UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 25, 2008

Mr. Ashok S. Bhatnagar
Senior Vice President
Nuclear Generation Development
and Construction
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT UNIT 2 - REQUEST FOR ADDITIONAL INFORMATION REGARDING CABLE ISSUES CORRECTIVE ACTION PROGRAM (TAC NO. MD9182)

Dear Mr. Bhatnagar:

By letter dated May 29, 2008, the Tennessee Valley Authority (TVA) submitted the program methods that it proposes to use to resolve those sub-issues of the Cable Issues Corrective Action Program (CAP) at Watts Bar Nuclear Plant (WBN) Unit 2 that are different from those used for WBN Unit 1. TVA also provided the differences, along with their justification, to demonstrate that the alternate resolutions to these cable issues would be equally effective.

The staff has reviewed the information provided by TVA and has determined that additional information is required to complete its evaluation of the proposed cable issues CAP for WBN Unit 2. The specific questions are detailed for each of the issues in the enclosed request for additional information (RAI). Based on discussions with your staff, we understand that you plan to respond to the enclosed RAI within 30 days of the date of this letter.

If you should have any questions, please contact me at 301-415-1457.

Sincerely,

Patrick D. Milano, Senior Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-391

Enclosure:
RAI

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Request for Additional Information

Related to Cable Issues Corrective Action Program

Tennessee Valley Authority

Watts Bar Nuclear Plant Unit 2

Docket No. 50-391

By letter dated May 29, 2008 (Agencywide Documents Access and Management System Accession No. ML081560183), the Tennessee Valley Authority (TVA) submitted its proposed program methods to resolve those sub-issues of the Cable Issues Corrective Action Program (CAP) at Watts Bar Nuclear Plant (WBN) Unit 2 that are different from those used for WBN Unit 1. TVA provided the differences in the program for WBN Unit 2, along with the justification for the differences, to demonstrate that the alternate resolutions would be equally effective.

After reviewing the information provided by TVA, the NRC staff requests the following be addressed:

1. Cable Jamming Issue

a. Justify the acceptance criteria regarding the assumed relationship between sidewall bearing pressure (SWBP) and jamming. If applicable, provide industry references.

b. Identify the manufacturer and types of cable used at WBN Unit 2. Also, identify the manufacturer and types of the six cables that formed the basis for the conclusions.

c. Provide a detailed justification on how TVA was able to extrapolate the results of the six cables to a total of 39 cables. Also, provide a detailed discussion on the condition of the additional 37 conduits found with unacceptable jamming ratios during walkdowns. Furthermore, explain why the additional 37 conduits were not identified during the original investigation that discovered 39 cables with unacceptable jamming ratios.

d. Describe the circumstances that would lead TVA to accepting a jamming ratio outside the requirements of General Construction Specification G-38.

e. Regarding TVA Calculation WBPEVAR8905050, which establishes the criteria for selecting cables in the jamming population (2.8 - 3.1) based on SWBP:

   1. The calculation appears to define jam ratio as the ratio of the conduit inside diameter (D) to the average cable outside diameter (d). This is contrary to other industry guidance on cable pulling, which defines the jam ratio as 1.05 D/d (e.g., Okonite Cable Installation Manual; Polywater Technical Paper; Electric Power Research Institute (EPRI) EL-5036, "Power Plant Electrical Reference Series, Vol. 4, Wire and Cable;" Thue, et al., *Electrical Power Cable Engineering*, 2nd Edition; and Southwire Power Cable Installation Guide). In addition, many of these industry sources extend the jam ratio upper limit to 3.2, and at least two sources use a jam ratio lower limit of 2.6.

Discuss the discrepancy between TVA' s criteria and the recommended industry criteria, and explain how TVA's criteria bounds the recommended industry criteria.

2. Describe whether pulling tensions and SWBP were calculated in both directions and whether the samples were categorized by the worst-case results.

