TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

November 10, 1982

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

By your letter dated July 30, 1982 to H. G. Parris, TVA was requested to provide additional information concerning the Loose Parts Monitoring System (LPMS) for Watts Bar Nuclear Plant. The requested information is enclosed. TVA will provide an FSAR revision to section 7.6.7 reflecting the specified items in Regulatory Guide 1.133, item C.4 in amendment 48.

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 10th day of November 1982
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, Regional Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

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ENCLOSURE

Watts Bar Nuclear Plant Units 1 And 2
Loose Parts Monitoring

C.1.f Capability for Sensor Channel Operability Tests. Provision should be made for periodic online channel check and channel functional tests for offline channel calibration[2] during periods of cold shutdown or refueling (see Regulatory Position 3.a(3)).

[2]The standard technical specifications define channel check, channel functional test, and channel calibration as follows:

A channel check is the qualitative assessment of channel behavior during operation by observation, including where possible, comparison of the channel indication or status with other indications or status derived from independent instrument channels measuring the same parameter.

A channel functional test for analog channels is the injection of a simulated signal into the channel as close to the primary sensor as practicable to verify operability, including alarm and trip functions; for bistable channels it is the injection of a simulated signal into the channel sensor to verify operability, including alarm and trip functions.

A channel calibration is the adjustment, as necessary, of the channel output so that it responds with the necessary range and accuracy to known values of the parameter that the channel monitors. The channel calibration encompasses the entire channel, including the sensor and alarm and trip functions, and includes the channel functional test. The channel calibration may be performed by any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated.

Response:

The definition used for channel operability is not readily adaptable to loose part monitoring. There are basically three means of verifying operation.

A. The alarm function can be verified by an internal simulator which injects a test signal directly into the signal conditioners before the alarm discrimination circuitry.

B. Operation of the sensors, remote preamplifiers, cabling, and amplifiers can be verified by periodically comparing the conditioned signals to a baseline signal. During power operation the reactor coolant system provides an extremely stable noise level for comparison purposes.

C. System calibration during refueling outages can be accommodated by mounting the accelerometer on a shaker which provides a known mechanical input. An input signal such as a pendulum is not repeatable and is not suitable for a calibration input.

C.1.i <u>System Repair.</u> The system should be designed to facilitate the recognition, location, replacement, repair, and adjustment of malfunctioning components. Equipment, procedures, and layout should facilitate maintenance to minimize personnel time in high radiation areas and minimize occupational radiation exposure.

Response:

Most control cabinet circuits are contained in modules which can be removed and repaired without disabling the entire system.

Redundant sensors provided on the reactor vessel and steam generators are routed to a patch panel in the auxiliary instrument room. If a failure occurs, the inactive sensor can be patched in without entering containment.

The remote charge preamplifiers are being relocated to junction boxes which ensure access from floors or platforms and to increase the distance from radiation sources when maintenance is required.

C.2.a The alert logic should incorporate suitable internal criteria to distinguish the transient signal caused by the impact of a loose part from the signals associated with normal hydraulic, mechanical, and electric noise and large-amplitude electrical transients. For example, it may be desirable to include logic that requires the comparison of two or more sensor signals with the alert level.

Response:

The loose part monitoring system (LPMS) includes an alarm logic which requires that a predetermined number of events occur during a selected time interval following the initial event. This presumes that a loose part will have multiple impacts, whereas electrical spikes and other anomalies are single events.

The LPMS circuitry develops a signal (V_{BG}) proportional to the RMS value of the background noise level and a signal (V) proportional to the RMS value of the total signal. The time constant in the background level circuitry is sufficiently long that V_{BG} cannot be influenced by rapid signal changes; however, the level can respond to slower changes caused by a shift in plant operating conditions. The time constant in the V RMS converter is very short so that V can respond to rapid transients indicative of loose part impacts. The alert threshold is a multiple (k) of the background signal level so that an alert is detected whenever V is greater than kV_{BG}.

The system, through the process described above, automatically adjusts its impact alert alarm level above the background noise, detecting only those signals which rise above the changing average. This feature permits the impact alert alarm level to be adjusted to a maximum sensitivity level consistent with the short term averaging of the normal background noises over a preselected time period. Preliminary alert levels shall be established during initial preoperational testing utilizing vendor supplied information. Additional adjustments, if necessary, will be made and the settings verified at plant output power levels of 0%, 25%, 50%, 75%, and 100%. Standard operating procedures will be to periodically verify, through calibration checks on the active accelerometers, the 0.5 ft-lb sensitivity requirement.

