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NOV 26 1993

U.S. Nuclear Regulatory Commission
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Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - REPLY TO NRC REQUEST FOR ADDITIONAL INFORMATION - CABLE TRAY AND RACEWAY FIRE BARRIER PROGRAM (TAC M63648)

The purpose of this letter is to reply to NRC's request for additional information and supplementary questions which were provided during the October 13, 1993, meeting between TVA and NRC to discuss fire barrier qualification efforts. Enclosure 1 provides a restatement of the individual information request items followed by its associated TVA response. Enclosure 1 also includes TVA's response to the three supplemental questions which arose during the meeting. These questions are restated followed by their associated response. Enclosure 2 describes the commitments made in this submittal.

If you should have any questions, contact P. L. Pace at (615)-365-1824.

Very truly yours,

William J. Museler

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Enclosures
cc: See page 2

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ENCLOSURE 1
WATTS BAR NUCLEAR PLANT (WBN)
REPLY TO REQUEST FOR ADDITIONAL INFORMATION
CABLE TRAY AND RACEWAY FIRE BARRIER PROGRAM

The following is in response to NRC's request for additional information provided during the TVA/NRC meeting on October 13, 1993, to discuss fire barrier qualification efforts.

NRC INFORMATION REQUEST ITEM NUMBER 1

TVA in their conduit testing program tested conduit air drops. These air drops transition from a conduit to a conduit, from conduit to cable tray and from cable tray to cable tray. One of the critical attributes of an air drop design is at the point where it penetrates or transitions into another fire barrier system (e.g., through the top of a cable tray fire barrier panel, or multiple cables exiting from a conduit and air dropping into multiple conduits). In reviewing your test program, it appears that your conduit testing program did not bound typical air drops which are generally used in nuclear power plant designs. TVA should explain how they intend to qualify and bound the typical air drop fire barrier systems being proposed for use at the Watts Bar facility. In addition, TVA should provide any engineering analysis that they have performed in support of typical field variances in the design and installation of the TVA tested Thermo-Lag fire barrier designs.

TVA RESPONSE

TVA's Thermo-Lag air drop designs are qualified by testing conducted at Omega Point Laboratories (OPL). The acceptable thermal and hose stream performance of the 5/8" + 3/8" TVA Thermo-Lag air drop designs qualified for use at WBN is documented in OPL test report number 11210-9455a submitted to NRC on July 9, 1993. The TVA air drop design is considered conservative because there was no cable tray thermal mass to lower the internal temperature of the air drop nor any cable tray to shield the air drop from the full effects of the test furnace. Additionally, the air drop was free standing with no mechanical support from a cable tray or internal cables (the only cable inside the air drop test assembly was the bare #8 AWG stranded copper conductor instrumented every 6" with thermocouples).

The air drop design qualified by TVA testing utilizes two pre-formed sections of Thermo-Lag material, exactly as used to protect small-diameter conduits. As described in TVA design standards, the joints where air drops enter cable trays (or junction boxes) are constructed in the same manner as the conduit/junction box joints qualified by testing. There were no failures experienced at this joint in any of the fire tests of TVA designs. Copies of the applicable tests were provided in TVA's July 9, 1993, submittal. Watts Bar will not utilize air drop configurations in which multiple cables pass from a single conduit to multiple conduits.

TVA design standards, design drawings, and installation procedures have been developed to require that the air drop installations conform to the tested configuration or be approved by engineering based upon appropriate engineering evaluation. Approved typical field variances are not specified in TVA's design standards, design drawings, or installation procedures. If a field variance is required during installation, the appropriate engineering evaluation will be conducted and the documentation made available for NRC review at WBN.

NRC INFORMATION REQUEST ITEM NUMBER 2

TVA indicated that they intend to use the Texas Utilities (TU) Comanche Peak Unit 2 Thermo-Lag cable tray fire barrier tests. TVA has not explained how they intend to apply the results of these plant-specific tests to the Watts Bar facility. TVA is requested to provide their engineering analysis which demonstrates applicability of the TU test results and demonstrates that the differences in cable construction (e.g., thermal damage properties of cable jacket and insulation material properties) will not have an affect on the functionality of the protected circuit.