3. The basic assumption used in the calculation is that damage from jamming is worse with higher SWBP. However, SWBP is calculated without regard to jamming. Therefore, a cable with a lower value of SWBP could jam and result in higher SWBP than calculated.

   Provide the technical basis for the above mentioned assumption.

4. Confirm that SWBP was not calculated with tension assumed at the breaking point of the pull rope or conductor.

f. Regarding TVA calculation WBPEVAR9008003, which provided the results of inspections and evaluation of the sample of six cables in 34 conduits:

1. Provide a detailed discussion on the follow-up actions that were performed after cable 1PL4985B was found in different conduits.

2. The TVA analysis addressed only single conductor power cables (e.g., 3-1/c, 400 and 500 MCM, 600 V with jam ratios in the range 2.8-3.0 and a single 3-1/c, 2/0, 8 kV cable with a jam ratio of 2.9). Provide a detailed technical justification for routing the one medium voltage cable in a three inch conduit. Describe any corrective actions that may be associated with this cable routing.

3. Provide a detailed technical justification as to why the three-multi-conductor cables (either multi-conductor control cable (2/c #14 and 7/c #14), low voltage power cables (3/c #10,1/c#12 and 2/c #12), or instrumentation cables (2/c#16 SHLD, 3/c#16 TW)) with the same outside diameter were not addressed in the acceptance criteria even though their jam ratios were within the target range.

2. <u>Cable Pull-By Issue</u>

a. Identify the physical mechanisms that could result in cable damage from pull-bys. This should include damage that may result from the pulling rope on existing cables and the residual dried cable pulling lubricant in the conduit on the new cable.

b. Clarify the relationship of SWBP on cable pull-by damage. If applicable, provide industry references.

c. The assumption that pull-bys have always occurred does not appear to be conservative. This could imply that any cable could be subject to pull-by damage, and the lack of evidence on any cable selected could be used for justification of not having a problem with cable damage due to pull-bys. Given this scenario, describe how the assumption that pull-bys have always occurred is conservative.

d. Describe how SWBP is calculated with existing cables in the conduit. If applicable, provide industry references. Explain the basis for crediting a coefficient of friction less than 1.0. In the response, discuss how the presence of foreign material in the conduit (e.g., other cables and dried lubricant) would impact the coefficient of friction?

e. Provide the total number of cables that were high-pot tested. Provide the total number of cables that only received a visual inspection.

f. Define "short length" of conduit.

g. TVA's proposed corrective action for WBN Unit 2 states that "[i]f any segment remains in a high risk category, the cables in that conduit will be replaced." Confirm that the entire length of cable will be replaced, not just the cable in the high-risk segment.

h. The TVA Cable Issues CAP noted that industry guidance did not exist for cable pull-bys. The Institute of Electrical and Electronics Engineers (IEEE) Standard 1185-1994, "IEEE Guide for Installation Methods for Generating Station Cables," provides guidance for cable pull-bys. Address the recommended precautions contained in IEEE 1185, Section 9, "Cable Pull-bys," and identify how concerns similar to those identified in the industry guidance as noted below were addressed.

   1. What, if any, limits were in place at WBN UNIT 2 for conduit fill before and following the installation of additional cables using the cable pull-by method?

   2. Did any of the cable pull-bys result in adding a third cable to two existing cables of the same cable outside diameter (OD) such that cable jamming could be a factor?

   3. Was the compatibility of the existing cable installation and the additional cable installation evaluated for (1) their abrasive effect on one another, (2) cut-through resistance, and (3) thermal endurance?

   4. IEEE 1185 states that the coefficient of friction between unlubricated, soft, rubber-like jackets could easily exceed 1.0. Clarify how the coefficients of friction used in the cable pulling calculation were adjusted for the unlubricated cable sections, solidified lubricants, and leftover pulling ropes existing in the conduits.

   5. IEEE 1185 states that the damage that can occur during cable pull-bys could affect both the existing cables and the cables being installed. Describe how the impact of sidewall pressures on the existing cables during the pulling of new cables was evaluated.

