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MEMORANDUM FOR: Docket File

FROM: Peter S. Tam, Senior Project Manager
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

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SUBJECT: WATTS BAR UNIT 1 - ISSUES FOR DISCUSSION IN AN UPCOMING MEETING (TAC M89109)

The enclosed document is faxed to TVA today with the sole purpose to prepare its personnel for an upcoming meeting. While formal actions may result from the meeting, the document does not currently constitute a staff position or a request for additional information.

Docket Numbers 50-390

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AGENDA TOPICS PERTAINING TO ELECTRICAL SEPARATION AT WATTS BAR

1. In the response to NRC Question 1 contained in the enclosure to the TVA January 11, 1995, letter, two specific design provisions for cables in Seismic Category I structures at Watts Bar (WBN) are listed at the bottom of Page E-1. The following clarifications need to be provided:

   a. Provisions 1 and 2 start with the words "These cables." Does the use of this statement imply that all cables in Seismic Category I structures are encompassed by both provisions (that is the ICEA Flame Test and the IEEE Vertical Tray Test)? Discuss this apparent conflict with the information provided in the table above the listed provisions that implies two of the three types of cables had the ICEA flame test and the other cable type had the IEEE 383 test.

   b. Provision 2 states that "these cables either conform to IEEE Standard 383-1974 Vertical Tray Flame Test or are coated with a conformable flame retardant coating (Vimasco) that provides flame retardance equivalent to IEEE 383-1974." On Page 8.3-44 of the WBN FSAR, it is stated that "In all cable coating applications, up to 10 cables not qualified to the IEEE 383 flame test or equivalent may remain uncoated on cable trays, unless small gaps or cracks in the coating exist in the tray segment. In such cases, up to 9 cables not qualified to the IEEE 383 flame test or equivalent may remain uncoated." Discuss this apparent conflict.

   c. As noted in b. above, Provision 2 states that Vimasco provides flame retardance equivalent to IEEE 383-1974. While this may be true, it is not clear how the application of this flame retardant material at WBN affects the cable heating created by a sustained locked rotor/fault current. Discuss how Vimasco coated cables compare to non-coated cables used in the referenced tests for the other nuclear plants as specifically pertaining to maximum temperature assumptions and effects on test results.

2. In Enclosure 2 (first page) to the WBN July 29, 1994, letter, under the heading Conduit to Cable Tray, two Wyle Lab tests are cited as demonstrating the acceptability of a design where a conduit passes within one inch of an uncovered cable tray. The enclosure also contains tables which compare parameters of interest in determining the applicability of the two cited tests to plant configurations at WBN. However, these parameters appear to have only been compared one at a time instead of looking at the combined affect of all the parameters together to see if the tests bound the electrical separation criteria at WBN.

For example, one table compares cable sizes and largest locked rotor currents (LRA). The entry for 4/0 AWG cable shows a LRA of 912 amps (WBN), 1184 amps (BV2), and 1860 amps (NMP2). The statement above this table reads, "The cable sizing (i.e., LRA/conductor size) at WBN is clearly more conservative than at BV2 and/or NMP2." Looking only at the LRA magnitude listed in the table, one would agree with this statement. However, the assumption used to eliminate further testing of 4/0 AWG cable at BV2 was that the motor pigtails used with 4/0 cable (#2 AWG) would open circuit in 9.5 minutes and limit the amount of heat generated in the cable. Assuming WBN uses the same size motor pigtails with 4/0 AWG cable, the lower LRA at WBN means the 9.5 minutes used by BV2 must be adjusted to account for the longer time needed for the pigtails to open circuit. The correction factor is the square of the LRA ratio $[(1184/912)^2 * 9.5 \text{ min.} = 16 \text{ min.}]$. Referring to the graph of the BV2 heat rise test for 4/0 AWG cable, and looking at a point 16 minutes after LRA was applied to the test cable, one notes the 4/0 AWG cable had already ignited and was burning. Thus, a LRA of 912 amps may not necessarily be more conservative. Please address the potential for 4/0 AWG cables at WBN to ignite and burn prior to the largest size motor pigtails used with these cables causing an open circuit. This example for 4/0 AWG cable also applies to other cable sizes.

The table column of largest LRA for NMP2 in Enclosure 2 does not list the correct values for LRA currents at NMP2 . The values listed in the table are short circuit currents for NMP2. For example, the "Largest LRA" table lists 1860 amps as the LRA value at NMP2 for 4/0 AWG cables. The correct value from the test report is 746 amps. Thus, the statement that the cable sizing (i.e., LRA/conductor size) at WBN is clearly more conservative than at NMP2 does not appear to be correct.

The cited test reports used screening tests to determine worst case cables at BV2 and NMP2, and only these worst case cables were then tested further. Please discuss how these worst case screening tests apply to WBN and bound WBN separation criteria (utilizing actual cited test data where appropriate) addressing the following specific details: (1) pigtail sizes and fusing times; (2) LRA currents; (3) cable size at WBN which produces the most heat for LRA currents and pigtail fusing times appropriate to WBN configurations; (4) the potential for certain cable sizes at WBN to burn prior to a fault being cleared (e.g., a motor seizes and continues to draw LRA due to a failure of the first protective device); and (5) the type and size of target cables likely to be located in the nearest raceway.

3. There are missing values for some cable sizes in two tables of the July 29, 1994, submittal that compares cables used at WBN to the tested BV2 and NMP2 cables. Explain how WBN is more conservative than BV2 and/or NMP2 in light of this missing data.

4. In the January 11, 1995, response to the staff's question regarding extension of the 600-volt industry tests to WBN's 6.9 kV system, it was stated that the protective relaying will clear any and all faults before thermal effects propagate to another location. This conclusion,

however, was not supported with any quantitative analysis. The 600-volt industry tests generally indicate that the most severe challenge to target cables occurs when the fault cable ignites. Therefore, provide support for the position that 6.9 kV system protective relaying will clear any and all faults before thermal effects propagate to another location with a quantitative analysis of the effect of the fault on the faulted cable. Specifically, for the cases of a bolted three phase fault, a 1600 amp ground fault, and a motor locked rotor condition, provide an analysis indicating that these conditions will be cleared by the protective relaying (assuming that the circuit breaker nearest the fault fails) before the fault cable temperature reaches the ignition temperature of the cable insulation, the jacket material, or the filler materials. Industry tests on low voltage systems indicate that the locked rotor case will present the greatest challenge to the fault cable. The January 11 response indicated that the ground fault protection will actuate before there is any substantial damage to the fault cable for this condition. In this regard, an analysis should substantiate that the temperature rise of the cable will cause the dielectric strength of the cable insulation to deteriorate to the point that a sufficient magnitude of ground fault current will flow between conductor and sheath to actuate the second upstream ground fault protection and interrupt the locked rotor current before the cable reaches ignition temperature. Substantiation that this level of ground fault current will not burn through the sheath prior to opening of the second upstream interrupting device should also be provided.

5. Page E-7 of the January 11, 1995, WBN submittal states, "The ground overcurrent relays for the 6.9 - kV load feeder circuits are an electricalmechanical type used with a ground sensor current transformer which encircles all three conductors of the feeder cable." Does the ground shield of the feeder cables pass through the current transformers? Describe how the ground shield is terminated or continued in the vicinity of the current transformers.