Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609

JUL 30 1993

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

Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - REGULATORY GUIDE 1.97 - BOILING WATER REACTOR NEUTRON FLUX MONITORING (TAC NOS. M51073, M51074, AND M51075)

Reference: NRC letter to TVA, dated May 27, 1993, Browns Ferry Nuclear Plant, Units 1, 2, and 3: Regulatory Guide 1.97 - Boiling Water Reactor Neutron Flux Monitoring

This letter provides information regarding the qualification of BFN's neutron monitoring instrumentation. In support of an industry wide effort to address qualification of neutron monitoring instrumentation, the BWR Owners Group (BWROG) developed NEDO-31558, Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Monitoring System. In the referenced Supplemental Safety Evaluation Report (SER), TVA was requested to review the BFN neutron flux monitoring instrumentation against the criteria of NEDO-31558-A to determine whether these criteria were satisfied. The enclosure to this letter summarizes the background of this issue and provides BFN's comparison to the criteria contained in NEDO-31558-A.

In summary, the BFN Average Power Range Monitors (APRMs) meet the alternate criteria contained in NEDO-31558-A, Section 5.2, with the following exceptions. While the APRM power supply is not uninterruptable as required by Criterion 8, the power supply is highly reliable and has redundant and diverse means of supply. TVA requests approval of the proposed deviation to this criterion.

Evaluation of the post-ATWS environment and the survivability of the APRMs (Criterion 4) is not complete. The evaluation of the APRM function time (Criterion 5) is dependent on those results. TVA will respond to these criteria by October 29, 1993.

A summary list of commitments contained in this letter is provided as Enclosure 2. If you have any questions, please telephone me at (205) 729-2636.

Sincerely,

Pedro Salas
Manager of Site Licensing

Enclosures
cc: see page 3

U.S. Nuclear Regulatory Commission

JUL 30 1993

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ENCLOSURE 1

Tennessee Valley Authority

Browns Ferry Nuclear Plant (BFN)

BWR Neutron Flux Monitiorng - Comparison to NEDO-31558-A Criteria

BACKGROUND

In the NRC's February 8, 1990 Safety Evaluation Report (Reference 1), NRC requested TVA provide qualified neutron flux monitoring instrumentation in accordance with the guidelines contained in Regulatory Guide 1.97, Instrumentation for Light Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident. In the NRC's Supplemental SER (Reference 2), the staff stated that implementation of qualified neutron flux monitoring capability could be deferred pending review of the BWR Owners Group (BWROG) position.

In support of the BWROG efforts, NEDO-31558, Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Monitoring System, was submitted. As part of a Supplemental SER (Reference 3), TVA was requested to review the BFN neutron flux monitoring instrumentation against the criteria of NEDO-31558-A to determine whether these criteria were satisfied.

ACTIONS REQUESTED AND RESPONSE

The alternate criteria for the neutron flux monitoring instrumentation is contained in Section 5.2 of NEDO-31558-A. The criteria and BFN's comparison to this criteria are summarized below:

1) Range - 1 to 100 percent of rated power

   The BFN Average Power Range Monitors (APRMs) meet the alternate criteria and have a range from 1 to 125 percent of rated power.

2) Accuracy - ± 2 percent of rated power

The APRMs meet the alternate criteria. The site specific setpoint and scaling calculation determined that the High Neutron Flux Upscale (setdown and fixed) has an as found value (worst case) of ±2 percent rated power.

3) Response Characteristic - 5 seconds for a 10 percent power change

The APRMs meet the alternate criteria and respond within 5 seconds to a 10 percent power change. The APRMs are designed to respond to a step change (going from 0 to 63% of final value) within 18 ± 7 msec.. Therefore after five of the (18 ± 7 msec.) time periods, the APRMs will responded to the final value of the step change. The recorders and indicators have an small additional time lag from the output of the APRM circuitry but the total response time will be well within the 5 second allowable.

4) Environmental Qualification - Operate in an ATWS environment

Evaluation of the post-ATWS environment and the survivability of the APRMs is not complete. TVA will respond to this criterion by October 29, 1993.

5) Function Time - 1 hour

The evaluation of the APRM function time is dependent on the results of the environmental qualification evaluation (Criterion 4, above). TVA will also respond to this criterion by October 29, 1993.

6) Seismic Qualification - Not required

As discussed in NEDO-31558-A, the neutron monitoring system equipment, which provides automatic trip functions, have been seismically qualified. The remainder of the neutron monitoring system equipment is not required to be seismically qualified. Therefore, no TVA response to this item is required.

7) Redundancy and Separation - Redundancy to Assure Reliability

The APRMs meet the alternate criteria and are sufficiently redundant to assure reliability. There are six redundant channels (A-F) of APRMs that receive inputs from a minimum of 14 to a maximum of 22 LPRMs. None of the LPRMs are shared and they are scattered in locations throughout the core so that each channel can provide an accurate indication of core power.

