UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TIA 94-004 - WATTS BAR COMPLIANCE WITH REGULATORY GUIDE 1.75

WATTS BAR NUCLEAR PLANT

DOCKET NOS. 50-390 AND 50-391

1.0 INTRODUCTION

Region II Inspection Report 50-390, 391/93-74 documented inspection results regarding TVA's compliance with Regulatory Guide 1.75, "Physical Separation of Electric Systems." That inspection report raised two issues pertaining to: (1) the acceptability of electrical splices in enclosed raceways and (2) the adequacy of physical separation between conduits and open cable trays at Watts Bar Nuclear Plant.

The applicant provided a position for each of these issues in a December 17, 1993, letter. In a memorandum dated January 31, 1994 (TIA 94-004), Region II requested NRR to review these two issues and the applicant's positions, and to provide technical assistance.

2.0 EVALUATION

Before we respond to the two technical questions, it is necessary that we address the applicability of RG 1.75 to Watts Bar. From a regulatory standpoint, Regulatory Guide (RG) 1.75 is not applicable to Watts Bar Nuclear Plant since its construction permit was issued before the RG was issued. Although the applicant stated that the Watts Bar design basically meets RG 1.75 in response to FSAR Question 040.25, we interpret this to be a reference for technical discussion and not a legal commitment for compliance. Therefore, in the following discussion related to the two issues, RG 1.75 will be used only as a technical reference.

(a) Electrical Splices in Enclosed Raceways

(b) Electrical Splices in Flexible Conduits for Device Termination

As noted in Region II's inspection report, Watts Bar Engineering Specification G-38, "Installation, Modification, and Maintenance of Insulated Cables Rated Up to 15,000 Volts," Revision 12, permits the installation of electrical splices in flexible conduits where electrical device pigtail leads and pigtail extensions are terminated.

Staff guidance on the use of splices in raceways is contained in RG 1.75. Although Section 5.1.1.3 (original version) states that cable splices in raceways should be prohibited, the staff has not prohibited the use of splices in conduits or splicing boxes which are not generally considered to be part of the raceway system where a field cable is connected to the final device. The staff therefore finds the applicant's use of splices in flexible conduits for

device termination acceptable (as long as qualification is maintained) with no further documentation required.

(1b) Electrical Splices in the Raceway System

The staff is concerned about splices within raceways in general. This general concern was not raised within the inspection report, but has surfaced during our review of the applicant's December 17, 1993, letter. In that letter the applicant described two methods of splicing cables in open cable trays allowed by Watts Bar Standard Drawing SD-E12.5.9. The staff's prohibition against splices in raceways (cable trays, etc.) is centered on the prevention of fires caused by improper splices. If splices are used in raceways, then an analysis justifying their use should be made and documented in the plant's FSAR as recommended by Revision 1 to RG 1.75. Without an analysis, the use of splices in raceways is counter to the guidance of RG 1.75 as noted above.

The only discussion contained in the plant's current Final Safety Analysis Report (FSAR) encompassing the use of splices is found on Page 8.3-35 where waterproof splices are used for long conduit duct bank runs which can exceed standard cable reel length or require excessive cable pull tensions. This discussion was placed in the FSAR in response to a concern about splices in underground duct runs raised during the staff's licensing review of FSAR Amendment 63. Although not documented in the FSAR, the applicant stated during an August 7 and 8, 1991, meeting that splices are not permitted by the Watts Bar design basis to be installed in raceways. Since this verbal statement is counter to that permitted by SD-E12.5.9, resolution of our concern pertaining to the use of cable splices in raceways will be pursued under Section 8.3.3.1.4 of the Watts Bar SER which was considered closed but will now be reopened until acceptable justification (supported by analysis and documented in the FSAR) is provided by the applicant.

(2) Minimum Physical Separation Between Divisional Conduits and Open Cable Trays

(2a) Watts Bar Design Specification

As noted in the inspection report, Watts Bar General Design Criteria WB-DC-30-4, "Separation/Isolation," contains the design requirements pertaining to this issue. Section 4.1.2.2 states that:

> "A minimum separation of 1 inch is also required when a conduit of one division crosses or runs parallel to a cable tray containing cables of a redundant division, provided the tray portion has a cover or is solid on the side adjacent to the conduit."

Further Section 4.1.2.3 states that:

> "If the above separation requirements (Section 4.1.2.1 & 4.1.2.2) are not attainable, a barrier consisting of 1/2-inch minimum thickness of Marinite-36, Marinite I (or their equivalent) may be used between the raceways, provided the trays are enclosed as specified in Section 4.1.2.2.... As an alternate, a case-by-case analysis shall

be made to ensure that redundant Class 1E circuits are not degraded below an acceptable level."

