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June 28, 1990

William J. Cahill, Jr.
Executive Vice President

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
ADVANCE FSAR SUBMITTAL
CLASS 1E CABLE AND RACEWAY SEPARATION

Gentlemen:

On May 23, 1990, the planned simplification of the CPSES cable separation criteria was briefly discussed with the NRC. This letter provides an advance copy of changes to be included in a future FSAR amendment which incorporates the simplified cable separation criteria.

Because it was approached on a case by case basis on Unit 1, the cable separation criteria for CPSES became complicated, with lengthy and detailed inspection criteria. This FSAR change simplifies the cable and raceway separation criteria by expanding the one barrier and one inch criterion to cover power cable tray separation and conduit separation above a cable tray or cable. The revised criteria are based on testing already docketed for CPSES with appropriate supplemental analysis. Specifically, the criteria are based on Test Configurations 1 and 4 for power cables/cable trays and Test Configuration 6 for conduit in Wyle Laboratories Test Report No. 17666-02, "Test Report on Electrical Separation Verification Testing for the Stone and Webster Engineering Corporation for Use in Duquesne Light Company's Beaver Valley Power Station - Unit 2," April 19, 1985.

The FSAR separation distance criteria remain conservative to the test data. To minimize future complications of the criteria, a discussion has been added in this FSAR change concerning the minimum distances demonstrated by the existing test data for use in the evaluation of unique plant conditions. Such plant conditions would be documented in accordance with site procedures.

The new separation criteria, which are based on testing and analysis, meet the requirements of Regulatory Guide 1.75, Revision 1.

In order to facilitate NRC staff review of these changes, the enclosure is organized as follows:

1. Draft revised FSAR pages, with changed portions indicated by a bar in the margin, as they are to appear in a future amendment (additional pages immediately preceding and/or following the revised pages are provided if needed to understand the change).

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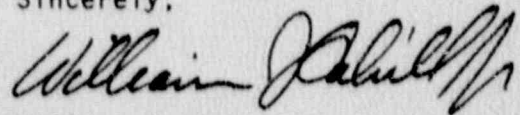
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2. A description/justification of each item revised.
3. A copy of related SER/SSER sections.
4. The bold/overstrike version of the revised FSAR pages referenced by the description/justification for each item identified above. The bold/overstrike version facilitates review of the revisions by highlighting each addition of new text in bold type font and overstriking with a slash (/) the portion of the text that is deleted. Although several portions of the text were simply relocated, they are overstruck and reprinted in bold in their new location.

TU Electric requests that the NRC perform an expedited review of the above FSAR changes. The revised cable separation criteria will be applied to both Unit 1 and Unit 2 as of the date of this letter. The revised criteria will be used for the Unit 2 walkdowns.

If you have any questions regarding this submittal, please contact Joe Harnden at (214) 812-8226.

Sincerely,



William J. Cahill, Jr.

WJH/vld
Enclosure

c - Mr. R. D. Martin, Region IV
Resident Inspectors, CPSES (3)

Enclosure to TXX-90229

Advanced FSAR Change Related to Class 1E Cable
and Raceway Separation

Item 1	Draft Revised FSAR Pages	pg 2 through 9
Item 2	Description/Justification for all FSAR pages	pg 10 through 11
Item 3	Related SER/SSER Pages	pg 12 through 15
Item 4	Markup of Existing FSAR Pages	pg 16 through 24

pg 1 of 24

Regulatory Position C.2 - For the purpose of electrical cable separation, acceptable barriers include rigid metal conduit, electrical metallic tubing (EMT), flexible metallic conduit, cable tray covers (both solid and ventilated types), cable bus enclosures, equipment and device enclosures, enclosed metal wireways inside equipment, and a wrap of woven silicon dioxide.

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A wrap of woven silicon dioxide is equivalent to a metal enclosed raceway with respect to protection from electrical failures.

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Metal Clad (MC) cable constructed of continuous corrugated 25 mil. thick seamless tube with an outer thermosetting chlorosulphonated polyethylene jacket and 600V XHHW, 90° C insulation is considered the same as cable inside conduit for the purpose of electrical separation. MC cable conductor size is limited to #10 AWG and below with a maximum of six (6) conductors. MC cable will only be used in non-Class 1E applications outside of the containment building for 120VAC/125VDC circuits in the following systems: lighting, fire protection, heat tracing and communication.

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Regulatory Position C.4 - The multiconductor cable between the Safety System Inoperable Indication (SSII) logic panel located in the control room and the termination cabinet in the cable spreading room meet the requirements of this position except for Class 1E environmental qualification. The cable materials meet IEEE Standard 383-1974 for the attributes of flame and radiation resistance. The cable is installed in a mild environment. Based on analysis, a fault at the SSII logic panel will not impact the availability of adjacent Class 1E cables with which these associated cables are routed. This analysis is provided in Section 8.3.

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Heliac and Radiac radio antenna coaxial cables are used in the non-Class 1E Radio Communication System. The energy carried by antenna cables is not sufficient to cause internally generated fire in these cables and, therefore, separation between these cables and Class 1E cables is not required.

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Fiber optic cables used in non-Class 1E monitoring circuits carry no electrical energy by themselves and, therefore, are not required to maintain physical separation from Class 1E circuits.

