	1	0 Sec	(4)	20	1	(4)	(4)	(20)
21) Hydrogen Recombiner	1	25/57kW	-	-	-	-	1	60 Min (4)	(4)	(44)
22) Drywell Cooling and Fans	Set	182kW	Set	0 Sec	(4)	182	-	-	-	-
23) Control Air Compressor	1	100/82kW	1	1 Hr (4)	(4)	(82)	-	-	-	-
24) Containment Instrument Air Compressor	1	15/12kW	1	0 Sec (3)	(4)	12	-	-	-	-
26) Reactor Bldg. Elec. Equip. HVAC	Set	368kW	Set	0 Sec (3)	(4)	15	Set	0 Sec (3)	(4)	15
27) Control Bldg. Elec. Equip. HVAC	Set	283kW	Set	5 Sec (3)	(4)	71	Set	5 Sec (3)	(4)	71
28) Radwaste Bldg. Elec. Equip. HVAC	Set	150kW	-	-	-	-	-	-	-	-
29) Makeup Water Pumphouse Elec. Equip. HVAC	* Set	90kW	Set	Note 6 (4)	(4)	(90)	-	-	-	-
30) Standby Service Water Pumphouse Elec. Equipment HVAC	Set	38kW	Set	0 Sec	(4)	10	Set	0 Sec	(4)	10
			Total Automatically Applied			3557kW	Total Automatically Applied			3860kW

For Notes see bottom of Table 8.3-2

* Only 1 required. Not added to load since other load can be dropped when they are necessary a few days later.

** Can be supplied manually after operator checks load capacity on generator.

( ) kW Figures in parenthesis are for manually applied loads not added to total automatically applied loads.

TABLE 8.3-2

DIVISION 2 DIESEL GENERATOR LOADING SEQUENCE

AUTOMATIC AND MANUAL LOADING OF ENGINEERED SAFETY SYSTEMS BUS

Item Description	No. On Bus	Total hp/kW Connected To Bus	SHUTDOWN WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW	LOCA WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW
1) Motor-Operated Valves (5)	Set	200kW	Set	0 Sec	(2)	-	Set	0 Sec	(2)	-
2) Emergency Lighting and Power	Set	122kW	Set	0 Sec	(4)	122	Set	0 Sec	(4)	122
3) Diesel Auxiliaries and HVAC	Set	185kW	Set	0 Sec (3)	(3)	127	Set	0 Sec (3)	(3)	97
4) RHR Water Leg Pump	1	15/12kW	1	0 Sec	(4)	12	1	0 Sec	(4)	12
5) Standby Liquid Control Pump	1	40/33kW	-	-	-	-	-	-	-	-
6) Standby Liquid Control Tank Heaters	2	50kW	1	0 Sec (3)	(3)	10	1	0 Sec (3)	(3)	10
7) Fuel Pool Cooling & Cleanup System	Set	50/40kW	Set	10 Hrs (4)	(4)	(40)	-	-	-	-
8) Plant Service Water Pump B	1	1500/1197kW	1	10 Sec	(4)	1197	-	-	-	-
9) RHR Pumps B & C	2	1600/1284kW	1	10 Min (4)	(4)	(642)	2	5 Sec & 0 Sec	(4)	1284
10) Standby Service Water Pump	1	1750/1377kW	1	20 Sec	(4)	1377	1	20 Sec	(4)	1377
11) Cooling Tower Makeup Water Pump	* 2	1600/1270kW	1	Note 6 (4)	(4)	(635)	-	-	-	-
12) Control Rod Drive Pump	** 1	250/205kW	1	(4)	(4)	(205)	-	-	-	-
13) Reactor Closed Cooling Pump	2	400/320kW	1	0 Sec	(4)	160	-	-	-	-
14) Load Center Transformer Losses TR-8-81 & 8-83	2	45kW	2	0 Sec	Cont.	33	2	0 Sec	Cont.	33
15) 125 V Battery Charger	1	43kW	1	0 Sec	(4)	43	1	0 Sec	(4)	43
16) Standby Gas Treatment Fans	2	50/40kW	1	10 Min (4)	(4)	(20)	1	30 Sec	(4)	20
and Heater Coils	2	45kW	-	-	-	-	2	20 Sec	(3)	45
17) RPS MG Set	1	25/20kW	1	0 Sec	(4)	20	1	(4)	(4)	(20)
18) Hydrogen Recombiner	1	25/37kW	-	-	-	-	1	60 Min (4)	(4)	(44)
19) Drywell Cooling and Fans	Set	186kW	Set	0 Sec	(4)	186	-	-	-	-
20) Control Air Compressor & Dryers	1	100/126kW	1	1 Hr (4)	(4)	(126)	-	-	-	-
21) Containment Instrument Air Compressor	1	15/12kW	1	0 Sec (3)	(4)	12	-	-	-	-
22) Reactor Bldg. Elec. Equip. HVAC	Set	371kW	Set	0 Sec (3)	(4)	12	Set	0 Sec (3)	(4)	12
23) Control Bldg. Elec. Equip. HVAC	Set	331kW	Set	0 Sec	(4)	61	Set	0 Sec	(4)	61
24) Radwaste Bldg. Elec. Equip. HVAC	Set	145kW	-	-	-	-	-	-	-	-
25) Makeup Water Pumphouse Elec. Equip. HVAC	** Set	90kW	Set	Note 6 (4)	(4)	(90)	-	-	-	-
26) Standby Service Water Pumphouse	Set	40kW	Set	0 Sec	(4)	10	Set	0 Sec	(4)	10
				Total Automatically Applied		3382kW		Total Automatically Applied		3126kW

NOTE: (1) Time to start after bus voltage and frequency have been established. Maximum time after signal to start generator for voltage to be established is 10 seconds.
(2) Motors stop automatically when valve action is completed.
(3) Start and/or stop automatically with associated pump or diesel, pressure, temperature switch, or flow.
(4) Start and/or stop manually.
(5) Intermittent loads not included as long-term loading.
(6) Available after one day.
For additional notes see bottom of Table 8.3-1.

TABLE 8.3-3

DIVISION 3 (HPCS) DIESEL GENERATOR LOADING SEQUENCE
AUTOMATIC AND MANUAL LOADING OF ENGINEERED SAFETY SYSTEMS BUS

			SHUTDOWN WITH LOSS OF OFFSITE POWER				LOCA WITH LOSS OF OFFSITE POWER			
Item Description	No. On Bus	Total hp/kW Connected To Bus	No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW	No. Req'd Part Of Set	Time to Start (1)	Time to Stop	kW
1) HPCS Pump	1	3000/2380kW	-	-	-	-	1	0 Sec	(4)	2380
2) Motor-Operated Valves (5)	Set	77/62kW	-	-	-	-	Set	0 Sec	(4)	-
3) HPCS Water Leg Pump	1	15/12kW	-	-	-	-	1	(3)	(3)	12
4) HPCS Service Water Pump	1	60/50kW	-	-	-	-	1	0 ~~[illegible]~~ Sec	(4)	50
5) Auxiliary Panel	1	24kW	1	0 Sec	(3)	24	1	0 Sec	(3)	24
6) D-G Room Exhaust Fan	1	50/40kW	-	-	-	-	1	(3)	(3)	40
7) Supply Fans	2	45/36kW	-	-	-	-	2	(3)	(3)	36
8) Fan Coil Unit	1	10/8kW	1	0 Sec	(3)	5	1	0 Sec	(3)	5
9) Instrument & Control Power	Pnl	6kW	Pnl	0 Sec	(4)	2	Pnl	0 Sec	(4)	5
10) Lighting	Pnl	12kW	Pnl	0 Sec	(4)	2	Pnl	0 Sec	(4)	3
11) Miscellaneous Auxiliary	Set	3kW	Set	0 Sec	(4)	2	Set	0 Sec	(4)	3
12) HPCS Battery Charger	1	5kW	1	0 Sec	-	5	1	0 Sec	-	5
					Total	40kW			Total	2563kW

For Notes see bottom of Table 8.3-2

TABLE 8.3-4a

DIVISION 1 125 V DC BATTERY/SYSTEM LOADS

EQUIPMENT	L1 NORMAL	L1 INRUSH	L2 0-3 SEC	L2 3-13 SEC	L2 13-30 SEC	L2 30-60 SEC	L2 60 SEC-2HR.
MC-S1-1D	69	423	423	69	47	47	0
4.16 kV & 6.9 kV Ckt. Bkrs.	4.15 CL 4.15 OP	75	75	75	75	1	1
480 V Ckt. Bkrs.	4.0 CL 4.0 OP	17	17	17	17	1	1
PP-7A-A (Inverter IN-3)	81	-	54	54	54	54	54
DP-S1-1A	36	-	17	17	17	17	17
DP-S1-1D1	15	-	8	8	8	8	8
DP-S1-1E1	64	-	64	64	64	5	5
TOTAL	-	-	658	304	282	133	86

NOTES:

1. Ckt. Bkr. close (CL) and trip (OP) loads supplied from these panels are accounted for in Ckt. Bkr. items above.
2. L1 = Maximum connected load (LOCA with loss of offsite power).
   L2 = System accident load (LOCA with loss of offsite power).
3. Normal system operating (continuous) load is less than 128 amperes.
4. All loadings indicated are amperes.

TABLE 8.3-4b

DIVISION 2 125 V DC BATTERY/SYSTEM LOADS

EQUIPMENT	L1 NORMAL	L1 INRUSH	L2 0-3 SEC	L2 3-13 SEC	L2 13-30 SEC	L2 30-60 SEC	L2 60 SEC-2HR.
MC-S1-2D	45	263	263	45	22	22	0
4.16 kV & 6.9 kV Ckt. Bkrs.	4.15 CL 4.15 OP	42	42	42	42	1	1
480 V Ckt. Bkrs.	4.0 CL 4.0 OP	17	17	17	17	1	1
PP-8A-A (Inverter IN-2)	99	-	53	53	53	53	53
DP-S1-2A	58	-	28	28	28	28	28
DP-S1-2D1	16	-	5	5	5	5	5
DP-S1-2E1	65	-	65	65	65	5	5
TOTAL	-	-	473	255	232	155	73

NOTES:

1. Ckt. Bkr. close (CL) and trip (OP) loads supplied from these panels are accounted for in Ckt. Bkr. items above.
2. L1 = Maximum connected load (LOCA with loss of offsite power).
   L2 = System accident load (LOCA with loss of offsite power).
3. Normal system operating (continuous) load is less than 137 amperes.
4. All loadings indicated are amperes.

TABLE 8.3-5

DIVISION 1 250 V DC BATTERY/SYSTEM LOADS

EQUIPMENT	L1 NORMAL	L1 INRUSH	L2 0-3 SEC	L2 3-60 SEC	L2 60 SEC-2HR	L2 1-2 HR	L3 CONTINUOUS
MC-S2-1A	139	726	726	139	22	22	2
MC-S2-1B (non-Class 1E)	308	616	616	308	308	272	2
US-PP (non-Class 1E) (Inverter IN-1)	120	120	120	102	102	102	80
TOTAL	-	-	1462	567	432	396	84

NOTES:

1. L1 = Maximum connected load (LOCA with loss of offsite power).
   L2 = System accident load (LOCA with loss of offsite power).
   L3 = Normal system operating load.

2. All loadings indicated are amperes.

no change

TABLE 8.3-6

DIVISION 3 (HPCS) 125 VDC BATTERY LOADS

Description	AMPERAGE REQUIREMENTS PER TIME INTERVAL AFTER AC POWER LOSS		
	0 - 1 Min	1 - 60 Min	60 - 120 Min
Diesel Engine Control	2	2	2
Generator Auxiliary Control	2	2	2
Field Flashing	20	-	-
Solenoid Valves	2	-	-
Relays HPCS Logic Panel	1	1	2
Indicator Lamps (Ctrl. Rm. Pnl.)	1	1	1
Switchgear (Breakers Closing)	28	-	-
Diesel Standby Fuel Pump	10	5	5
TOTAL	66	11	12

TABLE 8.3-7

ASSIGNMENT OF SYSTEMS TO DIVISION OF SEPARATION

Division 1	Division 2	Division 3
RHR A	RHR B	HPCS
LPCS	RHR C	Standby Emergency Power 3
Outboard Isolation Valves	Inboard Isolation Valves	125 VDC Battery 3
Standby Emergency Power 1	Standby Emergency Power 2	HPCS Service Water
RCIC		Safety-Related Display Instr. 3
Automatic Depressurization Div. 1 controls	Automatic Depressurization Div. 2 controls	
Standby Gas Treatment (Loop 1)	Standby Gas Treatment (Loop 2)	
250 volt DC Battery		
125 volt DC Battery 1	125 volt DC Battery 2	
24 volt DC Battery 1	24 volt DC Battery 2	
Standby Service Water Pump A	Standby Service Water Pump B	
MSIV-LCS (Inboard)	MSIV-LCS (Outboard)	
Leak Det. System 1	Leak Det. System 2	
CAC 1	CAC 2	
Cont. Inst. Air 1	Cont. Inst. Air 2	
SLCS 1	SLCS 2	
Mn. Cont. Rm. HVAC 1	Mn. Cont. Rm. HVAC 2	
Reactor Shutdown 1	Reactor Shutdown 2	
RPT 1 Output	RPT 2 Output	
Safety-Related Display Instr. 1	Safety-Related Display Instr. 2	
Suppression Pool Temp. Monit. 1	Suppression Pool Temp. Monit. 2	
Power & Control for Selected non-Class 1E Equipment (prime circuits)	Power & Control for Selected non-Class 1E Equipment (prime circuits)	
Fuel Pool Cooling and Cleanup 1	Fuel Pool Cooling and Cleanup 2	
Reactor Bldg. Pressure Control 1	Reactor Bldg. Pressure Control 2	
Drywell and Head Area Recirculation Fans 1	Drywell and Head Area Recirculation Fans 2	

TABLE 8.3-7 (Continued)

ASSIGNMENT OF RPS, NSSSS AND NMS TO DIVISIONS OF SEPARATION

(FAIL-SAFE WIRING)

Division 4	Division 5	Division 6	Division 7
(PGCC Div. 1)	(PGCC Div. 2)	(PGCC Div. 1)	(PGCC Div. 2)
RPS A1	RPS A2	RPS B1	RPS B2
NSSSS A1	NSSSS A2	NSSSS B1	NSSSS B2
NSM A	NMS C	NMS B	NMS D

TABLE 8.3-8

EXPLANATORY INFORMATION CONCERNING CABLE ROUTING

CABLE LEGEND

The Legend for the column identification in Table 8.3-9 is as follows:

(1) CABLE NUMBER

Cable numbers consist of ten spaces. Five spaces before the dash and four spaces after the dash. Each space has a specific meaning, as described below.

FIRST SPACE

1 DIVISION 1
2 DIVISION 2
3 DIVISION 3
4 DIVISION 4
5 DIVISION 5
6 DIVISION 6
7 DIVISION 7
A DIVISION A
B DIVISION B

SECOND, THIRD, FOURTH & FIFTH SPACE

System or Equipment Identification - The following are typical examples:

ADS AUTOMATIC DEPRESS. SYSTEM
RHR RESIDUAL HEAT REMOVAL

SIXTH SPACE

Always to be the Dash (-)

SEVENTH, EIGHTH, NINTH & TENTH SPACE

Numbers 1 thru 9999 as required

no change

TABLE 8.3-8 (Continued)

IR1A	INSTRUMENT RACK 1A
M7BA	MOTOR CONTROL CENTER, NO. MC-7B-A
MISC	MISCELLANEOUS
P8AE	POWER PANEL, NO. PP-8A-E
SH5	SWITCHGEAR 6.9 kV (HIGH), NO. SH-5
SM7	SWITCHGEAR 4.16 kV (MEDIUM), NO. SL-71
SL71	SWITCHGEAR 480 V (LOW), NO. SL-71

EXAMPLES OF CABLE NUMBERS:

1M7BA-221 = 1 (DIV. 1) M (MOTOR CONTROL CENTER) 7BA (MCC NO.) 221 (CABLE NO.)

2RHR-222 = 2 (DIV. 2) RHR (SYSTEM) 222 (CABLE NO.)

(2) T/C (TYPE AND COMPATIBILITY)

T = TYPE OF RACEWAY WHICH CABLE IS COMPATIBLE TO IS AS FOLLOWS:

- P POWER
- H HIGH VOLT (6.9kV, 4.16 kV)
- C CONTROL
- S SPECIAL (LOW LEVEL SIGNAL)
- R RPS SCRAM SOV RACEWAY
- R RPS

C = COMPATIBILITY (OUTSIDE OF PGCC) WHICH IS AS FOLLOWS:

1 COMPATIBLE CABLES ARE ROUTED IN DIV 1 TRAY SYSTEM ONLY
2 COMPATIBLE CABLES ARE ROUTED IN DIV 2 TRAY SYSTEM ONLY
3 COMPATIBLE CABLES ARE ROUTED IN DIV 3 TRAY SYSTEM ONLY
4 COMPATIBLE CABLES ARE ROUTED IN DIV 4 TRAY SYSTEM ONLY
5 COMPATIBLE CABLES ARE ROUTED IN DIV 5 TRAY SYSTEM ONLY
6 COMPATIBLE CABLES ARE ROUTED IN DIV 6 TRAY SYSTEM ONLY
7 COMPATIBLE CABLES ARE ROUTED IN DIV 7 TRAY SYSTEM ONLY

TABLE 8.3-8 (Continued)

A COMPATIBLE CABLES ARE ROUTED IN DIV A TRAY SYSTEM ONLY
B COMPATIBLE CABLES ARE ROUTED IN DIV B TRAY SYSTEM ONLY

(3) FROM

EQUIPMENT OR DEVICE IDENTIFICATION WHICH THE CABLE ORIGINATES FROM

(4) TO

EQUIPMENT OR DEVICE IDENTIFICATION WHICH THE CABLE TERMINATES TO

(5) FOR

SYSTEM AND/OR SERVICE CABLE IS BEING USED FOR

(6) TRAY ROUTING

NUMBER INDICATED DENOTE NODES THROUGH WHICH THE CABLE PASSES IN SEQUENCE. IF LETTERS "ENTR" APPEAR IN THE ROUTING, THE CABLE ENTERS AT A POINT BETWEEN THE PRECEDING AND SUCCEEDING NODES. IF THE LETTER "ENTR" DO NOT APPEAR, THE CABLE ENTERS AT FIRST NODE SHOWN. IF THE WORD "EXIT" APPEARS IN THE ROUTING, THE CABLE EXISTS AT A POINT BETWEEN THE PRECEDING AND SUCCEEDING NODES. IF THE WORD "EXIT" DOES NOT APPEAR, THE CABLE EXITS AT THE LAST NODE SHOWN. THE ABOVE MENTIONED NODES ARE LOCATED AND SHOWN ON TRAY DRAWINGS. WHEN NODES DO NOT APPEAR, TRAYS ARE NOT USED. IN SUCH CASES, CABLES SHALL RUN "FROM" POINT OF ORIGINATION "TO" POINT OF TERMINATION WITH OR WITHOUT CONDUIT, AS INDICATED ON THE DESIGN DRAWING.

(7) CABLE REQD.

NUMBER OF SINGLE OR MULTIPLE CONDUCTOR CABLES REQUIRED.

(8) CABLE SPEC

SEE CABLE TYPES AND DESCRIPTIONS BELOW.

no change

TABLE 8.3-8 (Continued)

CABLE TYPE	CONDUCTOR NUMBER	CONDUCTOR SIZE	OD INCHES	AREA SQ. IN.
A	8kV UNGROUNDED NEUTRAL POWER CABLE			
	1C	250	1.276	1.2788
	1C	350	1.380	1.4957
	1C	500	1.525	1.8265
B	5kV UNGROUNDED NEUTRAL POWER CABLE			
	1C	250	1.217	1.1632
	1C	350	1.267	1.2608
	1C	500	1.411	1.5637
	1C	4/0	1.101	0.9521
C	15kV UNGROUNDED NEUTRAL POWER CABLE			
	1C	1	1.196	1.1234
	1C	1/0	1.299	1.3253
G1	1000 V POWER CABLE			
	1C	2	0.440	0.1521
	1C	4	0.376	0.1110
	1C	6	0.326	0.0835
	1C	8	0.285	0.0638
	1C	10	0.222	0.0387
	1C	12	0.196	0.0302
	1C	250	0.794	0.4951
	1C	350	0.927	0.6749
	1C	500	1.066	0.8925
	1C	1/0	0.568	0.2534
	1C	2/0	0.616	0.2980
	1C	4/0	0.733	0.4220
	2C	2	0.189	1.1130

TABLE 8.3-8 (Continued)

CABLE TYPE	CONDUCTOR NUMBER	CONDUCTOR SIZE	OD INCHES	AREA SQ. IN.
G2	600 V POWER CABLE			
	1C	6	0.294	0.0679
	1C	8	0.253	0.0503
	1C	10	0.190	0.0284
	1C	12	0.164	0.0211
	1C	1/0	0.515	0.2083

(9) CONDUCTOR NO.

NUMBER OF CONDUCTORSS IN A CABLE. (1C = ONE CONDUCTOR, 12C = TWELVE CONDUCTORS, ETC.)

(10) CONDUCTOR SIZE

WIRE SIZE IN EITHER AWG. OR MCM.

(11) CIRCUIT LENGTH

INDICATES TOTAL LENGTH IN FEET FOR EACH CONDUCTOR INCLUSIVE OF THE DISTANCES "FROM" THE POINT OF ORIGINATION TO TRAY ENTRANCE AND FROM THE TRAY EXIT "TO" THE POINT OF TERMINATION. WHEN TRAY ROUTING IS OMITTED, LENGTH INDICATED REFERS TO DISTANCES "FROM" THE POINT OF ORIGINATION "TO" THE POINT OF TERMINATION IN FEET FOR EACH CONDUCTOR. THUS, IF THE CABLE CONSISTS OF THREE SINGLE CONDUCTORS, THE TOTAL LENGTH WOULD BE THREE TIMES RUN LENGTH.

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 LINE 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.

no change

TABLE 8.3-8 (Continued)

(13) REFERENCE NOTES (Cont.)

4. THIS CABLE WILL HAVE MORE THAN ONE CABLE DESIGNATION IN THE 9000 SERIES NUMBERS FOR ROUTING PURPOSES. THESE CABLES SHALL BE CONTINUOUS FROM ONE PIECE OF EQUIPMENT TO ANOTHER, THERE SHALL NOT BE ANY SPLICES OR TERMINATIONS AT TRANSITION POINTS. WHEN "NO ROUTING" NOTE APPEARS IN CABLE SCHEDULE, AND A RUN LENGTH IS GIVEN, THIS INDICATES THE CABLE WAS RUN OUTSIDE THE CABLE TRAY NODE SYSTEM, SUCH AS IN CONDUIT.

5. THIS CABLE IS CLASSIFIED IN THE SEPARATION GROUPING AS AN ASSOCIATED CABLE.

   A) CABLE NUMBERS PREFIXED (FIRST SPACE) WITH "A" AND ROUTED IN DIVISION 1 RACEWAYS
   (COMPATIBILITY IS 1)

   B) CABLE NUMBERS PREFIXED (FIRST SPACE) WITH "B" AND ROUTED IN DIVISION 2 RACEWAYS
   (COMPATIBILITY IS 2)

6. THIS CABLE IS NON-CLASS 1E CABLE THAT DOES NOT ROUTE INTO REDUNDANT CLASS 1 RACEWAYS

(14) SAFETY CLEARANCE FIELD

THE DESIGNATION OF A'1 IN THESE FIELDS REPRESENTS A DIVISION A (NON-CLASS 1E) CABLE THAT IS POWERED FROM DIVISION 1 (CLASS 1E). AND SIMILARLY, B'2 SIGNIFIES A DIVISION B (NON-CLASS 1E) CABLE THAT IS POWERED FROM DIVISION 2 (CLASS 1E).