   6. IEEE 1185 states that the severity of the potential damage encountered in cable pull-bys is a function of exerted forces and the duration of those forces between the existing (stationary) cable(s) and of the pull-by (moving) cables. Describe what limits, if any, were imposed on the length of the pull-by cable so as to limit the contact duration time between the existing (stationary) cable(s) and of the pull-by (moving) cable(s).

7. IEEE 1185 states that the existing raceway should be evaluated to assess the difficulty of the pull-by. Expected pull tension and sidewall pressure should be calculated to ensure that damaging forces will not be encountered. Describe how the pulling tension and sidewall calculations were performed to ensure that damage would not occur to either the existing cables or the new pull-by cables.

i. The following question relates to TVA calculation WBPEVAR8906036, which is the cable pull-by analysis.

Criterion 3 requires three polyvinyl chloride (PVC) jacketed cables in the conduit prior to the final pull-by. Criterion 4 requires the initial pull and at least two pull-bys be made prior to August 1984 (the time when the use of Polywater J began to be used for a cable lubricant). Criterion 7b requires a minimum of two cables with either Hypalon or CPE jackets installed prior to August 1984. Explain the technical bases for these criteria.

j. The following question relates to TVA calculation QIR EEB WBN 890003, which discusses the basis for the pull charts.

The coefficient of friction assumptions of 0.75 for fills of <40%, 0.85 for fills of 50%, and 1.0 for fills of 60% appear to be non-conservative when compared to the latest industry standards. Provide a detailed technical discussion on the apparent non-conservative coefficient of friction assumptions.

3. <u>Cable SWBP Issue</u>

a. Define "severe case conduit configurations."

b. Provide the cable manufacturers' allowable pulling tensions and SWBP for each Class 1E cable installed in WBN UNIT 2.

c. If applicable, identify all construction specifications (other than G-38) that were revised as a result of the SWBP issue.

d. Confirm that a minimum of 10 WBN UNIT 2 cables of each type (i.e., V2, V3, V4, and V5) were included in the WBN Unit 1 analysis. Identify the cable manufacturer and cable type and construction for each of these cables.

e. Did the manufacturers of cables for WBN UNIT 2 concur with the higher allowable SWBP values used by TVA? Provide the cable manufacturers' concurrence correspondence or a detailed technical justification that supports these higher allowable SWBP values.

f. Reference 7 appears to be a TVA report on cable ampacity, not SWBP. Please clarify.

g. Identify the contents of the one WBN UNIT 1 conduit that did not meet the new higher SWBP criteria. Describe the corrective action that was performed to assure that this condition does not exist in WBN UNIT 2.

h. The following question refers to TVA calculation WBPEVAR9010001, which relates to cable SWBP in harsh environments.

Describe how a random sampling of 40 cables out of a population of 1914 cables in harsh environments with the potential for damage from excessive SWBP is a conservative sample size without regard to the amount of excessive SWBP.

4. Pulling Cables Through 90-Degree Condulets and Mid-Route Flexible Conduits Issue

a. In an earlier submittal, TVA stated that there were no cases of cables actually being pulled through 90-degree conduits. Describe how TVA determined that no cables were pulled through 90-degree conduits. Also, clarify whether this statement is also applicable to 90-degree condulets.

b. Define "Critical case condulets."

c. The TVA evaluation was limited to silicone rubber (SR) cables pulled through two 90-degree condulets. Describe how TVA has determined that this was the worst-case scenario for SR cables and not, for instance, longer pulls through one 90-degree condulet.

d. Provide the construction details for all of the SR cables installed in WBN Unit 2, including the construction details of all SR cables used in the loss-of-coolant accident (LOCA) testing.

e. The TVA LOCA evaluation was limited to SR cables pulled through 90-degree condulets. Describe how this envelopes other cable constructions that may have had longer pulls.