The raceways of one train are separated from those of the other train by locating them in separate structures or on opposite sides of large rooms or spaces. Where this is not possible, separation is maintained as described below or by providing barriers. The Class 1E cables are routed such that any single failure in one train system does not cause a failure in another train system. The separation of associated circuit cables is maintained on a train basis in the same manner and degree as the Class 1E circuit cables with which they are associated.

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Where cables are exposed to such potential hazards as pipe whip, flammable material, and missiles, separation requirements are evaluated on a case-by-case basis to ensure an acceptable level of redundant circuit independence.

5. Minimum Separation Requirement

In plant areas which are free from potential hazards such as missiles, external fires, and pipe whip, the minimum separation between redundant cable trays is three feet between trays separated horizontally and five feet between trays separated vertically.

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In the cable spreading area and the Control Room, the minimum separation between redundant cable trays is one foot between trays separated horizontally and three feet between trays separated vertically.

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In general plant areas and in the cable spreading area, these separation criteria are also applied to cables which are not located in raceway and not inside equipment as if the cable were in an open ladder-type tray.

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A single barrier is provided and 1" separation or the separation described below is maintained for power and control cables or raceways outside equipment where plant arrangement precludes maintaining the above minimum separation criteria. The minimum separation required between redundant conduit and redundant cable tray is 1". Similarly, the minimum separation required between redundant conduit and redundant cables is 1". A minimum separation of 1" is required if one or both of the conduits are power circuits. However, a minimum of 1/8" is required between a Class 1E conduit and a non-Class 1E instrumentation or control conduit. A minimum separation of 1/8" is required for redundant conduits when both are control or instrumentation.

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The above minimum separation criteria are in accordance with Regulatory Guide 1.75, Revision 1, [15] and IEEE-384-1974 [31] and have been demonstrated by testing or analysis specifically for CPSES or have been demonstrated by testing performed by other utilities where the cables are of the same or similar construction as used at CPSES. Accordingly, the test results and conclusions are applicable to CPSES installations. The CPSES electrical separation criteria generally require greater separation distances than demonstrated in the test configuration.

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Where the above minimum separation distances are not practical, based on actual plant conditions, they will be evaluated on a

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CPSES/FSAR

DRAFT		case by case basis using existing or new test data. Each condition will be documented in accordance with site procedures.
DRAFT		The minimum distances demonstrated by the existing test data is as follows:
DRAFT		A. Conduit-to-cable, conduit-to-flexible conduit, and flexible conduit-to-cable.
DRAFT		Tests documented for Nine Mile Point Unit 2 [43] demonstrated "the acceptability of design where a rigid conduit, flexible conduit, and a cable in free air are separated by less than 1/4" (but not in contact), when the worst case power level, electrical fault occurs in either conduit or to the free air cable." Based on this test, power conduits with 1/4" separation may be accepted.
DRAFT		B. Covered cable tray to cable tray or to cable.
DRAFT		Tests documented for Beaver Valley Unit 2 [44] demonstrated that a solid tray cover with no additional distance separation provides adequate protection when the fault is either outside or inside the tray. Based on this test, 0" separation between conduit and covered cable tray may be accepted.
DRAFT		C. Redundant instrumentation and control conduit to instrumentation and control conduit or non-Class 1E instrumentation and control conduit to any Class 1E conduit.
DRAFT		Tests documented for CPSES [41] demonstrated that one conduit with no additional separation provides adequate protection from a faulted instrumentation or control cable. Based on this test, 0" separation between redundant instrument and control conduits or between non-Class 1E instrument and Class 1E power or instrument and control conduit may be accepted.

All Nuclear Instrumentation System (NIS) cables are routed in conduit according to their channel assignment. A minimum separation of 6 feet is maintained between NIS conduits and raceway containing 6.9 kV circuits. Also, a minimum separation of 2 feet is maintained from NIS conduits running parallel to raceways containing electrical noise sources such as low voltage power and rod control cables.

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The minimum separation distance between redundant Class 1E and between Class 1E and non-Class 1E equipment and circuits internal to control equipment is six inches. In this case, the wire and cables are flame-retardant with self-extinguishing and nonpropagating characteristics. Other components such as terminal blocks, wire troughs, wire cleats, raceways, cable ties, glastic barriers, and so forth are manufactured from self-extinguishing material.

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Separation within the Class 1E inverters listed in Table 8.3-10 between Class 1E train related input cables and the Class 1E channel related output cables is not required since these cables are integrally associated with each other. For the Class 1E Nuclear Instrumentation System (NIS) neutron flux preamplifiers, signal processors, and isolation expansion assemblies listed in Table 8.3-10, separation between Class 1E train related cables and Class 1E channel related cables is not required inside each cabinet, since their circuits are integrally associated with each other.

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Separation between associated circuits and non-Class 1E circuits in fire panels CPX-EIPRLV-29, CPX-EIPRLV-29A, and CPX-EIPRLV-30 (listed in Table 8.3-10) is not required based on analysis.

