TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

5N 157B Lookout Place

JUN 15 1990

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of)
Tennessee Valley Authority) Docket No. 50-390

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - SUPPLEMENTAL INFORMATION ON WBN CABLE ISSUES - AMPACITY AND LARGE LOW VOLTAGE POWER CABLES IN STANDARD CONDUIT BODIES

Reference: Electrical Cable Damage - Assessment and Resolution Plan submitted to NRC by TVA's letter dated June 15, 1990

On May 22, 1990, TVA presented the status of the WBN cable issues to NRC in a meeting held at the Region II offices in Atlanta, Georgia. At the conclusion of the meeting, TVA committed to provide NRC with supplemental information on several presentation topics. This is the second of three letters providing this information. Enclosures 1 and 2 contain supplemental explanations and clarifications relating to cable ampacity and large low voltage power cables in standard conduit bodies.

Enclosure 3 contains the commitments made in this submittal.

TVA requests a meeting with NRC in July 1990 in order to identify any remaining issues and assure that NRC has sufficient information to complete its review of the revised Electrical Cable Damage Assessment and Resolution Plan as well as the revised Cable Issues CAP Plan.

R. J. Stevens of my staff will be contacting the appropriate NRC personnel to arrange such a meeting.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. H. Shell
for E. G. Wallace, Manager
Nuclear Licensing and
Regulatory Affairs

Enclosures
cc: See page 2

A001
\11

JUN 15 1990

cc (Enclosures):
NRC Resident Inspector
Watts Bar Nuclear Plant
P.O. Box 700
Spring City, Tennessee 37381

Mr. Peter S. Tam
U.S. Nuclear Regulatory Commission
Mailstop 13H3
Washington, D.C. 20555

Mr. B. A. Wilson, Chief
of TVA Projects
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

ENCLOSURE 1
CABLE AMPACITY

Background

An Institute of Nuclear Power Operations (INPO) finding on Bellefonte Nuclear Plant (BLN) concerning the lack of design calculations to show the adequacy of cable ampacities resulted in a discrepancy report[1] which was applicable to all TVA nuclear plants. It was determined that TVA electrical design standards[2] were incomplete and did not adequately address the effects on cable ampacity of environmental conditions and cable installation configuration. TVA design standard[3] is now based on various industry standards and test reports and does address the environmental and cable installation configuration concerns on cable ampacity. Since the superseded standards were used at Watts Bar Nuclear Plant (WBN), the potential existed for undersized safety-related cable.

Method of Resolution

In order to determine the adequacy of power cables in Class 1E service at WBN to supply their loads and remain within their rated temperature, a program was initiated to review the cables for compliance with the upgraded design standard. This effort was directly modeled upon the ampacity program successfully employed at Sequoyah Nuclear Plant (SQN) and incorporates "lessons learned" from that review.

Voltage Levels V4 and V5:

As a result of the SQN experience, a sampling approach to evaluating V4 and V5 power cables was <u>not</u> utilized at WBN. Instead, a review is being performed of V4 and V5 auxiliary power cables routed in safety-related conduits, trays, and duct banks. Data to support these evaluations such as cable size and type, routing, load current, ambient temperature, and raceway attributes (tray covers, fire wrap, cable coating, etc.) is taken from the computerized cable routing system (CCRS), walkdowns, and project calculations.

A major factor in the SQN program was the presence of power cables, required for 10 CFR 50.49 service, for which the existing qualification documentation did not fully support its manufacturer's assigned rating of 90 degrees Celsius. In order to ensure that the operating temperatures of these cables did not exceed their derated values (ranging from 60 to 85 degrees Celsius) SQN reduced the allowable ampacity of all cables routed in common raceways with those cables.

---

1. Problem Identification Report (PIR) GENEEB8605.
2. Design Standards DS-E12.1.1 through DS-E12.1.4.
3. DS-E12.6.3 RO, issued on September 2, 1986, and subsequently revised on November 7, 1986, which supersedes DS-E12.1.1 through DS-E12.1.4.

ENCLOSURE 1
CABLE AMPACITY

Due to the impact of such a restriction, WBN has opted to initiate a test program at TVA's Central Laboratories in Chattanooga, to upgrade the cables' qualified temperature to its manufacturer's assigned value. These tests will be performed in accordance with the laboratory's quality assurance program and will utilize conventional qualification methodology patterned after Institute of Electrical and Electronic Engineers (IEEE) Standards 323 and 383. A total of five cable types, representing approximately 320 V4 and V5 cables required for Unit 1 service, will be subjected to a program which includes normal radiation aging, thermal aging, accident radiation aging, and simulated accident exposure.

