Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:S:83:195

JAN 26 1983

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

ELECTRIC POWER SYSTEM, PRELIMINARY SAFETY ANALYSIS REPORT (PSAR)
SECTION 8

Enclosed is additional information on the Clinch River Breeder Reactor Plant electric power system. The revised PSAR pages will be incorporated into a future amendment.

Sincerely,

John R. Longenecker

John R. Longenecker
Acting Director, Office of
Breeder Demonstration Projects
Office of Nuclear Energy

3 Enclosures

cc: Service List
Standard Distribution
Licensing Distribution

D001
s
1/40

ENCLOSURE

ITEM: Separation of associated non-1E equipment and clarification of items other than cables to be separated.

(See item 12 e) in letter HQ:S:82:119, dated November 2, 1982, for discussion of the NRC concern.)

RESOLUTION: See attached mark-up of Question/Response CS430.10 and PSAR Section 8.3.1.4.

Question CS430.10 (8.3.1)(8.3.2)

Section 8.3.1.2.14 of the PSAR indicates that physical separation of circuits and equipment comprising or associated with the Class 1E power system, Class 1E protection systems and Class 1E equipment, will be in accordance with criteria set forth in paragraph 8.3.1.4 of the PSAR. Separation criteria described in Sections 8.3.1.2.14 and 8.3.1.4 of the PSAR is not clear and does not meet the guidelines of IEEE Standard 384 and Regulatory Guide 1.75. For example, the PSAR indicates that non-Class 1E cables in panels will be separated from Class 1E cables so that they will not provide a combustion path between different divisions. Section 5.6.5 of IEEE Standard 384-1974 states that non-Class 1E cables shall be separated by six inches or a barrier. In general no criteria has been described for separation of Class 1E and non-Class 1E cables. Other examples include: (1) no criteria for separation between cables trays and conduits of another division, (2) confusing criteria for the separation of the third division (the design indicates there are three divisions but only two redundant divisions. Separation criteria refers to only two redundant divisions in many cases versus the three divisions), (3) confusing definition for associated cables, (4) no criteria for separation between associated cables and non-Class 1E cables, and (5) no criteria before and after an isolatoin device. Revise your PSAR description of physical separation of circuits to comply with the recommendations of IEEE Standard 384-1974 and guidance of R.G. 1.75 or justify noncompliance.

Response:

The CRBRP physical separation design criteria is fully consistent with the guidelines set forth in IEEE Standard 384-1974 and Regulatory Guide 1.75.

The PSAR Section 8.3.1.4 has been revised to further clarify consistency with IEEE Standard 384-1974 and Regulatory Guide 1.75 for the following items:

INSERT 1

1. Separation of Class 1E and non-Class 1E cables and circuits within control board and other panels.
2. Separation of Class 1E and non-Class 1E cables and circuits.
3. Separation between cable trays and conduits of another division.
4. Criteria for the separation of third division.
5. Criteria for separation between associated cables and circuits and non-Class 1E cables and circuits.
6. Separation criteria before and after an isolation device.

Insert 1

CRBRP separation criteria includes requirements for separating each of Safety-Related Divisions 1, 2 and 3 from each of the remaining Safety-Related Divisions in accordance with IEEE Standard 384-1974 and Regulatory Guide 1.75. Items being separated on these bases include Class 1E and associated cabling, circuits, equipment, raceways, and systems.

8.3.1.2.28 IEEE Standard 387 - 1977

The Standby AC Power Supply conforms to IEEE Standard 387-1977 which includes requirements for capability rating, independence, redundancy, testing, analyses, quality assurance, and identification.

8.3.1.3 Conformance with Appropriate Quality Assurance Standards

Assurance that equipment and workmanship quality is maintained throughout the construction process is provided by conformance to IEEE Standard 336 - 1971, "Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations". The methods used to accomplish conformance are described by construction procedures and instructions and in Chapter 17.0 of this PSAR.

