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January 28, 1985
RBG- 19,998
File No. G9.23, G9.5

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

A revision to the River Bend Station (RBS) Final Safety Analysis Report (FSAR) discussion of the physical independence of electric systems is enclosed for your information. This revision will be included in a future FSAR amendment and supercedes that submitted by my letter of November 9, 1984 (RBG-19,413).

As previously discussed with your staff, Gulf States Utilities Company (GSU) is proceeding to conduct RBS specific tests to provide a positive basis for plant specific spatial separation. IEEE 384-1974, paragraphs 5.1.1.2 and 5.1.4, allows lesser minimum distances when substantiated by analysis (tests). Where the required spatial separation distances are not achieved, barriers will be used.

RBS specific tests will be conducted on unique configurations and to establish the applicability of previous tests. The tests will include overcurrent based on a single failure of the primary current device and the worst credible over current that can be sustained indefinitely. Test and analysis results will be applied where the separation of Regulatory Guide 1.75 could not reasonably be maintained. Margin will be established between the test results and that released for construction.

The requirements of IEEE 384-1975 are fully implemented for 5 and 15 kV cables and raceways. The reduced spatial separation distances are limited to 480Vac, 120Vac, 125Vdc control and instrumentation cables.

Technical bases for the proposed changes are provided as follows:

1. RBS cables have passed 400,000-Btu/hour flame tests in addition to the required 70,000-Btu/hour flame tests, both of which were conducted in accordance with IEEE-383. The 70,000 Btu/hour flame tests were also repeated with thermally aged and irradiated cables. For both tests, the RBS-specific

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cables were exposed to heat sources of the above magnitudes, and the cables self-extinguished upon removal of the heat source.

2. The RBS raceway and cable design maintains six service level classifications (13.8 kV, 4.16 kV, 480-V maintained spacing, low power 120 Vac, 125Vdc, 480 V control cable and instrumentation). In addition to the spatial separations imposed due to Regulatory Guide 1.75, the design reflects segregation and spatial separation of these service level classifications. These trays are installed with the highest energy level cables in the uppermost tray and with the descending levels of trays containing lower energy level cables. This configuration minimizes the effects of cable fires caused by internal electrical faults. Furthermore, the current tray-to-tray design reflects the use of barriers where the minimum distances of IEEE 384-1974 and RG 1.75 are not achieved.

3. Review of cable fire tests for other installations has shown that the success of the test is based primarily on the criteria used to size the cables. In addition to using IPCEA standards that reflect the ampacity deratings as a result of cable tray fill, cable configuration, ambient, and 125-percent margin, RBS has sized the cables considering voltage drop and the effects of cable temperature rise for a fault at the load. In regard to the latter, RBS has established minimum lengths for each power cable size based upon limiting the conductor temperature to 250 C under a 3-phase fault for the primary protective devices clearing time. This establishes design margin below a cable ignition temperature.

4. Reviews of NRC, INPO, and other data bases indicate frequent administrative (separation violations with no safety impact) and few cable failures that had adverse safety consequences. While individual cable failures related to installation damage or inservice degradation do occur, circuit protective devices and the self-limiting effects of open circuits historically have prevented individual cable failures from propagating. Cable overloads, except due to improper sizing, were not mentioned as a cause of cable fires, except in the affected cable. In those few cases where a cable burned, no mention is made of fire propagation.

5. Wyle test provided for Long Island Lighting Company (Reference Test Report No. 46,287-1) demonstrate the adequacy of spatial separations of less than 1 ft between adjacent cables and conduits. These tests also show the use of 180 mils of siltemp to be adequate to prevent damage to adjacent cables and conduits.

6. RG 1.75 was developed based on judgement. Subsequent NRC-sponsored Sandia tests (Reference Report No. SAND 77-1125C) demonstrate that an open tray separation of 10.5 in. vertically and 8.5 in. horizontally is adequate to prevent propagation of damage to adjacent cables by fires caused by excessive currents. These results demonstrate a margin in excess of 400 percent for the required distances.

In summary, we believe that the proposed criteria changes are conservative and in compliance with Regulatory Guide 1.75.

Sincerely,

Eddie R Grant

for J. E. Booker
Manager-Engineering,
Nuclear Fuels & Licensing
River Bend Nuclear Group

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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

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 redundant cables and to separate the RPS, NSSSS, and ESF 13 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:

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

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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

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Where spatial separation distances are less than those specified above in accordance with IEEE-384, RBS plant specific configurations were tested and analyses performed to justify reduced separation. Spatial separation and barrier requirements are shown on drawings 12210-EE-34ZE, ZH and ZJ, which are referenced in FSAR Section 1.7.

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.

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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 and 300-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.

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TABLE 1.8-1 (Cont)

Regulatory Guide 1.75, Rev. 2 (September 1978)

Physical Independence of Electric Systems

Project Position - Comply with the following exceptions:

1. Paragraph C.7

RBS concurs with the regulatory position in the context stated where a fault current could challenge upstream distribution systems. RBS uses distribution panel circuit breakers and branch circuit fusing to isolate the reactor protection system (RPS) non-Class 1E motor-generator (MG) power supplies from Class 1E instrumentation and control circuitry during normal operation. General Electric (GE), the NSSS vendor, has provided RBS with a separation review study to demonstrate compliance with Regulatory Guide 1.75, Revision 2. The study demonstrates that the Class 1E functions of the RPS are unimpaired for any credible event postulated affecting the electrical operation of same. The secondary (backup) RPS power supplies are Class 1E for reliability. The GE study also addresses the separation afforded these supplies. Fault currents will propagate no further than the RPS MG power supplies, thus affecting only RPS functions which are designed to perform their Class 1E functions upon loss of power. 11

2. Paragraph C.10

Cables installed in enclosed raceways (conduit) are not generally marked every 5 ft where they reside inside the raceway.

Class 1E cables which are installed in cable trays dedicated to 4160-V or large 480-V power circuits where spacing is maintained between cables installed in a single layer are identified at each end of the cable only. The high visibility of the single-layer cable installation facilitates verification of the cable and raceway separation requirements described in FSAR Section 8.3.1.4.

TABLE 1.8-1 (Cont)

3. Paragraph C.11

The intent of this position is met by the RBS design. However, it is necessary to initially consult design documents to establish the separation conventions used at RBS. Thereafter, no further reference material need be consulted. 11

FSAR Sections - 7.1.2, 8.3.1, 9.5.1, Appendix 9A.

4. Use of analyses based on test reports is made to substantiate separation less than that specified in IEEE-384. This reduced separation and use of barriers is shown on drawings 12210-EE-34ZE, ZH and ZJ, referenced in Section 1.7.