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- 76 These circuits carry low energy fire detection control signals and the postulated failure/fault in the associated circuits inside the fire protection local panel does not degrade the Class 1E contacts or degrade the Class 1E function of the fire detection panel based on the following:
- 76 a. The associated circuits link normally open contacts of Class 1E auxiliary relays with the non-Class 1E alarm relays. The alarm relays and the alarm functions for CPSES are non-safety. Degradation of the associated circuits due to their proximity with the 120-V AC black circuits can occur due to imposition of 120-V AC on the associated circuit wires due to a hot short, or a line-to-ground fault. Since contacts of the Class 1E relays in the local fire detection panels are normally open and are required to close only during a fire in the respective fire detection zone, no current could flow through the same under a non-fire condition.
- 76 Occurrence of an electrical fault coincident with an external fire in two different plant areas is not credible because the 120-V cables (1) are rated for 600-V insulation, i.e., no dielectric failure hazard; (2) carry low current for their size (less than 5 Amps), i.e., no thermal hazard; and (3) run internal to the panel, i.e., no mechanical hazard.
- 76 b. The intra-panel non-Class 1E circuits are 24-28-V DC circuits energized by a low capacity 120-V AC to 24-V DC transformer-rectifier system. The internal wires are 600-V grade insulated wires which are used for low energy level circuits. The low-level power supply and the printed

CPSES/FSAR

electronic circuit cards have a very small capability to feed a dead short (a maximum current flow of three amps will open circuit on the circuit cards). This magnitude of fault current is considered too small to jeopardize the associated circuits and the Class 1E equipment associated with them. 75

Separation within other equipment listed in Table 8.3-10 is not required since circuits are isolated from Class 1E buses by isolation devices. 75

Minimum separation for control and instrumentation cables or raceways inside equipment is 1". Conduit to conduit minimum separation is 0". Cables #10 AWG and larger feeding power to control equipment from distribution panels and all power cables inside power equipment maintain 6" separation or are enclosed or separated by a barrier. DRAFT DRAFT 76

Control and instrumentation cables entering control equipment through BISCO fire sealant maintain a minimum separation of 1" and cables #10 AWG and larger feeding power to control equipment from distribution panels maintain 6" separation. DRAFT 76

The above separation criteria has been demonstrated by testing and analysis (refer to References 41 and 42) to meet or exceed Regulatory Guide 1.75 [15] and IEEE-384 [31]. 76 62

For the purpose of electrical cable separation, acceptable barriers include rigid metal conduit, electrical metallic tubing (EMT), flexible metallic conduit, cable tray covers (both solid and ventilated types), cable bus enclosures, equipment and device enclosures, enclosed metal wireways inside equipment, and a wrap of woven silicon dioxide. DRAFT

A wrap of woven silicon dioxide is equivalent to a conduit with respect to protection from electrical failures. 78

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39.	NEMA VE 1-1971, Cable Tray Systems, National Electrical Manufacturers Association.	
40.	IEEE 80-1961 (Reaff. 1971), Guide for Safety in AC Substation Grounding.	
41.	Wyle Laboratories Test Report No. 48037-02, Electrical Raceway Separation Verification Testing for the Texas Utilities Generating Company for use in the Comanche Peak Steam Electric Station Units 1 and 2, February 6, 1986.	62
42.	Wyle Laboratories Test Report No. 48422-1, Cable Separation Test Program for the Texas Utilities Generating Company Comanche Peak Steam Electric Station Units 1 and 2, August 14, 1986.	62
43.	Wyle Laboratories Test Report No. 47906-02, Test Report on Electrical Separation Verification Testing for the Stone & Webster Engineering Corporation for Use In Niagra Mohawk Power Corporation Nine Mile Point Nuclear Station - Unit 2, November 22, 1985, Configuration No.5.	65
44.	Wyle Laboratories Test Report No. 17666-02, Test Report on Electrical Separation Verification Testing for the Stone & Webster Engineering Corporation for Use In Duquesne Light Company's Beaver Valley Power Station - Unit 2, April 19, 1985, Configurations 1, 2, 3, 4 and 6.	DRAFT
45.	ASME Boiler and Pressure Vessel Code, Sections II, III, V, and IX.	66
46.	Brown Boveri Electric, Inc., Test Report K-82089-K1, Test Date May 27, 1982.	70

FSAR Page
(as amended)

Group Description

1A(B)-51

- 2 For clarity and consistency with the revised cable separation criteria, the discussion of "equivalent" raceway, enclosures and wraps is consolidated into a discussion of "acceptable barriers".
- Revision:
- For clarity and consistency with the revised cable separation criteria, the discussion of "equivalent" raceway, enclosures and wraps is consolidated into a discussion of "acceptable barriers". For the same reasons, equipment and device enclosures and enclosed metal wireways inside equipment are now specifically mentioned as "barriers".
- FSAR Change Request Number: 90-091.3
Related SER Section: 8.4.4; SSER22 8.4.4
SER/SSER Impact: Yes
- Although equivalency of these "barriers" is discussed in SSER 22, Section 8.4.4, they are not referred to as barriers.