5. Computer Cable Routing System (CCRS) Software and Database Verification And Validation Issue

a. TVA identified two contributing factors that resulted in this issue: (1) lack of verification procedures and (2) failure to follow installation procedures. TVA's resolution statement for this issue did not address failure to follow the installation procedures. Describe the corrective actions that were performed to assure that all cables were correctly installed or how the incorrectly installed cables were removed and then correctly routed.

b. TVA's verification of cable routing appears to have only addressed WBN Unit 1 cables. Describe how the cable routing of WBN Unit 2 cables that were previously installed using the original CCRS software was verified.

c. TVA's verification of cable routing appears to have only addressed Class 1E cables. The NRC staff is concerned that this could affect raceway fill and raceway permissible loading weights. Describe how non-Class 1E cables routed with Class 1E cables have been considered in determining the adequacy of raceway fill (e.g., permissible loading weights and ampacity).

d. Provide the total number of overfilled cable raceways that are identified in the CCRS/Integrated Cable and Raceway Design System (ICRDS) database. Provide a detailed technical justification for concluding that it is acceptable to allow overfilled raceways.

e. Provide documentation for the cable ampacity derating analyses that resulted from the overfilled raceways.

f. Provide a detailed technical justification for determining that the raceway supports for the overfilled raceways is adequate.

g. Describe how cables designated as "abandoned-in-place" were handled in the CCSR/ICRDS database.

h. Describe the independent verification steps in the procedure (for controlling data entry, data revision, and data utilization) that verify data entry into the CCSR/ICRDS database reflects the "as-built configuration."

i. The CCSR/ICRDS cable data sheets in Sampling Report Number WBNLEE-SR-2004-0001, provided as part of our supplemental information request, reflect design lengths. However, the installed length field is blank. Describe how the "as-built" lengths were verified and documented. In addition, describe how the electrical calculations/analyses involving cable length considered "as-built" cable lengths.

j. With regards to page 30 of Sampling Report Number WBNLEE-SR-2004-0001, it appears that the one cable splits into two cables starting from route 3643. Describe how cable 2PP 675 A was routed. Also, describe the ampere value that is reflected in AMP field (i.e., cable ampere, load ampere, derated ampere, etc.).

k. The Note at the bottom of hand-written sheet 30 of Sampling Report Number WBNLEE-SR-2004-0001 states that the exact insulation type of cable 2PP 675 A is unknown and requires further research. How many such cases exist, and when will this issue be verified and resolved?

l. With regard to hand written sheet 27 of Sampling Report Number WBNLEE-SR-2004-0001, describe why cable 2PL 3960 A is routed as #4/0 American wire gauge (AWG) (49.8 amps) for 75 feet and then changes cable size to #1/0 AWG (24.9 amps) for 2013 feet in a cable tray and then changes back to cable size #4/0 AWG (49.8 amps) for 334 feet. Provide the amperage value that was used to size the protection for this cable.

6. <u>TVA Cable Issue CAP</u>

a. The WBN Unit 2 Cable Issue CAP did not address how TVA will comply with General Design Criterion (GDC) 18, "Inspection and testing of electric power systems," of Appendix A to Part 50 of Title 10 of the *Code of Federal Regulations*. Describe the plant programs or procedures that address periodic inspection and testing of underground cables (including cable insulation) important to safety.

b. TVA's description of the various inspections and tests performed to justify acceptability of the as-installed cables stated that a sample of cables was selected for WBN Unit 1, WBN Unit 2, and common areas. Describe the sampling criteria. For the cables selected for WBN Unit 2, indicate how many of those cables are required to support WBN Unit 1 operations. Furthermore, describe how many WBN Unit 2 cables are required exclusively for WBN Unit 2 operation.

November 25, 2008

Mr. Ashok S. Bhatnagar
Senior Vice President
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SUBJECT: WATTS BAR NUCLEAR PLANT UNIT 2 - REQUEST FOR ADDITIONAL INFORMATION REGARDING CABLE ISSUES CORRECTIVE ACTION PROGRAM (TAC NO. MD9182)

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/RA/

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Enclosure: RAI
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