TABLE 8.3-9

SAMPLE CABLE SCHEDULE

(1) CABLE NUMBER	(2) T/C	(3) FROM	(4) TO	(5) FOR	MECH SYSTEM	FROM DWG NO	(7) CABL REQD	(8) CABL SPEC	CONDUCTOR NO	CONDUCTOR SIZE	(14) SFTY CLR	(11) CKT LGTH	(12) REV	S	(13) REF NOTES
AH7A-0102	P A	XFMR TR-7A-B	PNL ELP-7A-B	FEEDER	4150		4	G1	1C (9)	2/0 (10)	A'1	0015	002	*	
AH7A-0152	P A	LOCAL DISC SW	PUMP HOIST HT-CRA-6A	FEEDER	5110		3	G1	1C	2	A'1	0050	002	*	
AH7A-9010	P 1	MCC MC-7A ENTR:COLX K.1 13'06";COLY 11 22'06"; EL 54'8" (6) RTNG:6987-ENTR-6994-EXIT-6995 EXIT:COLX K.1 6'00";COLY 12.2 35'00"; EL 56'4"	RPS BUS MTG GEN SET MG-1	FEEDER	2620		3	G1	1C	4	A'1	0044	002	*	
AH7A-9100	P 1	MCC MC-7A ENTR:COLX K.1 13'06";COLY 11 22'06"; EL 54'0" RTNG:6992-ENTR-6987-6966-EXIT-6969 EXIT:COLX J 16'06";COLY 10 6'06"; EL 51'6"	TP CONT AH7A-9101	FEEDER	4150		3	G1	1C	1/0	A'1	0062	002	*	4,5
AH7A-9101	P A	TP CONT AH7A-9100 ENTR:COLX J 16'06";COLY 10 6'06"; EL 48'6" RTNG:6696-ENTR-6582-6583-7054-7055-7058-7062-7063-7064-7065-1050-1051-1070-EXIT-1073 EXIT:COLX F 6'00";COLY 14 13'06"; EL 73'6"	XFMR TR-7A-B	FEEDER	4150		3	G1	1C	1/0	A'1	0366	002	*	4
AH7A-9110	P 1	MCC MC-7A CONT AH7A-9111 ENTR:COLX K.1 9'06";COLY 11 22'06"; EL 54'8" RTNG:6992-ENTR-6987-6966-EXIT-6969 EXIT:COLX J 16'06";COLY 10 6'06"; EL 51'6"	TP	FEEDER	5250		3	G1	1C	4/0	A'1	0066	002	*	4,5
AH7A-9111	P A	TP CONT AH7A-9110 ENTR:COLX J 16'06";COLY 10 6'06"; EL 48'6" RTNG:6696-ENTR-6582-6583-6549-6540-6546-6545-0429-0427-EXIT-0424 EXIT:COLX G 6'06";COLY 7 8'00"; EL 41'6"	COMPRESSOR CAS-C-1A	FEEDER	5250		3	G1	1C	4/0	A'1	0278	002	*	4
AH7A-9120	P 1	MCC MC-7A ENTR:COLX K.1 12'00";COLY 11 22'06"; EL 54'8" RTNG:6987-ENTR-6992-6994-EXIT-6995 EXIT:COLX K.1 6'00";COLY 12.2 33'06"; EL 56'4"	INVERT PKG IN-1	FEEDER	4350		3	G1	1C	1/0	A'1.	0054	002	*	

TABLE 8.3-9 (Continued)

(1) CABLE NUMBER	(2) T/C	(3) FROM	(4) TO	(5) FOR	MECH SYSTEM	FROM DWG NO	(7) CABL REQD	(8) CABL SPEC	CONDUCTOR NO	CONDUCTOR SIZE	(14) SPTY CLR	(11) CKT LGTH	(12) REV	S	(13) REF NOTES
AH7B-9050	P 1	MCC MC-7B	TERM BOX TB-R320	FEEDER											
		ENTR:COLX J	15'06";COLY 8.3	5'00"; EL 111'4"	2520		3	G1	1C	6	A'1	0274	002	*	
		RTNG:4680-4695-4679-6481-4682-4683-4684-4685-4686-4688-4689													
		EXIT:COLX H	5'00";COLY 6.6	4'00"; EL 114'0"											
								(9)		(10)					
AH7B-9051	P 1	TERM BOX TB-C520	FAN CRA-RH-5A	FEEDER	2520		3	G1	1C	6	A'1	0117	002	*	
		ENTR:COLX H.5	4'00";COLY 6.6	6'07"; EL 114'0"											
	(6)	RTNG:4653-ENTR-EXIT-4654													
		EXIT:COLX H.5	6'06";COLY 6.6	7'06"; EL 118'6"											
AH7B-9060	P 1	MCC MC-7B	TERM BOX TB-R320	FEEDER	2520		3	G1	1C	6	A'1	0274	002	*	
		ENTR:COLX J	15'06";COLY 8.3	5'00"; EL 111'4"											
		RTNG:4680-4695-4679-4681-4682-4683-4684-4685-4686-4688-4689													
		EXIT:COLX H	5'00";COLY 6.6	4'00"; EL 114'0"											
AH7B-9061	P 1	TERM BOX TB-C520	FAN CRA-FH-4A	FEEDER	2520		3	G1	1C	6	A'1	0181	002	*	
		ENTR:COLX H.5	4'00";COLY 6.6	6'07"; EL 114'0"											
		RTNG:4654-ENTR-4653-4655-4656													
		EXIT:COLX L	0'00";COLY 5	0'06"; EL 118'6"											
AH7B-9070	P 1	MCC MC-7B	TERM BOX TB-R320	FEEDER	2520		3	G1	1C	2/0	A'1	0274	002	*	
		ENTR:COLX J	15'06";COLY 8.3	5'00"; EL 111'4"											
		RTNG:4680-4695-4679-4681-4682-4683-4684-4685-4686-4688-4689													
		EXIT:COLX H	5'00";COLY 6.6	4'00"; EL 114'0"											
AH7B-9071	P 1	TERM BOX TB-C520	FAN CRA-FH-1A-2	FEEDER	2520		3	G1	1C	2/0	A'1	0155	002	*	
		ENTR:COLX H.5	4'00";COLY 6.6	6'07"; EL 114'0"											
		RTNG:4654-ENTR-4653-4655-4656-4657													
		EXIT:COLX L	16'00";COLY 6	6'00"; EL 118'6"											
AH7B-9170	P 1	MCC MC-7B	TERM BOX TB-R320	FEEDER	2520		3	G1	1C	1/0	A'1	0274	002	*	
		ENTR:COLX J	15'06";COLY 8.3	5'00";EL 111'4"											
		RTNG:4680-4695-4679-4681-4682-4683-4684-4685-4686-4688-4689													
		EXIT:COLX H	5'00";COLY 6.6	4'00"; EL 114'0"											
AH7B-9171	P 1	TERM BOX TB-C520	FAN CRA-FH-1A-1	FEEDER	2520		3	G1	1C	1/0	A'1	0155	002	*	
		ENTR:COLX H.5	4'00";COLY 6.6	6'07"; EL 114'0"											
		RTNG:4654-ENTR-4653-4655-4656-4657													
		EXIT:COLX L	16'00";COLY 6	6'00"; EL 118'6"											

no change

TABLE 8.3-10

CABLE FLAME TEST SUMMARY

A. Cable Types

Cable Spec Type	Voltage	Insulation	Remarks
A	8 kV	Etlylene Propylene	-
B	5 kV	Etlylene Propylene	-
C	15 kV	Etlylene Propylene	Note 1
G	1000V, 600V	Cross-Linked Polyolefin	-
H	1000V, 600V	Cross-Linked Polyolefin	Note 2
J	600V	Cross-Linked Polyolefin	-
K	1000V, 600V, 300V	Cross-Linked Polyolefin	-
L	1000V, 600V	Cross-Linked Polyolefin	-
M	1000V	Cross-Linked Polyolefin	-

B. Test Criteria

.1 Vertical Tray Flame Test

Source: 70,000 Btu/hr (min)

Time: 480 sec (min)

Number: 3 (consecutive)

After Burn Time: 140 sec (max)

After Burn Length: 36 in (max)

Propagation: 0 in (max).

no change

.2 Oxygen Index Test

Source: See ASTM - D2863

Time: See ASTM - D2863

Number: 3 (consecutive)

Index: 20 (min)

Drip: None

Char: None

C. Test Conditions/Results - Vertical Tray

Cable Type	Source (Btu/hr)	Time (Sec)	After Burn Time (Sec)	After Burn Length (in)	Propogation (in)
A	70,000	480	40	26	-10
B	70,000	480	73	26	-11
G	210,000	521	18	14	-21
J	210,000	521	18	14	-21
K	210,000	521	18	14	-21
L	210,000	521	18	14	-21
M	120,000	2400	N/A	23	N/A

D. Test Results - Oxygen Index

Cable Type	Oxygen Index Insulation	Oxygen Index Jacket	Oxygen Index Other	Drip	Char
A	21	30(+)	-	None	None
B	21	30(+)	-	None	None
G	29	N/A	N/A	None	None
J	29	29	20	None	None
K	29	29	20	None	None
L	29	29	20	None	None
M	Note 3	29	-	Note 4	None

no change

TABLE 8.3-10 (Continued) Page 3 of 3

NOTES

1. Direct burial cable. Testing not required.

2. Type H cable constructed by same vendor, to same specification standards, and of same materials as Type G, J, K, L, M. Testing not required.

3. Overall (insulation and jacket) index is very good (O.I. = 25) and cable considered acceptable.

4. Minor drip on jacket; no drip on insulation. Cable considered acceptable.

no change

TABLE 8.3-11

DIVISIONS 1 AND 2
STANDBY DIESEL GENERATOR ANNUNCIATORS

	Annunciation (1)	Location (4) Local	MCR
1.	DG Bkr. 7-DG1(8-DG2) Trip	-	X
2.	DG Bkr. 7-DG1(8-DG2) Overcurrent Lockout	-	X
3.	DG Bkr. DG1-7(DG2-8) Close Ckt. Undervoltage/Test	-	X
4.	DG Bkr. DG1-7 (DG2-8) Trip	-	X
5.	DG No. 1 (No. 2) Overspeed Trip	X	X
6.	DG No. 1 (No. 2) Lockout (3)	-	X
7.	DG No. 1 (No. 2) Not in Auto Start	-	X
8.	DG Bkr. DG1-7 (DG2-8) Switch in Local or Remote	-	X
9.	DG No. 1 (No. 2) Failed to Start	X	X
10.	DG Bkr. 7-DG1 (8-DG2) Gnd	-	X
11.	DG No. 1 (No. 2) Generator Gnd	-	X
12.	DG No. 1 (No. 2) Generator Field Gnd.	-	X
13.	DG No. 1 (No. 2) Local DC Control Pwr Failure	-	X
14.	DG No. 1 (No. 2) Vibration Hi	X	X
15.	DG No. 1 (No. 2) Stator Temp Hi	-	X
16.	DG No. 1 (No. 2) Day Tnk Level Hi	X	X
17.	DG No. 1 (No. 2) Day Tnk Level Lo	X	X
18.	DG No. 1 (No. 2) Stg. Tnk Level Hi	-	X
19.	DG No. 1 (No. 2) Stg. Tnk Level Lo	-	X
20.	DG No. 1 (No. 2) Cable Cooling Flow Lo	-	X
21.	Power Failure-DG No. 1 (No. 2) Started Automatically	-	X
22.	DG No. 1 (No. 2) Engine Trouble (2)	X	X
23.	DG Bkr. 7-DG1 (8-DG2) Close Ckt. Undervoltage/Test	-	X
24.	Engines for DG No. 1 (DG No. 2) - Cooling Water Lo Flow	-	X

Table 8.3-11 (Continued)

Annunciation (1)	Location 4 Local	Location 4 MCR
25. DG No. 1 (DG No. 2) Room - Cooling Flow Lo	-	X
26. DG No. 1 (No. 2) Solenoid Valve Failure	X	-
27. DG No. 1 (No. 2) Lube Oil Press. Lo	X	-
28. DG No. 1 (No. 2) Oil Temp. Hi	X	-
29. DG No. 1 (No. 2) Crankcase Press Hi	X	-
30. DG No. 1 (No. 2) Engine Water Level Lo	X	-
31. DG No. 1 (No. 2) Lube Oil Level Lo	X	-
32. DG No. 1 (No. 2) Oil Temp. Lo	X	-
33. DG No. 1 (No. 2) Diff. Fuel Press. Hi	X	-
34. DG No. 1 (No. 2) Jacket Water Temp Hi	X	-
35. DG No. 1 (No. 2) Jacket Water Temp Lo	X	-
36. DG No. 1 (No. 2) Fuel Oil Press. Lo	X	-
37. DG No. 1 (No. 2) Starting Air Receivers No. 1 and No. 2 Press Lo	X	-

Notes:

1. Independent drops are provided for Division 1 and Division 2 annunciators. Drop titles for the Division 2 annunciators are indicated by parenthesis.

2. All abnormal signals detected at the local diesel generator control panels provide input to the general "engine trouble" (Item 22) alarms.

3. Diesel generating unit incomplete sequence and differential current signals trip the units via the unit lockout relays (Item 6).

4. Main Control Room - Board "C" (Panel P800).

TABLE 8.3-12

Class 1E Auxiliary AC Distribution System-Acceptable Voltage Range

	Voltages		Voltage Ranges	
System Level	System Nominal	Motor Nameplate	Normal Operation[1]	Starting[2]
4.16 kv Swgr.	4.16 kv	4.0 kv	3.6-4.4 kv	3.2-4.4 kv
480V Swgr.	480 V	460 V	414-506 V	368-506 V
480V MCC's	480 V	460 V	414-506 V	368-506 V

NOTES: 1. Minimum and maximum voltages indicated correspond to 90% and 110% (respectively) of motor nameplate voltage for the particular voltage level.

2. Minimum and maximum voltages indicated correspond to 80% and 110% (respectively) of motor nameplate voltage for the particular voltage level.

no change

TABLE 8.3-13

Motor and Motor Starter Voltage Requirements

Equipment	Nameplate Voltage	Min. Requirement Voltage	Min. Requirement % NPV	Max. Capability Voltage	Max. Capability % NPV
6.9kv Motors (Continuous Operation)	6600V	5940	90%	7260	110%
4.16kv Motors (Continuous Operation)	4000V	3600	90%	4400	110%
480V Motors (Continuous Operation)	460V	414	90%	506	110%
480V Starters (Pickup)	480V	374	78%	528	110%
480V Starters (Holding)	480V	264	55%	-	-

NOTES: 1. NPV indicates nameplate voltage of motors or starters for the particular voltage level.

no change

AMENDMENT NO. 1
July 1978

TABLE 8.3-14

CLASS 1E AUXILIARY AC DISTRIBUTION SYSTEM (25kV MAIN GENERATING UNIT SUPPLY)
EXPECTED VOLTAGES OVER GENERATOR VOLTAGE RANGE

	Minimum 25kV Generator Voltage (23.8kV)				Maximum 25kV Generator Voltage (26.3kV)			
	Steady State Loading		4.16kV Motor Starting		Steady State Loading		4.16kV Motor Starting	
System Level	Voltage[2]	% Motor NPV	Voltage[2]	% Motor NPV	Voltage[3]	% Motor NPV	Voltage[3]	% Motor NPV
4.16kV Swgr.	3751	93	3438	85	4399	109	3996	99
480 V Swgr.	438	95	402	87		Note 5		
480 V Motor[4] Terminals	436	94	400	86		Note 5		

NOTES: 1. NPV indicates nameplate voltage of motors for the particular voltage level.

2. Under plant maximum loading conditions.

3. Under plant minimum loading conditions.

4. Voltage at terminals of "worst case" motor.

5. Analysis for this case performed with 480V system unloaded to obtain maximum 4.16kV Swgr. level voltage.

no change

TABLE 8.3-15

CLASS 1E AUXILIARY AC DISTRIBUTION SYSTEM (230kV GRID SUPPLY)
EXPECTED VOLTAGES OVER GRID VOLTAGE RANGE

System Level	Minimum 230kV Grid Voltage (230kV)				Maximum 230kV Grid Voltage (240kV)			
	Steady State Loading		4.16kV Motor Starting		Steady State Loading		4.16kV Motor Starting	
	Voltage[2]	% Motor NPV	Voltage[2]	% Motor NPV	Voltage[3]	% Motor NPV	Voltage[3]	% Motor NPV
4.16kV Swgr.	3849	96	3433	85	4271	106	3886	95
480 V Swgr.	447	97	399	86	506	110	453	98
480 V Motor[4] Terminals	445	96	397	86	504	109	451	98

NOTES: 1. NPV indicates nameplate voltage of motors for the particular voltage level.

2. Under plant maximum loading conditions.

3. Under plant minimum loading conditions.

4. Voltage at terminals of "worst case" motor.

no change

AMENDMENT NO. 14
April 1981

TABLE 8.3-16

CLASS 1E AUXILIARY AC DISTRIBUTION SYSTEM (115kV GRID SUPPLY) EXPECTED VOLTAGES OVER GRID VOLTAGE RANGE

no change

	Minimum 115kV Grid Voltage (113kV)				Maximum 115kV Grid Voltage (122kV)			
	Steady State Loading		4.16kV Motor Starting		Steady State Loading		4.16kV Motor Starting	
System Level	Voltage[2]	% Motor NPV	Voltage[2]	% Motor NPV	Voltage[3]	% Motor NPV	Voltage[3]	% Motor NPV
4.16kV Swgr.	3804	95	3587	~~98~~ 89	4200	105	3960	99
480 V Swgr.	445	96	420	91	506	110	472	102
480 V Motor[4] Terminals	443	96	418	90	504	109	470	102

NOTES:
1. NPV indicates nameplate voltage of motors for the particular voltage level.
2. Under plant maximum loading conditions.
3. Under plant minimum loading conditions.
4. Voltage at terminals of "worst case" motor.

no change

TABLE 8.3-17

System Bus Voltage Monitoring Alarms

System Level	Monitoring Device	Location	Undervoltage Alarms[1] Annunciator	Undervoltage Alarms[1] Computer
500kv Grid	Voltmeter	Main Control Room	-	-
230kv Grid	Voltmeter	Main Control Room	-	-
115kv Grid	Voltmeter	Main Control Room	X	-
4.16kv Swgr.	Voltmeter	Main Control Room	X	X
480V Swgr.	Voltmeter	Main Control Room	-	-
480V MCC's	-	-	-	-

NOTES: 1. Located in Main Control Room.

AMENDMENT NO. 1
July 1978

no change

TABLE 8.3-18

Plant Switchgear and Motor Control Center
DC Control Power Summary

Swgr./MCC			DC Control Power Source	
Designation	Voltage[1]	Division	Panel[2]	Division
SH-5	6.9kV	A	DP-S1-1C	A
SH-6	6.9kV	B	DP-S1-2C	B
SH-9	6.9kV	1	DP-S1-1D	1
SH-10	6.9kV	2	DP-S1-2D	2
SH-11	6.9kV	2	DP-S1-2D	2
SH-12	6.9kV	1	DP-S1-1D	1
SH-13	6.9kV	A	DP-S1-1C	A
SH-14	6.9kV	B	DP-S1-2C	B
SM-1	4.16kV	A	DP-S1-1C	A
SM-2	4.16kV	B	DP-S1-2C	B
SM-3	4.16kV	A	DP-S1-1C	A
SM-4	4.16kV	3	DP-HPCS	3
SM-7	4.16kV	1	DP-S1-1D	1
SM-8	4.16kV	2	DP-S1-2D	2
SM-72	4.16kV	A	DP-S1-3	A
SM-75	4.16kV	A	DP-S1-1C	A
SM-82	4.16kV	B	DP-S1-4	B
SM-85	4.16kV	B	DP-S1-2C	B
DG1-7	4.16kV	1	DP-S1-1E	1
DG2-8	4.16kV	2	DP-S1-2E	2
SL-11	480V	A	DP-S1-1C	A
SL-21	480V	B	DP-S1-2C	B
SL-31	480V	A	DP-S1-1C	A
SL-51	480V	A	Note 4	
SL-52	480V	A	Note 4	
SL-53	480V	A	DP-S1-1C-2	A

no change

TABLE 8.3-18 (Continued)

Swgr./MCC			DC Control Power Source	
Designation	Voltage[1]	Division	Panel[2]	Division
SL-61	480V	B	Note 4	
SL-62	480V	B	Note 4	
SL-63	480V	B	DP-S1-2C	B
SL-71	480V	1	DP-S1-1D	1
SL-73	480V	1	DP-S1-1D	1
SL-81	480V	2	DP-S1-2D	2
SL-83	480V	2	DP-S1-2D	2
MC-S1-1D	125VDC	1	DP-S1-1	1
MC-S1-2D	125VDC	2	DP-S1-2	2
MC-S2-1A	250VDC	1	DP-S1-1D	1
MC-S2-1B	250VDC	A	DP-S1-1C-1	A

NOTES:

1. Voltage is ac, unless otherwise noted.

2. See Figure 8.3-19

3. Control power for 480 volt ac motor control centers is obtained from control power transformers located in the units.

4. Swgr. contains manually operated breakers. All indication is remote powered via the non-Class 1E supervisory system.

no change

TABLE 8.3-19

CLASS 1E AUXILIARY AC DISTRIBUTION SYSTEM (ALL SUPPLIES)
EXPECTED VOLTAGES UNDER DEGRADED SUPPLY CONDITIONS

System Level	Degraded Class 1E Bus Supply (2870V)(3) Voltage(2)	% Motor NPV(1)
4.16kV Swgr.	2870	71.8
480 V Swgr.	331	71.0
480 V Motor Terminals	329	~~77.0~~ 71.0

NOTES: 1. NPV indicates nameplate voltage of motors for the particular voltage level.

2. Under plant maximum loading condition.

3. Corresponds to 69% of nominal 4.16kV bus voltage (undervoltage relay setpoint).

CABLE ROUTING CRITERIA

POWER CABLES

POWER RACEWAYS: Raceway Types	Raceway Divisions	14.4KV Power; 15KV C: A	B	6.9KV Power; 8KV A: A	B	4.16KV Power; 5KV B: 1	2	3	A	B	480/240/208/120VAC, 250/125VDC PWR; 1000V/600V G: 1	2	3	A	B
H_c	A	X													
H_c	B		X												
H	A			X					X						
H	B				X					X					
H	1					O			A						
H	2						O			A					
H	3							O							
P	A								X					X	
P	B									X					X
P	1										O			A	
P	2											O			A
P	3												O		

(Cable Application / Cable Insulation Voltage/Type / Cable Divisions)

SIGNAL (INSTRUMENTATION) CABLES

SIGNAL RACEWAYS: Raceway Types	Raceway Divisions	Analog: 1	2	3	NMS & RPS Trip Logic Signal Ckts: 4	5	6	7	Analog: A	Digital: B	Digital Cables in RB: A	B
S	1	O							A			
S	2		O							A		
S	3			O								
S	4				O							
S	5					O						
S	6						O					
S	7							O				
S	A								X			
S	B									X		
E	1										A	
C	2											A

Cable Insulation Voltage/Type: 600V/1000V L, K, M, J

+ ANALOG-DIGITAL CABLE SEPARATION OUTSIDE REACTOR BUILDING.