8.3-70, 71

- 2 See Page No(s):72, 73 & 75
- Simplified criteria for cable and raceway separation at CPSES based on existing docketed testing and supplemental analysis.
- Revision:
- Since it was approached on a case by case basis on Unit 1, the cable separation criteria for CPSES became complicated, with lengthy and detailed inspection criteria. This change simplifies the cable and raceway separation criteria by expanding the 1 barrier and 1" criterion to cover power tray separation and conduit separation above a tray or cable. The revised criteria are based on testing already docketed for CPSES with appropriate supplemental analysis. The separation criteria based on testing and analysis meet the requirements of Regulatory Guide 1.75, Revision 1. The discussion of separation criteria has been rearranged and editorial corrections made for clarity and to consolidate the discussion.
- To minimize future complications to the criteria, included in the revision is a discussion of the minimum distances demonstrated by the existing test data. These distances would be used to evaluate any conditions found or encountered in construction where it is not practical to meet the more conservative minimum separation criteria due to actual plant conditions. These cases would be documented in accordance with site procedures and, if found acceptable based on the testing and analysis described in the FSAR, will be in compliance with Regulatory Guide 1.75, Revision 1.

CPSES FSAR AMENDMENT
DETAILED DESCRIPTION

FSAR Page
(as amended)

Group Description

The revised criteria have been evaluated under 10CFR50.59 and been found not to be an Unreviewed Safety Question.

The revised criteria will be applied to both Unit 1 and Unit 2 as of the date of the advance amendment (TXX-90229) and will be used for the walkdowns in Unit 2.

FSAR Change Request Number: 90-091.1

Related SER Section: 8.4.4; SSER22 8.4.4

SER/SSER Impact: Yes

The 1 barrier and 1" criteria is expanded to cover power tray separations and conduit separation above a tray or cable, which is not reflected in the current SSER 22 discussion.

8.3-75

- 2 For clarity and consistency with the revised cable separation criteria, the discussion of "equivalent" raceway, enclosures and wraps is consolidated into a discussion of "acceptable barriers".

Revision:

For clarity and consistency with the revised cable separation criteria, the discussion of "equivalent" raceway, enclosures and wraps is consolidated into a discussion of "acceptable barriers". For the same reasons, equipment and device enclosures and enclosed metal wireways inside equipment are now specifically mentioned as "barriers".

FSAR Change Request Number: 90-091.2

Related SER Section: 8.4.4; SSER22 8.4.4

SER/SSER Impact: Yes

Although equivalency of these "barriers" is discussed in SSER 22, Section 8.4.4, they are not referred to as barriers.

8.3-100

- 3 Adds test configurations 3 and 6 to Reference 44.
Addition:

The revised separation criteria for power cables/trays and for conduit above a cable tray or cable are based on test configurations which include test configurations 3 and 4 for power cables/trays and test configuration 6 for conduit. The additional test configurations are added for reference.

FSAR Change Request Number: 90-091.4

Related SER Section: 8.4.4; SSER22 8.4.4

SER/SSER Impact: No

the staff position on this issue, the applicant has provided a keylock control board control power cutoff switch for each valve whose spurious movement could result in degraded emergency core cooling system performance. Keylock switch contacts are arranged in valve operator control circuits so that energizing the operator contactor coils from attendant control power sources can be precluded.

In order to meet the staff position that redundant valve status indication be provided in the control room, the MOVs are provided with red (open) and green (closed) position-indicating lights located at the control switch for each valve. These lights are powered by valve control power and actuated by valve motor operator limit switches. This indication circuitry is such that valve position indication is not lost when power is removed by the keylock control board control power cutoff switch. In addition, a monitor light is provided in an array of monitor lights that are all off when their respective valves are in proper position enabling safeguards operation. These lights are energized from a separate monitor light supply and actuated by valve motor-operated limit switches which are different from those used to actuate the red and green lights.

On the basis of its review and evaluation, the staff concludes that the electrical design provisions for the identified list of valves satisfy the staff position and are, therefore, acceptable.

→ 8.4.4 Physical Identification and Independence of Redundant Safety-Related Electrical Systems

Physical Identification of Electrical Equipment

In the FSAR, the applicant has provided the criteria for physical identification of electrical equipment, including cables and raceways. Electrical equipment has its own tagging scheme developed by equipment type. All Class 1E system cables and the seismic Category I raceway system are marked by a nine-alphanumeric-character tag identifier. In addition to a tag number, each Class 1E raceway and cable in raceways are color coded to indicate its separation group. The identification scheme provides a means of readily distinguishing a cable or raceway associated with a particular separation group.

Exposed raceways containing Class 1E cables are marked by color codes in a distinct permanent manner at intervals not to exceed 15 feet and at points of entry to and exit from enclosed areas. In general, all Class 1E cables and associated cables are jacket color-coded throughout their entire length. Cable jackets that require field color coding before installation will be so worked at intervals not to exceed 5 feet. Cable jackets that require field color coding after installation due to reclassification of cables (e.g., from associated Class 1E to Class 1E or vice versa) will be color coded where the cables enter and exit equipment, in the raceway, and inside junction/pull boxes. Further, all exposed portions of these cables will be marked at intervals not to exceed 5 feet. In general, non-Class 1E equipment, raceways, and cables in raceways are not marked by color code, but are left in their natural color, generally black. However, non-Class 1E cables whose natural color is not black will be field color coded black at intervals not to exceed 5 feet.