Appendix C of WB-DC-30-4 provides the basis for the 1-inch minimum separation between a conduit and a cable tray containing redundant divisions when the portion of the cable tray adjacent to the conduit is solid. Additionally, Appendix C provides the rational (unsupported by analysis/test) for distances down to one inch when the tray is not covered. The appendix states that the metal conduit (twice as thick as a cable tray cover) used at Watts Bar is sufficient as a heat shield/sink to provide protection for cables contained in the conduit against the physical energy associated with a fault in an open cable tray located as close as one inch to the conduit. The appendix further states that the conduit thickness and the lack of sufficient oxygen needed to support combustion inside the conduit ensure that damage to cables in cable trays as close as one inch is unlikely if a fault should occur inside the conduit. Credit is also taken in the appendix for the fire detection/ suppression systems to minimize the propagation of a fire, for the use of fire-retardant material in specific cases, for certain cable passing vertical flame tests, and for the protection provided by primary breakers.

(2b) Staff Guidance

Staff guidance on the minimum physical separation between redundant conduits and cable trays is contained in RG 1.75. Sections 5.1.3 and 5.1.4 state where the minimum separation distance (as specified in RG 1.75) cannot be maintained, the redundant circuits should be run in solid enclosed raceways (cable trays, conduits, etc.) that qualify as barriers or other barriers should be provided with a minimum separation of one inch between enclosed raceways and between the barriers and raceways.

A quick comparison between RG 1.75 and the above sections of WB-DC-30-4 reveals several differences such as the use of a cable tray cover allowed by Section 4.1.2.2 versus a barrier or completely enclosed cable tray as recommended by RG 1.75. Also the use of a 1/2-inch of Marinite-36 or -I barrier without the additional one-inch air gap allowed in Section 4.1.2.3. These and other differences should be justified by analysis supported by actual test results as allowed by Section 5.1.1.2 of RG 1.75. As noted above, Section 4.1.2.3 of WB-DC-30-4 supported by Appendix C allows exceptions (such as no tray cover required between a cable tray and a conduit for separations down to an inch) to the separation requirements based on a case-by-case analysis without supporting test results.

(2c) Watts Bar FSAR

The plant's FSAR Section 8.3.1.4.2 states that there is no established minimum separation between open top nondivisional (non-Class 1E) cable trays and conduits containing redundant cables and that the applicant takes credit for fire-resistant cable coating installed prior to October 18, 1984, together with adequate circuit protective device(s) as meeting the intent of RG 1.75 to achieve independence between Class 1E and non-Class 1E cables routed in cable trays or conduits. Coating is not used after October 18, 1984, on cables which meet IEEE Standard 383-1974, "IEEE Standard for Type Test of Class 1E

Electric Cables; Field Splices, and Connections for Nuclear Power Generating Stations." Further, there is no discussion of separation distances between Class 1E open cable trays and conduits or reductions to the minimum separation requirements based on case-by-case analyses.

(2d) Staff's Safety Evaluation Report (SER) for Watts Bar

In Section 8.3.3.3 (3) of the SER for Watts Bar, the staff stated that separation between conduits and open-top cable trays was not described in the FSAR. In that section of the SER, the staff did accept minimum separation distances less than those recommended by RG 1.75 between non-Class 1E and Class 1E cable trays based on proper operation of protective devices. To ensure proper operation of those protective devices, the staff required high quality and periodic testing for the protective devices. There was no specific discussion in the SER pertaining to separation distances between redundant Class 1E cable trays/conduits.

In the December 17, 1993, response to this issue, the applicant referred to IEEE Standard 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," as providing guidance for separation distances between open cable trays and conduits. Although this revision to the IEEE standard has not been formally endorsed by the staff, our review indicates that it does provide guidance (with limiting assumptions) for minimum separation distances based on actual, credible test results. Unfortunately, as noted in the applicant's letter, WB-DC-30-4 allows minimum separation less than that supported by the IEEE standard. Therefore, the staff will open this issue under SER Section 8.3.3.3 to review the applicant's case-by-case justification (supported by analysis/tests) for deviation from RG 1.75 with further current industry guidance contained in IEEE Standard 384-1992 and its supporting documentation. The open item will initially focus on deviations related to separation distances between open cable trays and conduits but will be expanded to encompass other deviations from RG 1.75 should they arise.

3.0 CONCLUSION

The staff finds the applicant's use of splices in flexible conduits or other conduits/splicing boxes for device termination (as long as qualification is maintained) acceptable with no further documentation. There has been no staff prohibition against splices in enclosed raceways that are near the device and are not part of the general raceway system. The acceptability for this is based on the need for splices for terminations and the likelihood that a fire or poor connection resulting from a bad splice would only affect one device.

The staff is concerned about splices within raceways in general where fires caused by improper splices could affect surrounding cables and proper operation of their associated equipment. Justification (supported by analysis and documented in the plant's FSAR) will be requested from the applicant by separate correspondence, and will be reviewed by the staff under Section 8.3.3.1.4 of the Watts Bar SER.

The staff is also concerned about the applicant's deviation from guidance for physical separation between open cable trays and conduits contained in RG 1.75

and IEEE Standard 384-1992. The staff will request the applicant, by separate correspondence, to provide case-by-case justification (supported by analysis/tests) for any deviation from the guidance under review associated with Watts Bar SER Section 8.3.3.3. If other deviations from staff guidance arise, they will be included in that review.

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Dated: March 28, 1994