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

Dear Mr. Denton:

River Bend Station - Unit 1
Docket No. 50-458

References:

1. Notes from the NRC Region I, Appendix R and Fire Protection Workshop held on April 18, 1984 at the Valley Forge Holiday Inn, King of Prussia, PA
2. Sandia Report No. SAND 77-1125C
3. Wyle Laboratories Test Report No. 46,287-1

A revision to FSAR Section 8.3.1.4.2, Class 1E Electric Equipment Arrangement, is enclosed for your information. This revision will be included in a future FSAR amendment.

This change is based on the following:

1. Regulatory Guide 1.75, Revision 2, dated September 1978, Physical Independence of Electrical System, endorses with certain exceptions IEEE 384-1974. The introductory paragraph of Regulatory Guide 1.75 states the following:

   This guide addresses only some aspects of defense against the effect of fires. Additional criteria for protection against the effects of fires are provided in Regulatory Guide 1.120, Fire Protection Guidelines for Nuclear Power Plants.

2. IEEE 384-1974 Requirements for minimum separation distance (3 ft/5 ft for general plant areas and 1 ft/3 ft for cable spreading room) were based on the following conditions:

   a. Cables and raceways involved shall be flame retardant.

   b. The design basis for cable trays shall be that they will not be filled above the side rails.

   c. Hazards shall be limited to failures of faults internal to the electric equipment or cables.

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IEEE 384-1974 also specifies:

> If lesser separation distances are used, they shall be established by analysis of the proposed cable installation.

3. Since September 1978, more guidance has been provided for protection against fire damage of redundant systems by later versions of IEEE 384 (the latest is the 1981 edition), by Appendix R to 10CFR50, and by Branch Technical Position (BTP) CMEB 9.5-1. These documents give more emphasis on protection of safe shutdown systems but at the same time require that, for other safety-related systems not necessary for safe shutdown, measures shall be taken to prevent the ignition of cables in one division by a fire in the cables of the other division.

   Following are the clarifications given by the new guidelines:

   a. IEEE 384-1981 clarifies the difference between solid enclosing barrier (that requires no minimum distance between the barrier and the raceways) and conduits and enclosed metallic raceways that required a 1-inch air gap between raceways.

   b. Appendix R to 10CFR50 and BTP CMEB 9.5-1 define the requirements of the barrier to separate redundant divisions in noninerted containment as noncombustible radiant energy shields having a minimum fire rating of 1/2 hour. The NRC staff has stated in Reference 1 that the shields usually considered were constructed of 1/2-inch marinite boards and that any material with a 1/2-hour fire rating should be capable of performing the required function.

4. Sandia Laboratories has performed tests with cables qualified to IEEE 383 with tray spacing reduced to 10.5 inches vertically and 8 inches horizontally with fire initiated electrically in one raceway. No propagation of fire between trays was found possible (See Ref. 2).

5. Wyle Laboratories has performed tests (Ref. 3) proving that an electrical fault on power cable enclosed inside metallic conduit does not impair cable in free air outside of the conduit. Also, enclosing a cable in a glass fabric (Siltemp) will provide protection for the cable against an external electrical fire or protect external cables against a fault occurring on the wrapped cable.

Based on the above:

1. Spacing of cable trays of different divisions can be reduced to 1 ft horizontally and vertically if the area is protected by an automatic fire suppression system because it is proven by test that a 1-ft distance is adequate separation without any fire protection. The automatic fire suppression system constitutes a safety margin that prevents the electrical fire from becoming an exposure fire.

2. Separation of two divisions of cable on the same stack of trays can be attained with a solid bottom tray installed at the bottom of one division and a solid cover installed at the top of the other division at the interface between the two divisions with a minimum of 1 inch air gap between the two metal covers. The Wyle test has proven that one metal cover is sufficient. Safety margin is provided by the use of two covers and an air gap.

3. Use of Siltemp to wrap one division only is proven adequate by the Wyle test.

4. Non-metallic, fire retardant-type barriers can be used for those separation applications where the required air gap space for a metallic barrier is not available (a metallic barrier requires a 1 inch air gap on each side).

Because installation of raceway and cable barriers is imminent, concurrence with the enclosed FSAR change is requested by November 21, 1984.

Sincerely,

J. E. Booker

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and at the standby cooling towers, where separation between divisions is also maintained.