8.3.1.4 Independence of Class 1E Systems

The following criteria is used to preserve the independence of Class 1E system.

INSERT 1

A. General Separation of Cables and Circuits by Voltage Class

A raceway contains cables of only one class. Classes are based on the nominal utilization voltage of the cable and/or vulnerability to spurious signals.

Voltage Classes are:

15KV Class - 13.8KV AC nominal power
5KV Class - 4.16KV AC nominal power
600V Class - 480-277 volt AC and 250 volt DC nominal power
Control - 120V/208V AC, 125V DC, 120V AC nominal power and control
Low level instrumentation including digital and analog signals

When cable trays are arranged in a vertical stack, the preferable arrangement is in order of voltage class, with the highest voltage at the top.

B. Cable Derating

Ampacity rating and group derating factors of cables are in accordance with the Insulated Power Cable Engineers Association Publication IPCEA-P54-440 and IPCEA-P46-426. Cables are selected to minimize deterioration due to temperature, humidity, and radiation during design life of the plant. Environmental type tests for the expected environments will be performed on all cables and terminations. The tests will include radiation exposure, heat aging, and electrical measurements to assure that the cable will function in the design environment for the required time. Cable derating as a result of fire stops/seals are included in the design.

Insert 1

CRBRP separation criteria includes requirements for separating each of Safety-Related Divisions 1, 2 and 3 from each of the remaining Safety-Related Divisions in accordance with IEEE Standard 384-1974 and Regulatory Guide 1.75. Items being separated on these bases include Class 1E and associated cabling, circuits, equipment, raceways, and systems.

C. Raceway Fill

Cable tray fill will be limited such that the summation of the cross-sectional areas of cables in a tray section will in general be not more than 40% of the usable cross-sectional area of that tray section.

Conduits will be sized for a maximum percent fill of the inside area of the conduit in accordance with NFPA 70 "National Electrical Code" Art. 346.

D. Sealing Raceway Blockouts and Wall and Floor Penetrations

Fire stops will be installed for cable trays wherever the cables pass through fire walls and floors other than the Reactor Containment vessel. Cable and cable tray penetrations of fire baarriers are sealed to provide protection at least equivalent to that required of the fire barrier. Penetrations are qualified to meet the requirements of ASTM E-119, and IEEE Std. 634-1978. The actual fire ratings of stops and penetrations are determined by fire hazards analysis.

Fire stops, fire barriers, and air seals will be constructed of mastic type materials or elastomer modular construction materials qualified in accordance with IEEE Std. 623 and ASTM E-119. Fire stop/seal material will be compatible with insulation and conductor materials and will be shock, vibration, seismic, and radiation resistant in accordance with the area(s) penetrated.

E. Physical Separation of Class 1E Cables and Circuits

The separation design description for raceways, Class 1E circuitry and associated cabling and circuits given below incorporates the requirements of IEEE Std. 384-1974, Regulatory Guide 1.6 and NRC Regulatory Guide 1.75.

Load groups, cables and raceways of a safety-related system will be separated from load groups, cables, or raceways of other safety-related groups in accordance with the separation criteria described herein. This separation criteria will preclude a single failure within the safety-related system from preventing proper protective action at the system level when required. Raceways and cables will be classified by separation groups, namely Class 1E Division 1, Class 1E Division 2, Class 1E Division 3, and Plant Protection System. For the purpose of physical separation criteria Class 1E Division 1, 2, and 3 are treated as redundant divisions.

Cables and circuits designated in each division will be run in raceways separated from cables and circuits designated in other divisions and from Non-Class 1E cables. Associated cables and circuits will be separated as if they were Class 1E pursuant to the Class 1E division associated with these cables and circuits.

Each division of Class 1E equipment of Divisions 1, 2 and 3 are located in separate rooms which are separated by a minimum of 3 hours rated fire barriers.