TVA RESPONSE

TVA design standards and installation procedures have been developed to ensure that the installation of Thermo-Lag at WBN conforms to the acceptable configurations established by the following TU tests:

* TU-13-1, 12" x 4" straight tray (OPL report 12340-94367l)
* TU-12-1, 30" x 4" straight tray (OPL report 12340-94367i)
* TU-12-2, 24" x 4" tray with Tee (OPL report 12340-94367h)
* TU-14-1, 30" x 4" tray with Tee (OPL report 12340-94367m)

The above tests form the design basis, test documentation, and installation procedures for protecting cable trays with Thermo-Lag at Watts Bar. Watts Bar will be protecting 18" x 4" and 24" x 4" cable trays which are bounded by the above test configurations.

These tests were accepted since the TVA thermal acceptance criteria (i.e., average temperature rise on the cable tray side rail not to exceed 250°F and no single thermocouple temperature rise to exceed 325°F) and hose stream criteria were met. Under the test criteria approved by NRC for the TU tests, barriers meeting these criteria are considered to be rated barriers independent of cable type.

The cable trays were tested with some cable fill. This fill added an amount of mass to the tested assembly and acted as a heat sink. In order to ensure the TVA designs are bounded by the TU testing, the TVA design standard requires protected cable trays to have a minimum cable fill equal to or greater than the tested configuration.

NRC INFORMATION REQUEST ITEM NUMBER 3

At Watts Bar, 3M CS-195 fire barrier systems are installed. Please provide the details on how TVA intends to qualify these fire barrier systems. In addition, TVA should provide the fire barrier tests being utilized to qualify these barrier systems, summary of the installation methods used to install these barrier systems, physical dimensions of the cable tray and raceway this fire barrier material is used on, and drawings which identify typical designs for the various fire barrier installations to the staff for review.

TVA RESPONSE

Watts Bar uses CS-195 and M20A electrical raceway fire barrier systems. These systems are listed and classified in Underwriters Laboratories (UL) Building Material Directory. The systems were tested by UL in accordance with UL 1724. TVA is currently reviewing the test reports to determine the bounding configurations and develop the temperature profiles required to perform the Appendix B portion of UL 1724, Compression Load Testing. TVA will be performing the compression load testing and additional ampacity derating tests. This testing is currently scheduled to be completed by February 1994. The test results will be submitted for NRC review following test completion. Also, following completion of the testing, TVA will revise Nuclear Power Design Standards DS-M17.2.2, "Electrical Raceway Fire Barrier Systems" and DS-E12.6.3, "Auxiliary and Control Power Cable Sizing up to 15,000 Volts", and General Engineering Specification G-98, "Installation, Modification and Maintenance of Electrical Raceway Fire Barrier Systems" to document the requirements for installing 3M fire barrier systems. These documents will be available for NRC review at the WBN site or the TVA Rockville Licensing Office when completed.

The following UL fire test reports were provided to Watts Bar by 3M:

REPORT FILE NUMBER	REPORT DATE
R10125-1,2 (Project 82NK21937)	Oct. 19, 1983
R10125 (Project 82NK21937)	Nov. 2, 1983
R10125 (Project 82NK21937)	Jan. 19, 1984
R10125 (Project 82NK21937)	April 18, 1984
R10125 (Project 82NK21937)	August 7, 1984

In addition, 3M provided a copy of a fire test conducted by 3M (Test #84-10) which was witnessed by UL. 3M also provided copies of the following tests:

TYPE OF TEST	DONE BY	REPORT DATE	REPORT FILE NO.
Test Review	UL	Sept. 25, 1982	82NK21937
Surface Burning	UL	June 8, 1982	82NK9009
Ampacity	SWRI	Sept. 29, 1986	01-8818-208/209
Seismic	S & L	August 26, 1986	CQD No. 003576 Project 6661-00

The 3M fire barrier systems were installed per the 3M supplied Installation Manual for Interam Rigid Panel System M20A Mat and CS-195 Composite Sheet. The 3M systems were installed on cable trays (18" x 4"), conduits (3/4" through 5") and junction boxes. The typical drawings are included in the 3M installation manual. Any 3M currently installed on junction boxes will be removed and the junction box will be protected with Thermo-Lag.