All the preceding equipment items are located within Seismic Category I structures. Fire extinguishing systems are identified in Chapter 9.

8.3.1.4.2 Class 1E Electric Equipment Arrangement

→ INSERT 1

13 | Redundant electrical equipment and wiring for the RPS, nuclear steam supply shutoff system (NSSSS), and the ESF functions are physically separated, electrically independent, and are located such that no single credible event is capable of disabling redundant equipment which would prevent reactor shutdown, removal of decay heat from the core, nor which would prevent isolation of the containment in the event of an accident. Separation requirements were applied to control, power, and instrumentation for all systems concerned. Rules governing separation apply equally for Class 1E to Class 1E, and for Class 1E to non-Class 1E systems. In addition, the distance between the electrical portions of the HPCS and RCIC systems 13 | is maximized within the space available to ensure the functional availability of high pressure water for core cooling immediately following a transient.

Arrangement and/or protective barriers are such that no locally generated force or missile can destroy any redundant RPS, NSSSS, or ESF functions. Arrangement and/or separation barriers are provided to ensure that such disturbances do not affect both HPCS and RCIC.

Arrangement of wiring/cabling is such as to eliminate, insofar as practical, all potential for fire damage to 13 | redundant cables and to separate the RPS, NSSSS, and ESF divisions so that fire in one division will not damage another division. In addition, arrangement of wiring and cabling of the HPCS and RCIC systems ensures that both systems are not disabled by a single fire as described in Chapter 9. The following general rules were followed:

REPLACE WITH INSERT 2

13 | 1. Routing of Class 1E control, power, and instrumentation cables through rooms or spaces where there is potential for accumulation of large quantities (gallons) of oil or other combustible fluids through leakage or rupture of lube oil or cooling systems is avoided. Where such routing is 13 | unavoidable, only one division of Class 1E cabling is allowed in any such space.

2. In any room or compartment, other than the cable chases, in which the primary source of fire is of

an electrical nature, cable trays of redundant systems have a minimum horizontal separation of 3 ft if no physical barrier exists between trays. If a horizontal separation of 3 ft is unattainable, a fire-resistant barrier is installed, extending at least 1 ft above (or to the ceiling) and 1 ft below (or to the floor) line-of-site communication between the two trays. Totally enclosed metallic raceway is occasionally used in lieu of barriers at least 1 inch under open cable trays, to a point where the minimum separation is again maintained. Totally enclosed metallic raceway of redundant systems maintains a minimum separation distance of 1 in.

3. In any room or compartment, other than the cable chases, in which the primary source of fire is of an electrical nature, cable trays of redundant systems have a minimum vertical separation of 5 ft between vertically stacked trays of different divisions, or trays of different divisions one above the other; however, vertical or cross stacking of trays is avoided wherever possible. In cases where the redundant trays must be stacked or crossed one stack above the other, and when the trays do not meet the 5-ft vertical separation requirement, a fire barrier is installed between the redundant trays. The barrier extends beyond either side of the tray system, in accordance with IEEE-384. Occasionally, totally enclosed metallic raceway (e.g., conduit) is used in lieu of barriers in the following cases:

   a. Class 1E ladder type cable trays are fitted with protective metal covers wherever 480 V ac non-Class 1E cabling or 480 V ac Class 1E cabling of a different division than the subject trays is routed in conduit within 1 in. of the subject trays. 13

   b. Low voltage (120 V) power, control, and instrumentation cabling, when routed in close proximity to Class 1E ladder type cable trays, is routed in conduit and maintains at least 1-in. separation.

   c. River Bend Station does not route Class 1E or non-Class 1E 4.16 kV/13.8 kV cabling in conduit that is in close proximity to Class 1E

ladder type trays, except to exit cables from the subject tray.

13 d. Totally enclosed metallic raceway of different Class 1E divisions maintains a minimum separation distance of 1 in. Conduits containing cables of different Class 1E divisions which perform the same redundant safe shutdown functions are not routed in close proximity to one another.

13 4. Any openings in fired-rated floors or walls for vertical or horizontal runs of Class 1E cabling are sealed with fire-resistant material of equal fire rating.

