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OCT 26 1992

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

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - INSTALLATION OF WESTINGHOUSE EAGLE-21 PROCESS PROTECTION SYSTEM (TAC 81063)

This letter provides TVA's response to the NRC request for additional information (RAI) that was attached to a letter dated March 27, 1992, summarizing the routine conference on WBN licensing status which occurred on March 24, 1992. The RAI was also discussed with Messrs. Hulbert Li, Ray Scholl, and Peter Tam of the NRC staff in a telephone conversation on March 27, 1992. The RAI posed a series of detailed questions about the design of the Westinghouse Eagle-21 process protection system that is being installed at WBN.

TVA has previously submitted information concerning the Eagle-21 system in letters dated July 10, 1991 and February 26, 1992. The first of these letters described TVA's intent to replace WBN's current Foxboro process control system with the newer Eagle-21 system. The second letter provided a technical description of the Eagle-21 system by enclosing Westinghouse Topical Report WCAP-12374 ("Eagle-21 Microprocessor-Based Process Protection System"), Revision 1. This letter also stated that the information in WCAP-12417 ("Median Signal Selector for Foxboro Series Process Instrumentation - Application to Deletion of Low Feedwater Flow Reactor Trip") applies to WBN's Eagle-21 design change.

The enclosure restates the questions in the RAI and gives TVA's answer to each one. In general, the questions involve comparing the differences between the Eagle-21 system that will be installed at WBN and the Eagle-21 system that is already in operation at Sequoyah Nuclear Plant (SQN). When

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answering this type of question, TVA considers the basis of comparison to be the current design of SQN's Eagle-21 system including all hardware and software modifications that have been made since the system first became operational in late 1990. Also, TVA notes that certain minor design details of WBN's Eagle-21 system are still being finalized. However, none of the remaining design work is expected to affect the responses provided in the enclosure.

The enclosed responses focus on the functional capabilities of the various modules within the Eagle-21 system and the basic parameters that Eagle-21 processes for its control and protection features. A totally comprehensive description of Eagle-21's individual electronic components, its signal inputs, outputs, and adjustments, and the software coding and algorithms developed by Westinghouse to perform required calculations and logic operations would be far too extensive for a functional comparison of the systems at WBN and SQN. Detailed design documentation for WBN's Eagle-21 system is available onsite for NRC review. TVA can provide appropriate excerpts from this documentation for any additional design features that the NRC staff needs to review.

If you have further questions, please telephone John Vorees at (615) 365-8819.

Very truly yours,

W. J. Museler

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Enclosure
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ENCLOSURE

REQUEST FOR ADDITIONAL INFORMATION
ON THE USE OF EAGLE-21 AT WATTS BAR NUCLEAR PLANT (WBN)

1. (1.3)
   (7.1.1.4)

Question:

FSAR Section 7.1.1.4 states that "System functions for all plant systems discussed in Chapter 7 are similar to those of Sequoyah Nuclear Plant. Detailed comparison is provided in Section 1.3." However, the discussion in Section 1.3 is far from detailed. What discussion is provided appears to contradict the staff's understanding of your plans because Section 1.3 states that the Reactor Trip System and Engineered Safety Features System are "similar to D. C. Cook, Trojan, and Sequoyah" and that there are no significant differences.

In order to avoid duplication of effort on the part of TVA and NRC staffs, please amend the FSAR to identify all areas where your implementation of the Eagle-21 system at Watts Bar are different from Sequoyah. Your response should include, but not be limited to, answers to the following specific questions:

A. Describe all differences in the functions to be performed by the Eagle-21 equipment at the two sites.

B. Describe all differences in input instrumentation for the Eagle-21 and Median Signal Selector at the two sites including:

   i. Parameter, instrument manufacturer, model number, range, accuracy, and electrical characteristics, and

   ii. Number of channels.

C. Describe all differences in the Configuration Layer of the Eagle-21 software at each site. Your response should cover the 10 items identified under "D" at the bottom of page 27 in WCAP-12374 Revision 1.

D. Describe all differences in the Main Program and Support Routines between the two sites.

E. Describe any differences in the criteria for the installation of the Eagle-21 and Median Signal Selector at each site with regard to:

   i. Electrical power (including divisional assignments),

   ii. Physical separation,

   iii. Electrical isolation,

   iv. EMI/RFI protection,

   v. Heating, ventilation, and air conditioning,

vi. Physical security, and

vii. Fire protection.