F. Separation Criteria between Class 1E and Non-Class 1E and Associated Circuits and Circuits

1. Separation of Cables Within Safety-Related Panels

Within safety-related control boards and panels the separation between wiring of redundant divisions or of non-Class 1E wiring from Class 1E and associated Class 1E wiring will comply with at least one of the following:

I) A minimum separation distance of 6 inches vertical and horizontal will be maintained where the control board or panel materials are flame retardant.

II) An analysis will be performed to determine the minimum separation distance. The analysis will be based on tests performed to determine the flame retardant characteristics of the wiring, wiring materials, equipment and other material internal to the control board or panel.

III) Barriers will be installed in the event the above separation distances are not maintained.

Within safety-related control boards and panels, non-Class 1E wiring is not harnessed with Class 1E or associated Class 1E wiring. Associated Class 1E wiring is harnessed with Class 1E wiring of the same division.

2. Separation of Class 1E and Non-Class 1E Cables and Circuits

All Class 1E and non-Class 1E cables will be routed in raceways consisting of cable trays and conduits. Each raceway will contain cable(s) of one Class 1E safety division or a non-class 1E system only. For the purpose of cable and raceways, the plant areas have been divided into six (6) separation zones as described in Section 8.3.1.4.

3. Separation Between Cable Trays and Conduits of Another Division

A Class 1E conduit will contain circuits of only one load division. In non-hazard zones exposed Class 1E conduits are separated from trays of another division as described in Section 8.3.1.4E. In all other separation zones the Class 1E conduits are not routed with trays of another division.

4. Criteria for the Separation of Third Division

The Class 1E electrical distribution system consists of three Class 1E divisions (Division 1, 2 and 3). Each of these divisions is designed to have physical and electrical independence from the other two divisions as described elsewhere in this section. Each of these divisions is provided with an onsite (standby) diesel generator and has the capability to shutdown the plant safely. However, from the consideration of connected loads, Class 1E

Divisions 1 and 2 provide power to redundant load groups and as such are described as redundant divisions in Sections 8.1.2 and 8.3.1.1. Class 1E Division 3 provides power to heat removal system of Loop 3 and to important non-Class 1E loads through an isolation subsystem. Class 1E Division 3 as stated above has the capability to shutdown the plant safely; however, since all the loads powered from this division are not similar or identical to those powered by Division 1 or 2, this division has not been identified as redundant to Division 1 or 2.

5. Criteria for Separation Between Associated Cables and Non-Class 1E Cables and Circuits

The associated circuits as defined in paragraph 4.5 of IEEE Standard 384-1974 will be considered as Class 1E cables and circuits for the purpose of their routing and installation. The separation criteria between associated cables and non-Class 1E cables is the same as described in Item 2 above for the separation between Class 1E and non-Class 1E cables. These cables, once identified as associated with a safety division, will be routed and installed in a raceway of that division. Each associated cable will be uniquely identified as described in Section 8.3.1.5.

6. Separation Criteria Before and After an Isolation Device

The cables and circuits before an isolation device are Class 1E circuits and ~~are routed in Class 1E circuits and~~ are routed in Class 1E raceway system in accordance with criteria described in Item 2 above for physical separation of Class 1E cables. The cables and circuits after the isolation device are considered non-Class 1E cables and are routed in non-Class 1E raceway system.

The minimum separation maintained between cables and circuits of each division varies according to cable location with respect to potential hazards. The design intent is to provide separation greater than the minimum listed where consistent with a practical plant layout. Six general classifications of hazard zones or areas are defined for electrical separation consideration:

I. Non-Hazard Zones

Areas in which the only potential hazard is a fire of an electrical nature.

II. Fire Hazard Zones

Areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible materials as defined in PSAR Section 9.13.1.

III. Equipment Hazard Zone (Pipe Break Hazard Zone)

Areas in which a potential hazard could exist as a consequence of postulated pipe break events in high energy lines.