Physical Independence of Electrical Equipment

The cable and raceway separation criteria are based on preservation of independence of redundant systems. Cables of redundant Class 1E systems are separated from each other as well as from cables of non-Class 1E systems. Cables of redundant Class 1E circuits are run in separate cable trays, conduits, ducts, and penetrations. The applicant has used lesser separation distances than those provided in guidance documents in several locations between Class 1E wiring and non-Class 1E area radiation monitoring detector wiring and public address system speaker wiring. The applicant has analyzed the effect of lesser separation between the non-Class 1E circuits and the Class 1E circuits. The applicant has treated these non-Class 1E circuits as low-energy circuits. An analysis has been performed that concludes for electric fault conditions in these non-Class 1E circuits, associated Class 1E circuits are not degraded below an acceptable level.

Fiber optic cables used in non-Class 1E monitoring circuits carry no electrical energy by themselves and therefore are not required to maintain physical separation from Class 1E circuits. In addition, radio antenna coaxial cables are used in the non-Class 1E radio communication system. The energy carried by such cables is not sufficient to cause an internally generated fire in these cables and therefore separation between these and Class 1E cables is not required.

In plant areas that are free from potential hazards such as missiles, external fires, and pipe whip, the minimum separation between redundant cable trays is 3 feet between trays separated horizontally and 5 feet between trays separated vertically. The minimum separation between safety-related conduit and redundant cable tray in these areas is 3 feet in both horizontal and vertical directions when the conduit elevation is above that of the tray side rails. The control room and cable spreading areas do not contain high-energy equipment such as switchgear, motor control centers, transformers, rotating equipment, or potential sources of missiles or pipe whip. In the cable spreading area and the control room, the minimum separation between redundant cable trays is 1 foot between trays separated horizontally and 3 feet between trays separated vertically. The minimum separation between safety-related conduit and redundant cable tray in this area is 1 foot horizontally and 2 feet vertically when the conduit elevation is above that of the tray side rails. Where cable spreading area and control room raceway arrangements preclude maintaining minimum separation distances, the redundant circuits are run in enclosed raceways, or barriers are provided between redundant circuits.

In all plant areas free of potential hazards, the minimum separation required in any direction between redundant tray and conduit is 1 inch when the conduit is not safety related or its elevation is not above the tray side rails. In SSER 17 (November 1988), the response on page 74 for Open Item E-28 indicates that for power cables, the 1-inch minimum separation is used in conjunction with two enclosures (conduit, Siltemp protective wrap, tray with cover top and bottom). This information was provided in the attachment to a letter from the applicant dated April 11, 1988. By letter dated June 5, 1989, the applicant provided clarifying information for this response. As noted in the clarifying information, as well as indicated above, CPSES uses lesser separation distances for power circuits, based on analysis, when conduit is located either above open tray, adjacent to open tray but not above the side rails, or below a ladder-type

tray. In addition, these separation criteria are also applied to power cables which are not located in raceway and are not inside equipment (as if the cables were in an open ladder-type tray). These CPSES criteria for lesser separation distances have been analyzed to show no adverse impact on Class 1E circuits.

Nuclear instrumentation system (NIS) cables are routed in conduit according to their channel assignment. A minimum separation of 6 feet is maintained between NIS conduits and raceways containing 6.9-kV circuits. In addition, a minimum separation of 2 feet is maintained from NIS conduits running parallel to raceways containing electrical noise sources such as low-voltage power and rod-control cables.

The minimum separation distance between redundant Class 1E and between Class 1E and non-Class 1E equipment and circuits internal to the control equipment is 6 inches. In this case, the wire and cables are flame retardant with self-extinguishing and nonpropagating characteristics. Other components, such as terminal blocks, wire troughs and cleats, cable ties, and glastic barriers, are manufactured from self-extinguishing material.

Where plant arrangements preclude maintaining the applicable minimum separation distances, as stated above, tray covers, solid bottoms, or other barriers are provided between the circuits requiring separation. The minimum distances between raceways requiring separation and between barriers and the raceways are in accordance with RG 1.75 and IEEE Standard 384-1974, "Trial-Use Standard Criteria for Separation of Class 1E Equipment and Circuits."

Inside equipment, for control and instrumentation cables or raceways, minimum separation is 1 inch. Cables No. 10 AWG (American wire gauge) and larger feeding power to control equipment from distribution panels and all power cables inside power equipment maintain a 6-inch separation or are enclosed or separated by a barrier.

For the purpose of electrical cable separation, enclosed raceway includes rigid metal conduit, electrical metallic tubing, and flexible metallic conduit. Ventilated tray covers are considered equivalent to solid nonventilated tray covers, and cable bus enclosures are considered the same as enclosed raceways. In addition, a wrap of woven silicon dioxide is equivalent to a conduit with respect to protection from electrical failures.

Metal-clad (MC) cable, constructed of a continuous corrugated 25-mil-thick seamless tube with an outer thermosetting chlorosulphonated polyethylene jacket and 600-V, 90°C insulation, is considered the same as cable inside conduit for the purpose of electrical separation. MC cable conductor size is limited to No. 10 AWG and below, with a maximum of six conductors. MC cable will only be used in non-Class 1E applications outside the containment building for 120-V ac/125-V dc circuits in the following systems: lighting, fire protection, heat tracing, and communication.

Use of these separation criteria and materials has been demonstrated to be adequate by testing and/or analyses.