TVA understands that the above information has been made available for NRC review by 3M. TVA is reviewing the above documentation to determine which can be used to support establishment of acceptable configurations at Watts Bar. If copies of the documents described above which are used to qualify Watts Bar 3M fire barriers are required for NRC review, they will be submitted with the results of the compression load and ampacity testing being conducted by TVA as described above.

NRC INFORMATION REQUEST ITEM NUMBER 4

Please identify the major findings and conclusions which can be derived from the TVA ampacity test data. Explain the scientific basis for the negative ampacity derating (i.e., Ampacity Correction Factor (ACF) > 1.0) test results reported in the TVA Final Report "Testing to Determine Ampacity Derating Factors For Fire Protected Cables For Watts Bar Nuclear Plant". Do these negative derating factors result from experimental errors or a flaw in the test methodology?

TVA RESPONSE

There were several observations made by TVA during the Thermo-Lag ampacity test program. The most significant was that elimination of the annular air space between the conduit outer surface and the inner surface of the Thermo-Lag can significantly lessen the impact of the barrier on ampacity. This was accomplished by pre-buttering the preformed sections of Thermo-Lag prior to placing it over the conduit as required by the TVA installation procedures. The effect of reducing the air gap can be seen from using the following formula.

$$R_{gap} := 0.012 n \cdot \rho_{air} \cdot \log\left(\frac{OD_{cnd} + 2 \cdot gap}{OD_{cnd}}\right)$$

where:
- R_{gap} - thermal resistance of the of the gap, in thermal ohms.
- **n** - number of enclosed conductors.
- OD_{cnd} - overall diameter of the conduit, in inches.
- **gap** - length of the gap, in inches.
- ρ_{air} - thermal resistivity of the air (approximately 4000 C°-cm/watt).

If the above relationship is evaluated for a Thermo-Lag protected 1" conduit containing a single 3/c #6 AWG cable, approximately 4.6 thermal ohms are added to the circuit (compared to the TVA design) for each 0.05" of air gap between the conduit and the barrier. Given that the total thermal resistance of the above configuration is approximately 20 thermal ohms, the effect of the gap can be significant (an approximate additional 10% derating for the first 0.05" of gap). By eliminating this gap, TVA significantly improved the ampacity performance of the system.

Ampacity correction factors in excess of 1.0 were unexpected, based on our observation of TU testing and on the original TSI results. Given the improved performance resulting from the elimination of the air gap as described above, the ACFs at or above 1.0 appear to be the result of the decreased thermal resistance from the Thermo-Lag to the air which more than offsets the increased thermal resistance due to the addition of the Thermo-Lag.

The Neher-McGrath expression for the thermal resistance from the surface to the surrounding air is shown below. As can be seen, the decreased thermal resistance is a function of the greater surface area presented by the wrapped conduit and the higher emissivity of the barrier material. In our testing, 1" conduits (with a nominal 1.32" OD) were wrapped with a 5/8" thick barrier (with the + 1/8" tolerance). The resultant new OD is approximately 2.8" with a corresponding increase in the surface area. Additionally, the surface emissivity of the dull white Thermo-Lag is well above that of a bare conduit. This further increases the systems ability to dissipate heat.

$$Re := \frac{15.6n}{Ds\cdot\left(\frac{dT}{Ds}\right)^{\frac{1}{4}} + 1.6\cdot\varepsilon\cdot(1+0.0167\,Tm)}$$

where: **Re** - the effective thermal resistance from the conduit (or Thermo-Lag) to the surrounding air.
Ds - the diameter of the conduit (or Thermo-Lag).
dT - the temperature difference between the surface of the conduit (or Thermo-Lag) and ambient air.
Tm - average surface temperature of the conduit (or Thermo-Lag) and the surrounding air.
n - number of conductors within the conduit.
ϵ - the emissivity of the conduit (or Thermo-Lag).