CONTROL CABLES

CONTROL RACEWAYS: Raceway Types	Raceway Divisions	Control Indication & Annun.; 600/1000V L,K,H: 1	2	3	RPS Trip Logic Cables; 600V K: 4	5	6	7	Contr Ind & Ann; 600V/1000V H.K.G*: A	B	RPS Scram SOV Ckt Only; 600V H, G*: 4	5	6	7
C	1	O							A					
C	2		O							A				
C	3			O										
C	4				O									
C	5					O								
C	6						O							
C	7							O						
C	A								X					
C	B									X				
R_c	4										O			
R_c	5											O		
R_c	6												O	
R_c	7													O

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

Interface BOP/A Div	ASSS PGCC Cable Div	BOP PGCC Cable Div	PGCC Raceway Division: 1	2	3	Non 1E	
1	ESS1	DIV1	O				
2	ESS2	DIV2		O			
3	ESS3	DIV3			O		
4	A1		O				SEE FIGURE 8.3-41
6	B1		O				
5	A2			O			
7	B2			O			
1	NSS1		O				SEE FIGURE 8.3-42
2	NSS2			O			
4	DIV1A		O				SEE FIGURE 8.3-41
6	DIV1B		O				
5	DIV2A			O			
7	DIV2B			O			
A	XXX1	DIVA	A			X	
B	XXX1	DIVA	A			X	
A	XXX2	DIVB		A		X	
B	XXX2	DIVB		A		X	
3	XXX3	DIV3			A		

* #14AWG "G" (1000V) IS USED FOR RMC (C12A). #8AWG "G" (1000V) IS USED FOR SCRAM RETURN AND "G" (1000V) IS USED FOR RPS POWER

LEGEND: X-NON-1E, A-ASSOCIATED, O-CLASS 1E, H_c - THE SUBSCRIPT "C" REFERS TO GND.
RB-REACTOR BUILDING O-HPCS (ONLY)

EXA[...] NSSS PGCC CABLE-INFORMATION OBTA[...] FROM THE GE SYSTEM CABLE SUMMARY: CABLE: [...]8708/C51B-002, FROM: H13 P687, TO: H13-P608, SYSTEM: C51B, SIGNAL: GE/MAC, SEPARATION: B2, CABLE TYPE: SP4

TABLE 8.3-2[...]

POWER GENERATION CONTROL COMPLE[...] (PGCC) CABLE DESIGN INFORMATION

EXAMPLE 2: BOP PGCC CABLE-IN[...]N OBTAINED FROM THE B&R BOP PGC[...] ROUTING SUMMARY: CABLE No. CM-K2-[...], FROM: H13 PC91 TO: H13-P811, SIGNAL/SEPARATION CLASS: C2, CABLE TYPE: GE-1, RACEWAY: DIV2

SEPARATION CODES

INDEX OF SYSTEMS

B22A	NUCLEAR BOILER PROCESS INSTRUMENTATION
B22D	AUTO DEPRESSURIZATION (ADS)
B22E	JET PUMP INSTRUMENTATION
B22H	NUCLEAR STEAM SUPPLY SHUTOFF (NSSS)
B33A	REACTOR RECIRC (REVAG)
C11A	REACTOR MANUAL CONTROL (RMC)
C11?	CONTROL ROD DRIVE HYDRAULIC (CRD HYD)
C34A	FEEDWATER CONTROL
C41A	STAND-BY LIQUID CONTROL
C51A	START-UP RANGE NEUTRON MONITORING
C51D	POWER RANGE NEUTRON MONITORING
C51C	START UP DRIVE CONTROL
C51D	TRAVERSING IN-CORE PROBE CALIB (TIP)
C61A	REMOTE SHUTDOWN
C72A	REACTOR PROTECTION SYSTEM (RPS)
C72D	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)
E22D	HPCS POWER SUPPLY
E31A	LEAK DETECTION
E51A	REACTOR CORE ISOLATION COOLING (RCIC)
G11A	RADWASTE
G33A	REACTOR WATER CLEAN-UP
N10A	ANNUNCIATOR SYSTEM
N64A	OFF GAS SYSTEM - LOW TEMP

PGCC POWER SUPPLY CLASSIFICATION (NSSS)

POWER SOURCE DESCRIPTION AS SHOWN ON ELEMENTARY	NON CLASS 1E						CLASS 1E		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
120VAC INSTR BUS	X	X	X						
125VDC INSTR BUS	X	X	X						
24VDC INSTR BUS	X	X	X						
24VDC INSTR BUS	X	X	X						
120VAC INSTR BUS A				X			X		
120VAC INSTR BUS B					X			X	
125VDC INSTR BUS A				X			X		
125VDC INSTR BUS B					X			X	
24VDC INSTR BUS A				X			X		
24VDC INSTR BUS B					X			X	
120VAC UPS BUS	X	X	X						
120VAC UPS BUS A				X			X		
120VAC UPS BUS B					X			X	
120VAC UPS BUS A	X	X							
120VAC UPS BUS B	X	X							
120VAC INSTR BUS C						X			X
125VDC INSTR BUS C						X			X
24VDC INSTR BUS C						X			X

SAFETY RELATED SYSTEMS (NSSS)

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
28VDC	C	28 Volt DC Power
120VAC	C	120 Volt AC Power
125VDC	C	125 Volt DC Power
CI 120A	C	120 Volt AC Control and Indication Signal
CI 125D	C	125 Volt DC Control and Indication Signal
CI 28D	C/S	28 Volt DC Control and 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 C51B SEPARATION CATEGORIES

NSSS CODE	BOP CODE ②	DESCRIPTION
ESS1	DIV1	Core Standby Cooling System Division I
ESS2	DIV2	Core Standby Cooling System Division II
ESS3	DIV3	Core Standby Cooling System Division III
A1	DIV4	Reactor Protection System Channel A Division I
B1	DIV5	Reactor Protection System Channel B Division I
A2	DIV6	Reactor Protection System Channel A Division II
B2	DIV7	Reactor Protection System Channel B Division II
NSS1	DIV1	Nuclear Steam Supply Shutoff System Division I
NSSII	DIV2	Nuclear Steam Supply Shutoff System Division II
DIV1A	DIV4	Neutron Monitoring System Trip Logic A1 Division IA
DIV1B	DIV5	Neutron Monitoring System Trip Logic B1 Division IB
DIV2A	DIV6	Neutron Monitoring System Trip Logic A2 Division IIA
DIV2B	DIV7	Neutron Monitoring System Trip Logic B2 Division IIB
XXX1	DIVA or DIVB	All other non-safety functions routed with Division I cables or non 1E cables. (XXX1 cable in DIVB raceway is associated) (Class)
XXXII (XXX12)	DIVA or DIVB	All other non-safety functions routed with Division II cables or non 1E cables. (XXXII cable in DIVB raceway is associated) Class
XXXIII	DIVB	ALL OTHER NON SAFETY FUNCTIONS ROUTED WITH DIVISION III CABLES

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-3A	7 Twisted Shielded Pairs of #20 Wire
SP13 AWG 20		13 Twisted Shielded Pairs of #20 Wire
	GE 5	7 Twisted Shielded Pairs of #16 Wire
TC4 CuCn		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
MC7 AWG 14	GE 3	7 Conductors of #14 Wire
MC19 AWG 14	GE 1	19 Conductors of #14 Wire
MC8 AWG 16		8 Conductors of #16 Wire
MC12 AWG 16		12 Conductors of #16 Wire
MC19 AWG 16	GE 2	19 Conductors of #16 Wire
MC27 AWG 16		27 Conductors of #16 Wire
MC37 AWG 16		37 Conductors of #16 Wire
MC7 AWG 20		7 Conductors of #20 Wire
MC12 AWG 20		12 Conductors of #20 Wire
MC19 AWG 20		19 Conductors of #20 Wire
MC27 AWG 20		27 Conductors of #20 Wire
MC37 AWG 20		37 Conductors of #20 Wire
MC48 AWG 20		48 Conductors of #20 Wire
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 11	2 1/C #14
	GE 12	4-2/C #16 INDIVIDUALLY SHIELDED
	GE 13	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 I. BALANCE OF PLANT DIV B CABLES CAN INTERFACE WITH XXX1 PGCC CABLES PROVIDING "BRIDGING" BETWEEN ESSENTIAL RACEWAYS DOES NOT OCCUR. SIMILARLY FOR XXXII/DIVA INTERFACE CABLES. NOTE THAT "BRIDGING" BETWEEN ESSENTIAL RACEWAYS IS ACCEPTABLE IN THE FOLLOWING CASES: CASE 1 DIV 1 PGCC DUCT CAN INTERFACE WITH DIV4 OR DIV6 BOP RACEWAY. CASE 2 DIV2 PGCC DUCT CAN INTERFACE WITH DIV5 OR DIV7 BOP RACEWAY.

TABLE 8.3-22 SYSTEM CABLE AND ROUTING CRITERIA

DESCRIPTION (Class)		NON IE	CLASS IE	FIELD: CABLE TYPE	FIELD: RACEWAY TYPE/DIV	IN PGCC MODULAR FLOOR DUCTS: RACEWAY DIV.	PGCC SEPARATION CATEGORY	PGCC SIGNAL CLASS	PGCC CABLE TYPE	NSSS SPECIAL CABLE REQUIREMENT: IMPED (OHMS)	CAP (PF/FT)	MAX VOLT (V DC)	SPECIAL REQUIREMENTS	REMARKS
RPS TRIPLOGIC CONTROL CABLES			X	K1	C4	DIV 1	A1	C1120A	12/C#14	NA				FAILSAFE CABLES ROUTED IN GRDD. FLEX CND WITHIN PGCC
			X	K1	C6	DIV 1	B1	C1120A	12/C#14					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	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	2COND#12				SCRAM SOV LEG NEUTRAL TO C2 [illegible] FROM MAIN CONTROL PANEL TO SCRAM GROUP FUSE BOX AT [illegible]	
			X	H2	R6	DIV 1	B1	C1120A	2COND#12					
			X	H2	R5	DIV 2	A2	C1120A	2COND#12					
			X	H2	R7	DIV 2	B2	C1120A	2COND#12					
RPS TRIPLOGIC SIGNAL CABLES			X	L2	S4	DIV 1	A1	GEMAC	SP4	NA				
			X	L2	S6	DIV 1	B1	GEMAC	SP4					
			X	L2	S5	DIV 2	A2	GEMAC	SP4					
			X	L2	S7	DIV 2	B2	GEMAC	SP4					
NEUTRON MONITORING SYSTEM CABLES (INCLUDING MAIN STEAM RADIATION) C51A SRM	SENSOR CA.			M7				—	—	78	20.5	1000	COAX 3SHLD HI RAD, TEMP	NEUTRON MONITORING SYSTEM GROUP I — THE LPRM CABLES ARE SUBDIVIDED INTO FOUR GROUPS AS FOLLOWS: GROUP 1 (DIV1A) APRM CH E; GROUP 2 (DIV2A) APRM CH C & D; GROUP 3 (DIV1B) APRM CH A & B; GROUP 4 (DIV2B) APRM CH F
	PREAMP SIG. CA.			M1				LOW A	COAX RG6	75	20	1500	COAX STD	
	PREAMP. HV CA.			L4				LOW A	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 3SHLD	
	PREAMP SIG. CA.			M1				LOW A	COAX RG6	75	20	1500	COAX STD	
	PREAMP HV. CA.			L4				LOW A	COAX RG59	47	37.3	2000	SHLD	
	PREAMP LV CA.		X	L4	S4	DIV 1	DIV 1A	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	2500	COAX HI RAD/TEMP	
	EPA/PGCC CA.			L4				LOW A	COAX RG59	47	37.3	2000	SHLD	
D17A PROCESS RAD'N	SENSOR CA			M1						75	20.5	1000	COAX 3SHLD HI RAD, TEMP.	
	PREAMP SIG CA			M1				LOW A	COAX RG6	75	20	1500	COAX STD	
	PREAMP HV CA			L4				LOW A	COAX RG59	47	37.3	2000	SHLD	
	PREAMP LV CA			L4				LOW A	COAX RG59	47	37.3	2000	SHLD	
SAME AS NMS GROUP I			X	SAME AS NMS I	S6	DIV 1	DIV 1B	← SAME AS NMS GROUP I →						NMS GROUP III
SAME AS NMS GROUP I			X	SAME AS NMS I	S5	DIV 2	DIV 2A	← SAME AS NMS GROUP I →						NMS GROUP II
SAME AS NMS GROUP I			X	SAME AS NMS I	S7	DIV 2	DIV 2B	← SAME AS NMS GROUP I →						NMS GROUP IV
PROCESS RADIATION MONITORING (D17A)		X		SAME AS NMS I	S2	DIV 2	XXX2	← SAME AS D17A IN NMS (ABOVE) →						
		X		SAME AS NMS I	SB	DIV 2	XXX2	← SAME AS D17A IN NMS (ABOVE) →						
AREA RADIATION MONITORING (D21A)		X		L3	S2	DIV 2	XXX2	ARM-IN	MC8	NA				
		X		L3	SA	DIV 2	XXX2	ARM-IN	MC8	NA				
TRAVERSING INCORE PROBE TIP (C51D)	INDEX MECH. CABLE	X		L3	C2	—	—	—	—				27/C SHLD	
	DRIVE MECH. POS IND	X		L3	C2	DIV 2	XXX2	LOW D	MC48				48/C SHLD	
	DRIVE MECH. CONTR CA	X		L3	C2	DIV 2	XXX2	LOW D	MC37				37/C SHLD	
	DRIVE MECH ANALOG POS	X		L1	S2	DIV 2	XXX2	LOW A	ST1					
	DRIVE MECH. DET. SIG	X		L4	S2	DIV 2	XXX2	LOW A	COAX RG59	47	37.3	2000	SHLD	
	DRIVE MECH. CHAMBER	X		L3	C2	—	—	—	—				4/C SHLD	
	DRIVE MECH. BALL VALVE	X		K1	C2	—	—	—	—				2/C #16	
	SHEAR VA ASSY CA.	X		L3	C2	—	—	—	—				4/C SHLD	
REACTOR MANUAL CONTROL (C11A)	ROD POSITION CABINET LEFT/RIGHT BRANCH JUNCT. MODULES	X		G1	CA	DIV 1	XXX1	C1120A	2COND#12	NA				
		X		M8	SA	DIV 1	XXX1	LOW D	COAX RG22					
	CRD PROBE/EPA CABLE	X		K2	S1					[illegible]			18/C	
	EPA/RPIS CABLE	X		L3	S1	DIV 1	XXX1	LOW A	MC48					
	EPA 1H22-P007	X		J2	S1	—	—	—	—				28 PAIR CA SHLD	
RPS POWER SUPPLY (C72B)	RPS BUS A	X		H2	C1	DIV 1	XXX1	C1120A	2COND#12					FAILSAFE POWER CABLES ROUTED IN GROUNDED FLEXIBLE CONDUIT WITHIN PGCC
		X		G2	PA	DIV 1	XXX1	C1120A	2COND#12					
		X		G2	C2	DIV 2	XXX2	C1 120A	2COND#12					
		X		G2	P2	DIV 2	XXX2	C1 120A	2COND#12					
	RPS BUS B	X		H2	C2	DIV 2	XXX2	C1 120A	2COND#12					
		X		G2	PB	DIV 2	XXX2	C1 120A	2COND#12					
		X		H2	C1	DIV 1	XXX1	C1 120A	2COND#12					

TABLE 8.3-23

Transformer Tap Settings

Transformer	Taps
TR-S	-5.0%
TR-B	+2.5%
TR-N1	-2.5%
TR-N2	-2.5%
TR-1-11	-2.5%
TR-2-21	-2.5%
TR-3-31	-2.5%
TR-7-71	-2.5%
TR-8-73	-5.0%
TR-8-81	-5.0%
TR-8-83	-5.0%
TR-4-41	-2.5%
TR-4-53	-2.5%

	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	N.A.	
ANY	ABOVE 120 VAC, 125 VDC	P	P	N.A.	P	P	P	P	C	N.A.	

NOTES:

1. (* *) INCLUDED ARE: ELECTRO HYDRAULIC OPERATORS (EHO'S), HVAC DAMPERS, REACTOR START-UP 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 8.3-24: POWER/CONTROL CABLE CLASSIFICATION

TABLE 8:3-25

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

DIVISIONAL SEPARATION CLASS	SAFETY CLASS: CLASS IE	SAFETY CLASS: ASSOCIATED	SAFETY CLASS: NON-IE -CLASS	REPRESENTATIVE CABLE NUMBER	CABLE DIVISION MARKING CHARACTER	RACEWAY TYPE (CABLE COMPATIBILITY FROM E550/E551 DRAWINGS)	REPRESENTATIVE TRAY DIVISION MARKING CHARACTERS	RACEWAY/EQUIP. MARKER BACKGROUND COLOR	REPRESENTATIVE CABLE MARKER BACKGROUND COLOR	CHARACTER COLOR	PRIME CABLES (NON-IE -CLASS CABLES POWERED FROM CLASS IE SOURCES) HAVE AN ADDITIONAL CHECKED MARKER. ALSO ON RACEWAYS USED.	PRIME CABLES ARE IDENTIFIED IN THE SFTY CLR FLD OF DWG E550/E551	CLASS IE 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/WHT
		X		ALPCS-9001	DIV 1				SILVER / YELLOW		RED/WHITE	A'1.	YEL/WHT
2	X			2RHR-10	DIV 2	H,P,C,S	CDIV2	ORANGE	ORANGE	BLACK	NA	NA	BL/WHT
		X		BRHR-9001	DIV 2				GOLD / ORANGE		GREEN/WHITE	B'2	BL/WHT
3	X			3HPCS-14	DIV 3	P,C,S	CDIV3	RED	RED	BLACK	NA	NA	GN/WHT
4	X			4RPS-17	CHA1	R,C,S	RCHA1	LT. BLUE	LIGHT BLUE	RED	NA	NA	YEL/WHT
5	X			5RRS-17	CHA2	R,C,S	RCHA2	GREEN	GREEN	RED	NA	NA	BL/WHT
6	X			6RPS-17	CHB1	R,C,S	RCHB1	DRK. BLUE	DARK BLUE	RED	NA	NA	YEL/WHT
7	X			7RPS-17	CHB2	R,C,S	RCHB2	BROWN	BROWN	RED	NA	NA	BL/WHT
A			X	AMIA-402	DIV A	H,P,C,S	CDIVA	SILVER	SILVER	BLACK	RED/WHITE	A'1 (NOTE 1)	YEL/WHT
			X	ASL53-9073	DIV A				SILVER / YELLOW				
B			X	BD12C-103	DIV B	H,P,C,S	CDIVB	GOLD	GOLD	BLACK	GREEN/WHITE	B'2 (NOTE 1)	BL/WHT
			X	BSM7-9126	DIV B				GOLD / ORANGE				

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

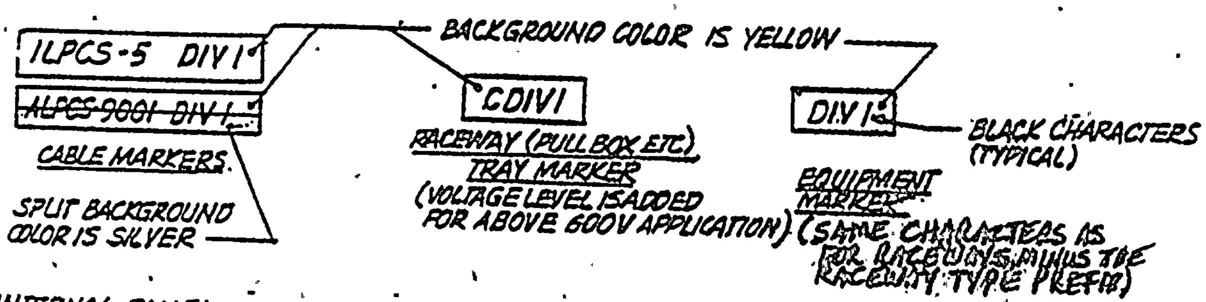
H - POWER 6.9/4.16 KV
P - POWER 1000/600VAC, 250VDC, 125VDC, 120/208/240VAC
C - CONTROL 120VAC/125VDC
S - SIGNAL
R - RPS SCRAM SOV RACEWAY

PRIME CABLES:
A'1 SIGNIFIES DIV 1 POWER / DIV A NON-IE -Class FUNCTION
B'2 SIGNIFIES DIV 2 POWER / DIV B NON-IE FUNCTION
A'2 & B'1 ARE PROHIBITED

NON-IE 9000 SERIES CABLE NUMBER -Class:
A NON-CLASS IE 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 IE CABLE WITHIN ITS EQUIPMENT OF ORIGIN OR DESTINATION

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

TYPICAL DIVISION MARKERS



① INTERNAL PANEL WIREMARKERS.

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

TABLE 8.3-26

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

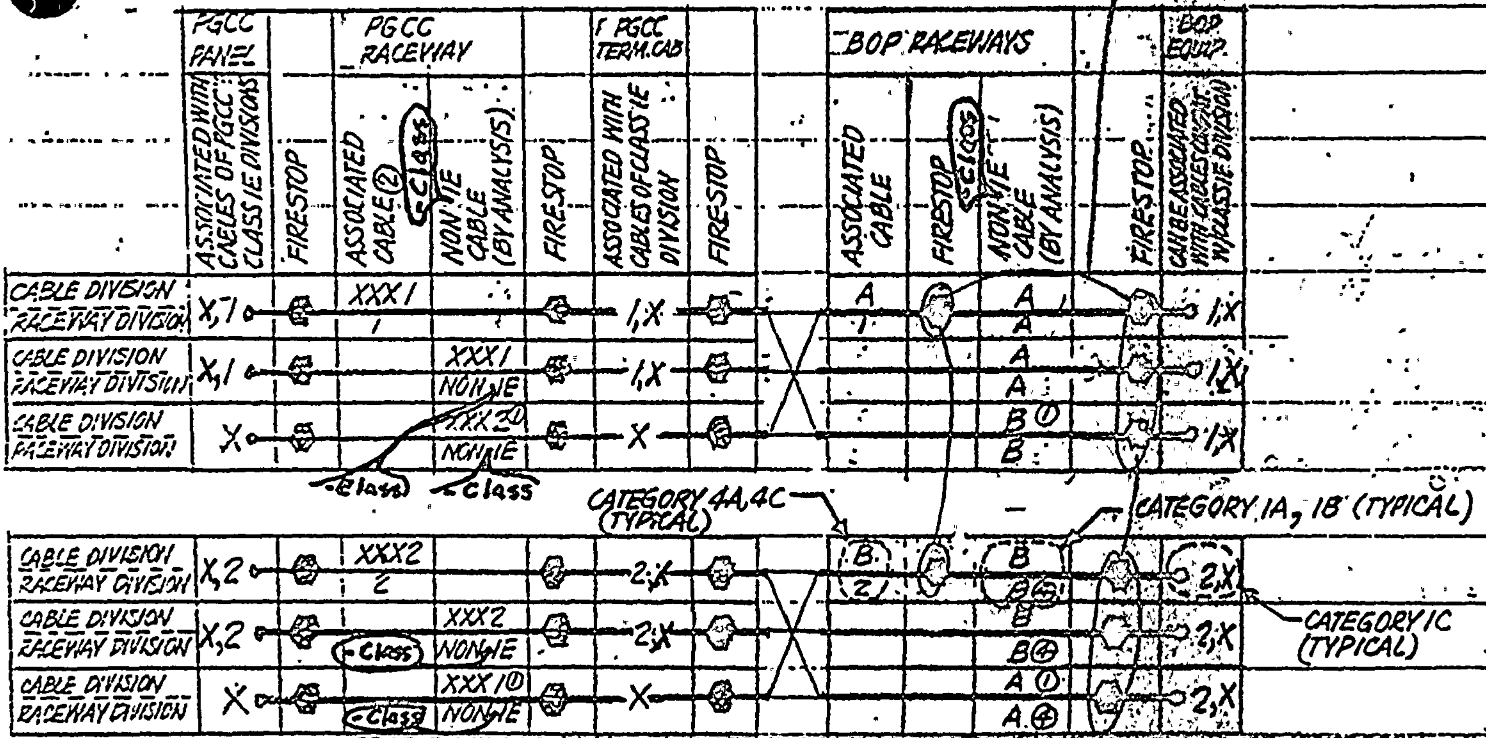
PGCC DIVISIONAL SEPARATION CLASSES	SAFETY CLASSES: CLASS IE	SAFETY CLASSES: ASSOCIATED	SAFETY CLASSES: NON-IE	CABLE MARKERS: CABLE SEPARATION CATEGORY AS SHOWN ON CABLE ID MARKER	CABLE MARKERS: CABLE SEPARATION MARKER: LETTERING	CABLE MARKERS: CABLE SEPARATION MARKER: LETTERING COLOR	CABLE MARKERS: PRIME CABLES (NON-IE CABLES POWERED FROM CLASS IE SOURCES) HAVE AN ADDITIONAL CHECKERED MARKER	PGCC RACEWAY/EQUIPMENT MARKER - LETTERING, LETTERING COLOR IS BLACK	PGCC RACEWAY/EQUIPMENT CABLE MARKER BACKGROUND COLOR	EXTERNAL TO PGCC INTERFACES WITH DIVISIONAL SEPARATION CLASS SHOWN ON TABLE 8.3-25	WIRE MARKERS ①: IF A CABLE INTRUDES INTO A PANEL (IN PGCC) OF A DIFFERENT DIVISION, THEN THE INTERNAL PANEL WIRING WHICH IS ELECTRICALLY CONNECTED SHALL BE IDENTIFIED WITH STRIPED MARKER TAPE.
1	X			RPS-A1	RPS-I	RED	N/A	DIV1	YELLOW	4	YELLOW/WHITE
	X			DIV-1A	DIV I	BLACK					
	X			RPS-B1	RPS-I	RED				6	
	X			DIV1B	DIV I	BLACK					
	X			ESS1	DIV I	BLACK				1	
	X			NSS1	DIV I	BLACK					
	X			DIV1	DIV I	BLACK					
		X		XXX1	N/A	N/A	RED/WHITE			A,B,1	FOR PRIME CABLES ONLY YELLOW/WHITE
		X		DIVA	N/A	N/A	RED/WHITE		—		
		X		DIVB	N/A	N/A	N/A				N/A
2	X			RPS-A2	RPS-II	RED	N/A	DIV2	BLUE	5	BLUE/WHITE
	X			DIV-2A	DIV II	BLACK					
	X			RPS-B2	RPS II	RED				7	
	X			DIV2B	DIV II	BLACK					
	X			ESS2	DIV II	BLACK				2	
	X			NSS2	DIV II	BLACK					
	X			DIV2	DIV II	BLACK					
		X		XXX2	N/A	N/A	GREEN/WHITE			A,B,2	FOR PRIME CABLES ONLY BLUE/WHITE
		X		DIVB	N/A	N/A	GREEN/WHITE				
		X		DIVA	N/A	N/A	N/A				N/A
3	X			ESS III	ESS III	WHITE	N/A	DIV3	GREEN	3	GREEN/WHITE
		X		XXXIII	N/A	N/A	BLUE/YELLOW				
	X			DIV3	ESS III	WHITE	N/A				
NON-IE DUCT			X	XXX1	N/A	N/A	N/A	N/A	WHITE	A,B,1,2	N/A
			X	XXX11							
			X	DIVA							
			X	DIVB							

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 I PANEL THAT ~~INTERFACE~~ ARE COMPATIBLE WITH THE VARIOUS DIVISION I CABLE SEPARATION CATEGORIES WILL NOT BE IDENTIFIED. SIMILARLY FOR DIVISION 2 & 3 PANELS.

