TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

JAN 1 1 1995

U.S. Nuclear Regulatory Commission
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Washington, DC 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - ADDITIONAL INFORMATION CONCERNING ELECTRICAL SEPARATION REQUIREMENTS FOR WBN (TAC M89109 AND M89110)

This letter is TVA's response to the NRC request for additional information (RAI) dated August 22, 1994. The RAI asked seven followup questions based on the NRC staff's review of a letter from TVA dated July 29, 1994, which itself responded to a previous NRC staff question concerning WBN's electrical separation design criteria. The RAI primarily focuses on the applicability of industry testing that TVA cited as justification for WBN's electrical separation design criteria in the letter dated July 29, 1994.

The enclosure to this letter restates each question in the RAI and then presents TVA's detailed response to the question.

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If you have any questions about the information provided in this letter, please telephone John Vorees at (615) 365-8819.

Sincerely,

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Enclosure
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ENCLOSURE

WATTS BAR NUCLEAR PLANT
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
(LETTER DATED JULY 29, 1994)
ELECTRICAL SEPARATION

NRC QUESTION 1:

Enclosure 2 to the July 29, 1994, letter describes testing of electrical cable and raceway installations at other plants. Please provide a comparison between the cable materials used at WBN to the cable materials used in the test specimens cited in Enclosure 2 (e.g., cable manufacturer and flammability of cable materials).

TVA RESPONSE:

The electrical cables that were tested for Beaver Valley 2 and Nine Mile Point 2 conformed to IEEE Standard 383-1974. Beaver Valley 2's 600-volt power cable had EPR insulation with a CSPE jacket. Nine Mile Point 2's 600-volt power cable had EP insulation with a CSPE jacket. The tested cables for both Beaver Valley 2 and Nine Mile Point 2 were manufactured by Okonite.

Corresponding cables installed at WBN are from various manufacturers such as Rockbestos, Okonite, AIW, Anaconda, Essex, and Triangle. WBN's cables are of several different construction types which are summarized in the following table with a listing of the corresponding flame test.

TVA CABLE TYPE	DESCRIPTION	FLAME TEST
PJJ	PE/PVC - Polyethylene insulation with PVC jacket	ICEA Flame Test
CPJ/CPJJ	XLPE/PVC - Cross-linked polyethelene insulation with PVC jacket	ICEA Flame Test
PXJ/PXMJ	FRXLPE or FREPR/CSPE or CPE - Flame-retardant cross-linked polyethylene or flame-retardant ethylene propylene rubber insulation with chlorosulfonated polyethylene (Hypalon) or chlorinated polyethylene jacket	IEEE 383 Vertical Tray Test

The following specific design provisions apply to the cables in Seismic Category I structures at WBN.

1. These cables conform to ICEA S-19-81 Flame Test.

2. 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.

Cable coating was originally applied to exposed cabling at WBN that had been installed before October 1984. Since July 1988, only cables qualified to IEEE 383 have been installed in Seismic Category I structures. These newer cable installations are not routinely coated in view of their qualification pedigree. (Refer to Section 8.3.1.4.3 in WBN's Final Safety Analysis Report (FSAR) for further information.)

Based on the above comparison, TVA concludes that the cable test results for Beaver Valley 2 and Nine Mile Point 2 are applicable to WBN's electrical cables, which are either qualified to IEEE 383 or are coated.

NRC QUESTION 2:

Do all the installed Class 1E cables used at WBN conform to the flame tests in IEEE Standard 383-1974? If they do not, please discuss how the test results cited in Enclosure 2 are applied to any nonconforming cables.

TVA RESPONSE:

Refer to the response for Question 1. As noted in that response, some cables at WBN are not directly qualified to IEEE Standard 383-1974. However, in such cases, exposed cables are coated with Vimasco to provide flame retardance equivalent to IEEE 383-1974.

NRC QUESTION 3:

Are there any General Electric TEFZEL cables installed at WBN? The staff is concerned about TEFZEL cables because they failed initial tray-to-tray tests used to support electrical separation criteria at Clinton Power Station.

TVA RESPONSE:

No General Electric TEFZEL cables are used in Seismic Category I buildings at WBN. Electrical cable installation information from WBN's Computerized Cable Routing System indicates that a few TEFZEL-insulated cables, which were supplied by other vendors (such as Teledyne), are installed in WBN raceways. Additionally, a few cables with Teflon insulation were identified. Because of the similarities between Teflon and TEFZEL, the Teflon-insulated cables were also evaluated. The TEFZEL-insulated cables are used in low-energy instrumentation circuits and a few non-Class 1E control circuits.