TVA noted that conduit tests performed with three conductors connected in series and powered single phase, as was required by both drafts 11 and 12 of P-848, do not produce meaningful results. The eddy currents and hysteresis losses in the conduit are of such a magnitude for this configuration (due to the incomplete cancellation of magnetic fields) that the test is more a measure of the cable-and-conduit ampacity than cable-in-conduit ampacity. The conduit losses are a function of the material properties of the steel used in its manufacture. As we noted in our response to your RAI dated May 5, 1993, those losses vary according to the following formula:

$$Cnd_{Loss} := \frac{1}{\sqrt{\mu \cdot \rho}}$$

where: Cnd_{Loss} - conduit loss factor.
ρ - electrical resistivity of the conduit.
μ - magnetic permeability of the conduit.

The parameters ρ and μ are not controlled by industry standards so that the magnitude of the losses (and thus the equilibrium currents and ACFs) are dependent upon the specific conduit segments selected for a test having this power supply arrangement.

Thus, TVA performed additional testing with alternate conductor/power supply configurations in order to reduce the conduit losses. Conduit surface temperatures during these latter tests were approximately 60°C (as compared to 80°C when connected per the draft standard) which was a result of a reduction in the above losses.

Ideally, both the baseline and wrapped tests would be performed on the same physical conduit specimen. However, when the fire barrier system contains components with long cure times (such as Thermo-Lag's trowelable grade material), this may not be practical. In this case, the conduits should be "matched" (i.e., from the same vendor).

Finally, TVA noted that the surface emissivity of the baseline conduit can significantly impact the final ampacity correction factor. As noted above, this parameter directly affects the thermal resistance from the conduit to the surrounding air. Since the final correction factor is a function of the tests performed on both a 1" conduit and a 4" conduit, these specimens should likewise be matched (from the same vendor). Controlling this parameter will further ensure that baseline testing will be repeatable from lab-to-lab.

TVA does not believe that the ACFs in excess of 1.0 were the result of experimental errors. While improvements in the test methodology were identified, as discussed above, alternate methodology was employed by TVA to obtain valid data.

<u>NRC INFORMATION REQUEST ITEM NUMBER 5</u>

Please explain how the Ampacity Correction Factors (ACFs) on Table 2 of the letter from William J. Museler, TVA, to NRC dated July 9, 1993 were derived based on the calculated derate values and the test results. Describe as cited in the subject letter how "calculated values based on the thermodynamic properties of the materials involved" were developed and used in the ACF methodology.

TVA RESPONSE

Because ACFs in excess of 1.0 were not originally anticipated, the results of our early tests caused us to revisit the basic ampacity relationships. Using the formulas given in the Neher-McGrath paper, mathematical models were constructed for bare 1" and 4" conduits. The models were evaluated to determine the allowable current for 3/c cables having standard ICEA diameters. By confirming that those calculated currents matched the ICEA published values, we were assured that our modelling methodology was correct. The model was then altered to evaluate cables having diameters equal to those under test, both with and without Thermo-Lag. The theoretical value of ACF for each configuration could then be compared with the test results and serve as a guide for the selection of the final ACF. The values chosen for inclusion in TVA's Electrical Design Standard DS-E12.6.3, "Auxiliary and Control Power Cable Sizing," bound both the tested and calculated ACFs to ensure a conservative margin is maintained.

NRC INFORMATION REQUEST ITEM NUMBER 6

Given the wide range of Ampacity Correction Factors found for the same configurations under different test methods (e.g., 3-Conductor test, 4-Conductor test, 24-Conductor test and 3-Phase test), which test method best represents the appropriate test method to meet the intent of IEEE Standard P848? For example, the configuration denoted by a Thermo-Lag 5/8 inch thickness had test results which indicate ampacity derating factors of -2% to -5% and 3% to -3% for the 4" conduit and 1" conduit, respectively, under the different test methods.

TVA RESPONSE

Based on the results of the TVA test program, TVA determined that three conductor single phase tests did not yield useful results due to the significant conduit heating which occurred. Aside from this factor, the greatest variation noted was the result of using multiple baseline conduits. Multiple baseline conduits were used in order to ensure that conduit effects were eliminated. No attempt was made to "match" the conduits used in the TVA tests. Thus, though the use of an even number of conductors (or three-phase power) may have sufficiently reduced the losses generated in the conduit, some conduit-to-conduit variations were still observed and ultimately became a factor in the decision to include margin in the selection of a final ACF. These variations may have been the result of the differing surface emissivities of the conduits.