ENCLOSURE

ITEM: Impact of Rotating Equipment Failure

(See item 12 i) in letter HQ:S:82:19 dated November 2, 1982, for discussion of the NRC concern.)

RESOLUTION: See attached mark-up of Question/Respnse CS430.14 and PSAR Section 8.3.1.4.E, Equipment Hazard Zone.

Question CS430.14

Separation between redundant raceways as defined in the PSAR takes into consideration the presence of rotating equipment, monorails, and equipment removal paths and the possibility that heavy equipment could be lifted and dropped and possibly cause failure of two raceway channels. Minimum separation between the two raceway channels is to be such as to preclude failure of both channels. Current regulatory guidelines, however, requires protection of each raceway as well as separation so that the dropped equipment will not cause failure of either raceway. An alternative to protection would be a design that provides an additional two independent systems each capable of shutting down the reactor and separated such that neither will be affected by the "dropped equipment" or failure of rotating equipment. Indicate compliance with the above guidelines in the PSAR or describe and justify an acceptable alternative.

Response

The routing of the safety-related raceways of CRBRP is such that any "dropped equipment" will not result in a failure of any of these raceways.

The CRBRP raceway design is in full compliance with IEEE Standard 384-1974 as supplemented by Regulatory Guide 1.75.

In addition, the safety systems design for CRBRP includes three physically and electrically independent divisions, each capable of shutting down the reactor. Equipment of each of these divisions, are located and cables are routed in separate plant areas such that failure of rotating equipment will not cause failure of more than one safety division.

The PSAR Section 8.3.1.4 has been revised.

INSERT 3

INSERT 2

Insert 2

The likelihood of rotating equipment missile damage to Class 1E equipment* is minimized or eliminated by one or a combination of the following:

i) Qualification of Non-Class 1E and Class 1E rotating equipment to prevent missiles during the worst case seismic event (which envelopes normal operating conditions) for that rotating equipment.

ii) Segregate rotating equipment from Class 1E equipment.*

iii) Provide missile protection by walls or barriers for the Class 1E equipment.*

iv) Provide redundant equipment* necessary to meet the single failure criterion.

*Equipment is construed here to include equipment, circuits, cabling, raceways, systems, etc.

See PSAR Section 3.5 for additional information on missile protection.

Insert 3

Division 3 cables within the control room and upper cable spreading room areas are routed in raceways embedded in concrete floors and walls up to the point of entry to the Division 3 panels. There are no Division 3 cables or raceways in either the upper cable spreading room or the lower cable spreading room.

In Non-Hazard Zones, a minimum horizontal clear space of three feet is maintained between cable trays of different divisions as shown in Figure 8.3-6. If a horizontal clearance of less than three feet is unavoidable, a fire barrier is provided between the divisions as shown in Figure 8.3-6.

Vertical stacking of cable trays of different divisions is avoided wherever possible. Where cable trays of different divisions are stacked vertically, a minimum clear space of five feet is provided between the divisions as shown in Figure 8.3-6. If a vertical clearance of less than five feet is unavoidable, a fire barrier is provided between the divisions as shown in Figure 8.3-6.

Fire Hazard Zones

In fire hazard zones, Class 1E conduits, trays, wireways or raceways of only one safety division are routed. This division is suitably protected by fire barriers and fire protections systems to mitigate the effects of fire in this zone on the safety function of the other safety groups.

Equipment Hazard Zone (Pipe Break Hazard Zone)

To the extent practical, Class 1E cables are routed in areas remote from high energy piping or areas of potential sodium fires; if unavoidable, the following precautions are taken:

a) CRBRP has three (3) Class 1E Divisions with complete physical separation between divisions. Any damage to cable trays caused by pipe whip missles, jet impingement, or environmental effect will be limited to the same safety division to which the pipe belongs, and the two other divisions capable of safety shutting down the plant will remain unaffected.