Separation of electrical equipment is achieved by physical distance, separate rooms, and/or barriers. Possible hostile effects of non-safety-related equipment failure on safety-related equipment are also considered in determining adequate separation of components.

Each diesel generator, including its associated auxiliaries, is located in a separate room. The electrical switchgear of train A is separated from that of train B by physical distance, separate rooms, and barriers.

A separated and independently ventilated room is provided for the 125-V dc Class 1E batteries of each train in each unit. Battery chargers, distribution switchboards, and static uninterruptible power supplies of one train are separated from those of other trains by locating them in separate rooms. Physical independence is maintained to ensure that a single failure in one train does not cause a failure in the redundant train. There is no sharing between such Class 1E trains of equipment as batteries, battery chargers, or distribution panels.

On the basis of its review of the applicant's design criteria regarding physical identification and independence of redundant safety-related electrical equipment and systems, the staff finds these criteria to be in accordance with Regulatory Guide 1.75 and, therefore, acceptable.

8.4.5 Nonsafety Loads on Emergency Sources

Regulatory practice for operating license applications permits the connection of nonsafety loads, in addition to the required safety loads, to Class 1E (emergency) power sources if it can be shown that the connection of nonsafety loads will not result in degradation of the Class 1E system. The CPSS design provides for the connection of both safety and selected nonsafety loads to the Class 1E emergency buses of the ac and dc onsite emergency power systems. With this arrangement, electrical isolation is provided to preclude interaction between Class 1E and non-Class 1E circuits.

Electrical isolation devices and/or methods are used as required in power, control, and instrumentation circuits to maintain the independence of redundant circuits and equipment so that protective functions required during and after any design-basis event are accomplished. Different types of isolation devices are used for power, control, and instrumentation circuits. The following types of devices and/or methods are used for electrically isolating power circuits:

- (1) Circuit breaker tripped by a safety injection signal.
- (2) Starter contactor opened by a safety injection signal.
- (3) Two circuit breakers, two fuses, or a breaker and a fuse in series, both coordinated with an upstream circuit breaker, and the circuit breakers periodically tested.

For instrumentation and control circuits, the following devices and/or methods are used for electrical isolation:

Regulatory Position C.2 - For the purpose of electrical cable separation, acceptable barriers ~~enclosed raceway~~ includes rigid metal conduit, electrical metallic tubing (EMT), and flexible metallic conduit, cable tray covers (both solid and ventilated types), cable bus enclosures, equipment and device enclosures, enclosed metal wireways inside equipment, and a wrap of woven silicon dioxide. ~~Ventilated tray covers are considered equivalent to solid non-ventilated tray covers. Cable bus enclosures are considered the same as enclosed raceway for separation purposes.~~

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A wrap of woven silicon dioxide is equivalent to a metal enclosed raceway with respect to protection from electrical failures.

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Metal Clad (MC) cable constructed of continuous corrugated 25 mil. thick seamless tube with an outer thermosetting chlorosulphonated polyethylene jacket and 600V XHHW, 90° C insulation is considered the same as cable inside conduit for the purpose of electrical separation. MC cable conductor size is limited to #10 AWG and below with a maximum of six (6) conductors. MC cable will only be used in non-Class 1E applications outside of the containment building for 120VAC/125VDC circuits in the following systems: lighting, fire protection, heat tracing and communication.

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Regulatory Position C.4 - The multiconductor cable between the Safety System Inoperable Indication (SSII) logic panel located in the control room and the termination cabinet in the cable spreading room meet the requirements of this position except for Class 1E environmental qualification. The cable materials meet IEEE Standard 383-1974 for the attributes of flame and radiation resistance. The cable is installed in a mild environment. Based on analysis, a fault at the SSII logic panel will not impact the availability of adjacent Class 1E cables with which these associated cables are routed. This analysis is provided in Section 8.3.

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Heliac and Radiac radio antenna coaxial cables are used in the non-Class 1E Radio Communication System. The energy carried by antenna cables is not sufficient to cause internally generated fire in these cables and, therefore, separation between these cables and Class 1E cables is not required.

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Fiber optic cables used in non-Class 1E monitoring circuits carry no electrical energy by themselves and, therefore, are not required to maintain physical separation from Class 1E circuits.

The raceways of one train are separated from those of the other train by locating them in separate structures or on opposite sides of large rooms or spaces. Where this is not possible, separation is maintained as described below or by providing barriers. The Class 1E cables are routed such that any single failure in one train system does not cause a failure in another train system. The separation of associated circuit cables is maintained on a train basis in the same manner and degree as the Class 1E circuit cables with which they are associated.

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Where cables are exposed to such potential hazards as pipe whip, flammable material, and missiles, separation requirements are evaluated on a case-by-case basis to ensure an acceptable level of redundant circuit independence.