Some of the variation is due to changes in cabling. In the 1" tests, the 4/c #6 AWG was replaced with a 3/c #6 AWG for the three phase tests. In the 4" tests, the 4-1/c 750 kcmil cables were replaced with 8-3/c #6 AWG cables. In both cases, the thermal resistance attributable to the insulation and jacket material changed and thus would have some impact on the resulting ACF.

Some variation from the single-phase to the three-phase tests may also be attributable to the criteria for current adjustment necessitated by the use of three individually adjustable power supplies in the latter test.

Using the 5/8" wrap as an example, the ACFs shown in Table 1 below were measured for each baseline conduit.

Table 1

ACFs for 5/8" Thermo-Lag per Baseline Conduit

	4/c	24/c	3-phase	max Δ
1" base No. 1	0.982	N/A	1.002	2%
1" base No. 2	N/A	N/A	1.027	N/A
4" base No. 1	1.073	1.069	1.049	2.4%
4" base No. 2	1.038	1.033	1.018	2%

From the above, it can be seen that when the results are evaluated for the specific baseline conduit utilized, the variation is minimal. Also, the variations are approaching the accuracy of laboratory measurements.

In summary, TVA has determined that either the 4/c or 24/c tests yielded acceptable results without the complexity introduced by trying to keep three individual power supplies synchronized. Therefore, they are the most representative tests.

NRC INFORMATION REQUEST ITEM NUMBER 7

Please explain why the Ampacity Correction Factor (ACF) of 0.93 is utilized for both the 5/8" and 3/8" + 3/8" Thermo-Lag thickness configurations given the wide range in test results and specimen weights (e.g. 3/8" + 3/8" configuration had 53% to 86% greater weight than the 5/8" configuration). Thermo-Lag 3/8" + 3/8" thickness configuration had test results which indicate ampacity derating factors of +8% to -3% and +3% to -2% for the 4" conduit and 1" conduit, respectively, under the different test methods.

TVA RESPONSE

As noted in the response to NRC Information Request Item 6, the 4/c and 24/c single phase tests were determined to be the most representative methodologies. Using the data from these tests, the lowest ACFs are shown in Table 2 below, both in the measured form and rounded to the nearest 0.01.

Table 2

Selection of Design Standard ACFs

TSI CONFIGURATION	LOWEST ACF	BASED ON	ACF ROUNDED TO NEAREST .01	DESIGN STANDARD ACF
5/8"	0.982	1" Conduit Set No. 1	0.98	0.93
3/8" + 3/8"	0.977	4" Conduit Set No. 1	0.98	0.93
5/8" + 3/8"	0.967	1" Conduit Set No. 1	0.97	0.92

As can be seen from the measured data, the ACFs for the 5/8" and the 3/8" plus 3/8" Thermo-Lag systems differ by only 0.005. This is beyond the reliable accuracy maintainable during the tests and thus TVA rounded the data points prior to selecting the ACF for use in TVA's Electrical Design Standard. As is noted in the response to NRC Information Request Item 5, TVA decided to bound both the tested and calculated ACFs in order to ensure a conservative margin was maintained.

The ACFs are close for the three configurations since the addition of more Thermo-Lag thickness is offset by the corresponding increased surface area as described in the response to NRC Information Request Item 4.

Weight does not figure directly into the equations for ampacity.

NRC INFORMATION REQUEST ITEM NUMBER 8

Section 4.2.3 of Draft 12 of IEEE P-848 states, "Conduit ampacity tests shall utilize 1- and 4-inch rigid steel conduits. Tests conducted using these two sizes shall be considered representative of all sizes provided that the fire protective system installation methods and configurations are consistent across the entire size range." Given the wide ranges of ampacity derating factors provided in the test results as noted in Questions 6 and 7 above, what is the technical basis that the Ampacity Correction Factor (ACF) selected are independent of conduit size. For example, although the ACF for the Thermo-Lag

5/8 inch thickness is 0.93 (or an ampacity derating factor of 7%) the worst case absolute difference of the ampacity derating factors between the 1" and 4" conduit vary from 8%, 9% and 7% for the 3-Conductor test, 4-Conductor test and 3-phase tests respectively. Please describe how the other conduit sizes (e.g. 3/4" and 5" conduit sizes) are enveloped by the ampacity derating test results.