   Additional protection will be provided against any single Class 1E Division cable tray damage due to high energy pipe whip missiles by restraint of high energy pipe lines in the vicinity of Class 1E raceways. The design of restraints and/or barriers will be determined by analysis to meet BTP APCSB 3-1.

b) Redundant Class 1E circuits are routed or protected such that a postulated event in one system and division cannot preclude the operation of the other redundant system or division.

c) In all areas of the plant, the separation between redundant Class 1E cable raceways takes into consideration the presence of rotating equipment, monorails, equipment removal paths and dropped equipment such that failure of rotating equipment will not cause failure of more than one safety division and any dropped equipment will not cause failure of any safety-related raceways.

INSERT 2

d) In general, Class 1E electrical distribution equipment (e.g., switchgear, motor control centers, etc.) is not located in areas where high energy piping or other similar hazards are located.

Insert 2

The likelihood of rotating equipment missile damage to Class 1E equipment* is minimized or eliminated by one or a combination of the following:

i) Qualification of Non-Class 1E and Class 1E rotating equipment to prevent missiles during the worst case seismic event (which envelopes normal operating conditions) for that rotating equipment.

ii) Segregate rotating equipment from Class 1E equipment.*

iii) Provide missile protection by walls or barriers for the Class 1E equipment.*

iv) Provide redundant equipment* necessary to meet the single failure criterion.

*Equipment is construed here to include equipment, circuits, cabling, raceways, systems, etc.

See PSAR Section 3.5 for additional information on missile protection.

ENCLOSURE

ITEM: Cable Spreading Room/Fire Protection

(See item 12 h) in letter HQ:S:82:119, dated November 2, 1982, for discusion of the NRC concern.)

RESOLUTION: See attached mark-up of PSAR Section 8.3.1.4.E, Cable Spreading Rooms.

e) In general, no Class 1E raceways are installed in equipment hazard zones or potential missile areas. Where this is not practical, only one Class 1E division is installed in the area.

f) In all areas, Class 1E raceways of adequate construction are installed so as to minimize or eliminate the possibility of damage due to potential missiles or pipe whip. The damage potential of the missile or pipe whip is evaluated, and the physical separation between different safety division raceways is specified accordingly or the raceways are relocated. When physical separation is not practical, appropriately designed barriers are installed between redundant raceways. The separation of redundant Class 1E division circuits and equipment make effective use of inherent plant design features such as using different rooms or opposite sides of rooms or areas.

Cable Spreading Rooms

a) Two cable spreading rooms are provided, one above the Control Room for Division 1, ~~Division 3~~, and Non-Class 1E Division A and one below the Control Room for Division 2, and Non-Class 1E Division B. ← INSERT 3

b) Circuits routed in cable trays in the cable spreading rooms are limited to control and instrument functions. No power cables are routed through the cable spreading rooms or the control room.

c) The cable spreading rooms are protected against external missiles (there are no internal sources of missiles) such as high-pressure piping or rotating heavy machinery. The only potential source of damage to redundant division cables would be from fire generated by the cabling itself. A fire detection and suppression system is installed ensuring that potential for fire damage to cables is minimized in the cable spreading room.

~~d~~ A minimum clear separation of one foot horizontal and three feet vertical is maintained between trays carrying cables of different divisions. If the minimum horizontal or vertical separation does not exist, a fire-resistant barrier or covered cable trays without barriers are provided.

d~~e~~) There is no cable tray or conduit connection between the upper and lower cable spreading rooms.

Containment Penetration Areas

Three separate penetration areas are provided for all cables that must pass through the containment wall. Where possible, redundant Class 1E cables utilize electrical penetrations spaced horizontally rather than vertically. Cables through penetration of the primary containment are grouped such that failure of all cables in a single penetration will not

Insert 3

Division 3 cables within the control room and upper cable spreading room areas are routed in raceways embedded in concrete floors and walls up to the point of entry to the Division 3 panels. There are no Division 3 cables or raceways in either the upper cable spreading room or the lower cable spreading room.