

8.5 SEPARATION CRITERIA

8.5.1 DESIGN BASIS

Channels that provide signals for the same plant protective function are independent and physically separated to assure that the minimum availability required during any design basis event is met.

8.5.2 CHANNEL IDENTIFICATION

Each circuit (scheme) and raceway is given a unique identification and each is additionally coded as follows:

- a. The channel or load group designation,
- b. Whether the circuit or raceway is associated with safety-related equipment,
- c. Whether the circuit is associated with 125 Volt DC or 120 Volt vital AC panel feeders and non-safety-related equipment.

The facility code designations are classified according to their association and redundancy with respect to one another. This classification has resulted in the seven separation groups shown here with the associated facility codes. The facility codes are assigned on the basis of the accompanying descriptions:

SEPARATION GROUP 1

- A - A non-safety-related scheme or raceway, Channel A.
- DA - A 125 Volt DC or 120 Volt vital AC control feed to a non-safety-related item associated with Battery No. 11.
- ZA - A safety-related instrumentation, control, or power scheme or raceway, Channel A.
- ZD - One channel of a four-channel safety-related instrumentation channel or raceway, Channel D.
- D - One channel of a four-channel non-safety-related instrumentation channel or raceway, Channel D.

SEPARATION GROUP 2

- B - A non-safety-related scheme or raceway, Channel B.
- DB - A 125 Volt DC or 120 Volt vital AC control feed to a non-safety-related item associated with Battery No. 21.
- ZB - A safety-related instrumentation, control, or power scheme or raceway, Channel B.
- ZE - One channel of a four-channel safety-related instrumentation channel or raceway, Channel E.
- E - One channel of a four-channel non-safety-related instrumentation channel or raceway, Channel E.

SEPARATION GROUP 3

- ZC - A safety-related control or power scheme or raceway associated with Battery No. 12 and shared items; e.g., all third-pump power circuits and Diesel Generator No. 1B.
- DC - A 125 Volt DC or 120 Volt vital AC control feed to a non-safety-related item associated with Battery No. 12.
- ZF - One channel of a four-channel safety-related instrumentation channel or raceway, Channel F.

- F - One channel of a four-channel non-safety-related instrumentation channel or raceway, Channel F.

SEPARATION GROUP 4

- ZH - A safety-related control scheme or raceway associated with Battery No. 22.
- DH - A 125 Volt DC or 120 Volt vital AC control feed to a non-safety-related item associated with Battery No. 22.
- ZG - One channel of a four-channel safety-related instrumentation channel or raceway, Channel G.
- G - One channel of a four-channel non-safety-related instrumentation channel or raceway, Channel G.

SEPARATION GROUP 5

- A - A non-safety-related scheme or raceway, Channel A.
- B - A non-safety-related scheme or raceway, Channel B.

SEPARATION GROUP 6

- ZJ - A safety-related control scheme or raceway associated with Battery No. 01, which is capable of assuming any of the first four separation groups, one at a time. Cables from another group may not be routed with Separation Group 6.

SEPARATION GROUP 7

- K - An Augmented Quality-Station Blackout instrumentation, control, or power scheme or raceway related to Diesel Generator 0C or its dedicated battery (Battery No. 15).
- A - A non-safety-related scheme or raceway, Channel A.

The facility code facilitates and ensures the maintenance of channel separation in the routing of cables and the connection of control boards and panels. All cables and raceways are physically labeled with the appropriate facility code for positive identification. Cable routing is checked and confirmed visually at the time of the cable pull.

8.5.3 CABLE ROUTING

The following principles apply for the routing of cables throughout the plant:

- a. Cables with a facility code preceded by Z of a particular separation group are routed only in safety-related raceways of the same separation group.
- b. Non-safety-related cables (A or B facility code) may be routed in safety-related raceways, but cannot be routed in safety-related trays of more than one safety separation group (i.e., Groups 1 or 2 respectively).
- c. Non-safety-related cables (A or B facility code) of different non-safety facility codes can be routed together in non-safety-related raceways.
- d. Control feeders (DA, DB, DC and DH facility code) from redundant 125 Volt DC unit control or 120 Volt vital AC control panels to non-safety-related equipment are routed separately to maintain independent battery and inverter emergency power sources.
- e. Protective system instrumentation cables (ZD, ZE, ZF, and ZG facility code) are routed solely in "instrumentation only" raceways of the same separation group.
- f. Control and instrumentation cables with K facility code are related to Diesel Generator 0C or its dedicated battery and are, therefore, routed separately.

- g. The non-safety-related low voltage power, control, and instrumentation circuits related to the Station Blackout Diesel Generator Building are assigned a Facility Code A. These Facility Code A circuits will be routed in Separation Group 7 with the following exceptions:

In the Auxiliary Building, these control and instrumentation circuits may be routed in either Separation Group 7 or Facility Code ZA or A raceway. However, once these circuits have been moved into Facility Code ZA or A to use existing raceway to enter equipment, they may not move back to Separation Group 7.

In the Safety-related Diesel Generator Building, these circuits may be routed in the dedicated Facility Code A raceway.