TVA RESPONSE

Derating factors could have been developed for each conduit size. However, the scope of such a program would have been much more extensive without an appreciable benefit in determining the appropriate ACF. The intent of the standards Working Group in selecting the cable and conduit combinations specified in P-848 was to utilize raceways filled to their limit with a single circuit. Based on feedback from group members, the largest power circuits typically used were 750 kcmil (which would fill a 4" conduit) and the smallest conduit which contained "significant" power circuits was 1". The ACF was expected to vary somewhat as a function of conduit size since several components of the thermal circuit are also size dependent (i.e., thermal resistance from the cable to the conduit wall, thermal resistance to the air and the thermal resistance of the barrier material). Thus, the draft standard required that tests be conducted for both 1" and 4" conduits so that the final ACF (for a given thickness of barrier material) would be the lower of the two and thus envelop the range. Additional variances observed by TVA may have been a function of the test configurations (as discussed in the response to NRC Information Request Item 4).

Though testing of 0.75" and 5" conduits is not required by the standard, informal analysis of the wrapped 0.75" conduit indicates that it would be able to carry more current than in the baseline condition. This is because the application of Thermo-Lag results in a significant increase in the heat dissipating surface area as discussed above. Informal analysis of 3-1/c 750 kcmil cables in a 5" conduit indicates, while the relative increase in surface is not as great, the ampacity correction factor is expected to vary by no more than 1%.

The final ACFs chosen for use in TVA's Design Standards include margin, partly to account for the differing configurations, variances due to manufacturing, and maintenance of conservatism in the overall design.

NRC INFORMATION REQUEST ITEM NUMBER 9

Please describe how the use of the correction factor of 0.682 (or 31.8% ampacity derating factor) selected for the air drop will be utilized in raceway design calculations. For example, during the transition from air drop to conduit or air drop to cable tray, what methodology will be used to ensure that the overall ampacity for the entire raceway will not be exceeded by the ampacity derating factors for the different raceway equipment types?

TVA RESPONSE

Cable sizing (with respect to ampacity considerations) is a function of the load current, load type, raceway type and environment along its route. The general formula for determining the required ampacity of a cable is given by the following relationship.

$$I_{required} := \frac{I_{load} Load_{mult}}{ACF_{eff}}$$

and:

$$I_{allowed} \geq I_{required}$$

where: $I_{required}$ - the required ampacity of the cable under evaluation.
I_{load} - the current drawn by the connected end device.
$Load_{mult}$ - the multiplying factor selected according to the type of connected load (motor, heater, transformer etc.).
ACF_{eff} - the effective ampacity correction factor for the raceway segment and environment under evaluation.
$I_{allowed}$ - the current which a cable can carry according to internal or industry standards.

The identification of I_{load} and $Load_{mult}$ is straightforward, the former is taken from vendor nameplate data and the latter from a table in TVA's Electrical Design Standard DS-E12.6.3. Because the raceway type and environment may change along the route of a cable, a series of ACFs often exist, each applicable to a single raceway configuration and environment. Thus, ACFs are determined for each segment and a corresponding set of values of $I_{required}$ are calculated. These are compared to the set of $I_{allowed}$ currents for each raceway type for the cable being evaluated. As expected, cable sizing is dictated by the most limiting segment and ambient along its entire route.

WBN's cable ampacity program evaluates cables in each raceway segment and applies the necessary correction factors. In the past, no ampacity evaluation was required for power cable air drops, since the ampacity in free air far exceeds that in tray or in conduit. Given the application of Appendix R wrap, air drops containing power circuits which are wrapped in excess of 6 feet require evaluation.

The following is in response to NRC's supplemental questions provided during the TVA/NRC meeting on October 13, 1993, to discuss fire barrier qualification efforts.

NRC SUPPLEMENTAL QUESTION NUMBER 1

The TVA presentation described cable-specific reviews for 31 cables potentially impacted by new ampacity correction factors for Thermo-Lag. TVA reported that these reviews considered actual loads, ambient temperatures, and raceway fill rather than the bounding values used in the screening calculations. As a result, no cable replacements were found needed. NRC requested an explanation of the means by which TVA will assure that any changes in the actual conditions during plant life do not invalidate the conclusion that the ampacity derate due to Thermo-Lag is acceptable.