TABLE 8.3-27

~~NON-CLASS IE~~ ASSOCIATED CIRCUITS ③ (CONTROL & INSTRUMENTATION)

delete firestop



X – FOR NON CLASS IE POWERED CABLES ONLY. THESE CABLES ARE NOT TREATED AS ASSOCIATED (CATEGORY 1C) ~~NOT ASSOCIATED WITH ANY CLASS IE CABLES; PART 1, 2 – SEE ASSOCIATED DEFINITION 8.3-SGe.~~

① ~~DESIGN CONTROL IS PROVIDED TO NOT ALLOW THESE CIRCUITS IN REDUNDANT~~ ~~CLASS IE RACEWAYS DOWNSTREAM OF EQUIPMENT OF ORIGIN/DESTINATION.~~ THESE CABLES ~~SHALL~~ ARE NOT ~~[illegible]~~ PRIME CABLES.

② ALL XXX III CABLES ARE ASSOCIATED & 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 GENERALIZIED BY REPLACING PGCC WITH BOP, XXX1 WITH DIV A AND XXX2 WITH DIV B

④ NON-CLASS IE POWERED CABLES CONTAINED IN RACEWAYS THAT ARE ROUTED INTO DIVISION 2 RACEWAYS ~~SHALL BE~~ ARE ISOLATED BY OVER CURRENT PROTECTIVE DEVICES.

NON-CLASS IE ASSOCIATED CIRCUITS (POWER)

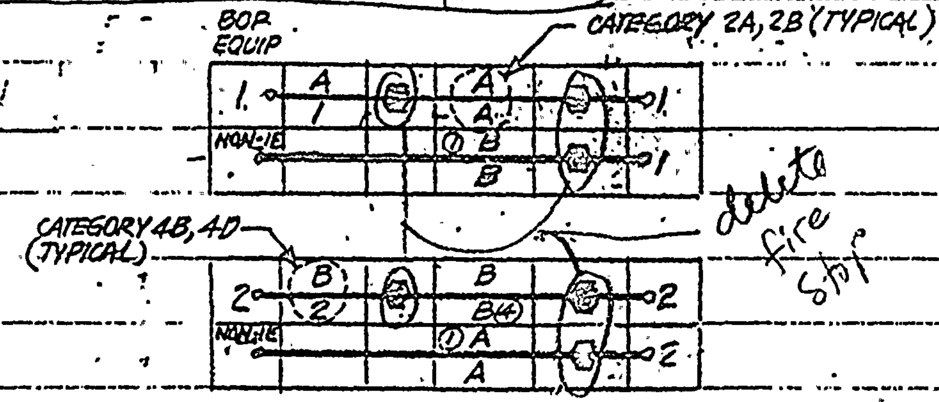


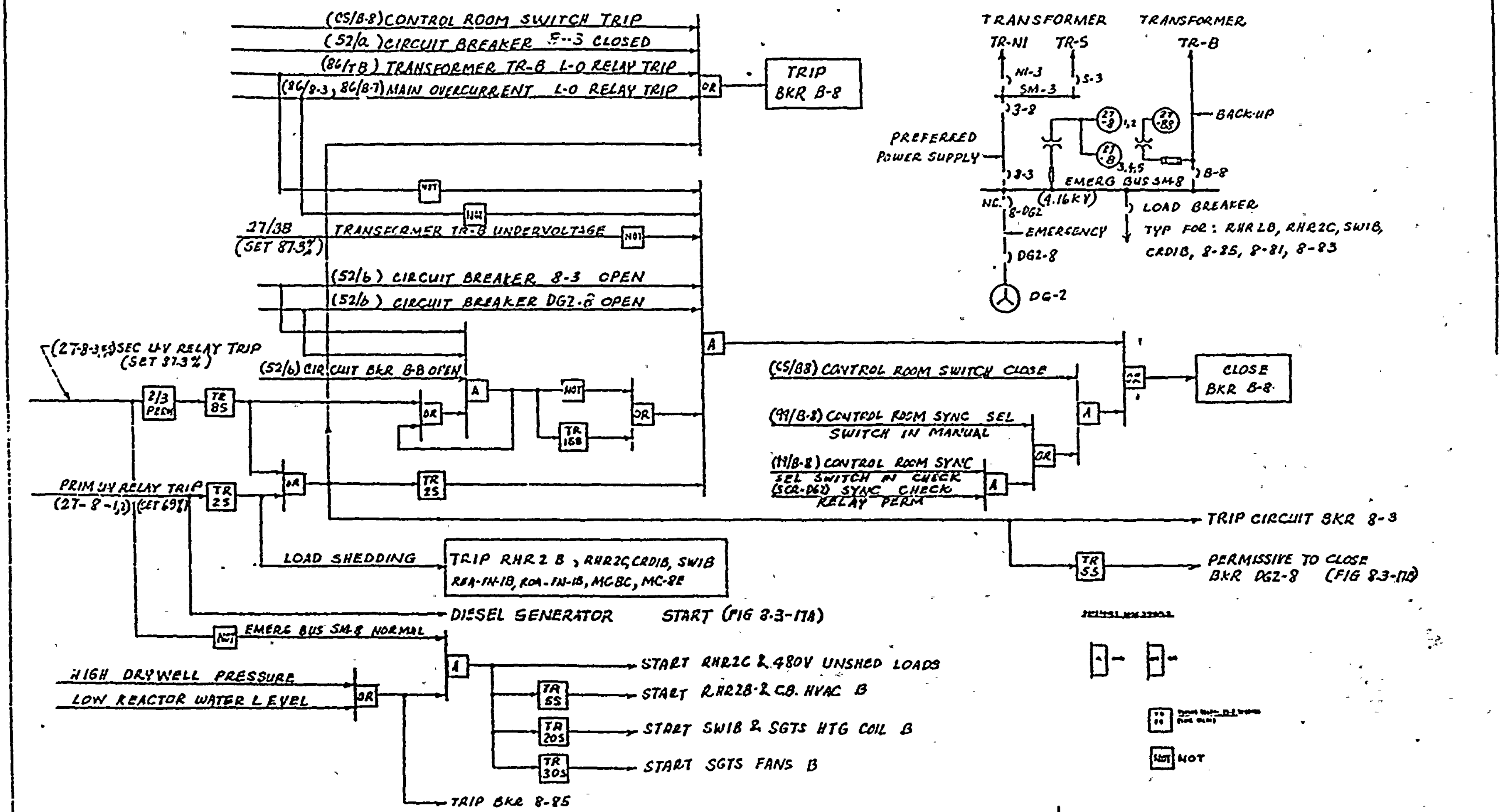
TABLE 8.3-28

COMPARISON OF HPCS DIESEL GENERATORS USED IN LA SALLE & WNP-2

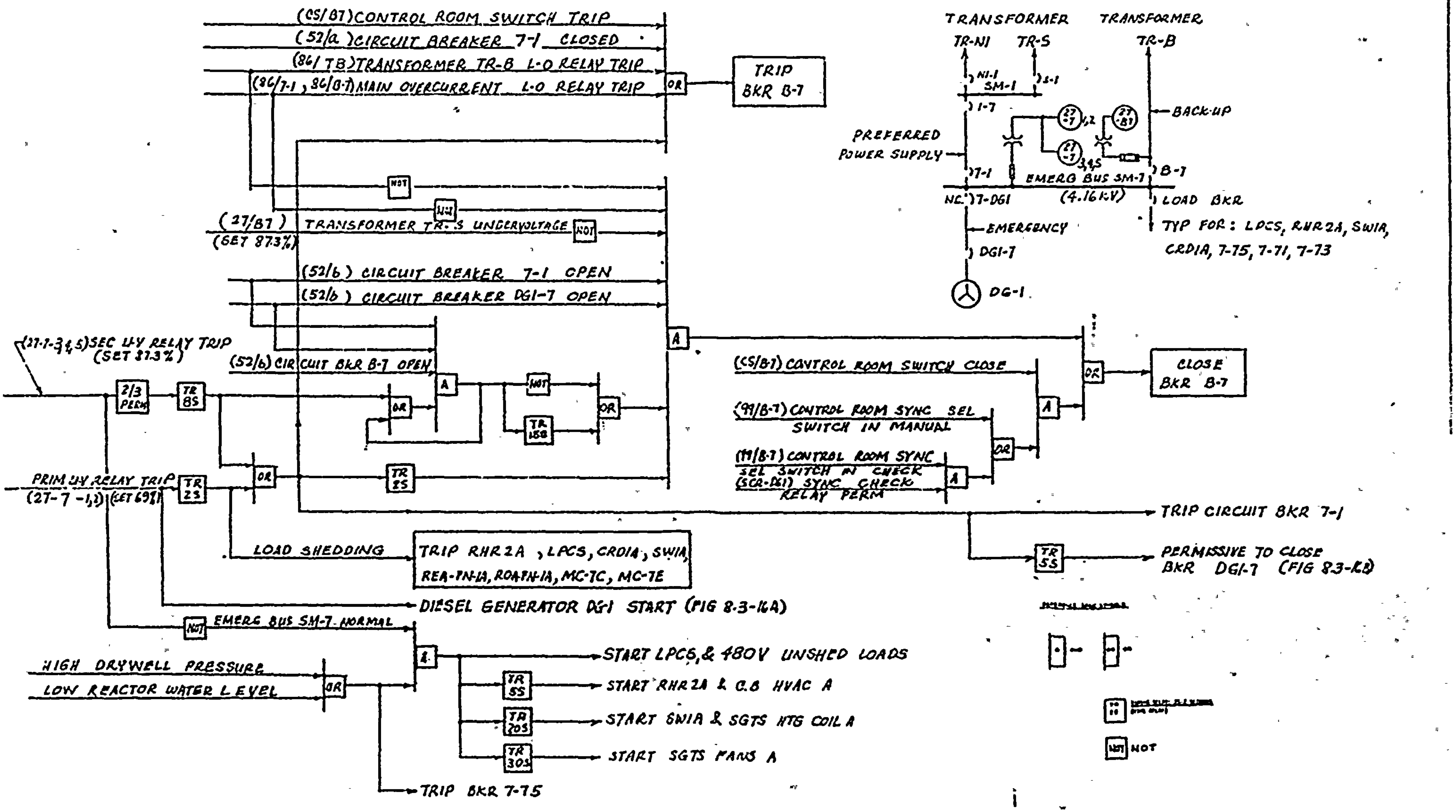
COMPONENT	DATA	
	LA SALLE	WNP-2
ENGINE:		
MODEL	EMD-20-645E4	EMD-20-645E4
HP	3600	3600
SPEED (RPM)	900	900
GENERATOR:		
MODEL	IDEAL ELEC.-CO-SAB	GE - 264X730
KVA	3560	3560
VOLTS	2400/4160Y	2400/4160Y
HERTZ	60	60
INSULATION	CLASS B	CLASS B
MOMENT OF INERTIA (#-FT²)	36,000	32,450 (NOTE 1)
REACTANCE (%)		
SUBTRANSIENT (X_d'')	7.1	10.9 (NOTE 2)
TRANSIENT (X_d')	14.3	16.5
SYNCHRONOUS (X_d)	112.	82.
TIME CONST (SEC)		
T_d'' (S-C)	.021	.01
T_d' (O-C)	3.5	2.87
REGULATOR TYPE	SOLID STATE	SOLID STATE
EXCITER TYPE	BRUSHLESS ROTARY	STATIC WITH FIELD FLASHING
GOVERNOR:		
MODEL	WOODWARD UG-8	WOODWARD EGB-10
SPEED SENSOR	MECHANICAL	ELECTRONIC (NOTE 3)
ERROR	∓1%	∓1/4%
LOADS:		
HPCS PUMP	3000 HP 1800 RPM 373 FLA	3000 HP 1800 RPM 373 FLA
AUX LOADS	220 KW	220 KW

NOTES: (1) WNP-2 OVERALL DIESEL GEN MOMENT OF INERTIA IS LOWER THAN LA SALLE'S. HENCE D-G STARTING TIME MAYBE LESS FOR WNP-2 THAN FOR LA SALLE.

(2) THE HIGHER TRANSIENT & SUBTRANSIENT REACTANCE FOR WNP-2 IS COMPENSATED BY THE USE OF A STATIC EXCITER WHICH PROVIDES FASTER VOLTAGE RECOVERY DURING VOLTAGE DIPS.



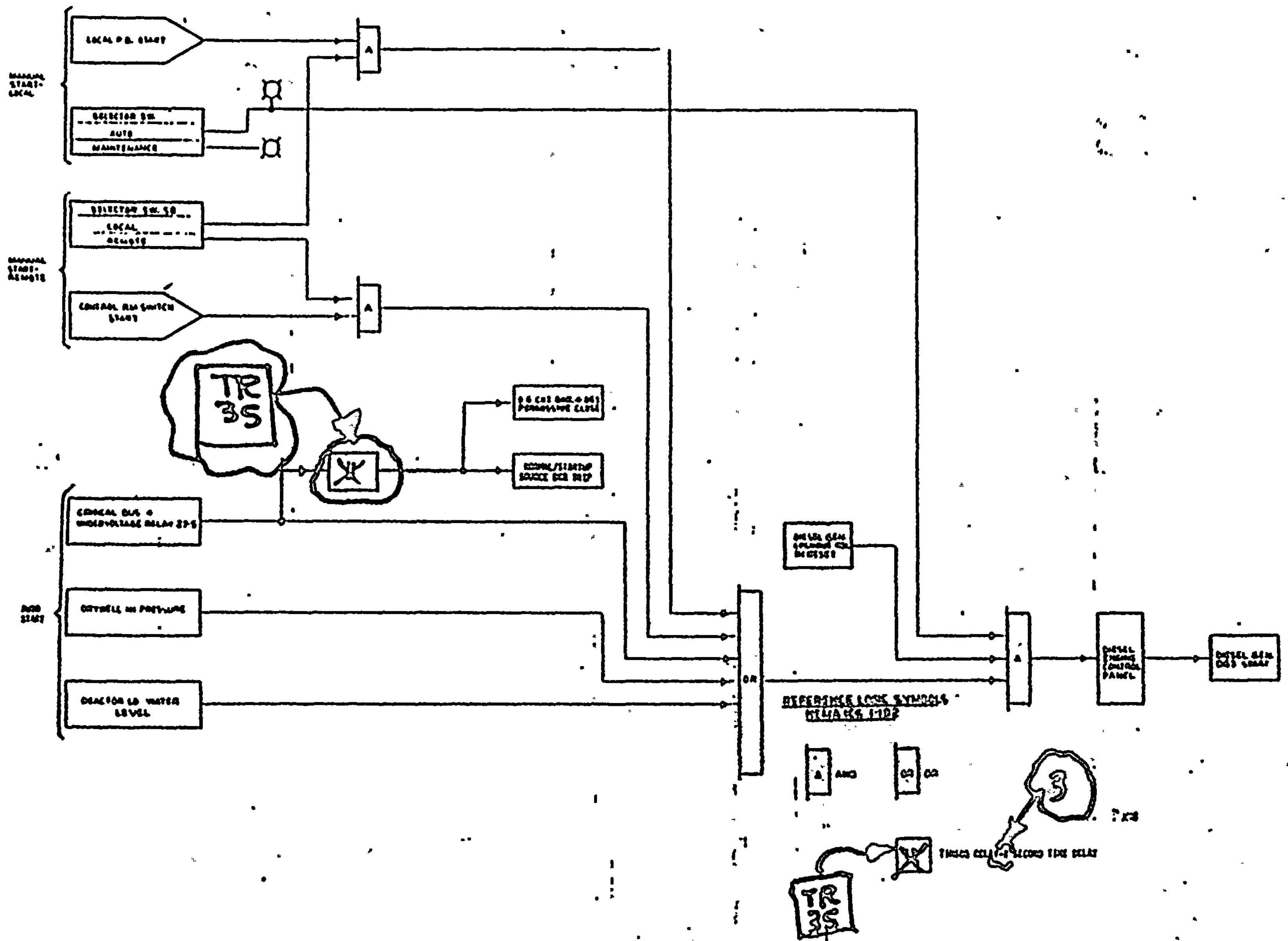
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	EMERGENCY BUS SM-8 UNDERVOLTAGE PROTECTION, BUS TRANSFER & LOAD SEQUENCING	FIGUR[E] 8.3-1[7]



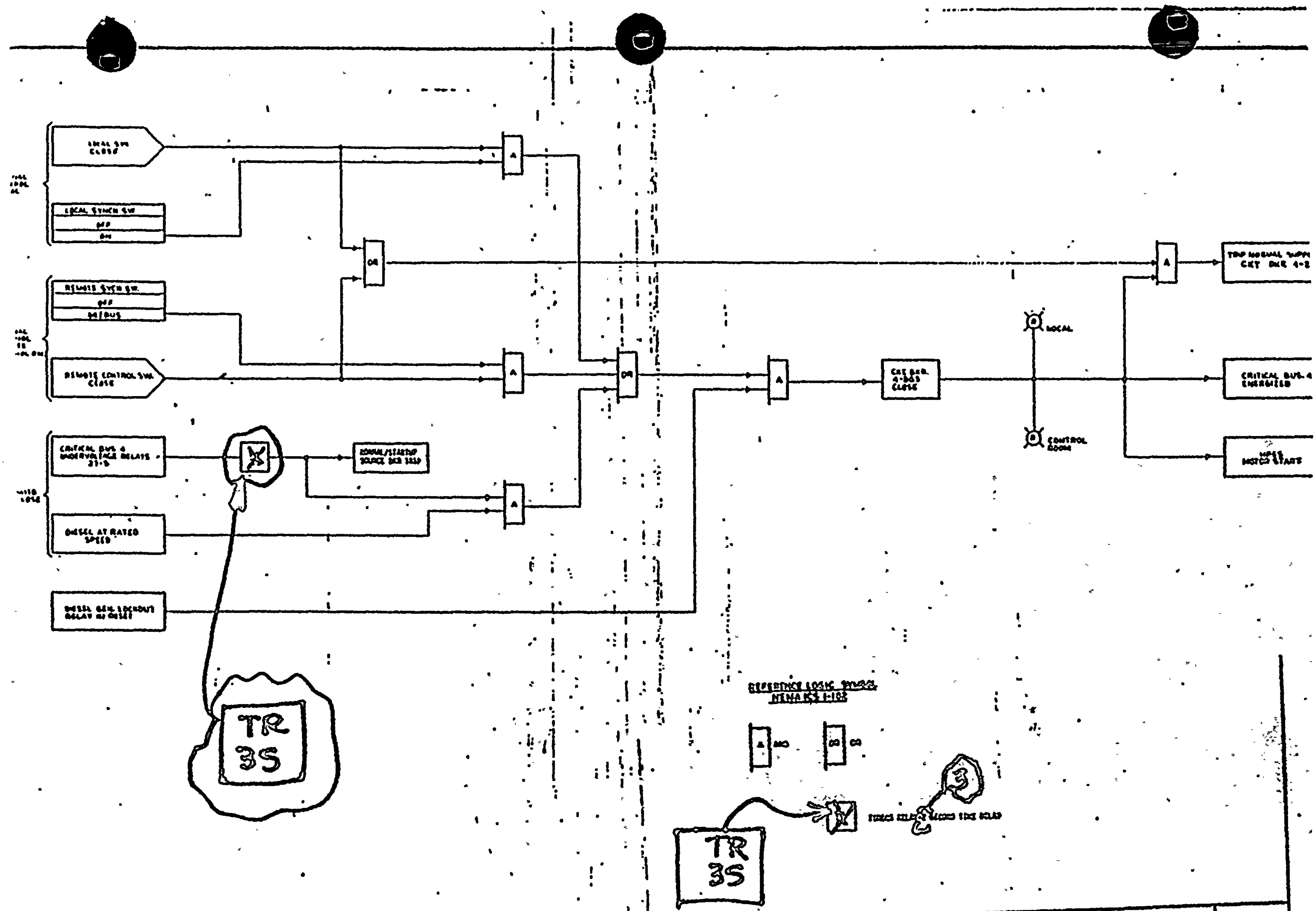
WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

EMERGENCY BUS SM-7 UNDERVOLTAGE PROTECTION, BUS TRANSFER & LOAD SEQUENCING

FIGURE 8.3-16



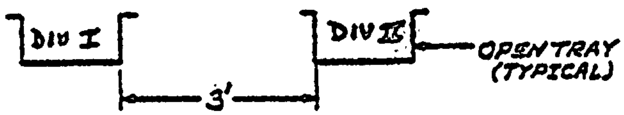
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIESEL GENERATOR LOGIC DIAGRAM - DIVISION 3 (HPCS), ENGINE START	FIGURE 8.3-18a



