



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

January 18, 1994

Docket Nos. 50-259, 50-260
and 50-296

Dr. Mark O. Medford, Vice President
Technical Support
Tennessee Valley Authority
3B Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

Dear Dr. Medford:

SUBJECT: BROWNS FERRY NUCLEAR PLANT UNITS 1, 2, AND 3 - DENIAL OF EXEMPTION
FROM SECTION III.G OF APPENDIX R TO 10 CFR PART 50 AND REQUEST FOR
ADDITIONAL INFORMATION (TAC NOS. M85523, M85524, AND M85525)

By letter dated May 10, 1993, the Tennessee Valley Authority (TVA) requested an exemption for the Browns Ferry Nuclear Plant (BFN) from certain requirements of Section III.G.2.b of Appendix R to 10 CFR Part 50. This regulation requires, in part, that cables and equipment and associated non-safety circuits of redundant safe shutdown equipment be separated by a horizontal distance of at least 20 feet with no intervening combustible or fire hazards. TVA requested the exemption for Residual Heat Removal Service Water (RHRSW) circuits in the BFN Intake Pump Station which do not satisfy this requirement.

The NRC staff has denied the requested exemption, as documented in the enclosed Safety Evaluation. The denial is based on the staff's conclusion that TVA's submittal did not provide reasonable assurance that the spacial separation of the redundant RHRSW cables would provide a level of fire protection to redundant safe shutdown functions equivalent to that required by the regulations. The staff also finds that TVA did not propose enhancements in fire protection defense-in-depth, such as improved administrative controls or quantifying the fire resistive rating of the installed Thermo-Lag fire barrier, which could provide an equivalent level of fire safety.

The staff's Safety Evaluation also discusses other concerns such as applicability of cable test results and the conservatism of the cable

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January 18, 1994

Dr. Mark O. Medford

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temperature acceptance criterion, and usage of an unapproved model for predicting fire growth and propagation. TVA should address these concerns if it chooses to submit a new exemption request.

Since the requested exemption has been denied, the staff requests that TVA provide additional information to describe what measures will be taken to ensure long-term compliance with Appendix R to 10 CFR 50 at BFN. This information should include the schedule for achieving Appendix R compliance. If appropriate, TVA should provide information consistent with that requested by Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," dated December 17, 1992. TVA is requested to provide this information within 45 days of the date of receipt of this letter.

Please contact Joseph F. Williams at (301) 504-1470 if you have any questions regarding this issue. This request affects nine or fewer respondents, and therefore is not subject to Office of Management and Budget review under P.L. 56-911.

Sincerely,

Original Signed by:
Steven A. Varga, Director
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

*see previous concurrence

OFC	PDII-4/LA	PDII-4/PM	PDII-4/PM	SPLB	PDII-4/D
NAME	BClayton	JWilliams	DTrimble*	CMcCracken*	FHebdon*
DATE	1/18/94	1/18/94	1/14/94	1/14/94	1/14/94
OFC	AD:RII	DRPE:D			
NAME	GLainas*	SVarga			
DATE	1/14/94	1/18/94			

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NRC & Local PDRs

BFN Reading

T. Murley/F. Miraglia

L. J. Callan, Acting

E. Rossi

J. Lieberman

S. Varga

G. Lainas

F. Hebdon

B. Clayton

J. Williams

D. Trimble

M. Gamberoni

C. McCracken

OGC

G. Hill (6)

ACRS (10)

OPA

OC/LFDCB

EDO Contact for RII plants

P. Madden

E. Merschoff, RII

P. Kellogg

J. Crlenjak, RII

Tennessee Valley Authority
ATTN: Dr. Mark O. Medford

cc:

Mr. Craven Crowell, Chairman
Tennessee Valley Authority
ET 12A
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. W. H. Kennoy, Director
Tennessee Valley Authority
ET 12A
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. Johnny H. Hayes, Director
Tennessee Valley Authority
ET 12A
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. O. J. Zeringue, Vice President
Nuclear Operations
Tennessee Valley Authority
3B Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Pedro Salas
Site Licensing Manager
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35602