All of these cables are located outside of primary containment. As a result of the low activation energies (and correspondingly long thermal aging times) for several compounds, test completion to establish a full 40-year life is projected to extend beyond Unit 1 startup. Therefore, additional specimens have been prepared for testing with reduced thermal aging durations to establish both a 5- and a 20-year life, while still supporting cable loading at its full rated temperature (90 degrees Celsius). Results of the 5-year program should be available in the fourth quarter of this year. The 20-year results are expected prior to fuel loading for Unit 1. Until completion of the 5-year portion of the program, application of the cables at the manufacturer's assigned rating in 10 CFR 50.49 applications is being carried as an unverified assumption in the ampacity calculations. In accordance with WBN environmental qualification (EQ) procedures, those cables with a qualified life of less than 40 years at the time of plant startup will be identified and tracked until successful completion of the program.

In the same manner as the SQN effort, cables which do not meet the sizing criteria are being individually evaluated further to determine their exact installed configurations and assess the feasibility of modifications and/or analysis to establish the basis for their acceptance. Where appropriate, the following considerations may be employed to resolve specific cable installations:

- removal or shortening of tray covers

- utilization of a reduced derating factor for cable coating thicknesses verified to be less than the conservatively assumed 1/2 inch

- utilization of actual operating load currents in lieu of bus or breaker ratings for cables supporting load centers on boards

- elimination or reduction of the conduit grouping factor based on verification of the installed configuration

- utilization of intermittent-duty ampacities for motor-operated valves

- review of load-type multipliers for motor and heaters to remove excess conservatism

ENCLOSURE 1
CABLE AMPACITY

Voltage Level V3:

The Browns Ferry Nuclear Plant (BFN) and SQN ampacity programs included similar evaluations of cables in voltage level V3 (control and control power). Both studies concluded that cables in this service which had been designed before the above-mentioned revisions to design standards were adequately sized with respect to ampacity. Of the approximately 2350 V3 cables reviewed in those studies, only 5 were identified that met the design standard definition of a control power cable. All 5 were found to be adequately sized. The balance of the cables were in "control function" service. As a result, SQN and BFN terminated their V3 sampling on the basis that insufficient heat would be generated at this voltage level to warrant further review.

Since the sizing process employed at WBN for control/control power cables was the same as that utilized at BFN and SQN, the same low heat loading of V3 raceways can be expected. As a result, in lieu of an extensive program of random sampling and evaluation of control function and control power cables, WBN will perform a review of the sizing of the Class 1E, V3 cables required for Unit 1 service which have a protective device rating in excess of 5 amps and are the main feeders from the vital inverters, vital battery boards, and from large control power transformers in various motor control centers.

Results

A TVA design calculation[4] has been issued to document the above analysis for V4 and V5 cables installed in tray and conduit. A TVA design calculation[5] has been issued which documents the reviews of cables installed in duct banks. This latter analysis is ongoing with the calculation to be revised as the evaluation for additional ducts is completed.

Reviews performed to date indicate that approximately 600 cables do not meet the sizing criteria stipulated in TVA design standard[3]. Approximately 500 of these cables are Unit 1, common, or are Unit 2 cables required for Unit 1 service. Corrective actions[6] for the identified missized cables are being tracked. Additional evaluations of the missized cables are ongoing, utilizing the "dispositioning" process outlined above. Results of those reviews will also be documented in a project calculation to either establish the adequacy of the cables based on additional considerations or to identify the need for field modifications (tray cover removal, cable replacement, etc.).

A separate calculation will be prepared to document the results of the V3 control power cable analysis.

4. Calculation WBPEVAR8909010, Revision 4, "Cable Ampacity - NV4 and NV5 Cables in Class 1E Raceways."
5. Calculation WBPEVAR9003002, Revision 0, "Cable Temperature Calculation of Auxiliary Power Cables in Underground Duct Banks."
6. Condition Adverse to Quality Reports (CAQRs) WBP 900116 and WBP 900257.

ENCLOSURE 1
CABLE AMPACITY

Project EQ cable binders will be revised to incorporate the results of the qualification testing described above. At a minimum, the results of the tests performed on the 5-year specimens will be available before Unit 1 startup.

