TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

February 27, 1984

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

Enclosed is the TVA response to an informal NRC question concerning calculation of vertical temperature gradients at Watts Bar Nuclear Plant. This information was reqested by the NRC Radiological Emergency Planning Branch.

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Licensing

Sworn to and subscribed before me
this 27th day of Feb. 1984
Paulette H. White
Notary Public
My Commission Expires 9-5-84

Enclosure
cc: U.S. Nuclear Regulatory Commission (Enclosure)
Region II
Attn: Mr. James P. O'Reilly Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

B001
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TVA Response to NRC Question on Watts Bar (same question as Bellefonte NRC question, number 451.22)

Question

Vertical temperatures gradient is most often measured directly (e.g., through a resistance bridge circuit) to obtain the measurement accuracy for this parameter specified in Regulatory Guide 1.23. However, at the Watts Bar site, the vertical temperature gradient is determined by the calculation of the difference in temperature measurements, apparently performed electronically from instantaneous measurements recorded once per minute. Although the accuracy for the determination of vertical temperature gradient stated in Section 2.3.3 of the FSAR is in compliance with the recommendation of Regulatory Guide 1.23, generally the subtraction of two temperature measurements is considerably less accurate than a direct measure of temperature difference. At other sites reviewed by the NRC, the accuracy of vertical temperature gradient determined by the subtraction of two temperatures has often exceeded the specification in Regulatory Guide 1.23.

a) Provide an expanded discussion of the accuracy of the measurement of vertical temperature gradient which includes identification of the type (not manufacturer) of temperature sensors and the bases for the stated accuracy of temperature measurement (0.06 F). Also indicate whether the sensors are matched at installation and replacement, and indicate the "drift" between sensors found at instrument calibrations.

b) Identify the averaging period considered for the determination of temperature difference (e.g., 60 1-minute values?) and clarify the computational procedures for the determination of temperature difference (i.e., is temperature difference computed for each interrogation of the sensors or from an ensemble average of temperature measurements?).

c) Provide a discussion of the display of vertical temperature difference in the control room, technical support center, and Emergency Operations Facility, and identify what procedures will be used to determine temperature difference if electronic subtraction is not functional.

Response

a) The measurement system consists of one 100-ohm, 4-wire platinum resistance temperature sensor at each tower level, one NOVA computer-controlled multiplexer with low thermal e.m.f. relays to select the desired sensor, and one NOVA computer-controlled digital multimeter (DMM) which has a resolution of 0.001 ohm. The computer rounds each instantaneous reading to the nearest 0.01 ohm and computes air temperature with a resolution of 0.05°F using the linear equation given in the FSAR.

Sensors are calibrated and used in matched sets. Calibration data from tests of each set at the ice point, 40°C, and 100°C are used to evaluate acceptability for air temperature and vertical temperature difference measurements. First, coefficients in the Callendar-Van Dusen equation are determined for each sensor to define its actual resistance/temperature (R/T) relationship, which is slightly non-linear. Next each non-linear equation is solved to determine the value of each sensor's "0°F Constant" which, when used in the NOVA linear equation, will yield a computed value of 50.00°F at a true air temperature of 50.00°F. (At other air temperatures the computed values would, in general, be less than true because of the sensor's slightly curved R/T relation.) Then the actual resistance of each sensor is calculated at several true temperatures in the range -10°F to +110°F, and those values are converted to computed temperatures using the NOVA linear equation. Below are listed the true temperatures, the computed temperature values expected from the linear equation, and tolerances of those computed temperatures.

True Temperatures	Computed Temperatures ± Tolerance
-10°F	-10.27° ± 0.18
30°F	30.00° ± 0.09
70°F	70.00° ± 0.09
110°F	109.59° ± 0.18

Only those sensors that conform to these values are acceptable from the air temperature standpoint.

Finally, the computed temperature values of all sensors in the set are compared. To be acceptable for vertical temperature difference measurements, the values for all sensors must be the same within 0.13°F.

Sensor drift between calibrations is normally less than ± 0.05°F.

b) TVA determines the hourly vertical temperature gradient ($\Delta T/\Delta Z$) between two tower levels by computing the difference between the hourly average values of the individually measured temperatures at the two levels. The hourly average temperature at each level is the mean of 60 instantaneous values taken one each minute.

c) Vertical temperature difference (ΔT) is calculated by the computer in the Environmental Data Station (EDS) and transmitted to the Watts Bar Nuclear Plant (WBN). The temperature values are transmitted from the EDS to the Central Emergency Control Center (CECC) computer in Chattanooga, where ΔT values are calculated. The data are displayed in both the WBN control room and the WBN technical support center. The CECC computer is accessible by the emergency centers for data display in those centers. Display in the plant control room is on strip charts, but digital display is also planned. Display in the technical support center is on a computer printer and/or CRT. In the emergency centers, the data will be printed at computer terminals, or displayed on a CRT if the terminal source is unavailable.

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There are no procedures to determine ΔT if electronic subtraction is not functional. If one or more calculated ΔT values are unavailable, one or more of the three temperature values would be expected to be missing as well. However, procedures for obtaining stability class (based on ΔT) when real time ΔT values (and temperature values) are unavailable are contained in the Watts Bar backup procedures manual. This manual is similar to those that have been prepared for Browns Ferry and Sequoyah Nuclear Plants. These manuals provide a statistical means for supplying values for the wind direction, wind speed, and stability class variables that are required for radiological emergency program (REP) support in the event that real time values are missing or invalid. Functional use of these backup procedures will be limited to times when REP procedures are activated (during drills and exercises, and if any actual events occur).

Prepared on February 17, 1984 by Norris Nielsen, Air Quality Branch, with Data Services Branch input for parts a) and b).