The minimum horizontal and vertical separation and/or barrier requirements in the cable chases are as follows (NOTE: There are no cable spreading rooms in RBS):

1. Where cables of different divisions approach the same or adjacent control panels with vertical spacing less than the 3-ft minimum, at least one division's circuit is run in totally enclosed

metallic raceway or a barrier is provided to a point where 3 ft of separation exists.

2. A minimum horizontal separation of 1 ft is maintained between trays containing cables of different divisions where no physical barrier exists between trays. Where a horizontal separation of 1 ft is not attainable, either a fire-resistant barrier is installed extending at least 1 ft above (or to the ceiling) and 1 ft below (or to the floor) line-of-sight communication between the two trays or totally enclosed metallic raceway is utilized to meet separation requirements.

3. Vertical stacking or crossing of trays carrying cables of different divisions is avoided wherever possible. Where this is not possible, however, there is a minimum vertical separation of not less than 3 ft between trays of redundant systems.

4. If vertical stacking or crossing of redundant trays is necessary and the minimum 3-ft vertical separation cannot be maintained, a fire barrier is installed between the redundant trays. The barrier extends 1 ft on each side of the tray system. Totally enclosed metallic raceway is used in lieu of the barrier, with open cable tray, to a point where the minimum separation is maintained. Totally enclosed metallic raceways of redundant systems maintain a minimum separation of 1 in.

An independent raceway system is provided for each Class 1E division . The trays are arranged top to bottom based on the cable rated voltage.

1. 4.16-kV power (5,000-V insulation class)

2. Large 480-V power (600-V insulation class)

3. 480-V power (600-V insulation class)

4. Control (600-V insulation class)

5. Instrumentation cables (300-V insulation class)

Nonsafety-related, non-Class 1E electric systems generally have the same arrangement of cable trays with the addition of a cable tray position for 13.8-kV power (15,000-v insulation class) occupying the uppermost tray position.

INSERT 1

The arrangement of Class 1E electrical equipment is designed to meet IEEE 279-1971 regarding redundancy and independence, BTP CMEB 9.5-1 regarding the ability to safely shutdown the plant in the event of an area fire and IEEE 384-74 as supplemented by Regulatory Guide 1.75 regarding the independence of Class 1E circuits in the event of an internally generated electrical fire. This section decribes the design features implemented and their bases.

INSERT 2

Protection of redundant systems, equipment and electrical cables against fire damage is in conformance with the guidelines for fire protection for nuclear power plants (branch technical position CMEB 9.5-1), which supplements Regulatory Guide 1.75 "Physical Independence of Electrical Systems" in determining the fire protection for redundant cable systems as follows:

Because fire may affect safe shutdown systems and because the loss of function of systems used to mitigate the consequences of design basis accidents under postfire conditions does not per se impact public safety, the need to limit fire damage to systems required to achieve and maintain safe shutdown conditions is greater than the need to limit fire damage to those systems required to mitigate the consequences of design basis accidents. Three levels of fire damage limits are established according to the safety function of the structure, system, or component:

Safety Function	Fire Damage Limits
Hot shutdown	One train of equipment necessary to achieve hot shutdown from either the control room or emergency control station(s) must be maintained free of fire damage by a single fire, including an exposure fire.
Cold shutdown	Both trains of equipment necessary to achieve cold shutdown may be damaged by a single fire, including an exposure fire, but damage must be limited so that at least one train can be repaired or made operable within 72 hours using onsite capability.
Design basis accidents	Both trains of equipment necessary for mitigation of consequences following design basis accidents may be damaged by a single exposure fire.

The most stringent fire damage limit should apply for those systems that fall into more than one category. Redundant systems used to mitigate the consequences of other design basis accidents but not necessary for safe shutdown may be lost to a single exposure fire. However, protection shall be provided so that a fire within only one such system will not damage the redundant system.

The objective set forth above is attained by implementation of the following measures for all Class 1E circuits. In addition see Section 9.5 for the evaluation and description of design features for BTP CMEB 9.5-1.

Arrangement of wiring/cabling is such as to eliminate, insofar as practical, all potential for fire damage to redundant cables and to separate the RPS, NSSSS, and ESF divisions so that fire in one division will not damage another division. In addition, arrangement of wiring and cabling of the HPCS and RCIC systems ensures that both systems are not disabled by a single fire as described in Chapter 9. The following general rules were followed:

1. Routing of a maximum of one Class 1E division in areas of high combustible loading. Routing of Class 1E control, power, and instrumentation cables through rooms or spaces where there is potential for accumulation of large quantities (gallons) of oil or other combustible fluids through leakage or rupture of lube oil or cooling systems is avoided. Where such routing is unavoidable, only one division of Class 1E cabling is allowed in any such space.