Since WBN's TEFZEL-insulated cables are used only in low-energy circuits, they do not pose a credible threat to cables in adjacent raceways. In a reciprocal manner, the cables are not themselves threatened by adjacent instrumentation and control cables. The above conclusion is supported by Wyle Laboratories Test Report No. 48037 (performed for Comanche Peak Steam Electric Station), which documents successful separation testing of single-conductor TEFZEL-insulated cables that were used as switchboard wire and were connected to adjacent terminal block points.

TVA also considers that there is very little risk to plant safety from possible damage to TEFZEL-insulated or Teflon-insulated cables due to exposure to faulted power cables in adjacent raceways since only a small number (approximately thirty) of TEFZEL-insulated or Teflon-insulated cables are used in Class 1E circuits at WBN. Of the approximately thirty cables in this category, eight cables are designated as important to safety because their circuits monitor main turbine stop valve limit switches to initiate a reactor trip based on detection of a turbine trip. However, there is a redundant backup to this safety function that is performed by circuits using non-TEFZEL-insulated cables which monitor turbine auto-stop oil pressure. In addition to the redundancy of the circuits for detecting a main turbine trip, it is important to note that reactor-trip-on-turbine-trip is an anticipatory protective function. There are also safety-grade circuits that monitor main steam supply parameters and initiate protective actions if reactor-trip-on-turbine-trip does not occur.

The other 22 Class 1E TEFZEL-insulated cables are coaxial cables that are used for process radiation monitors and area radiation monitors. Failure of one of these cables due to the effects of a faulted power cable is highly unlikely since the faulted cable would have to be uniquely located in an open-top tray beneath the conduit containing the TEFZEL-insulated cable and the faulted cable's protective device would have to malfunction for it to become a threat. Even if such a set of circumstances did occur, it would only have safety significance if both the power cable and the TEFZEL-insulated radiation monitoring cable were associated with redundant paths for the same safety function. TVA considers the probability of such a coincidence to be negligible.

New Class 1E cable applications using TEFZEL or Teflon insulation are not anticipated because most of the applicable procurement documents have been superseded or revised to require cross-linked polyethylene or ethylene-propylene rubber insulation. Although TVA has no plans to do so, TEFZEL-insulated or Teflon-insulated cables could still be used within current procurement guidelines in a few specialty applications such as radiation monitor signal cables and internal switchboard wiring (not routed in raceways).

NRC QUESTION 4:

Please explain the following statement contained in WB-DC-30-4, Revision 13, Section 4.1.2.5, "Non-Class 1E circuits routed in Category I structures are evaluated in order to determine if they are to be classified as associated circuits...," in greater detail. Explain why this is necessary with examples of where it is applied.

TVA RESPONSE:

Section 4.1.2.5 of WB-DC-30-4, Revision 13, establishes WBN's basis for not specifying a minimum separation between non-Class 1E conduits and Class 1E raceways. Non-Class 1E cables in Seismic Category I structures are evaluated as associated circuits to verify that their protective devices meet the requirements for associated circuits, which are stated in Section 4.1.4 of WB-DC-30-4. This conservative approach of treating non-Class 1E cables as associated circuits assures that non-Class 1E cables are protected by reliable, properly sized fuses and/or breakers. Protecting each non-Class 1E cable itself from damage due to a fault current also provides inherent protection to adjacent cables. Refer to FSAR Section 8.3.1.4.3 for further information. Also, note that WBN's formal engineering calculations which demonstrate cable protection sizing to prevent auto-ignition and insulation damage have been satisfactorily reviewed on-site as documented in NRC Inspection Report No. 50-390/92-24 and 50-391/92-24, dated November 17, 1992.

NRC QUESTION 5:

In your discussion regarding the extension of the 600-volt industry tests to the 6.9-kV system at WBN, you stated that internal heating of the source (faulted) cable will cause dielectric breakdown and a ground fault before significant thermal propagation to target cables in adjacent raceways. Provide additional discussion on the basis for this statement, including the potential for the cable to ignite prior to tripping the secondary ground overcurrent protective device, and on the sensitivity (pickup) and time delay of the primary and secondary ground overcurrent protection.

TVA RESPONSE:

The discussion regarding extension of the 600-volt industry tests to WBN's 6.9-kV system indicates that the protective relaying will clear any and all faults before thermal effects propagate to another location. The following description of WBN's 6.9-kV system protective relaying is provided for further clarification.

The 6.9-kV secondary winding of each unit station service transformer and common station service transformer is wye-connected with its neutral point grounded through a resistor which limits ground fault current to a maximum of 1600 amperes. This neutral resistor prevents transient overvoltage on the winding which could occur in the event of a ground fault if the 6.9-kV system neutral point was not grounded. Since there is a deliberate ground current path, each 6.9-kV motor and transformer feeder circuit is protected by ground overcurrent relays which trip the circuit's feeder breaker in the event of a ground fault.