F. Describe all differences in indication and alarms between the two sites with regard to the use of Eagle-21.

Response:

Changes have not yet been incorporated into the FSAR to describe the Eagle-21 process protection system. TVA intends to submit design information concerning Eagle-21 as it becomes available. This plan has been discussed with the NRC staff during routine licensing status meetings and a series of technical information submittals have been identified. These planned submittals, including updates to the FSAR, should provide an adequate basis for NRC staff review of WBN's Eagle-21 system. Some submittals have already been made, but most will occur over the next several months.

With respect to the information requested above, the following discussion outlines the differences between WBN's Eagle-21 system design and the Eagle-21 system currently in operation at Sequoyah Nuclear Plant (SQN). TVA intends to include a brief overview of these relatively minor differences in a future revision of FSAR Section 1.3, but not in the level of detail that follows since Section 1.3 is only intended to highlight major differences in plant design.

A. The few specific differences between the functions performed by WBN's Eagle-21 system and those performed by SQN's Eagle-21 system are as follows:

- SQN's low-low steam generator (SG) level trip function is processed through an environmental allowance modifier/trip time delay (EAM/TTD) functional algorithm in the Eagle-21 process protection system. The EAM function allows the use of a lower (less conservative) low-low level setpoint whenever there is no indication of an adverse environment in containment (i.e., no indication that an accident may have occurred), as determined by monitoring the containment pressure signal. The TTD algorithm delays the low-low level trip output. The length of the time delay is calculated as a function of ΔT power. As power level increases, the allowable time delay decreases. WBN's low-low SG level trip function is processed through a TTD algorithm only.

- The temperature averaging system (TAS) algorithm that is used in WBN's Eagle-21 system to process reactor coolant system (RCS) temperature signals (T_{hot} and T_{cold}) for the overpower and overtemperature protection functions has been modified with respect to the algorithm used at SQN. A new quality code, disabled "D", has been created and is assigned to RCS resistance temperature detectors (RTDs) that are removed from scan. This allows the operator to differentiate between an RTD that is removed from scan and one that has failed an input diagnostic. RTD inputs to TAS that have failed a diagnostic are assigned a quality code of bad "B". Removal of a single T_{hot} or T_{cold} from scan will not cause a trouble alarm. SQN's TAS algorithm assigns a bad "B" quality code to RTDs that are removed from scan and actuates a trouble alarm when any RTD is removed from scan. WBN's provision for the "D" quality code is intended to avoid a trouble alarm for an

allowable (although abnormal) equipment condition that has been intentionally entered by operator action.

- Westinghouse recently increased the flexibility of its Eagle-21 design by including the capability to process an additional type of sensor that uses gain and offset adjustment coefficients. (Note that this is a change to the types of signal processing provided within Eagle-21 rather than a hardware change to the sensor/transmitter in the field.) This new type of sensor processing is used at WBN for the RCS flow input channels. Gain and offset adjustments can be made during an RCS flow calorimetric without affecting the channel range. For SQN, it is necessary to adjust the channel range. The range is required to be reset prior to analog output calibration.

- WBN's Eagle-21 system processes the following instrument channels that are not processed through Eagle-21 at SQN. Eagle-21 is used to process these channels at WBN only for convenience based on the preexisting arrangement of electronics and wiring hookups within the process instrumentation racks.

  - boric acid tank level,
  - containment spray pump header flow,
  - pressurizer liquid and vapor temperature, and
  - RHR pump discharge temperature.

- At WBN, instrument loops L-529 and L-539 have been moved from protection set I to protection set II. This change allows level signals from all four SGs to be processed by the TTD function in protection set II. By processing all four SG level signals, a longer trip time delay can be used if one low-low level request signal is received. At SQN, protection sets I and II process level signals from only two of the four SGs. Because of this, the shorter time delay for more than one low-low level request has to be used in protection sets I and II even if only one trip request is received since the status of the other two SG levels is unknown.