Conclusions

Completion of the above evaluations and subsequent corrective actions will ensure that the cables required for Unit 1 service are adequately sized to supply their end device and remain within their rated and qualification temperatures.

ENCLOSURE 2
LOW VOLTAGE POWER CABLES 300 MCM AND LARGER
INSTALLED IN A CONDUIT CONTAINING A STANDARD
LB CONDUIT BODY USED AS A PULL POINT

Background

During an inspection performed in November 1988 at Browns Ferry Nuclear Plant (BFN), damage was found on one conductor of a 3-conductor 400 MCM cable installed in a 3-inch conduit. The damage consisted of a cut to the cable jacket and insulation located inside of two back-to-back 3-inch standard LB condulets.

The root cause of the damage was determined to be the result of using standard condulet bodies as pull points in circuits consisting of multiple large single conductor cables. The inflexibility of these cables, especially when coupled with high fill, resulted in excessive congestion at the fitting when the last of the "loop" was being drawn back into the raceway. Evaluation of the cables from their route confirmed that the damage was confined to the cable immediately at the fitting.

In order to confirm the scope of this issue and establish a lower bound to this phenomenon, BFN performed evaluations on various combinations of conductor size, conduit size, and percent fill. Included were evaluations of smaller (300 MCM) cables with standard fittings in their route to ensure that the lower bound has been established.

This condition is documented at WBN by Condition Adverse to Quality Report (CAQR) WBP 900256.

Method of Resolution

Walkdowns have shown that only two medium voltage Class 1E cables have 90 degree condulets in their raceways. These cables are excluded from further consideration since they are being replaced due to bend radius problems.

A review of Watts Bar Nuclear Plant's (WBN) computerized cable routing system (CCRS) data base will be performed to identify conduits containing Class 1E low voltage cables 300 MCM and larger. The low voltage cables thus identified will be grouped into sets of common conductor size/conduit fill combinations in the same manner as was done at BFN. The resultant groupings will be reviewed to establish those of greater stiffness and congestion (and therefore higher damage potential) and those of greater flexibility and lesser congestion than the BFN conduit in which the damage was identified. Those conduits with an equal or higher damage potential will be walked down to identify the presence of standard condulet fittings. If none are present, no further action will be required. Where standard condulets are present, the cables will be inspected for damage at intermediate pull points and at each end of the circuit. If no significant damage is found, the cables will be used as is, otherwise, the cables will be repaired or replaced.

ENCLOSURE 2
LOW VOLTAGE POWER CABLES 300 MCM AND LARGER
INSTALLED IN A CONDUIT CONTAINING A STANDARD
LB CONDUIT BODY USED AS A PULL POINT

In the same manner as was done at BFN, inspections will also be performed on sets of a lower damage potential than the subject BFN conduit to confirm that the lower bound has been correctly identified for WBN.

The actions to prevent recurrence have been completed. This included issuing revisions to TVA design specifications and construction procedures to require that standard conduit bodies not be used as pull points for 300 MCM and larger low voltage power cables.

Conclusion

Completion of the evaluations and walkdowns of conduits containing power cables 300 MCM and larger which have been installed in standard conduit bodies will ensure that the cables are adequate to perform their intended safety functions.

ENCLOSURE 3

LIST OF COMMITMENTS

Ampacity:

For those Class 1E voltage level 4 and 5 cables which do not pass the initial ampacity screening, TVA will perform additional evaluations to determine their exact installed configurations and assess the feasibility of modifications and/or analysis to establish the basis for acceptance.

TVA will revise project environmental qualification (EQ) binders to incorporate the results of EQ testing of 10 CFR 50.49 cables which do not have adequate documentation to support their manufacturers' assigned rating of 90 degrees Celsius.

TVA will review the sizing for Class 1E voltage level 3 cables required for Unit 1 service which have a protective device rating in excess of 5 AMPs and are the main feeders from the vital inverters, vital battery boards, and from large control power transformers in various control centers.

TVA will perform evaluations for cable ampacity for Class 1E voltage 4 and 5 power cables routed in duct banks.

Large Low-Voltage Power Cables In Standard Conduit Bodies:

TVA will perform reviews and analysis of Class 1E low-voltage power cables 300 MCM and larger to establish the cable population most susceptible to damage as a result of using standard conduit bodies as pull points. TVA will walkdown the identified population, and where standard conduit bodies were used, the cables will be inspected for damage at intermediate pull points and termination points. Damaged cables will be repaired or replaced.

TVA will perform inspections to confirm that the lower bound has been correctly identified.