The ground overcurrent relays for the 6.9-kV load feeder circuits are an electromechanical type used with a ground sensor current transformer which encircles all three conductors of the feeder cable. With this arrangement, the sensor is not susceptible to errors caused by high in-rush currents during motor starting. The ground sensor relay operates instantaneously. It can detect ground fault currents as low as 5 amperes. The overall sensitivity and speed of this ground protection scheme are sufficient to limit the damage to the motor iron in the event of a ground fault. The ground fault current level of 1600 amperes has been successfully used in TVA projects for over 15 years. This fault current level was selected because it is large enough to ensure rapid detection of the fault and low enough to prevent excessive damage before the feeder breaker can open to clear the fault. The 6.9-kV load feeder circuits have backup ground fault protection at the incoming normal/alternate board supply set at 15 amperes with an inverse-time delay pickup characteristic.

WBN's 6.9-kV motors are protected on multiple phases by induction-type, inverse-time overcurrent relays that are specifically designed for protection of large motors. These relays have three individual contacts which respond to motor overloads, locked-rotor currents, and circuit faults. The motor overload contacts have inverse time-current characteristics with setpoints corresponding to approximately 1.15 - 1.40 times the normal full-load current. Time delay settings for the motor overload contacts are selected to allow normal motor starts. Actuation of the motor overload contacts is annunciated in the main control room. The locked-rotor contacts pick up instantaneously for currents above the overload range and trip the motor off-line after a short time delay to allow for motor starting. The fault contacts pick up instantaneously for currents greater than two times the locked-rotor current setting and trip the motor off-line. Inverse-time overcurrent sensors monitoring multiple phases provide a high degree of assurance that a fault will be detected and cleared without cable damage.

All phase-to-phase 50/51 or 51 relays in the 6.9-kV load feeder circuits have been shown by analysis to provide cable short-circuit protection up to 10 seconds. This prevents cable ignition for all levels of short-circuit current.

NRC QUESTION 6:

Also in your discussion regarding the extension of the 600-volt industry tests to the 6.9-kV system, you stated that dielectric breakdown of the insulation system would result in arcs internal to the cable (conductor shield which is grounded) and that these would be interrupted by either the primary or secondary ground overcurrent protection. Discuss the potential (prior to clearing by the secondary ground overcurrent protection) for the arc to burn through the shield and damage cable in conduit as close as 1 inch due to the indirect heating effects from the arc or the strike of the arc to the conduit.

TVA RESPONSE:

As described in the response for Question 5, the only anticipated dielectric breakdown and resultant arcing between the conductor and shield/ground is at the fault location. The response to Question 5 illustrates the probable mechanism of rapidly converting a ground fault into a line-to-line fault given failure of the multi-phase overcurrent relay. TVA considers fault current thermal conduction and convection to adjacent raceways to be insignificant since the fault clearing time for a 6.9-kV system breaker (i.e., a few cycles) is extremely rapid in comparison to the fault duration times that are typically used in industry cable testing (i.e., several minutes).

NRC QUESTION 7:

Section 4.1.1.3 of WB-DC-30-4, Revision 13, states where 1-foot vertical separation between tray-to-tray non-Class 1E to Class 1E is not possible, spacing may be decreased if adequate access for cable installation is maintained (typically 6 to 9 inches) and the top tray has a solid bottom or bottom cover. Enclosure 3 to the TVA letter cites Wyle Lab Report 17666-02, Configuration 4, as the industry source for this criterion.

That test configuration used a ventilated tray cover on the tray containing the faulted cable. Does WBN also use a ventilated tray cover for these plant configurations? If it does not, please justify this practice relating it to the tested configuration.

TVA RESPONSE:

WBN uses solid-bottom trays or ladder-back trays with solid (non-ventilated) bottom covers. This is conservative for the application in question based on the test results for the following configurations.

1. The Configuration 4 test in Wyle Laboratory Report 17666-02 (conducted for Beaver Valley 2) demonstrated the acceptability of a design with a single ventilated tray cover between two trays that were approximately 11 inches apart.

2. The Configuration 4 test in Wyle Laboratory Report 47906-02 (conducted for Nine Mile Point 2) similarly demonstrated the acceptability of a design without a tray cover between two trays that were approximately 9 inches apart.

3. In addition, the Configuration 4 test in Wyle Laboratory Report 17666-02 demonstrated the acceptability of a single ventilated tray cover with cables in contact with the cover.