- For WBN, a threshold setting has been added to the steam flow and feed flow calculations. This feature sets the flow output to zero if the differential pressure input signal is less than the threshold setting. The feature can be turned off by setting the threshold to zero. The threshold setting, if used, suppresses noise-induced fluctuations in the flow output signal for low-flow conditions (i.e., flow less than the threshold setting). Addition of the threshold setting feature is a recent upgrade to Westinghouse's Eagle-21 design. The Foxboro process control system that Eagle-21 replaces at WBN contained a similar feature.

B. Input instrumentation for WBN's Eagle-21 system and median signal selectors (MSSs) is nearly identical to the input instrumentation at SQN except for the additional channels that are identified above in Part A and differences in transmitter and sensor suppliers. A detailed comparison with SQN's input instrumentation is not possible at this time because the data for transmitter and sensor characteristics and accuracies at WBN has not yet been fully verified. Also, several pending design changes for operation and

maintenance improvements could result in replacing some of the transmitters that provide inputs to Eagle-21. Scaling and setpoint documents (SSDs) are currently being developed for WBN to provide detailed information about Eagle-21 inputs and outputs. TVA can make these SSDs available for NRC staff review upon request as soon as they are issued.

It should be noted, however, that the analog input modules provided within Eagle-21 have a standardized design that provides the capability to interface with different types of input signals. These include 4-20 mA current loops, 10-50 mA current loops, 0-10 Vdc voltage signals, and 4-wire resistance temperature detector (RTD) inputs. Based on these general categories of Eagle-21 input signals, there are no differences between WBN and SQN. For instance, a pressurizer water level input signal to Eagle-21 is 10-50 mA regardless of any minor differences that may exist in the input instrumentation for WBN as compared to SQN.

The characteristics and number of channels for the MSSs at WBN are identical to those at SQN. The changes in the channel assignments for SG level input signals that are described above in Part A and minor differences in interconnecting cables have no effect on the MSS module characteristics or its function.

C. The configuration layer of the WBN Eagle-21 software is nearly identical to that of the SQN Eagle-21 software with only the following differences, using the categories identified in WCAP-12374:

Channel Type Identifiers -- WBN channel types are the same as those for SQN except that WBN uses a TTD channel type in place of the EAM/TTD channel type used by SQN. This difference is described above as one of the functional differences in Part A.

Plant-Specific Tag Numbers and Names -- WBN tag numbers and names are nearly identical to those for SQN. WBN tag numbers and names are specified on the Westinghouse process block diagrams (drawing series 108D408), which can be provided for NRC staff review upon request.

Setpoints and Tuning Constants -- As at SQN, the WBN setpoint and tuning constant variables are operator adjustable via the parameter update function. WBN's minimum ranges of adjustment are nearly identical to those of SQN and are specified in the WBN functional requirements documents prepared by Westinghouse. These documents can be provided for NRC staff review upon request. The WBN system has steam and feed flow threshold settings, which are described above as one of the functional differences in Part A.

Scaling Information -- Scaling information for WBN is nearly identical to that for SQN with the exception of the gain and offset coefficients which are provided for the new sensor type that is used for RCS flow. This new flow sensor type is described above as one of the functional differences in Part A. Also, the SSDs, which are currently being developed for WBN as discussed above in Part B, are expected to identify some minor differences in ranges, setpoints, and scaling factors for Eagle-21 channels when compared to similar channels at SQN. In particular, these factors will be

different for channels such as $\Delta T/T_{avg}$, containment pressure, and steam pressure, which process plant parameters that have different design values at WBN than at SQN. TVA can make these SSDs available for NRC staff review upon request as soon as they are issued.

Hardware Configuration Information --

Input Sensor Type - WBN's input sensor types are identical to those for SQN with the exception of the RCS flow sensor type, which is described above as one of the functional differences in Part A.

Comparator Trip Type - WBN's comparator trip types are identical to those for SQN.

Preferred Failure Mode - WBN's preferred failure modes are identical to those for SQN.

Calibration Data - WBN's calibration data is identical to that for SQN.

Hardware Address Assignments - The hardware address assignment method for WBN is identical to that for SQN.