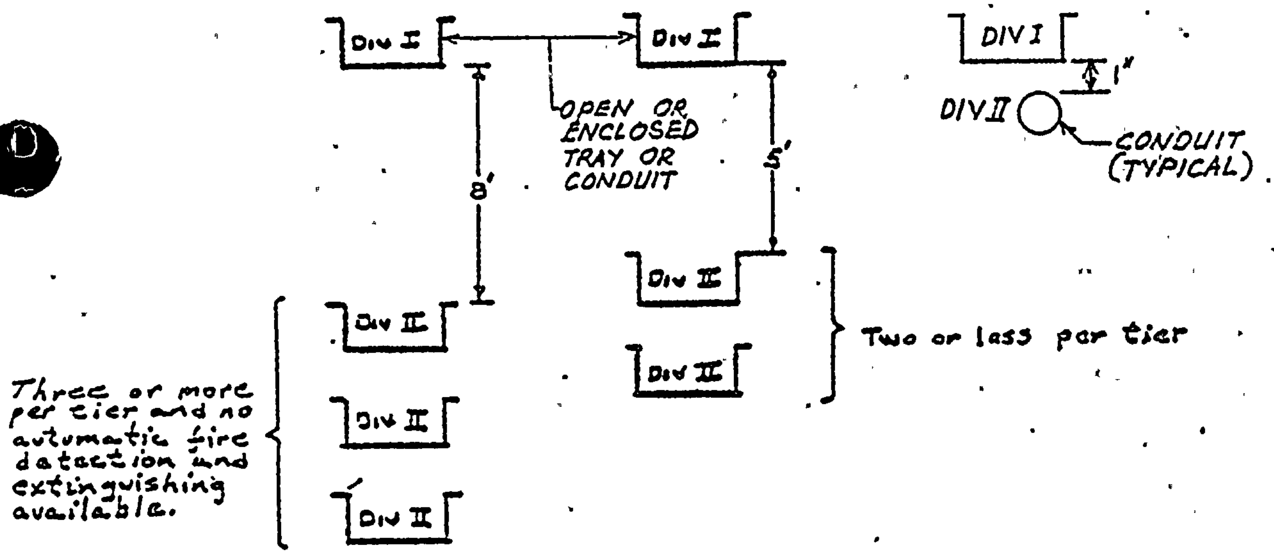
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIESEL GENERATOR LOGIC DIAGRAM - DIVISION 3 (HPCS), GENERATOR BREAKER CLOSE	FIGURE 8.3-18b

GENERAL AREAS ~~/OPEN TRAYS~~

A. Minimum horizontal separation requirement 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.

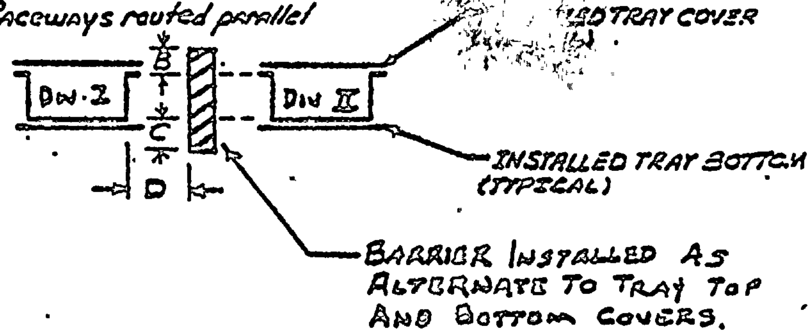
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	CABLE SEPARATION REQUIREMENTS GENERAL AREAS/OPEN TRAYS - PARALLEL ROUTING	FIGURE 8.3-29a

GENERAL AREAS/[illegible] TRAYS
(SEE NOTE ON FIGU[illegible])

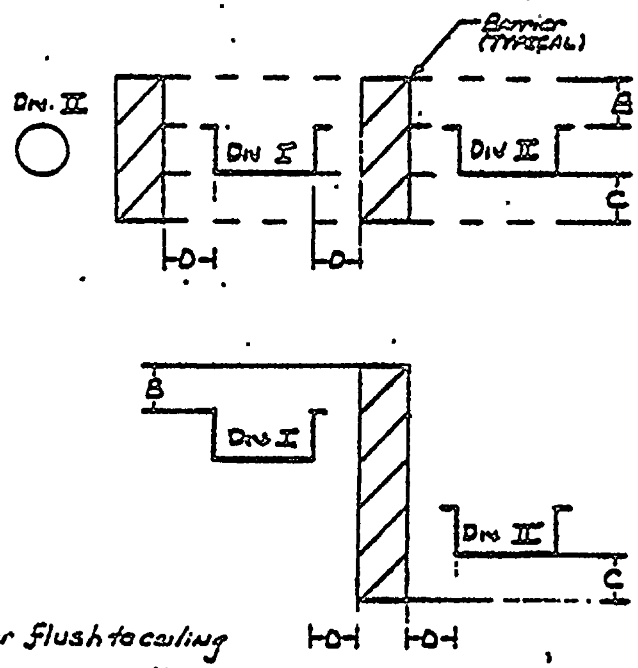
C. Where minimum separation requirements, b[illegible] two raceways of redundant divisions are Not met, the appropriate solution depicted [illegible] the following illustrations shall be implemented.

HORIZONTAL

1) Control & Instrumentation Raceways routed parallel



2) Power Raceways routed parallel



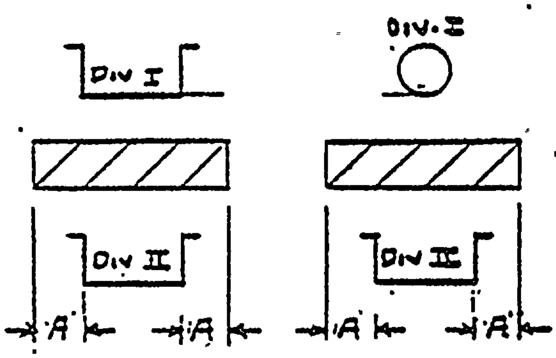
B = 12" Minimum or flush to ceiling
C = 12" Minimum or flush to floor
D = 1" Minimum

C. CONT'D.

GENERAL AREAS/~~OPEN TRAYS~~
VERTICAL
(SEE NOTE ON FIGURE 8.3-29a)

Where vertical separation requirements are not met the use of barriers, tray covers or conduits may be used with no specific dimentional requirements except as indicated below:

~~Barriers & Tray Covers~~ REQUIRED - ~~Where 2 or more Power raceways, of redundant divisions are routed parallel above or below each other And where Control & Instrumentation raceways, are routed Above or below Power raceways of redundant divisions: The use of conduits is equivalent to providing tray covers where the minimum separation requirements are not met.~~

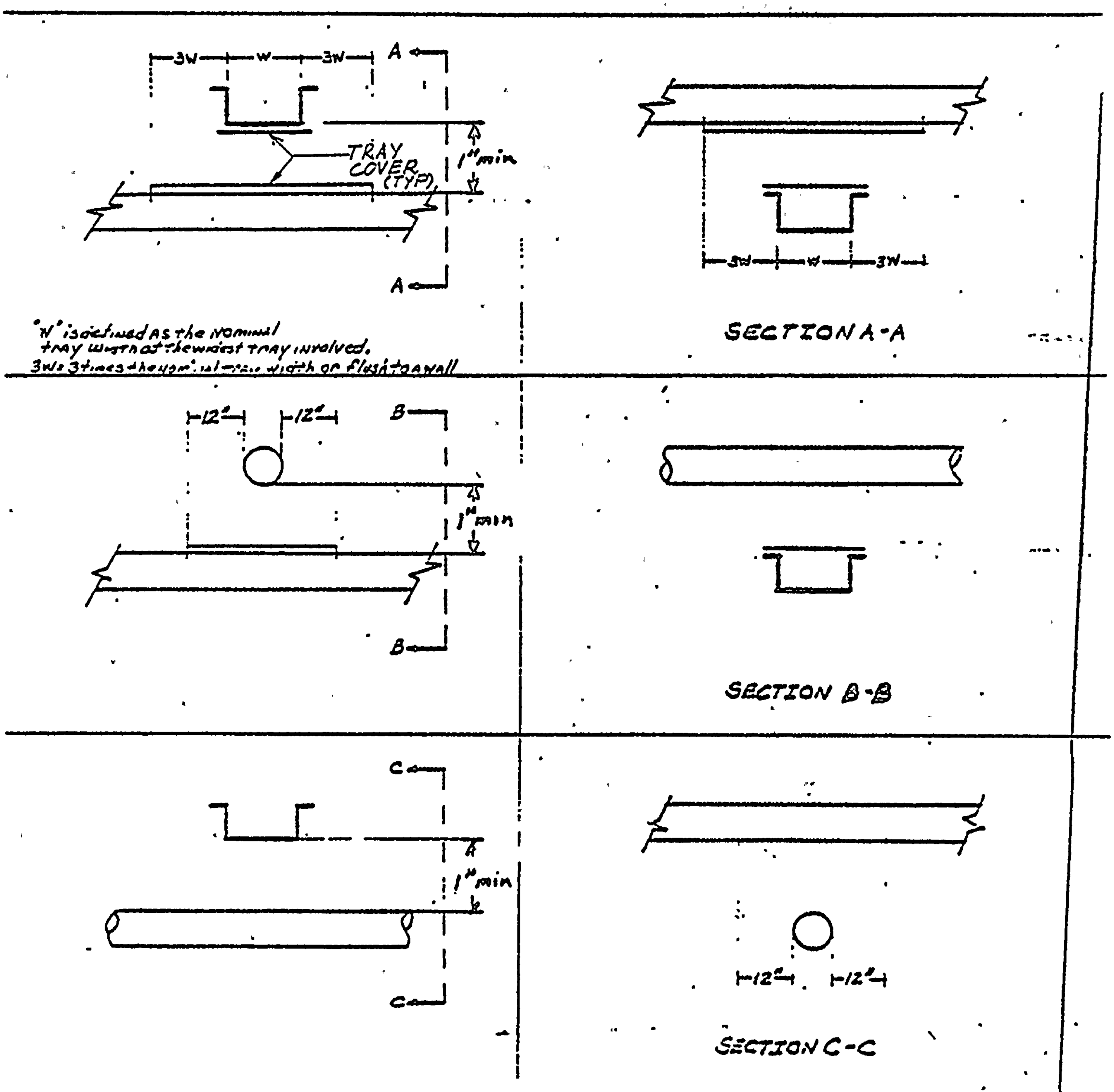


A = 12" minimum or flush to wall.

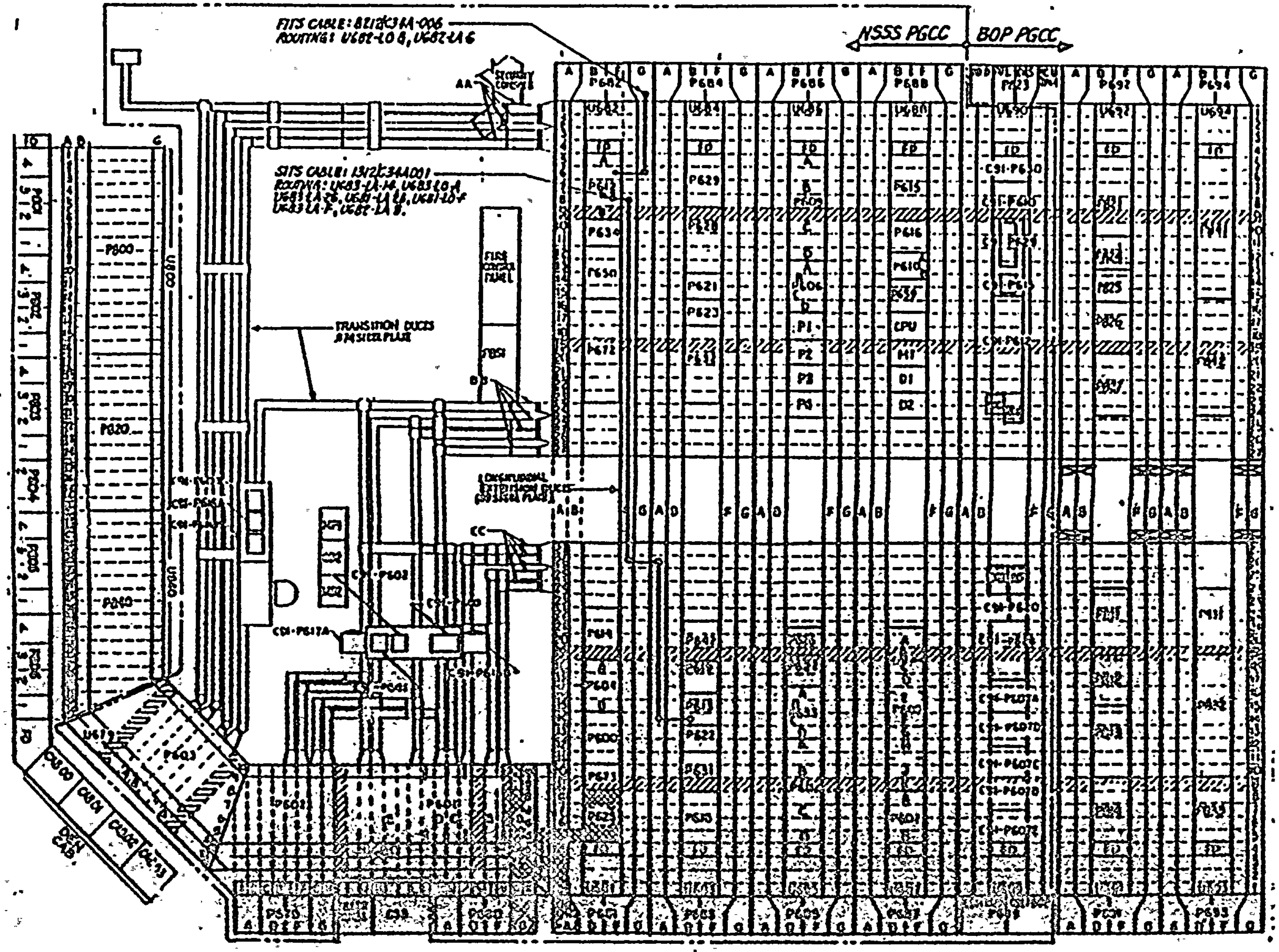
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	CABLE SEPARATION REQUIREMENTS GENERAL AREAS/OPEN TRAYS – PARALLEL ROUTING	FIGURE 8.3-29c

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.



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



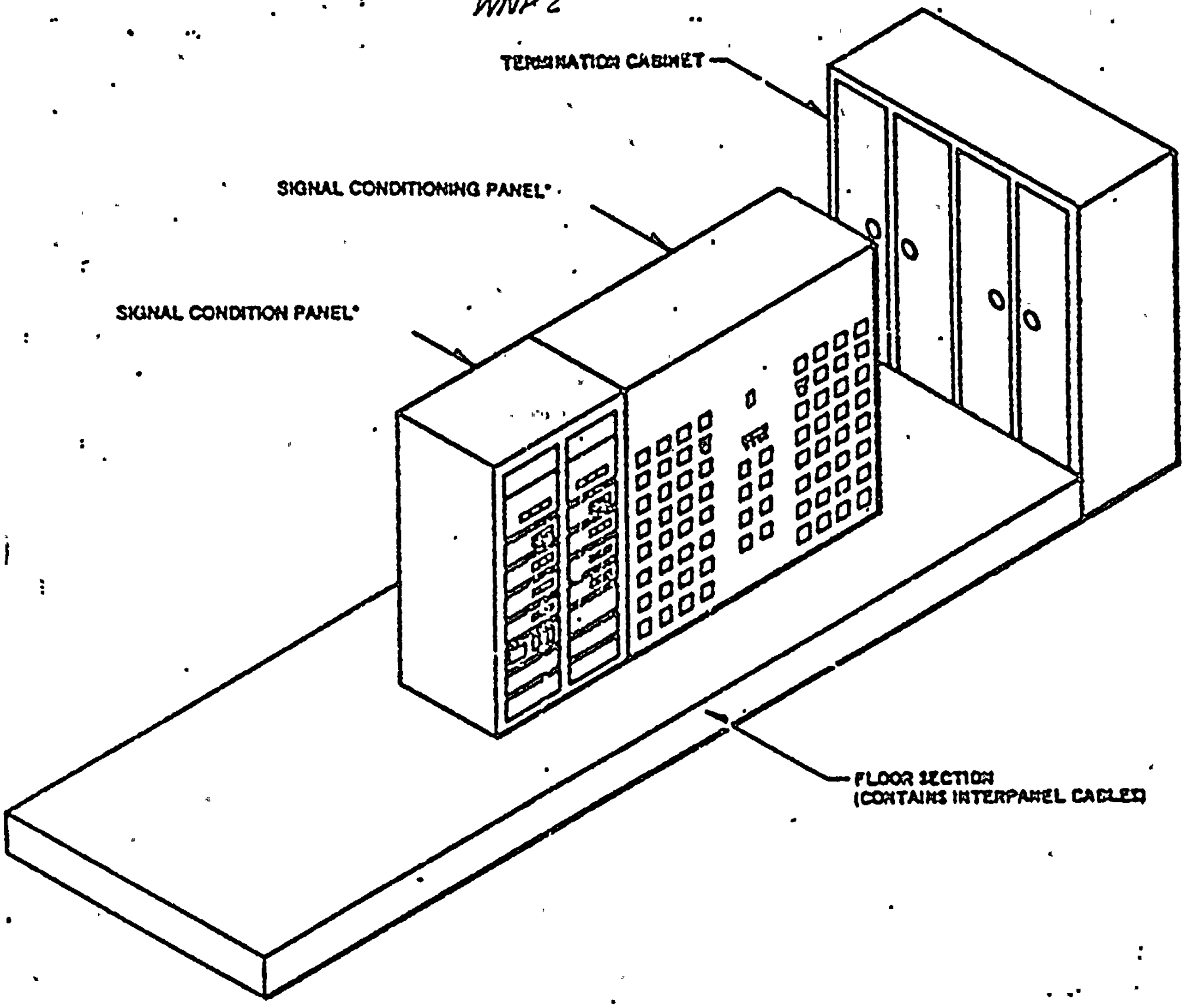
PLAN - POWER GENERATION CONTROL COMPLEX (PGCC)

WNP-2

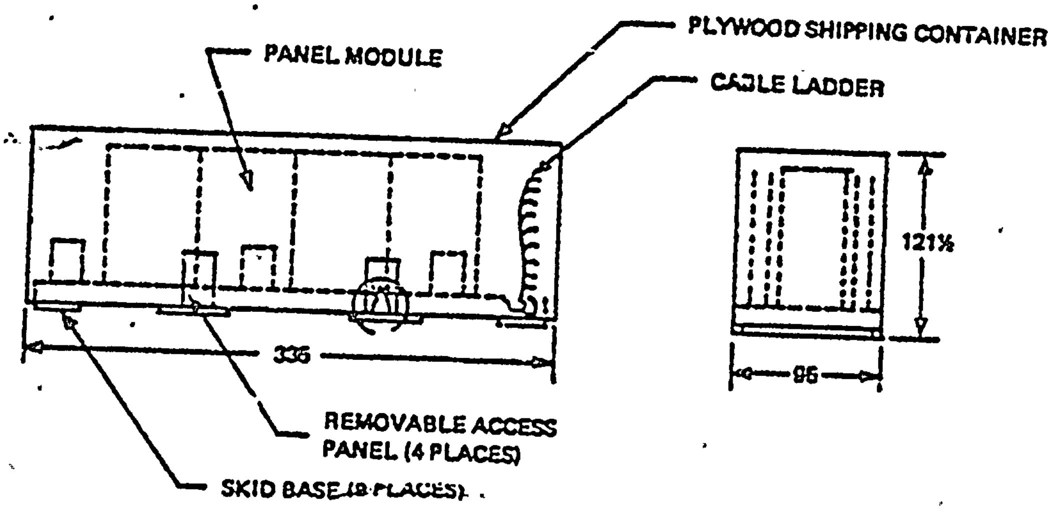
WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