- h. The power cables from Diesel Generator 0C to the four safety-related emergency buses may be compatible with either safety-related Separation Group 1 or 2, but not both at the same time.
- i. Cables are separated into four groups according to voltage classification and function as follows:
 - 1. Medium voltage power cables
 - 2. Low voltage load center power cables
 - 3. Low voltage power and control cables
 - 4. Instrumentation cables

8.5.4 CONTROL BOARDS AND OTHER PANELS

Within the control boards and other panels associated with Class 1E (in reference to electrical separation, post accident monitoring category #1 [PAM 1] circuits are included as Class 1E) systems, circuits and instruments are independent and physically separated by a distance of 6". Where physical separation is impracticable, conduit, metal barriers and fire retardant barriers are used to maintain independence.

Single-control devices to which redundant circuits are connected are avoided wherever practicable. Where single devices are unavoidable, electrical isolation is provided. Devices that provide electrical isolation include relays, isolation amplifiers, solid-state optical couplers, and resistors in instrumentation current loops across which isolated voltage signals are obtained. In the case of third-pump circuit-breaker control switches, the redundant circuits are in separate conduit and connect to the switch at separate locations. The connections are separated by an empty stage of the switch. Additional protection is obtained by the automatic disconnection of DC control power from the unused circuit. Therefore, both redundant circuits at the switch are not energized simultaneously.

With reference to the facility code designations, the separation criteria within control boards and other panels associated with Class 1E systems can be tabulated as follows to indicate compatibility of differently designated cables and devices:

- SEPARATION GROUP 1 - ZA, ZD, DA, D, A
- SEPARATION GROUP 2 - ZB, ZE, DB, E, B
- SEPARATION GROUP 3 - ZC, ZF, DC, F
- SEPARATION GROUP 4 - ZH, ZG, DH, G
- SEPARATION GROUP 5 - A, B
- SEPARATION GROUP 6 - ZJ
- SEPARATION GROUP 7 - K, A

In the case of non-Class 1E A or B circuits in the control boards and other panels, the above criteria are modified to permit A and B association with all of the separation groups. Four-channel non-Class 1E circuits are permitted to associate with each other.

8.5.5 RACEWAYS

Separation and independence is maintained between cable trays of different separation groups throughout the plant, including the containment, the penetration rooms, cable spreading rooms, and other congested or hostile areas. The criteria for separating are as follows:

- a. A minimum of 3' horizontal separation is maintained or physical fire barriers are installed between redundant cable trays. Where a barrier is required, it extends to a minimum of 1' above and below the cable tray or to the ceiling or floor, or it completely encloses each cable tray of one separation group.
- b. Where the vertical stacking of redundant cable trays is unavoidable, a minimum spacing of 5' is maintained, or horizontal fire barriers are installed between trays, or each cable tray of one separation group is completely enclosed with a fire barrier.
- c. In the case of the crossover of one redundant tray to another, a minimum of 9" vertical separation is maintained and fire barriers are installed on both top and bottom of one tray to extend 2' from the crossover. In the protected cable spreading room where arrangements preclude maintaining separation as outlined above, fire barriers are installed on the top and bottom of both redundant trays. These barriers, used in conjunction with flame-retardant cables, ensure that a fire in the cable trays, (in the cable spreading room) caused by a cable fault, will not render safety-related cables in a redundant tray inoperable.
- d. The arrangement and/or installation of protective barriers precludes the possibility that a locally-generated force or missile will destroy redundant systems. For example, in rooms having heavy rotating machinery or high-energy piping:
 1. Redundant cable trays are maintained 20' apart, or
 2. One of the redundant trays must be 20' or more from the missile source or high-energy pipe, or
 3. A 6"-thick reinforced concrete wall isolates one tray from its redundant tray, or
 4. A steel barrier isolates the trays from the heavy rotating machinery or high-energy piping.
- e. Within missile-endangered areas, a minimum horizontal separation of 20' is maintained, or a protective wall, ceiling, or floor of 6"-reinforced concrete provides isolation between redundant switchgear and between other redundant electrical equipment.
- f. Where routing is unavoidable through areas with potential accumulation of large quantities of oil or other combustible fluids as a result of leakage or rupture of lube oil or cooling systems, a single separation group only is routed through this area and the cables are protected from dripping oil by conduit or covered tray.
- g. Where it is necessary that cables of redundant systems approach the same or adjacent control panels with less than 3' separation, one system is installed in steel conduit or wireway.
- h. Isolation between redundant circuits is considered to be adequate where physical separation is less than that indicated above, and when one of the circuits is routed in steel conduit or wireway.
- i. The worst credible incident is a cable tray insulation fire in the cable spreading room caused by an electrical fault. There are no 208 Volt, 480 Volt or other high-voltage or high-fault cables in the trays of the cable spreading room. The highest

fault current in the trays is less than 1,000 Amp or less than an equivalent energy of 360,000 ampere² x seconds.

8.5.6 PENETRATION ROOMS

Two separate penetration rooms are provided for all cables that must pass through the containment wall. The East Penetration Room is divided such that there are, to one side of the division, the Separation Group 1 penetrations and to the other side of the division, the Separation Group 2 penetrations. The horizontal separation between redundant penetrations and associated cable trays is 3'. The West Penetration Room is similarly divided except for the addition of Separation Group 3 to the same side as Separation Group 2 and Separation Group 4 to the same side as Separation Group 1. Vertical and horizontal separation between redundant penetrations will be a minimum of 3'. Cable tray separation criteria, as described earlier, are applicable for the penetration rooms. Power cable penetrations of high-energy levels are located above those of low-energy level circuits.