Acting Vice President
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35602

Mr. B. S. Schofield, Manager
Nuclear Licensing and Regulatory Affairs
Tennessee Valley Authority
4G Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

BROWNS FERRY NUCLEAR PLANT

TVA Representative
Tennessee Valley Authority
11921 Rockville Pike, Suite 402
Rockville, MD 20852

General Counsel
Tennessee Valley Authority
ET 11H
400 West Summit Hill Drive
Knoxville, TN 37902

Chairman
Limestone County Commission
P.O. Box 188
Athens, AL 35611

State Health Officer
Alabama Department of Public Health
434 Monroe Street
Montgomery, AL 36130-1701

Regional Administrator
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW., Suite 2900
Atlanta, GA 30323

Mr. Charles Patterson
Senior Resident Inspector
Browns Ferry Nuclear Plant
U.S. Nuclear Regulatory Commission
Route 12, Box 637
Athens, AL 35611

Mr. T. D. Shriver
Site Quality Manager
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35602

Mr. D. E. Nunn, Vice President
Nuclear Projects
Tennessee Valley Authority
3B Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801



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ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

DENIAL OF EXEMPTION FROM SECTION III.G OF

APPENDIX R TO 10 CFR PART 50

BROWNS FERRY NUCLEAR PLANT UNITS 1, 2, AND 3

DOCKET NOS. 50-259, 50-260, AND 50-296

1.0 INTRODUCTION

By letter dated May 10, 1993, Tennessee Valley Authority (the licensee) requested an exemption from Section III.G of Appendix R to 10 CFR Part 50. The licensee requested relief from Section III.G.2.b in that it requires certain redundant trains of equipment located in the same fire area, where automatic fire detection and suppression are provided, to be separated horizontally from each other by 20 feet or more.

In their request, the licensee specifically requested the exemption for lack of separation between redundant Residual Heat Removal Service Water (RHRSW) Division I and Division II cables in the Intake Pump Station (IPS) on elevation 550'-0". These cables are routed through a corridor in close proximity, with a maximum horizontal separation distance of 9 feet and a minimum distance of 6 feet with a horizontal run of approximately 180 feet. The Division I cables are routed in conduits along the south wall and the Division II cables are located in a four cable tray stack configuration routed along the north wall. The conduits are enclosed in a Thermo-Lag fire barrier with a nominal thickness of 5/8-inch. The fire resistive rating of this fire barrier has not been determined. The corridor area is protected by an automatic fire detection system. This detection system actuates the water control valve for the pre-action sprinkler system installed in the area. The fire load in this area is 42,000 BTUs/sq. ft., which could produce a fire severity of 32 minutes.

The licensee, in their analysis, did not take credit for the Thermo-Lag fire barrier. The licensee applied the fire modeling techniques of the Electric Power Research Institute (EPRI) Fire Induced Vulnerability Evaluation Methodology (FIVE) and performed a multi-compartment analysis taking into account limited fire growth within the cable trays.

2.0 EVALUATION

Certain fire protection features are necessary in order to assure reactor safety and assure that the plant has the ability to remove decay heat and maintain shutdown conditions. The RHRSW is one of these systems. The Division I and Division II RHRSW cables of concern are located on elevation 550'-0" in the IPS. These cables are routed through a corridor in close proximity, with a maximum horizontal separation distance of 9 feet and a

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minimum horizontal separation distance of 6 feet with a horizontal run of approximately 180 feet. Division I is routed in conduits along the south wall and the Division II cables are located in a four cable tray stack configuration routed along the north wall. The conduits, routed along the south wall are enclosed in a Thermo-Lag fire barrier with a nominal thickness of 5/8-inch. The licensee has used Thermo-Lag fire barrier system in the intake pump structure to protect steel conduits which contain the RHRSW Division I cables. However, in lieu of qualifying the fire resistive capability of this barrier installation, the licensee has elected to treat this barrier as if it does not exist. The cables routed in the cable trays along the north wall are not IEEE 383 qualified. They are coated with Flammastic in an effort to improve the fire retardant properties of the cables.