TVA RESPONSE

Cable ampacity analysis is based on various standard Ampacity Correction Factors (ACF) which are conservatively chosen to bound actual conditions of plant environment, load type, raceway type, and attributes. When a cable displays marginally insufficient ampacity based on the standard ACF's it is economically prudent to re-evaluate based on ACF's more closely matching the actual conditions of the individual cable. This standard practice was applied in the ampacity re-evaluation considering the Thermo-Lag fire wrap derating factors for cable trays. The following adjustments were utilized:

1. Actual motor nameplate load current
2. Load factor for motor operated valves
3. Percent tray fill

The ACF values used for ampacity analysis must be documented in the Ampacity Calculation. Proposed changes to either the cable or load procedurally require review and revision of the Ampacity Calculation. The cable tray fill factor is controlled through the Computerized Cable Routing System (CCRS). The maximum percent fill for acceptable cable ampacity is established and becomes the tray fill limit in CCRS for the involved tray segments. Additional cables could only be added up to the tray limit. For the trays housing the 31 cables discussed in the meeting, the cable trays are at maximum fill and CCRS controls ensure that no additional cable is added to these trays.

NRC SUPPLEMENTAL QUESTION NUMBER 2

Since WBN will be using both Thermo-Lag and 3M barriers, describe how any interfaces between the two barrier types will be qualified.

TVA RESPONSE

TVA does not plan on allowing any interfaces between Thermo-Lag and 3M on WBN raceways (i.e., the raceway will be protected with either 3M or Thermo-Lag). The only interfaces would be on the primary supports for the raceway. Any raceway that will be protected with Thermo-Lag, but has the supports currently protected with 3M, will keep the 3M on the supports. Thermo-Lag will be applied to the supports out to 18 inches from the raceway as tested and qualified. The rest of the support will retain the 3M protection. The 3M will ensure that the support will not fail in the event of a fire. The 18 inches of Thermo-Lag will ensure that the heat transmitted into the Thermo-Lag protected raceway will be consistent with the tested configurations.

NRC SUPPLEMENTAL QUESTION NUMBER 3

TVA's plans for compressive load testing include testing of all safe shutdown cable "families" (i.e., insulation and jacket type) to be protected by 3M barriers. Are there any non safe shutdown cables in protected raceways which are of different families? If so, is there a potential for faulting which could affect the safe shutdown function?

TVA RESPONSE

There are non safe shutdown cables in the protected raceways; however, each of the non safe shutdown cables was addressed in the Associated Circuits evaluation. Type III Associated Circuits are defined as those circuits that share a common enclosure (e.g., cable tray, conduit, panel, or junction box) with a shutdown circuit and; (a) are not electrically protected by circuit breakers, fuses, or similar devices; or, (b) could allow propagation of fire into the common enclosure. Since each of the non-required cables at WBN is adequately protected by circuit breakers, fuses, or similar devices, Type III associated circuits are not an issue at WBN.

ENCLOSURE 2
WATTS BAR NUCLEAR PLANT
REPLY TO REQUEST FOR ADDITIONAL INFORMATION
PROVIDED ON OCTOBER 13, 1993
LIST OF COMMITMENTS

The following commitments were made in this submittal:

1. TVA will perform compression loading tests and ampacity derating tests for cables used in 3M fire barrier enclosures. This testing is currently scheduled to be completed by February 1994. The test results will be submitted for NRC review following test completion.

2. Following completion of the compression loading and ampacity testing above, TVA will revise Nuclear Power Design Standards DS-M17.2.2, "Electrical Raceway Fire Barrier Systems" and DS-E12.6.3, "Auxiliary and Control Power Cable Sizing up to 15,000 Volts", and General Engineering Specification G-98, "Installation, Modification and Maintenance of Electrical Raceway Fire Barrier Systems" to document the requirements for installing 3M fire barrier systems.

3. Any 3M currently installed on junction boxes will be removed and the junction box will be protected with Thermo-Lag prior to fuel load.

4. Requirements associated with air drop configurations and interfaces between Thermo-Lag and 3M will be incorporated into appropriate TVA standards.