POWER GENERATION CONTROL COMPLEX PLAN
CABLE ROUTING DETAIL

FIGURE 8.3-30

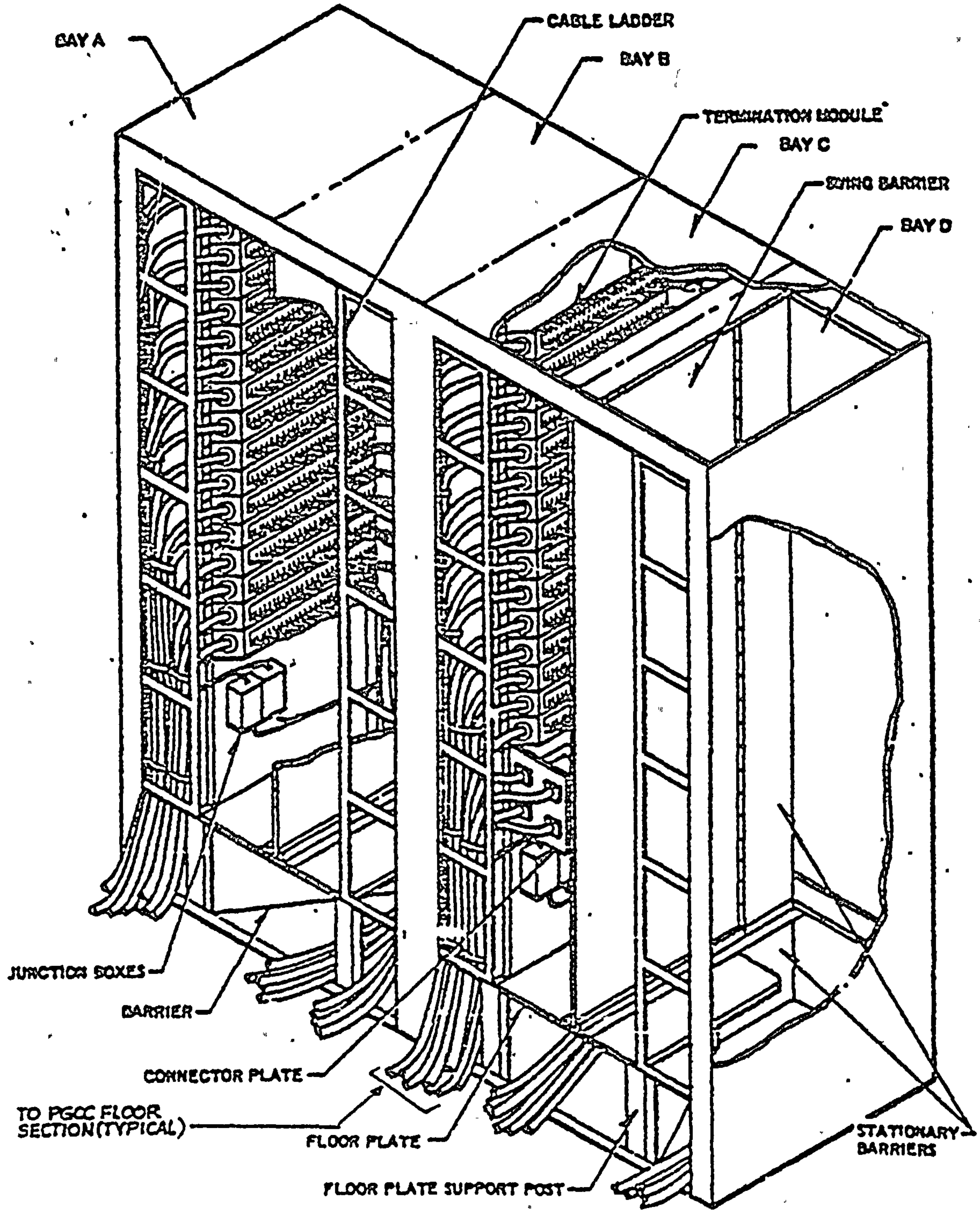


Basic PGCC Assemblies



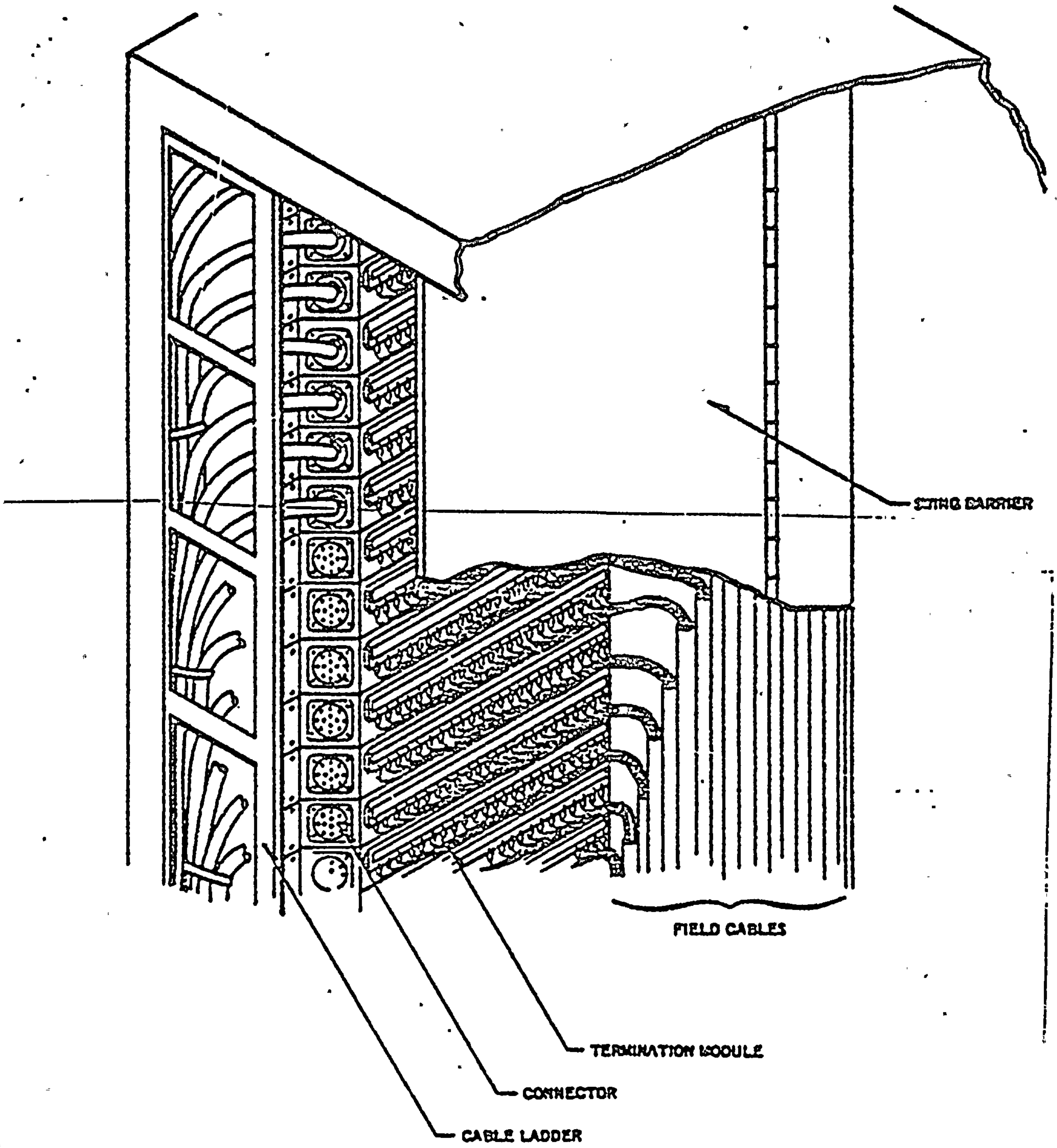
PANEL MODULE SHIPPING CONFIGURATION

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX BASIC ASSEMBLIES AND SHIPPING CONFIGURATION	FIGURE 8.3-31



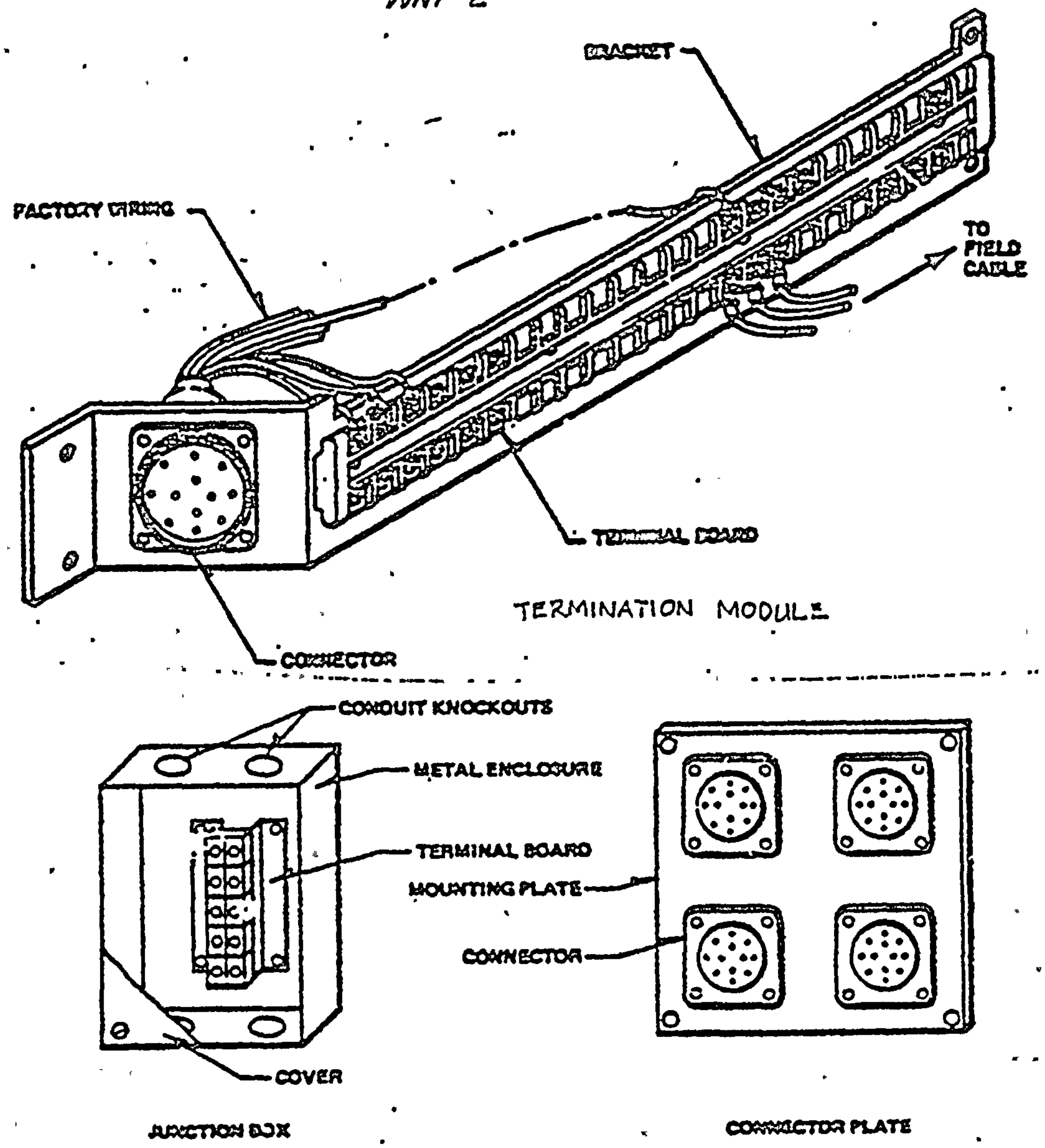
ASSEMBLED TERMINATION CABINET (DOOR REMOVED FOR CLARITY)

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



Termination Cabinet Assembly (FIELD CONNECTIONS)

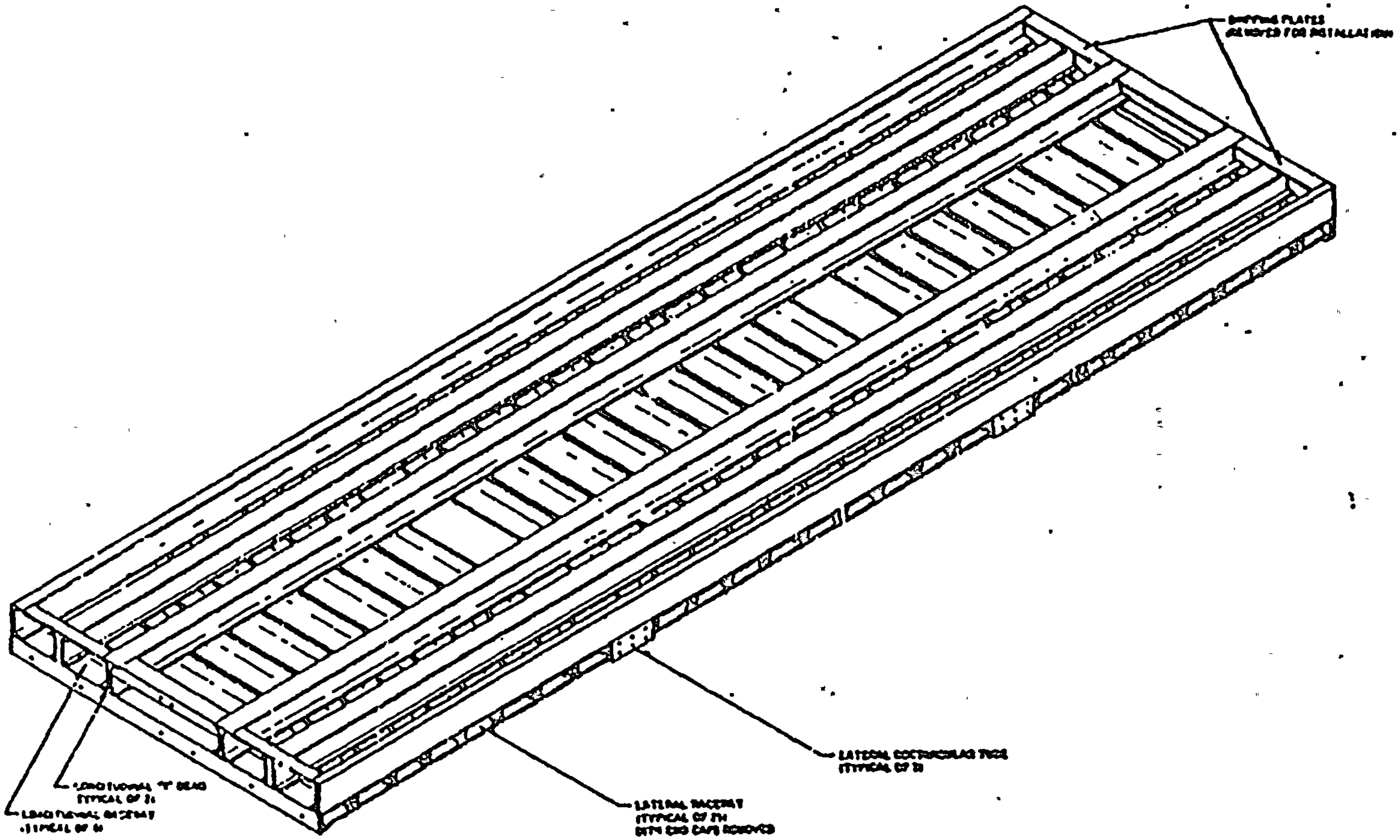
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX TERMINATION CABINET, FIELD CONNECTION	FIGURE 8.3-33



TERMINATION DEVICES

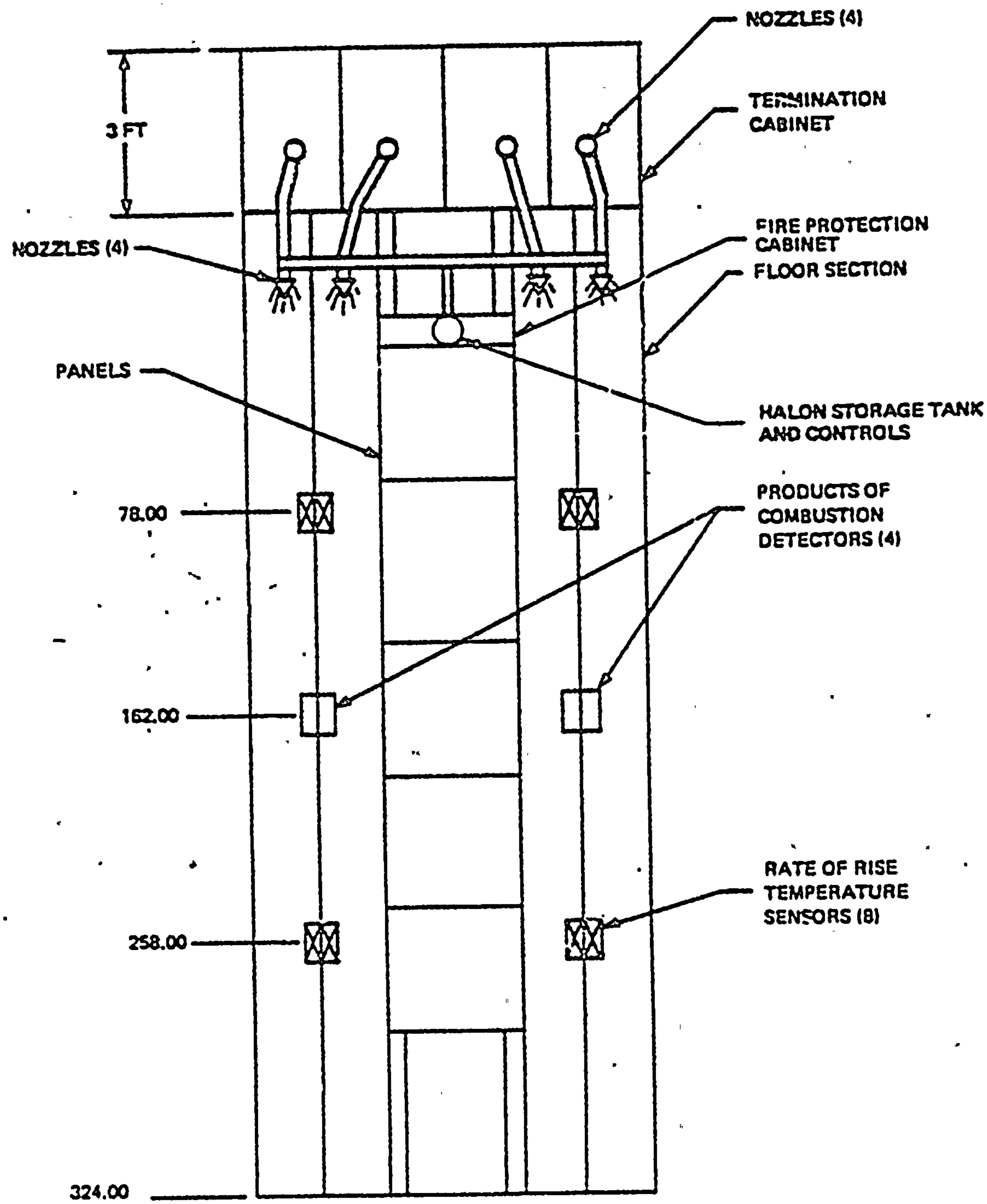
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX TERMINATION CABINET - TERMINATION DEVICES.	FIGURE 8.3-34

WNP-2



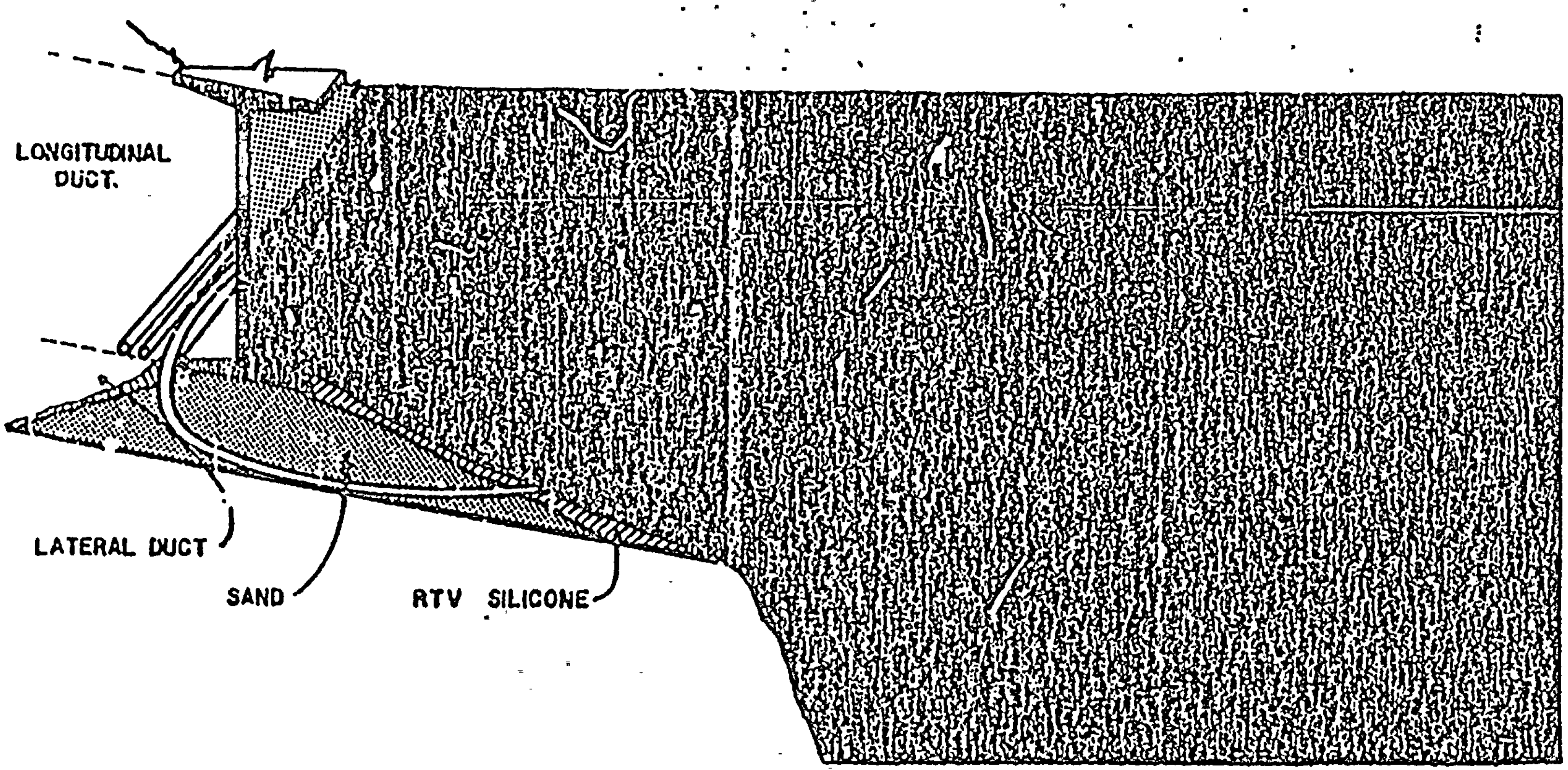
Floor Section Assembly

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX. FLOOR SECTION ASSEMBLY.	FIGURE 8.3-35



Fire Suppression

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX FIRE SUPPRESSION	FIGURE 8.3-36



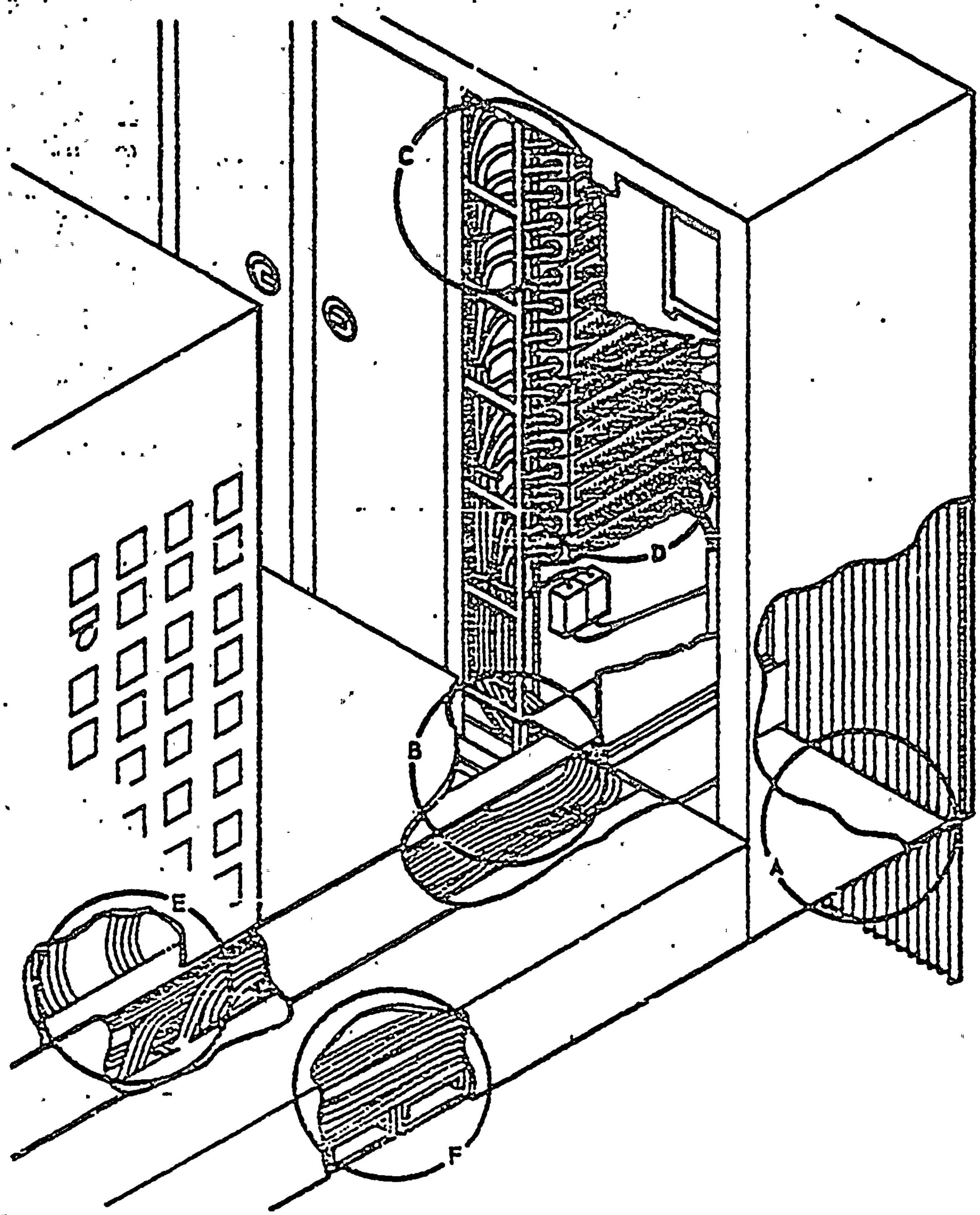
FIRESTOPPING DETAIL

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

POWER GENERATION CONTROL COMPLEX
"FIRESTOPPING DETAIL"