C.2.c The alert logic may provide for the alert level to be a function of the normal steady-state operating condition.

Response:

The LPMS circuitry develops a signal (V_{BG}) proportional to the RMS value of the background noise level and a signal (V) proportional to the RMS value of the total signal. The time constant in the background level circuitry is sufficiently long that V_{BG} cannot be influenced by rapid signal changes; however, the level can respond to slower changes caused by a shift in plant operating conditions. The time constant in the V RMS converter is very short so that V can respond to rapid transients indicative of loose part impacts. The alert threshold is a multiple (k) of the background signal level so that an alert is detected whenever V is greater than kV_{BG}.

The system through the process described above automatically adjusts its impact alert alarm level above the background noise, detecting only those signals which rise above the changing average. This feature permits the impact alert alarm level to be adjusted to a maximum sensitivity level consistent with the short term averaging of the normal background noises over a preselected time period. Preliminary alert levels shall be established during initial preoperational testing utilizing vendor-supplied information. Additional adjustments, if necessary, will be made and the settings verified at plant output power levels of 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent. * Standard operating procedures will be to periodically verify, through calibration checks on the active sensors, the 0.5 ft-lb sensitivity requirement.

C.3.a (1) Preoperational testing: Establish alert level for this test phase.

Response:

See response to item C.2.a.

C.3.a (2) (b) At least once per 24 hours: Perform channel check.

Response:

Verify that the OVERLOAD LED on each amplifier is not illuminated and that the STATUS LED for each channel is green (within range) and flashes red as scanned.

C.3.a (2) (c) At least once per 7 days: Listen to audio portion of signals from all recommended sensors for the purpose of detecting the presence of loose parts. If signals indicate the presence or possibility of a loose part, station personnel should actuate the data acquisition system to obtain data for further evaluation.

Response:

Step b above and the additional checks. Compare the amplifier range at full power (90 to 100 percent) to the original settings at full power. If the gain has been changed by a factor of more than 10, the discrepancy should be investigated. Listen to each channel on the audio monitor for impacting, electrical contamination, or other unusual noise.

C.3.a (2) (d) At least once per 31 days: Perform channel functional tests.

Response:

Step c plus one additional check. Use the alarm simulator to verify that the alarm circuitry is operable.

C.3.a (2) (e) At least once per 92 days: Verify that the background noise measured during normal plant operation is sufficiently small that the signal associated with the specified detectable loose-part impact would be clearly discernible in the presence of this background noise. Verify that the signal from each recommended sensor does not falsely indicate the presence of a loose part. This should include comparison with data, including audio data, obtained at the time of the last two quarterly measurements to verify that there does not exist a significant trend anomaly that may falsely indicate the presence of a loose part. The alert level and alert logic may be revised to provide for the background noise of these later measurements. If the revision is not temporary, its details should be submitted within 60 days to the Commission as an amendment to the program description.

Response:

Step d plus additional checks. Record frequency spectrums (at 90 to 100 percent power) compare with baseline full power spectra sensor by sensor. Additionally, verify that any apparent shifts in signal levels at any collection point are observed at both the active and passive sensor. An increase in the 60 Hz harmonics may signal equipment degradation. Suspected shifts in background will be investigated since they have the potential to reduce alarm sensitivity.

C.3.a (3) Cold shutdown or refueling: At least once per 18 months, verify channel calibration using a controlled mechanical input (e.g., weight falling through a known distance that impacts the external surface of the reactor coolant pressure boundary). Channels should, as necessary, be recalibrated at this time. If recalibration is necessary, consideration should be given to replacement of unstable components.

Response:

Channel calibration with a mechanical input is very difficult since impact devices and methods have been nonrepeatable and removal of the accelerometer for calibration with a shaker causes a variety of problems. The LPMS accelerometer sensitivities are very stable, even in the presence of high radiation and temperatures; therefore, the following calibration method will be used.

1. During each refueling outage, inject a test signal into each remote charge preamplifier input and monitor the signal conditioner output to verify the channel calibration.
2. At five year intervals (the nearest refueling outage) mount each accelerometer on a shaker and measure its charge sensitivity.
3. After each channel is restored to its normal condition, use a mechanical input such as a spring loaded center punch to input an impact and verify the channel operation.