5. Minimum Separation Requirement

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In plant areas which are free from potential hazards such as missiles, external fires, and pipe whip, the minimum separation between redundant cable trays is three feet between trays separated horizontally and five feet between trays separated vertically. ~~THE MINIMUM SEPARATION BETWEEN SAFETY-RELATED CONDUIT AND REDUNDANT CABLE TRAY IN THESE AREAS IS THREE FT IN BOTH HORIZONTAL AND VERTICAL DIRECTIONS WHENEVER THE CONDUIT ELEVATION IS ABOVE THAT OF THE TRAY SIDE RAILS.~~

In the cable spreading area and the Control Room, the minimum separation between redundant cable trays is one foot between trays separated horizontally and three feet between trays separated vertically. The minimum separation between safety-related conduit and redundant cable tray in this area is one ft between these raceways separated horizontally and two ft between these raceways separated vertically whenever the conduit elevation is above that of the tray side rails. In all plant areas free of potential hazards as described above, the minimum separation required in any direction between redundant tray and conduit is one inch whenever the conduit is non safety-related or its elevation is not above the tray side rails.

The above separation criteria are also applied to power cables which are not located in raceway and not inside equipment as if the cable were in an open ladder type tray. However, since there are no side rails, horizontal separation between such cable and safety-related conduit meets the following separation distances. For plant areas which are free from potential hazards such as missiles, external fires, and pipe whip, the minimum horizontal separation between cable and safety-related conduit is three feet. For the cable spreading area and the control room, the minimum horizontal separation between cable and safety-related conduit is one foot.

In all plant areas free from potential hazards, as described above, the minimum separation required in any direction between safety related conduit and non/safety related conduit or instrumentation cable tray or cable is one inch.

In general plant areas and in the cable spreading area, these separation criteria are also applied to cables which are not located in raceway and not inside equipment as if the cable were in an open ladder-type tray.

A single barrier is provided and 1" separation or the separation described below is maintained for power and control cables or

raceways outside equipment where plant arrangement precludes maintaining the above minimum separation criteria. The minimum separation required between redundant conduit and redundant cable tray is 1". Similarly, the minimum separation required between redundant conduit and redundant cables is 1". A minimum separation of 1" is required if one or both of the conduits are power circuits. However, a minimum of 1/8" is required between a Class 1E conduit and a non-Class 1E instrumentation or control conduit. A minimum separation of 1/8" is required for redundant conduits when both are control or instrumentation.

The above minimum separation criteria are in accordance with Regulatory Guide 1.75, Revision 1, [15] and IEEE-384-1974 [31] and have been demonstrated by testing or analysis specifically for CPSES or have been demonstrated by testing performed by other utilities where the cables are of the same or similar construction as used at CPSES. Accordingly, the test results and conclusions are applicable to CPSES installations. The CPSES electrical separation criteria generally require greater separation distances than demonstrated in the test configuration.

Where the above minimum separation distances are not practical, based on actual plant conditions, they will be evaluated on a case by case basis using existing or new test data. Each condition will be documented in accordance with site procedures. The minimum distances demonstrated by the existing test data is as follows:

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- A. Conduit-to-cable, conduit-to-flexible conduit, and flexible conduit-to-cable.

Tests documented for Nine Mile Point Unit 2 [43] demonstrated "the acceptability of design where a rigid conduit, flexible conduit, and a cable in free air are separated by less than 1/4" (but not in contact), when the worst case power level, electrical fault occurs in either conduit or to the free air cable." Based on this test, power conduits with 1/4" separation may be accepted.

- B. Covered cable tray to cable tray or to cable.

Tests documented for Beaver Valley Unit 2 [44] demonstrated that a solid tray cover with no additional distance separation provides adequate protection when the fault is either outside or inside the tray. Based on this test, 0" separation between conduit and covered cable tray may be accepted.

- C. Redundant instrumentation and control conduit to instrumentation and control conduit or non-Class 1E instrumentation and control conduit to any Class 1E conduit.

Tests documented for CPSES [41] demonstrated that one conduit with no additional separation provides adequate protection from a faulted instrumentation or control cable. Based on this test, 0" separation between redundant instrument and control conduits or between non-Class 1E instrument and Class 1E power or instrument and control conduit may be accepted.

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- 64 *ALL OF THE ABOVE CONDUIT TO CABLE LAY SEPARATION DISTANCES ARE
BASED ON TESTING AND ANALYSIS.*
- 41 All Nuclear Instrumentation System (NIS) cables are routed in
conduit according to their channel assignment. A minimum
separation of 6 feet is maintained between NIS conduits and
42 raceway containing 6.9 kV circuits. Also, a minimum separation
of 2 feet is maintained from NIS conduits running parallel to
raceways containing electrical noise sources such as low voltage
power and rod control cables.
- 76 The minimum separation distance between redundant Class 1E and
between Class 1E and non-Class 1E equipment and circuits internal
to control equipment is six inches. In this case, the wire and
cables are flame-retardant with self-extinguishing and
66 nonpropagating characteristics. Other components such as
terminal blocks, wire troughs, wire cleats, raceways, cable ties,
glastic barriers, and so forth are manufactured from self-
extinguishing material.
- 76 Separation within the Class 1E inverters listed in Table 8.3-10
between Class 1E train related input cables and the Class 1E
channel related output cables is not required since these cables
are integrally associated with each other. For the Class 1E
Nuclear Instrumentation System (NIS) neutron flux preamplifiers,
signal processors, and isolation expansion assemblies listed in
Table 8.3-10, separation between Class 1E train related cables
and Class 1E channel related cables is not required inside each
cabinet, since their circuits are integrally associated with each
other.
- 76 Separation between associated circuits and non-Class 1E circuits
in fire panels CPX-EIPRLV-29, CPX-EIPRLV-29A, and CPX-EIPRLV-30
(listed in Table 8.3-10) is not required based on analysis.