FIGURE 8.3-37

WNP-2



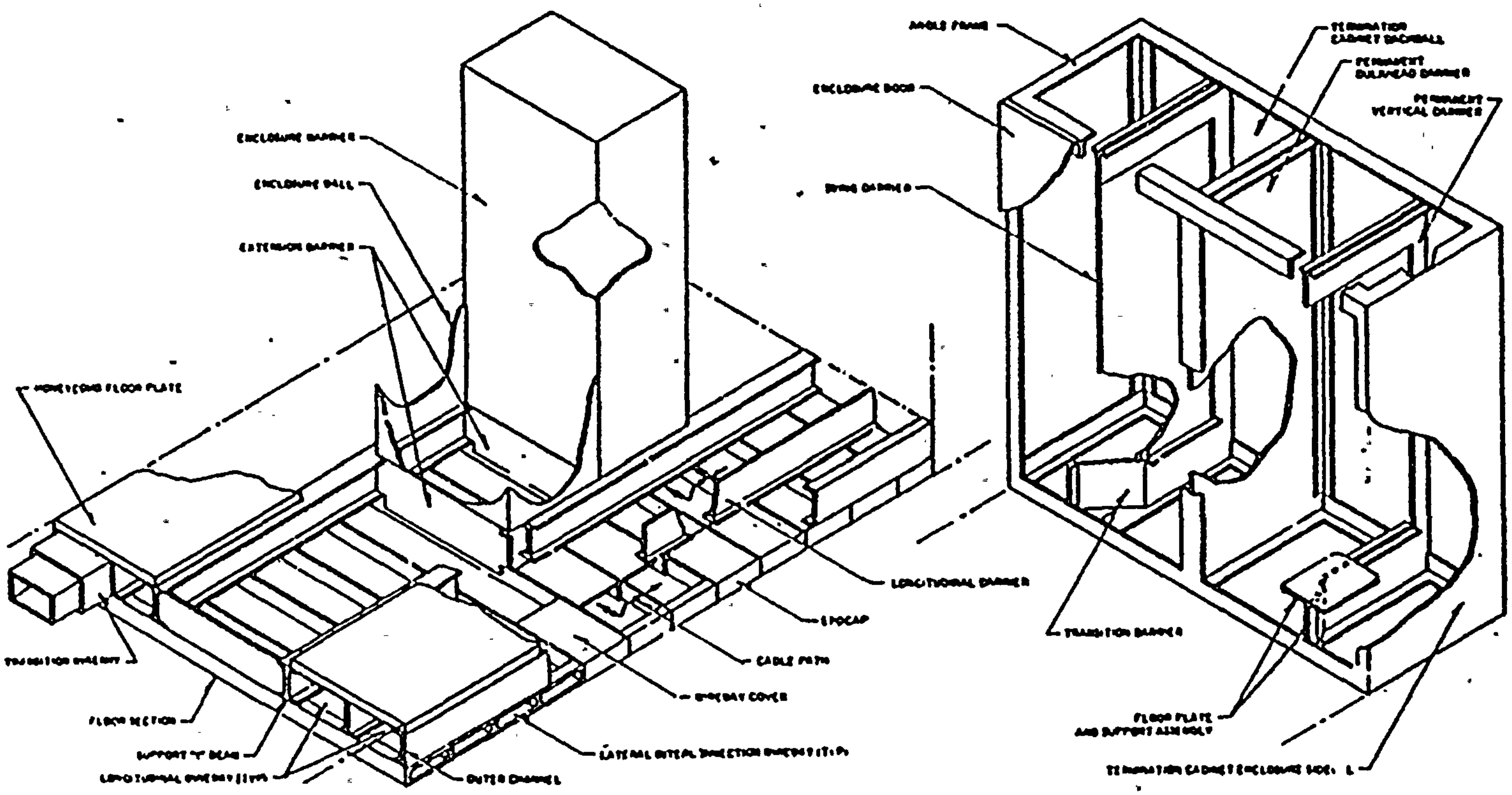
Cable Routing Method

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX CABLE ROUTING METHOD	FIGURE 8.3-38

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

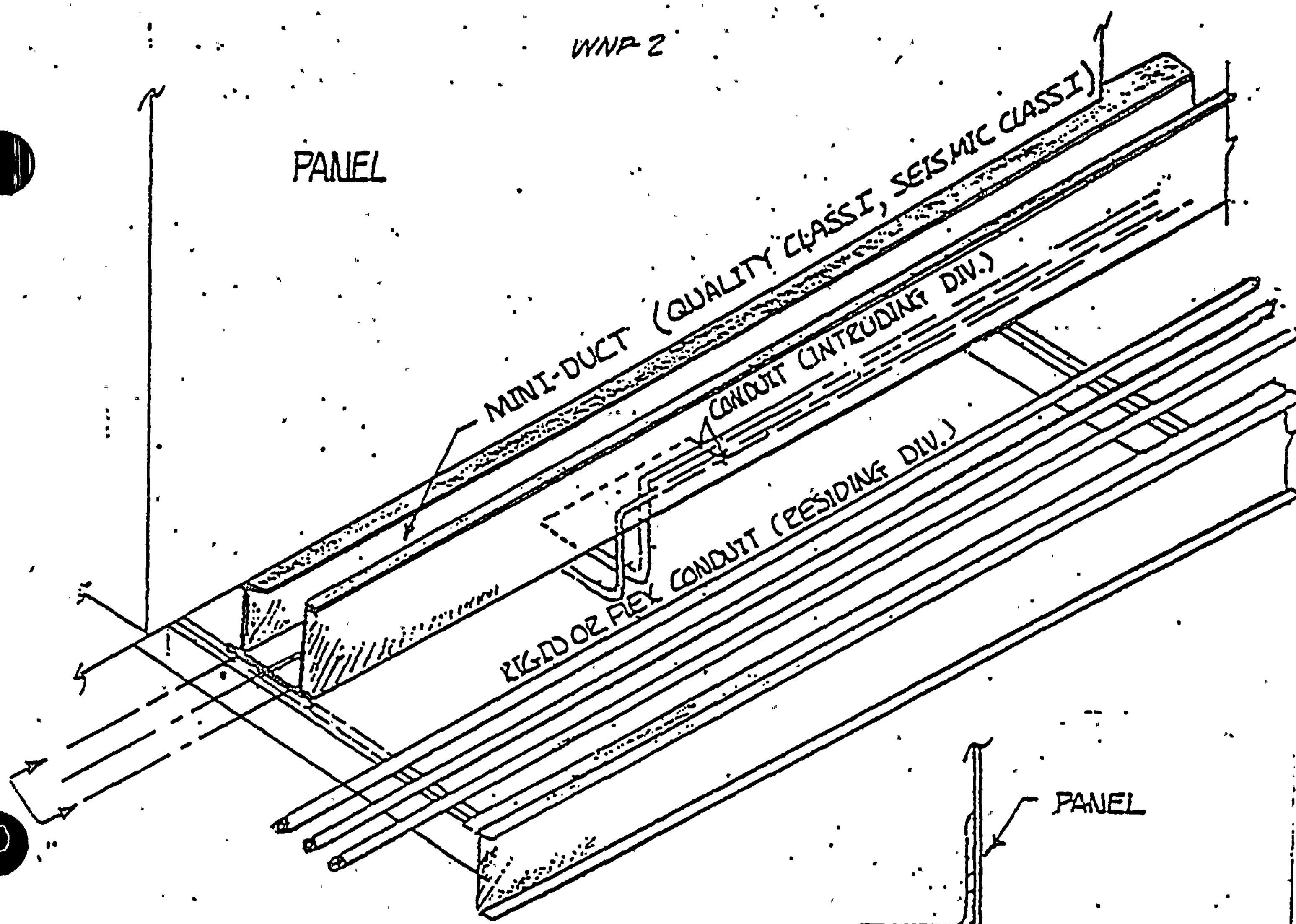
POWER GENERATION CONTROL COMPLEX
CABLE ISOLATION DESIGN.

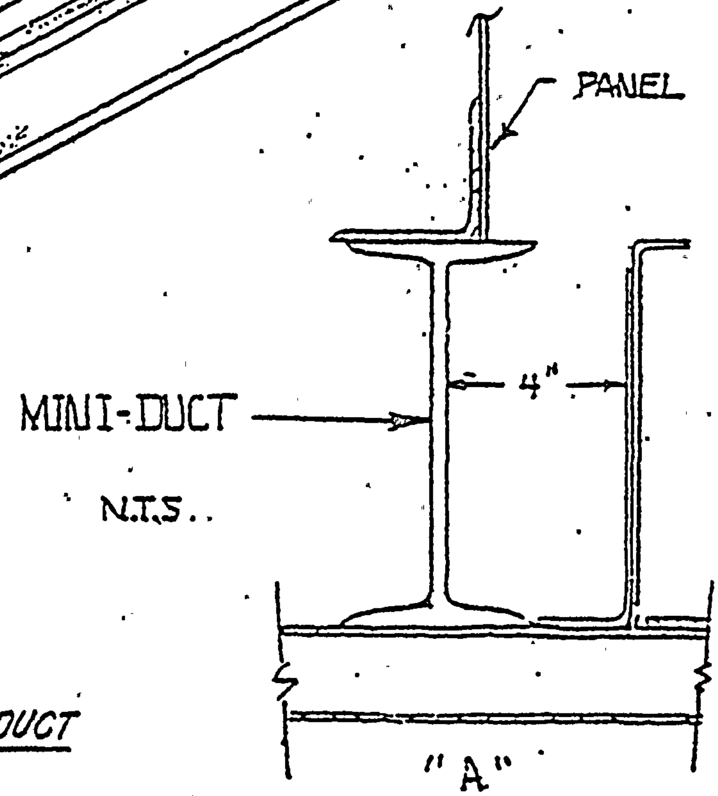
FIGURE
8.3-39



WNP-2

CABLE ISOLATION DESIGN.

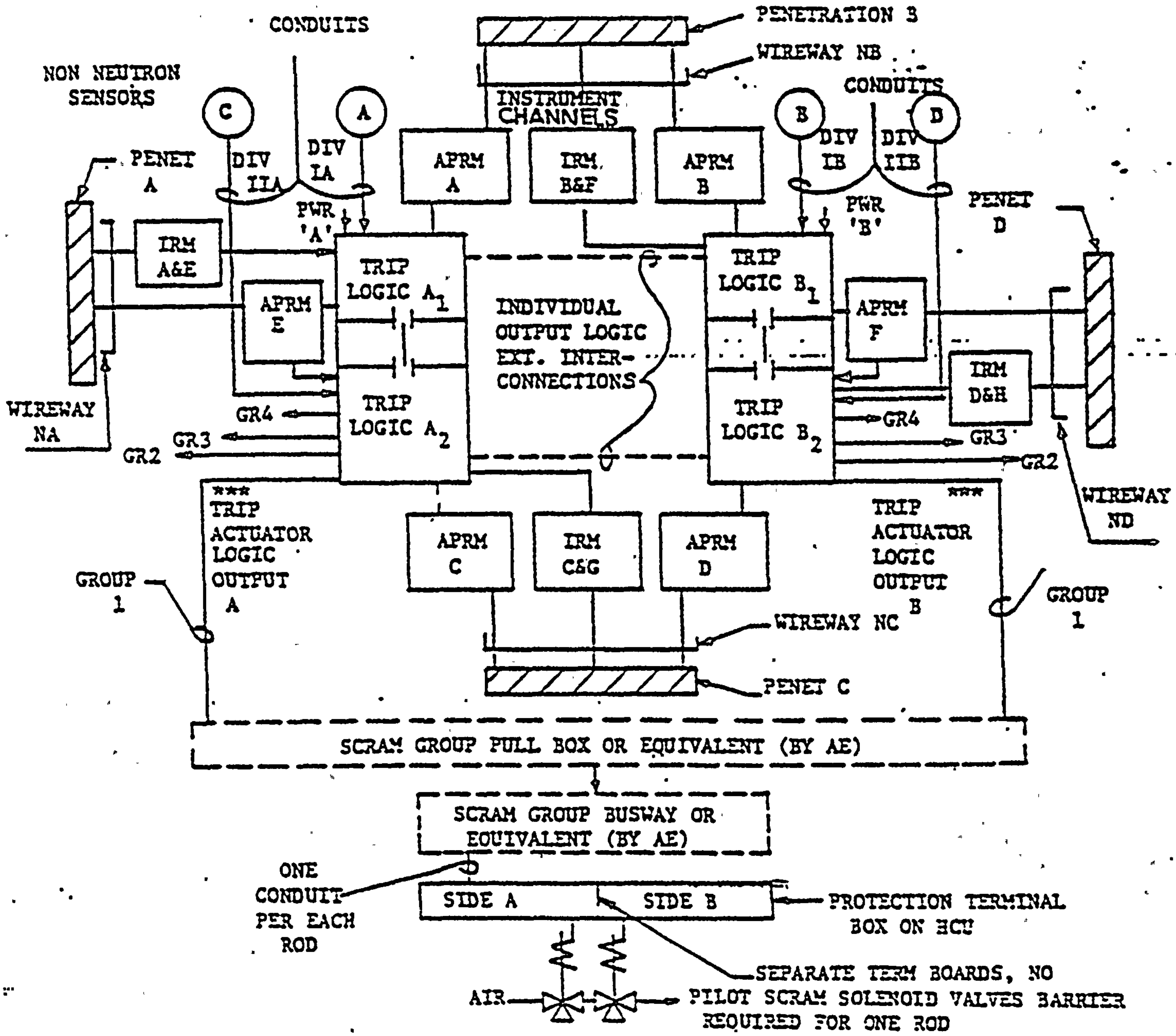




MINI DUCT

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

WNP-2



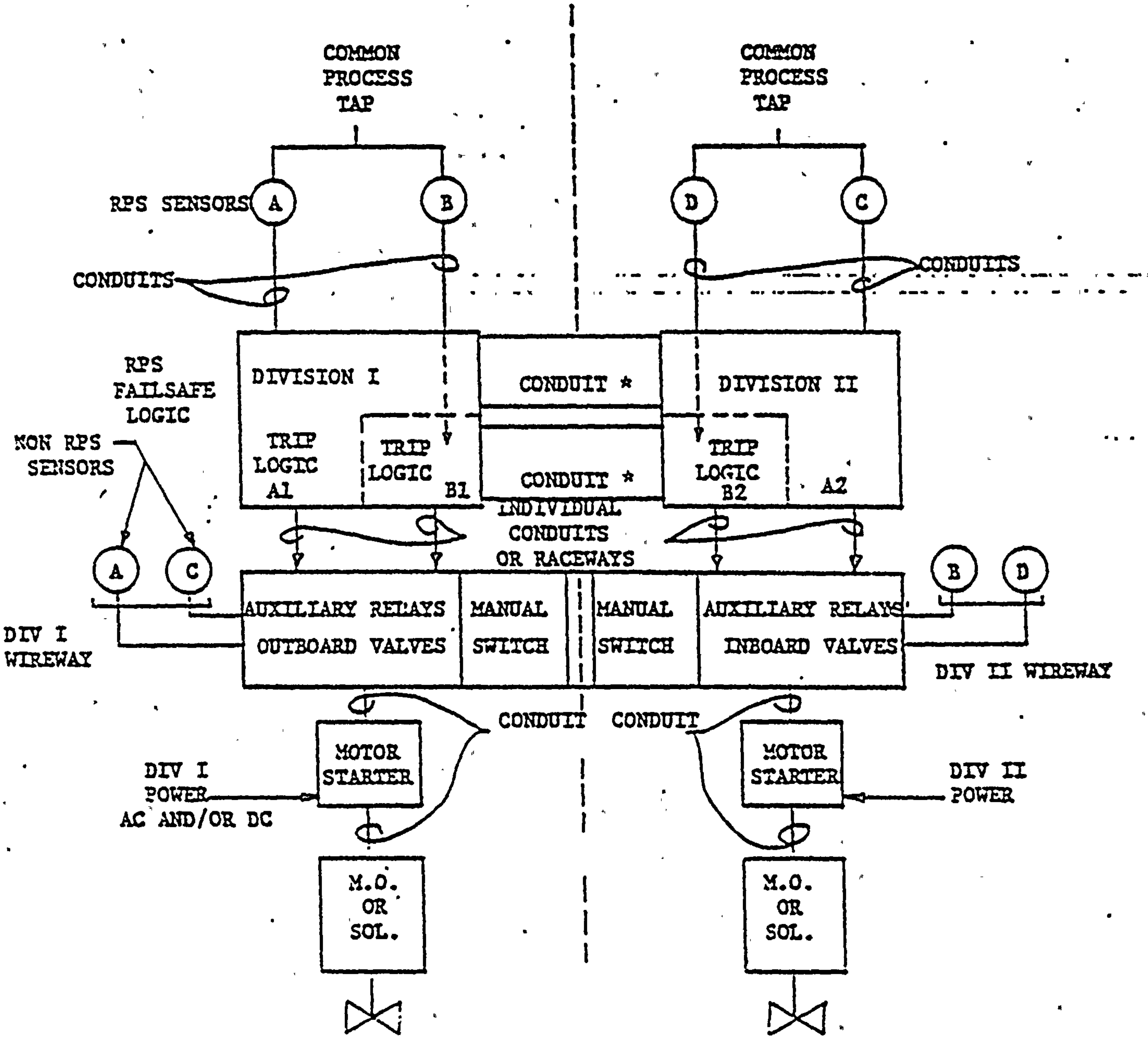
* RPS SENSORS A&B OR C&D MAY BE CONNECTED TO A COMMON PROCESS TAP.
RPS SENSORS A&C OR B&D MUST NOT BE CONNECTED TO A COMMON PROCESS TAP.

** WIREWAYS NA, NB, ETC. MAY BE ASSIGNED TO SEPARATE DIVISIONS AS APPROPRIATE TO PLANT LAYOUT.

*** SEE

FOUR PENETRATION RPS SEPARATION CONCEPT

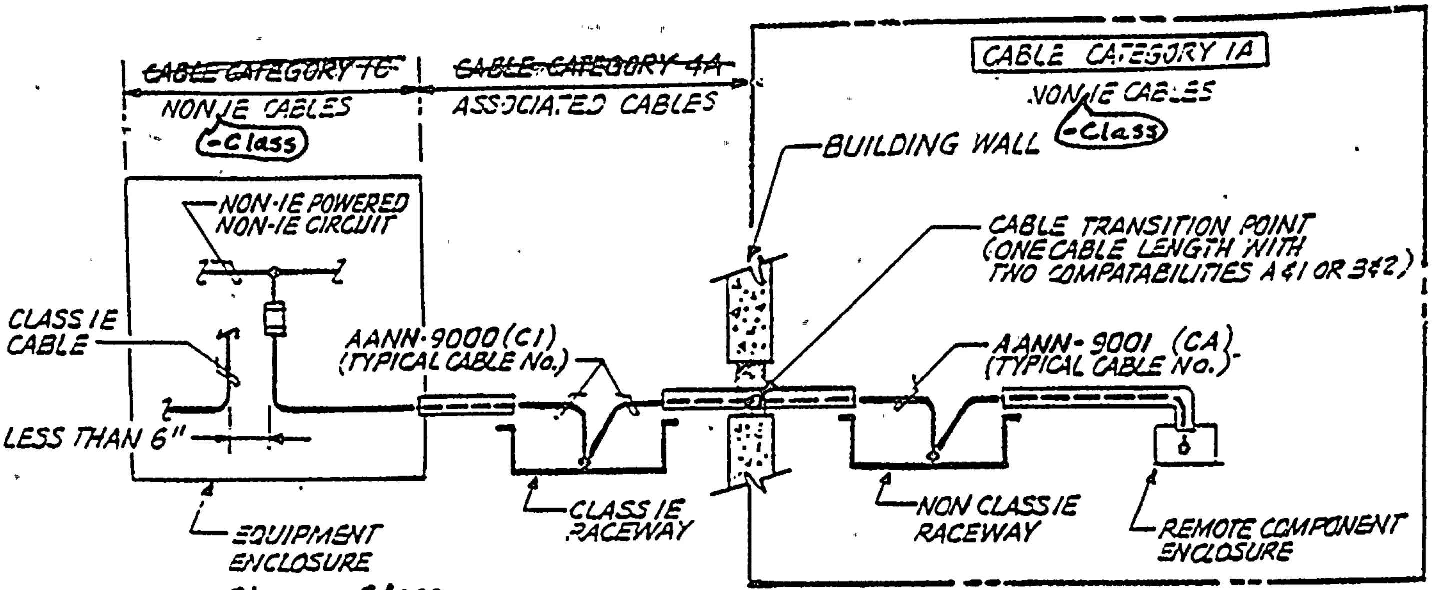
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	FOUR PENETRATION RPS SEPARATION CONCEPT	FIGURE 8.3-41



* INTERCONNECTING CONDUITS USED FOR MAIN STEAM ISOLATION VALVE LOGIC ONLY

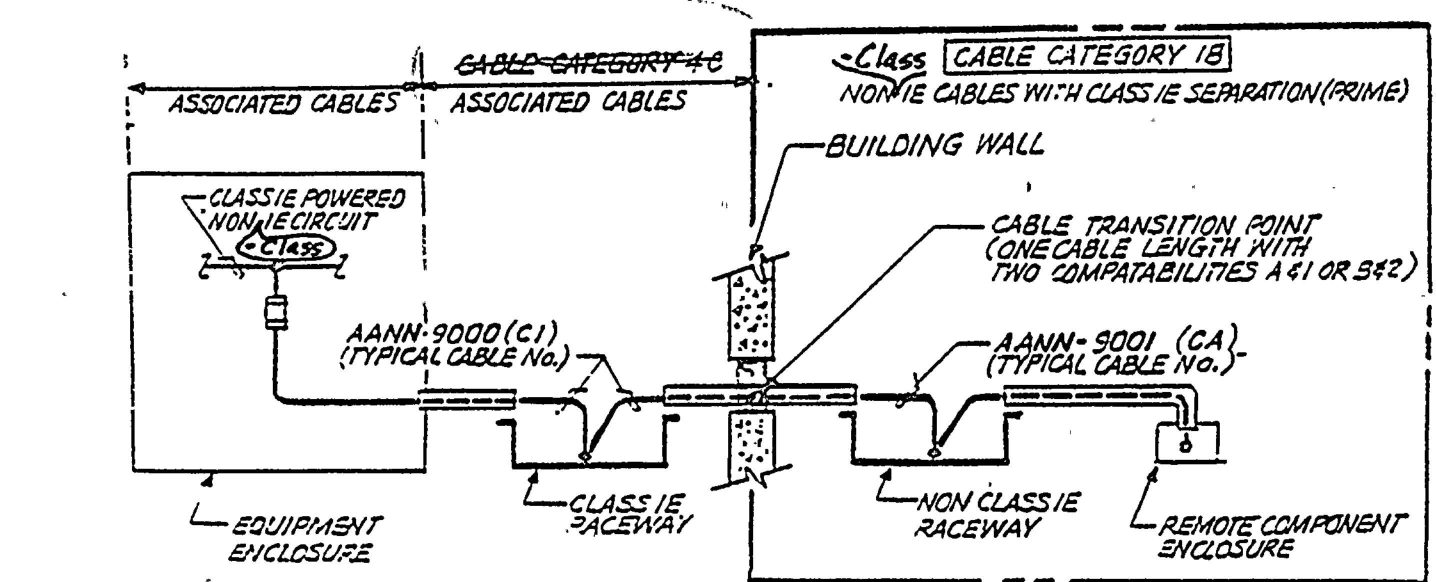
NSSSS SEPARATION CONCEPT

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NSSSS SEPARATION CONCEPT	FIGURE 8.3-42