2. Horizontal separation or barriers between cables of redundant Class 1E systems sufficient to prevent degradation or ignition of the cables in one system by an internally generated fire in the other.

   Horizontal separation of 3 ft. is provided between exposed areas. In areas where automatic detection and suppression is provided, this is reduced to 1 ft. minimum based on Sandia Laboratory tests (SAND 77-1125C).

   If the above horizontal separation is unattainable, a fire-resistant barrier is installed, extending at least 1 ft. above (or to the ceiling) and 1 ft. below (or to the floor) line-of-site communication between the two trays.

   The purpose of the barrier material is to direct convective heat energy away from other raceways. Barrier materials include solid tray bottoms and covers, sheet steel with a 1 inch or more air spaces on either side or fire resistant board material such as 1/2 inch thick maronite with a low thermal conductivity or fire rated wrapping materials described in Section 9.5.

3. Vertical separation or barriers between cables of redundant Class 1E systems sufficient to prevent degradation or ignition of the cables in one system by an internally generated fire in the other.

Vertical separation of 5 ft. is provided between exposed raceways. In areas where automatic detection and suppression is provided this is reduced to 1 ft. minimum based on Sandia Laboratory tests (SAND 77-1125C).

Vertical or cross stacking of trays is avoided wherever possible. In cases where the redundant trays must be stacked or crossed one stack above the other, and when the trays do not meet the above vertical separation requirement, a fire barrier is installed between the redundant trays. The barrier extends beyond either side of the tray system, in accordance with IEEE-384. When solid tray bottoms and covers are used to establish the minimum separation between divisions, a minimum 1 inch clearance is required between the two metallic surfaces.

4. Cable in free air and in conduit must meet the following separation or barrier requirements. Where cable of redundant systems approach each other with space less than adequate to prevent ignition of cables of one redundant system by a fire in the cables of the other, either the cables for both systems are run in totally enclosed metallic raceway (solid tray with solid cover) until sufficient separation exists, or barriers as described above are installed. An alternate method is to enclose one division in a fire resistant material having a low thermal conductivity coefficient that acts as a thermal barrier (siltemp CH 36 silicon dioxide glass type fabric) based on Wyle Laboratory Test Report No. 46,287-1.

Totally enclosed metallic raceway of redundant systems maintains a minimum separation distance of 1 in. Occasionally, totally enclosed metallic raceway is used in lieu of barriers in the following cases:

a. Class 1E ladder type cable trays are fitted with protective metal covers wherever 480 V ac non-Class 1E cabling or 480 V ac Class 1E cabling of a different division than the subject trays is routed in conduit within 1 inch of the subject trays.

b. Low voltage (120 V) power, control, and instrumentation cabling, when routed in close proximity to Class 1E ladder type cable trays, is routed in conduit and maintains at least 1 in. separation.

c. River Bend Station does not route Class 1E or non-Class 1E 4.16 kV/13.8 kV cabling in conduit that is in close proximity to Class 1E ladder type trays, except to exit cables from the subject tray.

d. Totally enclosed metallic raceway of different Class 1E divisions maintains a minimum separation

distance of 1 in. Conduits containing cables of different Class 1E divisions which perform the same redundant safe shutdown functions are not routed in close proximity to one another.

5. Any openings in fired-rated floors or walls for vertical or horizontal runs of Class 1E cabling are sealed with fire-resistant material of equal fire rating.

6. To prevent a fire in a non-safety system from affecting two redundant divisional systems at the same time, the same means of separation described above is provided between non-Class 1E and Class 1E cabling with the following exceptions:

    1. Metallic conduit containing non-Class 1E circuits may run as close as 1 in from a divisional tray.

    2. Metallic conduit containing Class 1E circuits may run as close as 1 inch under or along the side rail on a non-Class 1E tray. Where a Class 1E conduit runs over a non-Class 1E tray, the tray should be equipped with a metallic cover extending 6 inches to each side of the centerline of the conduit.