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76 | electronic circuit cards have a very small capability to feed a dead short (a maximum current flow of three amps will open circuit on the circuit cards). This magnitude of fault current is considered too small to jeopardize the associated circuits and the Class 1E equipment associated with them.

75 | Separation within other equipment listed in Table 8.3-10 is not required since circuits are isolated from Class 1E buses by isolation devices.

76 | WHERE PLANT ARRANGEMENTS PRECLUDE MAINTAINING THE MINIMUM SEPARATION DISTANCE AS STATED ABOVE, 1/2" COVERS, SOLID BOXES, OR OTHER BARRIERS ARE PROVIDED BETWEEN THE CIRCUITS REQUIRING SEPARATION. THE MINIMUM DISTANCES BETWEEN RACEWAYS REQUIRING SEPARATION AND BETWEEN BARRIERS AND THE RACEWAYS ARE IN ACCORDANCE WITH NRC REGULATORY GUIDE 1.7B [15] AND IEEE/388 [31].

76 | Minimum separation inside equipment for control and instrumentation cables or raceways inside equipment. Minimum separation is 1". Conduit to conduit minimum separation is 0".
Cables #10 AWG and larger feeding power to control equipment from distribution panels and all power cables inside power equipment maintain 6" separation or are enclosed or separated by a barrier.

76 | Outside equipment, for control and instrumentation cables or raceways where plant arrangements preclude maintaining minimum separation, a single barrier is provided and 1" separation is maintained. A 1/2" minimum separation is provided for redundant conduits when both are control or instrumentation. A 1/2" minimum separation is also provided between Class 1E and non-Class 1E conduits when the non-Class 1E conduit is control or instrumentation.

Control and instrumentation cables entering control equipment through BISCO fire sealant maintain a minimum separation of 1"

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and cables #10 AWG and larger feeding power to control equipment from distribution panels maintain 6" separation. 76

The above separation criteria has been demonstrated by testing and analysis (refer to References 41 and 42) to meet or exceed Regulatory Guide 1.75 [15] and IEEE-384 [31]. 76
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For the purpose of electrical cable separation, acceptable barriers ~~enclosed raceway~~ included rigid metal conduit, electrical metallic tubing (EMT), and flexible metallic conduit, cable tray covers (both solid and ventilated types), cable bus enclosures, equipment and device enclosures, enclosed metal wireways inside equipment, and a wrap of woven silicon dioxide. ~~ventilated tray covers are considered equivalent to solid non-ventilated tray covers. cable bus enclosures are considered the same as enclosed raceway for separation purposes.~~ 65

A wrap of woven silicon dioxide is equivalent to a conduit with respect to protection from electrical failures. 76

Metal Clad (MC) cable constructed of continuous corrugated 25 mil. thick seamless tube with an outer thermosetting chlorosulphonated polyethylene jacket and 600V XHHW, 90° C insulation is considered the same as cable inside conduit for the purpose of electrical separation. MC cable conductor size is limited to #10 AWG and below with a maximum of six conductors. MC cable will only be used in non-Class 1E applications outside of the containment building for 120VAC/125VDC circuits in the following systems: lighting, fire protection, heat tracing and communication. 77

Testing performed by other utilities has demonstrated the adequacy of the above materials to be used as enclosed raceway and barriers for Regulatory Guide 1.75 [15] separation purposes. 65

- a. Flexible Conduit: Tests documented in Reference 43 for Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station Unit 2 demonstrated the adequacy of BOA stainless steel flexible conduit and ⁸⁻³⁻⁷⁵Anaconda steel ^{Amendment 78}flexible conduit. 65
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| 39. | NEMA VE 1-1971, Cable Tray Systems, National Electrical Manufacturers Association. |
| 40. | IEEE 80-1961 (Reaff. 1971), Guide for Safety in AC Substation Grounding. |
| 62 | 41. Wyle Laboratories Test Report No. 48037-02, Electrical Raceway Separation Verification Testing for the Texas Utilities Generating Company for use in the Comanche Peak Steam Electric Station Units 1 and 2, February 6, 1986. |
| 62 | 42. Wyle Laboratories Test Report No. 46422-1, Cable Separation Test Program for the Texas Utilities Generating Company Comanche Peak Steam Electric Station Units 1 and 2, August 14, 1986. |
| 65 | 43. Wyle Laboratories Test Report No. 47906-02, Test Report on Electrical Separation Verification Testing for the Stone & Webster Engineering Corporation for Use In Niagra Mohawk Power Corporation Nine Mile Point Nuclear Station - Unit 2, November 22, 1985, Configuration No.5. |
| 65 | 44. Wyle Laboratories Test Report No. 17666-02, Test Report on Electrical Separation Verification Testing for the Stone & Webster Engineering Corporation for Use In Duquesne Light Company's Beaver Valley Power Station - Unit 2, April 19, 1985, Configurations 1, 2, 3, 4 and 6. |
| 66 | 45. ASME Boiler and Pressure Vessel Code, Sections II, III, V, and IX. |
| 70 | 46. Brown Boveri Electric, Inc., Test Report K-82089-K1, Test Date May 27, 1982. |