D. In addition to the functional changes described above in Part A, the following changes have been made to WBN's main program and support routines in comparison to the software in use at SQN:

- The loop calculation processor (LCP) main program loop has been rearranged to service communications to the test sequence processor (TSP) at the end of the LCP loop execution cycle. Previously, communications to the TSP were serviced at the beginning of the LCP loop execution cycle. This change eliminates Eagle partial trip (EPT) refresh pulse variance caused by differences in communication setup time from cycle to cycle. The change was recently developed by Westinghouse to solve a communication signal problem experienced by the Eagle-21 system at Commonwealth Edison's Zion Nuclear Power Station. It is believed that the problem at Zion resulted from consolidation of Eagle-21 electronics into fewer racks. No similar problem was experienced at SQN, where rack consolidation was not needed. The change was incorporated into WBN's Eagle-21 software only for standardization and future flexibility since there is currently no plan for rack consolidation at WBN.

- The LCP read input routine has been revised to add a diagnostic to evaluate the high and low reference counts read by the automatic input calibration routine. This change prevents failed reference signals from causing an erratic input signal. Inputs whose reference signals fail this check are assigned a bad "B" quality code, which actuates the trouble alarm.

- The TSP analog output calibration routine has been revised to add a diagnostic to evaluate analog output gain and offset coefficient calculations. This change prevents erroneous coefficients from being

displayed for entry. An error message is displayed on the man-machine interface (MMI) test unit if the coefficients fail the diagnostic.

- The MMI static information display and parameter update routines have been modified to display static information to seven significant digits. Previously (i.e., at SQN), only five significant digits were displayed even if six or seven significant digits were entered by the operator. This change allows the operator to verify more precisely the correct entry of static parameters into the MMI.

E. The basic design of Eagle-21 equipment racks and their modular electronics has not changed. Differences between WBN and SQN for the various categories of installation criteria listed in the above question are as follows:

i. Electrical power (including divisional assignments) - No differences.

ii. Physical separation - No differences.

iii. Electrical isolation - No differences.

iv. EMI/RFI protection - No differences.

v. Heating, ventilation, and air conditioning - No differences.

vi. Physical security - No differences.

vii. Fire protection - No differences.

F. Eagle-21 indication and alarms differ between WBN and SQN in the following areas:

- At WBN, an Eagle-21 trouble alarm will not be generated when a single T_{hot} or T_{cold} channel is removed from scan. This change is described above as one of the functional differences in Part A.

- At WBN, the Eagle-21 trouble, channel set failure, RTD failure, and bypass alarm contacts are wired individually to the annunciator system. At SQN, the alarm contacts are grouped via logical "or" gates by protection set. From these "or" gates, one set of contacts for each alarm function is wired to the annunciator system.

2. (7.2)
(7.3)

Question:

The discussions presented in FSAR Sections 7.2 and 7.3 do not reflect either the modifications approved by the Commission for the use of Eagle-21 in the replacement of the RTD bypass system or your subsequent plans for a far broader use of the Eagle-21. Please amend your application for an Operating License to comply with Title 10 Code of Federal Regulations Part 50.34(11)(b). (The key issue here is one of currency.) The format and content of the information requested is specified in Regulatory Guide 1.70.

Response:

As stated in the response to Question 1, TVA has not yet incorporated information about the Eagle-21 process protection system into the FSAR. An FSAR update and other technical information submittals describing WBN's current Eagle-21 implementation are planned for the next several months as relevant design documents are completed.

With respect to WBN's initial implementation of Eagle-21 digital electronics as part of the design modification for RTD bypass elimination, FSAR Sections 7.2 and 7.3 do contain descriptions of this instrumentation upgrade. FSAR markups reflecting the limited use of Eagle-21 electronics for the instrumentation changes related to RTD bypass elimination were submitted for NRC staff review in two letters dated December 1, 1986 (for Chapter 5 and 7 markups) and January 27, 1987 (for Chapter 15 markups). The FSAR changes shown in these markups were subsequently incorporated into the FSAR by Amendment 63 (transmitted by letter dated June 26, 1990). A few minor corrections and additions related to this initial use of Eagle-21 were also included in Amendment 65 (transmitted by letter dated April 10, 1991). NRC reviewed the overall design modification for RTD bypass elimination and its associated use of Eagle-21 instrumentation and electronics. The NRC staff's safety evaluation and approval of this limited use of Eagle-21 was provided to TVA in a letter dated June 13, 1989. The NRC staff's safety evaluation and approval of the overall design modification for RTD bypass elimination was provided in NUREG-0847 Supplement No. 8 (dated January 1992).