TVA

Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

JUL 09 1991

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

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - RESISTANCE TEMPERATURE DETECTOR (RTD) BYPASS SYSTEM REMOVAL (TAC NO. 63599)

This letter provides TVA's response to NRC's request for additional information (RAI) dated January 8, 1991, concerning RTD bypass removal and the associated Eagle-21 process control system. The RAI included five questions for TVA to answer. Our response to each of these questions is attached as Enclosure 1. A list of the commitments resulting from these responses is attached as Enclosure 2.

NRC's RAI requested a response within 60 days from the date of receipt of their letter. In order to obtain necessary information from the equipment vendor, TVA requested additional time. An extension for TVA's response was agreed to verbally by Mr. Peter Tam of NRC on March 11, 1991. This item was tracked at the NRC/TVA monthly review meetings for Technical Assignment Control items. At the meeting on June 27, 1991, a schedule date of July 12, 1991, was established for the response.

If there are any questions about this submittal, please telephone M. C. Bryan at (615) 365-8819.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. H. Shell

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

Enclosures
cc: See page 2

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cc (Enclosures):

Ms. S. C. Black, Deputy Director
Project Directorate II-4
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

NRC Resident Inspector
Watts Bar Nuclear Plant
P.O. Box 700
Spring City, Tennessee 37381

Mr. P. S. Tam, Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

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

ENCLOSURE 1

WATTS BAR RESISTANCE TEMPERATURE DETECTOR (RTD) BYPASS SYSTEM REMOVAL REQUEST FOR ADDITIONAL INFORMATION

1. Question:

In a letter from J. A. Domer (TVA) to B. J. Youngblood (USNRC) dated January 27, 1987, TVA presented Table 15.1-3, "Trip Points and Time Delays to Trip Assumed in Accident Analysis." This indicated that the analysis for overtemperature delta-T and overpower delta-T assumes a 7.0-second delay. This delay includes the RTD response time and trip circuit channel electronics delay from the time the temperature difference in the reactor coolant loop exceeds the trip setpoint until the rods are free to fall.

a. TVA's letter of March 17, 1987, shows that the new RTD response time is 6.5 seconds including electronics delay. This leaves a margin of 0.5 second (7.0 - 6.5) from the analysis value. Is this margin sufficient to account for the accuracy of the response time test method used including repeatability and the effects of aging and drift? Please justify.

b. What method is used to check the RTD response time and what is the frequency of the test? Where in the Technical Specifications is this surveillance specified?

Response:

a. Response time testing at five plants with RdF RTDs (equivalent to those used at WBN) determined the average response time to be from 4.3 to 4.9 seconds. Typically, about 10 to 20 loop current step response (LCSR) tests were performed on each RTD. In the more than one hundred RTD response time tests included in this sample, only about 10% exceeded a response time of 5.5 seconds.

Note: The above test data for other plants was provided in a letter (WAT-D-8516) from J.W. Irons (Westinghouse) to W.L. Elliott (TVA) dated April 15, 1991 (RIMS no. B26 910416 301).

After combining a routinely achievable RTD/thermowell response time of 5.5 seconds with a conservative electronics delay of an additional 1.0 second, there is still a margin of 0.5 second (compared to the safety analysis value of 7.0 seconds) to allow for response time test uncertainties. This corresponds with the +/-10% accuracy of the LCSR test method employed by the contractor organization (AMS) that is charged with performing these tests for TVA and other utilities. The uncertainty value noted in Section 25.2 of NUREG/CR-5560, "Aging of Nuclear Plant Resistance Temperature Detectors," June 1990, for tests performed by AMS under contract to NRC is also +/-10%.

For WBN's initial plant startup, RTD and electronics response times will be measured to ensure an overall channel response time of 7.0 seconds or less including a 10% allowance for LCSR test uncertainty. If the overall channel response time is greater than 7.0 seconds, then actions will be taken to correct the situation and retest the channel to verify an overall response time of 7.0 seconds or less. Subsequent to plant startup, a reanalysis of non-LOCA transients will be performed to model WBN's overall as-built performance more accurately. Based on this reanalysis, it should be possible to increase the overall channel response time to a higher value, thereby providing additional response time margin for future use.

It is not anticipated, however, that any of this additional margin will be required to compensate for systematic degradation of the response time of the installed RTDs since no such degradation is expected. NUREG/CR-5560 provides a comprehensive study of the effects of normal aging on the performance of nuclear safety-related RTDs. Section 9.2 of this document notes that "a major cause of response time degradation in nuclear plant RTDs is the change that occurs in the RTD/thermowell interface in well-mounted RTDs." WBN's RTDs, as recommended in the NUREG study, have a silver-plated sensing tip to maintain good contact between the tip and the thermowell. RTD response time testing, as described below in Part b, will verify this anticipated response time behavior of the RTDs.

b. WBN will use a loop current step response (LCSR) test to measure RTD response time. The LCSR test permits in-situ response time testing of installed RTDs by remote heating of the sensing element inside the RTD. This is done by applying a small electric current through the RTD leads to induce an internal temperature transient that is then analyzed to determine the RTD time constant. WBN's Technical Specifications are being developed in accordance with draft NUREG-1431 (Westinghouse Standard Technical Specifications). The requirements for reactor protection system (RPS) and engineered safety feature actuation system (ESFAS) response time testing, including the frequency of testing, are currently located in Surveillance Requirements 3.3.1.16 and 3.3.2.10 of this NUREG.

2. Question:

TVA has discussed three non-LOCA accidents that were analyzed for the increase in RTD response time due to the removal of the RTD bypass system and use of the new RTD temperature system. Also discuss the effect of the increase in RTD response time on the small-break LOCA and the large-break LOCA.