The licensee did not demonstrate that the thermal characteristics of the plant specific cables were equivalent to the cables referenced in the analysis. The small-scale cable burn tests performed by Factory Mutual are bench tests that determine the critical heat flux for a cable. These tests provide limited data with regard to predicting fire propagation in the four cable tray stack configuration located in the area of concern. In addition, the licensee referenced a combustibility study conducted by Factory Mutual for EPRI. From this study, the licensee concluded that the critical temperature is related to the ignition temperature of the cable. The licensee is using 700°F as the critical temperature for cables in their analysis. This assumption is non-conservative relative to the short circuit temperatures of most cables. Most cables have short circuit temperature ratings in the area of 500°F. Therefore, cable functionality could be lost prior to cable ignition as a result of thermal degradation.

The licensee calculated the fire plume temperature and the ceiling jet temperatures using the calculation methods described in the FIVE methodology. In addition, the licensee evaluated compartment fire growth through the application of the Hazard I Code. This code has not been endorsed by the NRC for predicting fire growth and propagation conditions at nuclear power plants.

The staff is concerned that if a fire were to occur in the trays, it would develop a hot gas layer in the overhead of the room. This hot gas layer would intensify and the layer depth would continue to increase until the hot gases could be vented to other areas through open doorways and ventilation openings to the outside. In reviewing the available fuel and its configuration within this IPS area of concern, the staff concluded that the excessive fire temperatures would be concentrated in the room overhead above the door soffits. When postulating a fire in the cable trays, an increase in fire plume and ceiling jet temperatures at the ceiling level can be noted. In order to make a relative judgment about the fire conditions in this room, the fire plume and ceiling jet temperatures, the staff estimated these temperatures by using the FIVE methodology. A constant burn rate of 1181 Kw results in a postulated fire plume temperature in excess of 1600°F with a ceiling jet temperature, at 9 feet away from the center line of the fire plume, in the range of approximately 600°F.

In the staff's view, if a fire were to occur within this space, the installed Thermo-Lag fire barrier would be needed to provide passive fire protection for the RHRSW Division I cables until the sprinklers could actuate and final fire extinguishment could be accomplished by the plant fire brigade. Without a fire barrier enclosing one division of RHRSW cables, the diversity in fire safety is degraded. In addition, the licensee's analysis did not consider the potential hazards associated with the combustibility of the fire barrier material nor did it clearly establish a basis which demonstrates that 6 feet of horizontal spacial separation is sufficient to assure that one train of safe shutdown capability is free of fire damage. Since, the licensee elected in this request not to take credit for the RHRSW Division I fire barrier, they did not determine the fire resistive rating of this barrier. Without an engineering analysis that evaluates the installed configuration to acceptable tests, the barrier's ability to resist fire is indeterminate. Therefore, diversity in fire protection defense-in-depth has not been demonstrated.

Section III.G of Appendix R requires that automatic fire detection and suppression capability and a 1-hour fire barrier or 20 feet of combustible free spacial separation between redundant shutdown trains be provided in plant areas that do not meet the 3-hour fire barrier separation requirement. The licensee has not provided either the required spacial separation between the redundant RHRSW cable divisions or a qualified 1-hour fire barrier for one RHRSW cable division.

3.0 CONCLUSION

Based on this review, the staff finds that the spacial separation between the redundant RHRSW does not provide reasonable assurance that a postulated fire would not impact these safe shutdown functions. Therefore, due to the lack of separation and the unknown fire resistive rating of the installed barrier, the staff concludes that the level of fire protection provided for the RHRSW cables in the IPS does not provide an equivalent level of fire safety to that required by Section III.G of Appendix R to 10 CFR Part 50. The staff concludes, therefore, that the licensee's request for exemption is not acceptable and is, therefore, denied.

Principal Contributor: Patrick Madden

Dated: January 18, 1994