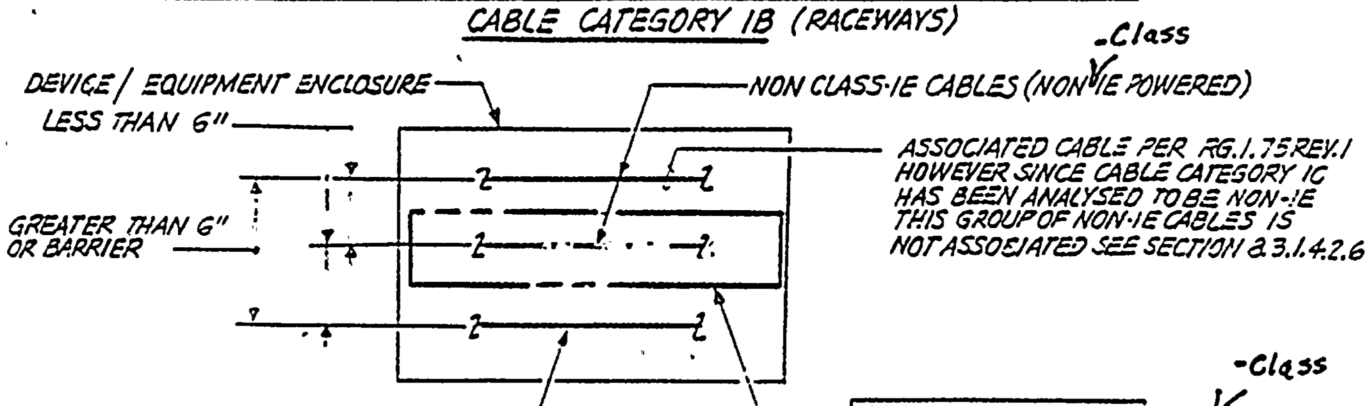
-Class -Class

NON IE (NON IE POWERED) INSTRUMENTATION & CONTROL CABLES
CABLE CATEGORY 1A (RACEWAYS)



-Class

NON IE (CLASS IE POWERED) INSTRUMENTATION & CONTROL CABLES
CABLE CATEGORY 1B (RACEWAYS)

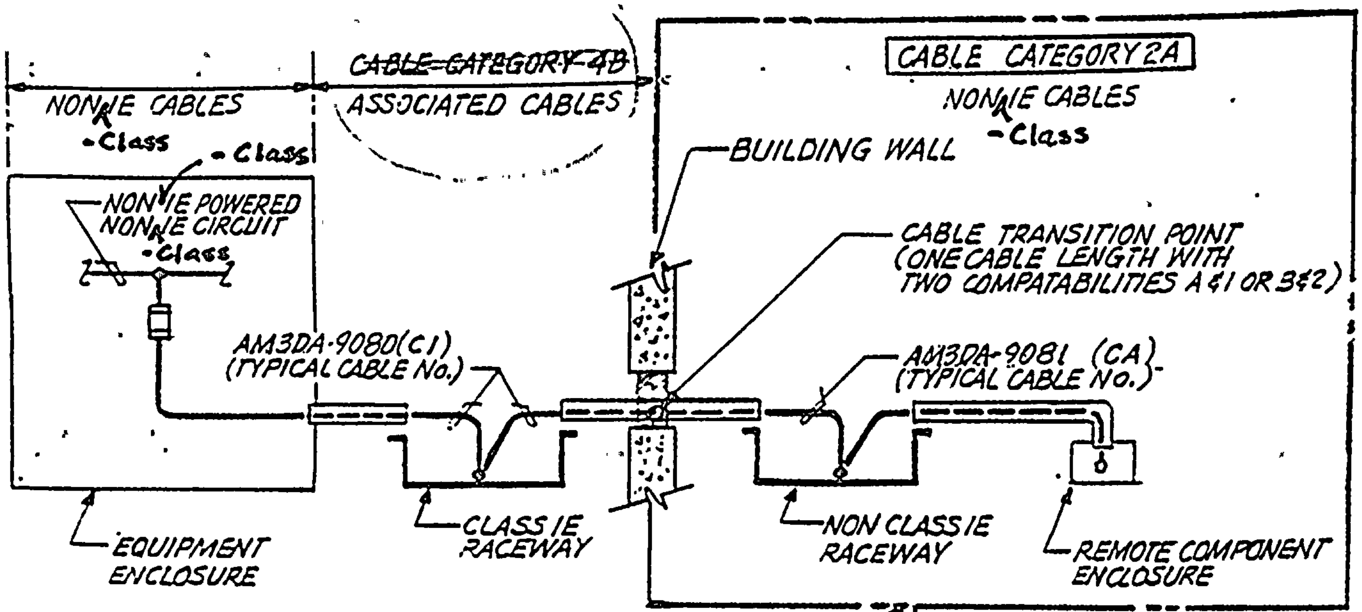


CLASS IE CABLES

-Class -Class

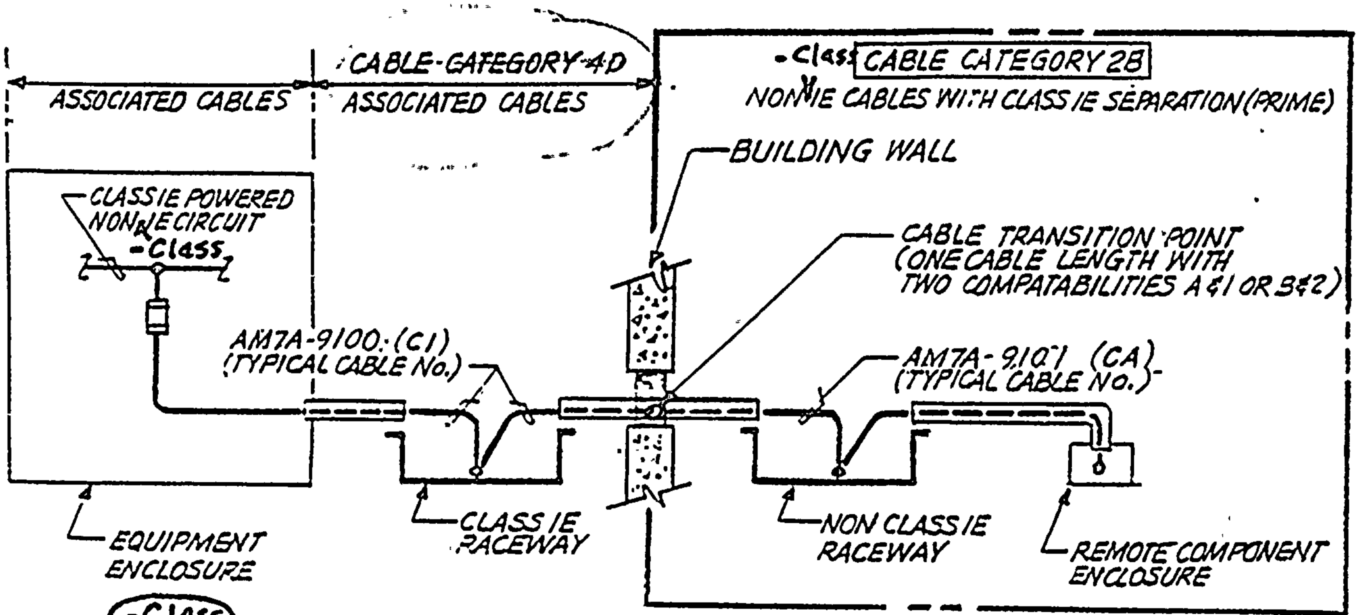
NON IE (NON IE POWERED) INSTRUMENTATION & CONTROL CIRCUITS
CABLE CATEGORY 1C (ENCLOSURES)

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



NON-IE (NON-IE POWERED) POWER CABLES (IN NON -Class IE RACEWAYS)

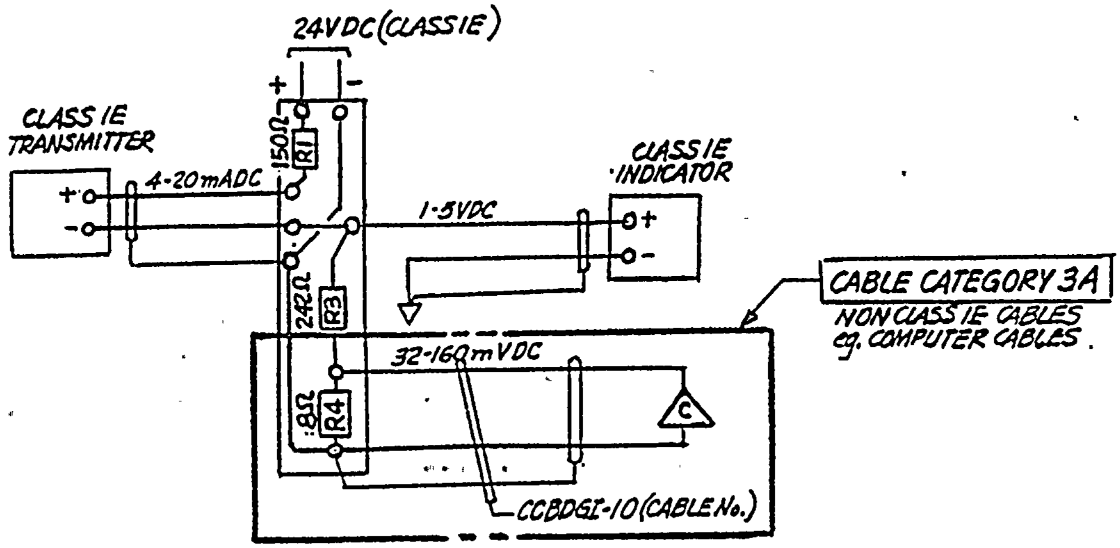
CABLE CATEGORY 2A



NON -Class IE (CLASS IE POWERED) POWER CABLES (IN NON -Class IE RACEWAYS).

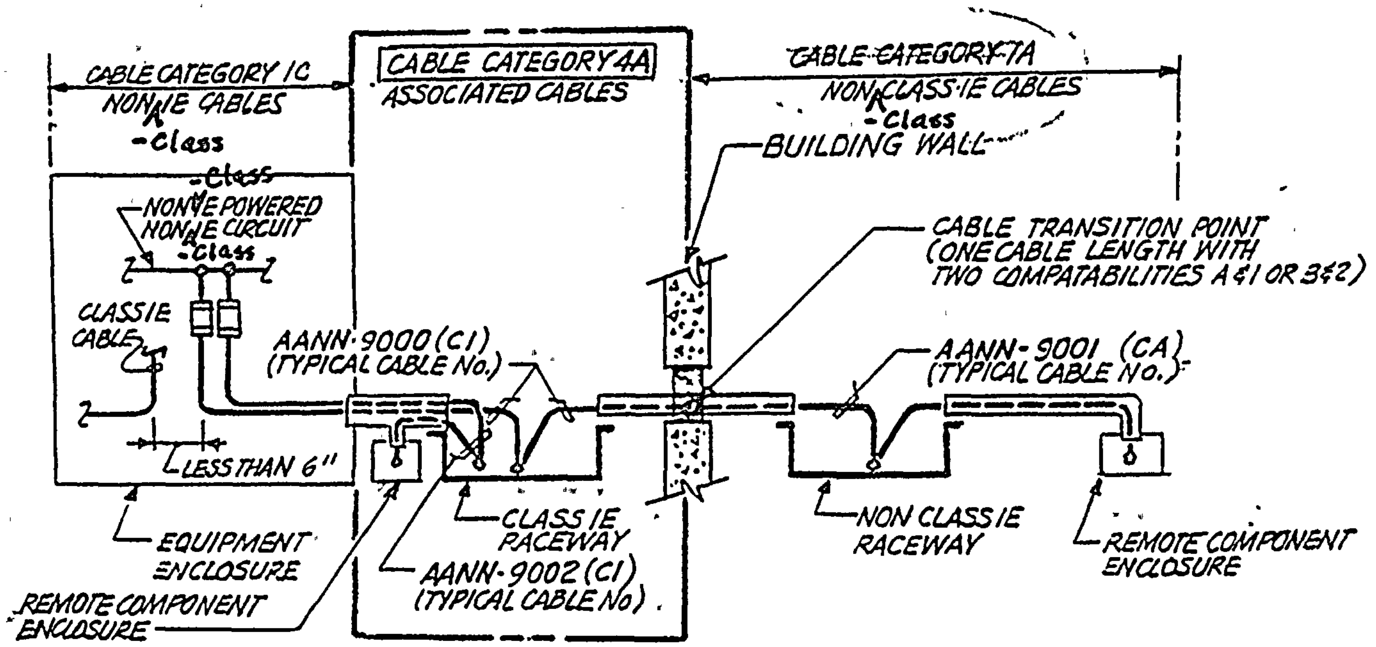
CABLE CATEGORY 2B

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

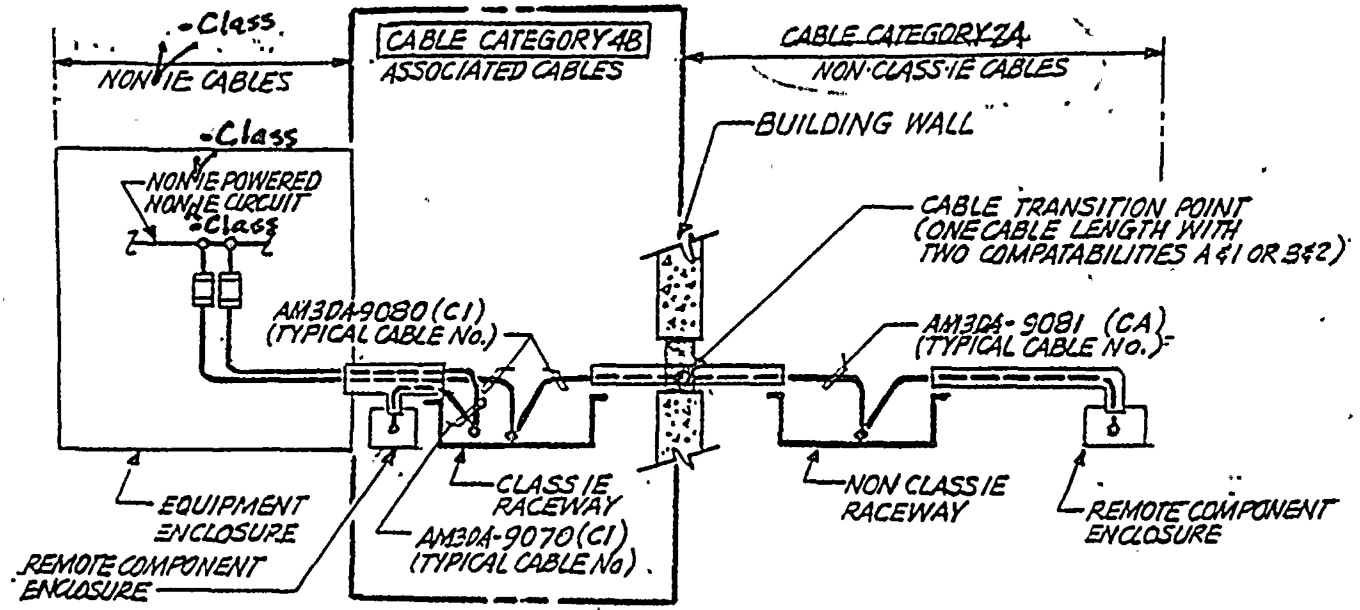


NON CLASS-IE INSTRUMENTATION CIRCUITS POWERED FROM CLASS IE THROUGH CURRENT LIMITING DEVICES - CABLE CATEGORY 3A ..

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NON-CLASS IE CIRCUIT CATEGORIES REQUIRING ANALYSIS	FIGURE 3.3-43C

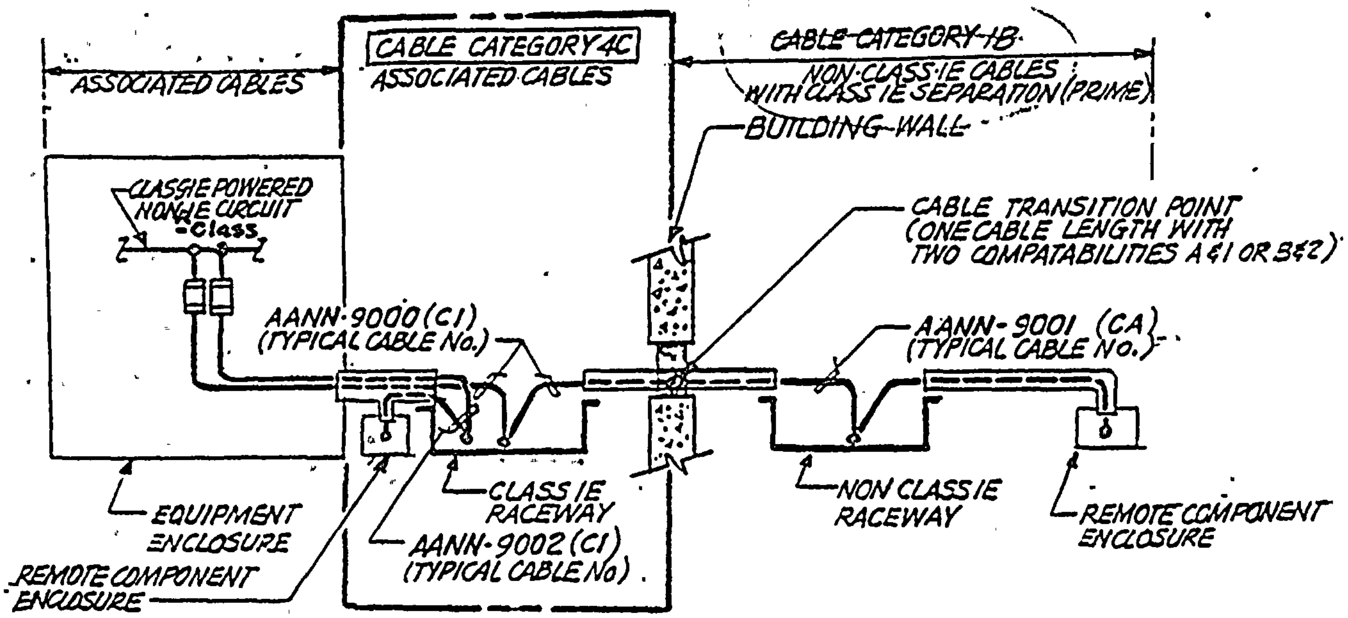


ASSOCIATED (NON-Class 1E POWERED) INSTRUMENTATION & CONTROL CABLES
CABLE CATEGORY 4A (RACEWAYS)

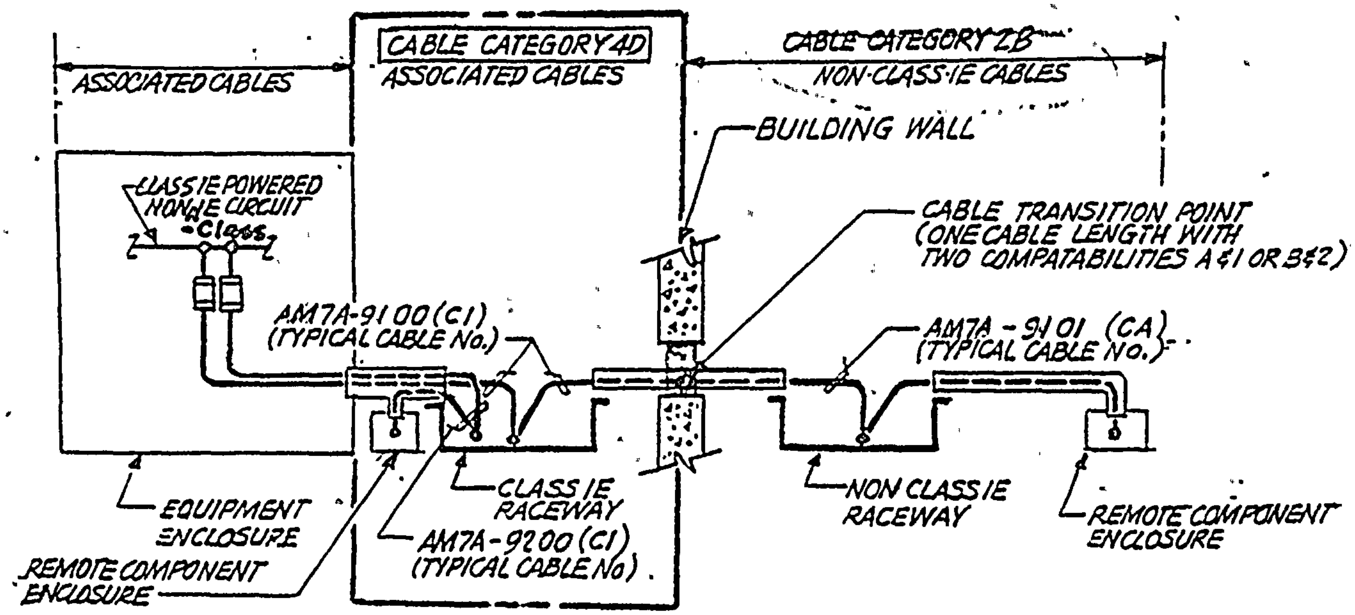


ASSOCIATED (NON-Class 1E POWERED) POWER CABLES (IN CLASS 1E RACEWAYS)
CABLE CATEGORY 4B

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



ASSOCIATED (CLASS-IE POWERED) INSTRUMENTATION & CONTROL CABLES
CABLE CATEGORY 4C (RACEWAYS)



ASSOCIATED (CLASS-IE POWERED) POWER CABLES (IN CLASS IE RACEWAYS)
CABLE CATEGORY 4D.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	ASSOCIATED CIRCUIT CATEGORIES	FIGURE 3.3-43E

General Compliance or Alternate Approach Assessment: (Cont'd)

5.8 Sensors and Sensor to Process Connections

Compliance

5.9 Actuated Equipment

Not in NSSS scope of supply.

Specific Evaluation Reference:

Refer to 8.3.1.4.2.6

Similar Application Reference:

Application of this Regulatory Guide is plant unique due to NRC agreements during the various stages of licensing and scope of responsibility of design and engineering necessary to comply with the NRC interpretation. Therefore reference plants cannot be cited.

* Information on compliance of actual installation is provided in C.3.0.

** Division 1 and 2 power compliance is provided in C.3.0.

*** The control room structure and location as well as local control switchboard location is discused in C.3.0.

Regulatory Guide 1.75, Rev. 1, January 1975

Physical Independence of Electric Systems

Compliance or Alternate Approach Statement:

This regulatory guide is not applicable to WNP-2 since it applies to the evaluation of construction permit applications docketed after February, 1974. However, WNP-2 complies with the intent of the guidance set forth in this regulatory guide by an alternate approach.

General Compliance or Alternate Approach Assessment:

Refer to 8.3.1.4.2.6 for an assessment of WNP-2 relative to this regulatory guide.

Specific Evaluation Reference:

Refer to 8.3.1.4.2.6.

Q. 031.100

In Table 7.1-2 of the FSAR, you indicate that many of your instrumentation and control systems are identical to those of LaSalle and Zimmer. During the course of our review of these facilities, which are similar to the WNP-2 facility, we encountered a number of errors in the implementation of the basic GE design. Our concern is that these same errors, or similar errors, could occur in implementing the electrical design of the WNP-2 facility. In particular, we find that your analyses in 7.3.2.1.2.3.1 and 7.3.2.2.2.3.1.1 of the FSAR, to determine compliance with the requirements of IEEE Std. 279-1971, are too gneral in content. We provide guidance for the information we need in Section 7.2 of the Standard Review Plan, especially in Appendix 7.2.A. Specific examples of areas where we require additional information are presented in Items 031.081, 031.084, 031.091, and 031.092 of this enclosure. Accordingly, provide more specific analyses of how you have implemented, in detail, the basic GE electrical design in the WNP-2 facility. References to other sections of the FSAR are acceptable in lieu of repeating this information in 7.3.2.1.2.3.1.

Response:

Refer to the revised Chapter 8.3.

Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

January 14, 1982
G02-82-41
SS-L-02-CDT-82-018

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
SUBMITTAL OF SER OPEN ISSUES

Enclosed are sixty (60) copies of our submittal responding to draft SER open issues and outstanding open branch meeting issues. For ease of review, the pertinent draft SER pages or branch question precedes each issue. A tabulation identifying each item and indicating its resolution status or schedule for close out is also provided.

Very truly yours,

GD Bouchey

G. D. Bouchey, Deputy Director
Safety & Security

CDT/ct
Enclosures

cc: R. Auluck - NRC
WS Chin - BPA
R. Feil - NRC-Site