Response:

Elimination of the RTD bypass system affects the uncertainties associated with reactor coolant system (RCS) temperature and flow measurements. In particular, the setpoints for overtemperature-delta-T, overpower-delta-T, and high-steamline-flow-coincident-with-low-low-T_{avg} that are used in the RPS and ESFAS may be affected. However, neither the safety analysis for a small-break LOCA nor the safety analysis for a large-break LOCA assumes a reactor trip or ESF actuation on the basis of any of these signals. Furthermore, the magnitude of the uncertainties is sufficiently small such that the thermal design flow rate (which is used in LOCA analyses) is unchanged.

The RCS primary-side conditions that are used in LOCA analysis models are unaffected by elimination of the RTD bypass system. The change in RCS volume due to the elimination of the RTD manifold piping is insignificant and does not affect LOCA analysis input. The RCS primary-side and steam generator secondary-side temperatures used in LOCA analyses are determined based on the anticipated, best-estimate loop average full-power operating temperature (T_{avg}) without uncertainty. Since the WBN best-estimate T_{avg} value (together with thermal design flow) is unaffected by RTD bypass removal, the RCS operating condition values used for LOCA analysis input are unaffected.

Based on the above considerations, it is concluded that the elimination of the RTD bypass piping will not affect the LOCA analysis input and, hence, the results of these analyses for WBN are unchanged. No LOCA reanalysis is required.

3. Question:

Describe how the RTDs are calibrated for accuracy after installation and the frequency of the calibration.

Response:

WBN will calibrate its RTDs for accuracy using a cross-calibration method. This method compares each RTD's output to the average output of the RTDs in the associated hot or cold leg over a series of temperature increments. The RTD's output is then adjusted if it exceeds the allowable deviation from the average of the RTDs. WBN's Technical Specifications are being developed in accordance with draft NUREG-1431 (Westinghouse Standard Technical Specifications). The requirements for RPS and ESFAS testing related to RTD cross-calibration, including the frequency of calibration, are currently located in Surveillance Requirements 3.3.1.12 and 3.3.2.9 of this NUREG.

4. Question:

In the letter from R. Gridley (TVA) to USNRC dated July 20, 1988, TVA indicated that a "preliminary" flow measurement uncertainty (FMU) analysis has shown that the current uncertainty value of 1.8% remains applicable and was included in the safety analysis. Please provide the final FMU analysis if it is different.

Response:

At the time RTD bypass elimination was implemented and the associated Eagle-21 electronics racks were installed, an FMU of 1.8% was appropriate. However, TVA now plans to install the remainder of the Eagle-21 process protection system at WBN prior to fuel load. This second phase of Eagle-21 installation will affect the uncertainties associated with the Westinghouse setpoint methodology document (WCAP-12096) and, consequently, may affect the FMU. For example, the uncertainty in pressurizer pressure measurement associated with the loss-of-flow setpoint will change. This, in turn, may directly affect the FMU. Since much of the Eagle-21 electronics upgrade is not yet complete, the FMU will be revalidated later as part of the reactor protection system evaluation which is included in the remaining scope of the upgrade effort. The results of FMU revalidation will be documented in a revision to the setpoint methodology document.

It should be noted that the methodology used to calculate uncertainties for the RPS is the same methodology which was used during the RTD bypass elimination evaluation. Therefore, although there may be a minor change in the actual flow uncertainty, such a change would be the result of variables described above rather than the result of a difference in methodology.

5. Question:

Are there alarms and control board indicators for failed RTDs based on the deviation of T_{avg} and delta-T? If so, please describe them and provide the deviation in °F which will cause the alarms and annunciation. If not, describe how the failed RTDs are detected.

Response:

The main control board alarms for deviation of T_{avg} and delta-T still exist. Specifically, the deviation of any single loop T_{avg} from the auctioneered high T_{avg} is alarmed. Also, the deviation of any single loop delta-T from the auctioneered high delta-T is alarmed. These alarms actuate at a deviation of 2°F.

In addition, the new Eagle-21 digital electronics equipment employs an algorithm that automatically detects a defective hot leg RTD input signal and eliminates that input from the calculation of average T_{hot} ($T_{h_{ave}}$). This is accomplished by incorporating a redundant sensor algorithm (RSA) into the hot leg temperature signal processing. The RSA determines the validity of each input signal and automatically rejects a defective input. The typical tolerance bandwidth for automatic rejection is 2-6°F. The exact value will be determined during startup based on actual hot leg temperature measurements. As a result of this enhanced signal processing capability, additional control room alarms, annunciators, and status lights are provided as part of the RTD bypass elimination and Eagle-21 functional upgrade. These additional indicators include:

1. A "Trouble" status light is added for each loop. This light indicates when there are only two good narrow-range T_{hot} signals for that loop.
2. An "RTD Failure" alarm and annunciator window are added for each loop. This alarm and annunciator indicate when there is an invalid T_{cold} or T_{hot} average group value for that loop.

ENCLOSURE 2

List of Commitments

1. During initial startup testing, actions will be taken to correct any resistance temperature detector (RTD) channel with an overall response time of greater than 7.0 seconds including electronics delay and a 10% allowance for loop current step response test uncertainty. After any such corrective action, the channel will be retested to verify an overall response time of 7.0 seconds or less (the value assumed in pertinent safety analyses).

2. Subsequent to plant startup, a reanalysis of non-LOCA transients will be performed to model WBN's overall as-built performance more accurately and to establish a more realistic safety analysis value for overall RTD channel response time.

3. The flow measurement uncertainty (FMU) will be revalidated as part of the reactor protection system evaluation which is included in the remaining scope of the Eagle-21 upgrade. The results of FMU revalidation will be documented in a revision to the Westinghouse setpoint methodology document (WCAP-12096).