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

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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) - ELECTROMAGNETIC INTERFERENCE/RADIO FREQUENCY INTERFERENCE (EMI/RFI) SURVEY REPORT CLARIFICATIONS FOR EAGLE-21 PROCESS PROTECTION SYSTEM (TAC M81963)

This letter provides supplemental information concerning the EMI/RFI survey report for WBN's Eagle-21 process protection system that was submitted for NRC staff review in a letter dated August 12, 1994. The information clarifies two issues that were discussed with Messrs. Eric Lee and Peter Tam of the NRC staff during telephone conversations on December 19, 1994, and January 18, 1995.

1. The first issue concerns WBN's basis for the susceptibility threshold for EMI/RFI at lower frequencies--in particular, below 20 MHz, which was the low frequency cutoff for Eagle-21 factory qualification testing. The technical report entitled "Analysis for EMI/RFI Mapping of Auxiliary Electric Equipment Room for Tennessee Valley Authority's Watts Bar Nuclear Plant Unit 1" that was enclosed with TVA's letter dated August 12, 1994, presented a detailed comparison of WBN survey results to a theoretical analysis performed by Westinghouse Electric Corporation for the Eagle-21 system installed at the Zion plant. To assist in reviewing the report, the following information summarizes pertinent aspects of WBN's EMI/RFI survey.

   The mapping of WBN Unit 1's auxiliary electric equipment room environment to determine the worst-case EMI/RFI noise profile within the frequency range from DC to 1 GHz included the same tests that were conducted for the Eagle-21 installation at Zion. The same survey

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FEB 1 6 1995

methods were also used for the Eagle-21 installation at Diablo Canyon. The results of the survey for WBN were evaluated and determined to be below the susceptibility threshold levels that were previously approved by the NRC staff for Zion.

The specific tests conducted during WBN's EMI/RFI survey were performed in accordance with MIL-STD-461 and MIL-STD-462 and included the following:

- CE01 - Conducted Emissions, Power and Signal Leads, 30 Hz to 15 KHz, Common and Differential Mode
- CE03 - Conducted Emissions, Power and Signal Leads, 15 KHz to 50 MHz, Common and Differential Mode
- CE07 - Conducted Emissions, Power and Signal Leads, Switching Transients, Time Domain, Common and Differential Mode
- REXX - Radiated Emissions, DC Magnetic Field
- RE01 - Radiated Emissions, 30 Hz to 50 KHz
- RE02 - Radiated Emissions, 14 KHz to 1 GHz
- RE02.1 - Radiated Emissions, Hand-Held Radio Profile

2. The second issue concerns the adequacy of the justification presented in WBN's survey report (i.e., "Analysis for EMI/RFI Mapping of Auxiliary Electric Equipment Room for Tennessee Valley Authority's Watts Bar Nuclear Plant Unit 1") that a noise spike described on Page 12 of the report does not challenge the susceptibility threshold for EMI/RFI degradation. This spike with a level of 152 dBμA was measured only one time during the CE03 test on the power lead to Rack 5 at a frequency of approximately 1.8 MHz. Although the spike was below the calculated susceptibility threshold, it was only 5 dBμA below the threshold. This does not appear to satisfy the 6 dBμA margin criterion that is applied to the test results. The 6 dBμA margin criterion is discussed in Section 1.1 of National Technical Systems Test Report 31590-95M ("Test Report for Point of Installation Electromagnetic Interference (EMI) Mapping of Auxiliary Electric Equipment Room for TVA's Watts Bar Station for Westinghouse Electric Corporation Process Control Division"), which is Appendix B in the survey report.

Note that the 6 dBμA margin is with respect to reactor protection system (RPS) signals that are processed within the Eagle-21 electronics at the circuit board level. The noise spike was measured on the power lead feeding one of the Eagle-21 racks rather than at a point on the RPS signal path itself. Therefore, various design features within the Eagle-21 rack, such as filters, shielding, and separation, attenuate the noise spike to some degree before it can affect a RPS signal. Only 1 dBμA of attenuation is needed to satisfy the 6 dBμA margin criterion for the noise spike measured at Rack 5.

FEB 1 6 1995

This amount of attenuation is easily available from the filter networks within the Eagle-21 rack.

There are two scenarios to consider in evaluating the noise spike's effect on a RPS signal. First, the spike could be directly coupled into the power supplies within the rack. Second, the spike could be capacitively coupled into input signal cables and processed by the Eagle-21 system.

For the first scenario where the spike is transmitted directly into the power supply and distribution subsystem within the rack, two filters are included within the rack to attenuate the spike before it can affect the RPS signal path. A line filter on each leg of the input to the power distribution panel provides attenuation of 60 dB at 1 MHz and 65 dB at 5 MHz. There is also a filter on the output stage of the DC power supplies.

For the second scenario where the spike is coupled into an input cable to the input/output (I/O) subsystem, there are also two filters through which the signal (and noise spike) must pass. One filter is on the Eagle analog input (EAI) board or the Eagle RTD input (ERI) board, depending on the type of signal being processed. This is an analog, single-pole, low-pass filter with the 3 dB point at 40 Hz and with a response of 8 dB/octave. It is an anti-aliasing filter that attenuates high-frequency components of the input signal. There is another filter in the analog-to-digital (A/D) converter. This filter is a digital, 3-pole, low-pass filter with a 3 dB point at 2.5 Hz and with a response of 24 dB/octave.

The filter networks described above and other measures such as cable shielding and separation of signal cables from potential noise sources safeguard the Eagle-21 system from potential RPS signal degradation due to noise transients such as the spike detected on the power feed to Rack 5. In total, these measures assure that the margin below the susceptibility threshold is greater than 6 dBμA.

In addition to the specific Eagle-21 design features that are intended to prevent EMI/RFI noise problems, there are two general considerations which are important to resolving this issue. First, successful operating experience at other plants with Eagle-21 equipment (Sequoyah, Zion, Diablo Canyon, and Turkey Point) demonstrates that its digital electronics operates properly within a range of EMI/RFI environments that are similar to those of WBN's auxiliary electric equipment room. There have been no reported failures or spurious trips within any plant's Eagle-21 equipment due to EMI/RFI problems. Second, WBN has existing programs to deal with any equipment failure or spurious trip due to an EMI/RFI problem that might occur in the future.

FEB 1 6 1995

If an Eagle-21 EMI/RFI problem were to occur, WBN procedures (primarily SSP-3.04 and SSP-3.06) require it to be documented as an adverse condition and tracked via an appropriate corrective action program. The corrective action program at WBN is proceduralized in detail and contains provisions to develop corrective actions and to evaluate each condition, on a case-by-case basis, for escalation as a significant condition adverse to quality.

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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