The six channels are divided into two redundant sets of APRM's for input into the Rod Block and SCRAM circuitry. The two sets of APRMs are redundantly powered from different RPS busses. Both of the RPS busses are highly reliable power sources that are diesel backed.

Each of the six APRM channel readings are recorded on paper in the control room. For diversity, the same information is also sent to the Safety Parameter Display System (SPDS), where the information can be displayed as current readings, as a chart for trending of the past 9 minutes, or called up as history for the past 3 days. After three days the information is downloaded onto magnetic tape and the tapes are then stored.

8) Power Sources - Uninterruptable and Reliable Power Sources

While the APRM power supply is not uninterruptable, the power supply is highly reliable and has redundant and diverse means of supply. TVA requests approval of the proposed deviation to this criterion.

The two sets of APRM channels are fed from the two RPS busses A and B. This power is highly reliable and is supplied by the RPS motor generator sets, the MG sets are supplied form the 480V Reactor MOV boards, the Reactor MOV boards can be supplied from either 480V shutdown board A or B which are fed through the 4KV shutdown boards. The 4KV shutdown boards can be tied to either shutdown bus 1 or 2 and are diesel backed normally from a Unit 2 Diesel Generator but can be tied to a Unit 3 Diesel Generator.

The APRM Power feeds, Reactor MOV boards and shutdown boards, are not load shed during the loss of normal power. In addition the RPS M-G set has inertia which will continue to provide power while alternate power sources are being aligned. If total loss of normal power to the RPS M-G set should occur the RPS buss can be manually aligned to an alternate 480V supply available through the Reactor MOV boards.

In summary, while the APRM power supply is not uninterruptable, the power supply is highly reliable and has redundant means of supply. It is also highly unlikely that both RPS busses would lose their power at the same time except during a loss of offsite power. There is such a diverse means of powering the APRMs that at least one set of APRMs should be available to give an indication of reactor power at all times.

9) Channel Availability - Available prior to an accident

The APRMs meet the alternate criteria and are continuously available.

The APRMs are constantly used to detect neutron flux during power operation. The APRMs have six redundant channels which are divided into two sets of three each for input into the Rod Block and SCRAM circuitry.

Technical Specification Table 3.1.A, Reactor Protection System (SCRAM) Instrumentation Requirements, require a minimum of two APRM instrument channels per trip system be operable during reactor power operations.

10) Quality Assurance - Limited QA requirements based on Generic Letter 85-06

The APRMs meet the alternate criteria. The existing APRM system is classified as safety related. The control room recorders and indicators are classified as quality related. The SPDS computer which can used to display or to retrieve information about the APRMs is classified as important to operations, however SPDS is a redundant and diverse backup to the APRM indication and recording and is not a part of the APRM circuitry or system.

The ATWS Rule (10 CFR 50.62) does not require systems to be safety-related and implementation of the ATWS system need not meet all aspects of 10 CFR 50 Appendix B, quality assurance requirements. NRC has recognized that existing industry practices applied to non-safety related equipment are acceptable for specific application for non-safety related ATWS equipment. This position is explicitly stated in Generic Letter 85-06. Therefore, the organization and program, design control, procurement, installation, inspection, testing, maintenance, modification and other work related to the APRMs are in accordance with the guidance in Generic Letter 85-06.

11) Display and Recording - Continuous Recording

The APRMs meet the alternate criteria and each APRM channel is continuously recorded on paper by the recorders in the main control room. This function is mimicked by SPDS. The APRM outputs are sent to SPDS computer where the information can be displayed as current readings, as a chart for trending of the past 9 minutes or called up as history for the past 3 days. After three days the information is downloaded onto magnetic tape and the tapes are then stored.

12) Equipment Identification - Identify in accordance with Control Room Design Review

The APRM instrumentation meets the alternate criteria. The APRM instrumentation was evaluated during the BFN Control Room Design Review. Instrumentation labels for the APRMs were changed to black letters on a white background to improve readability. However, in accordance with BFN's design criteria for post-accident monitoring instrumentation, Regulatory Guide 1.97, Category 3, Type B variables do not receive a special designation.

13) Interfaces - No interference with RPS trip functions

The APRMs meet the alternate criteria and do not interfere with the Reactor Protection System (RPS) trip function. The APRM system is isolated from the RPS power supply by fuses and from the RPS trip circuitry by relay contacts.

14) Service, Test and Calibration - Establish in-plant procedures

The APRMs meet the alternate criteria and their maintenance, testing, and calibration are governed by plant procedures. Maintenance - Procedures for LPRM replacement and testing ensure that the primary sensors are properly installed and adequately maintained. A preventative maintenance program initiates and schedules routine maintenance tasks throughout the Neutron Monitoring System. Maintenance planning evaluates all equipment malfunctions, provides work instructions and prescribes appropriate post maintenance testing.

Testing - Functional testing is required weekly by Technical Specification Table 4.1.A, Reactor Protection System (SCRAM) Instrumentation Functional Frequencies for Safety Instrument and Control Systems. An input to the primary sensor is not required for functional testing of the APRMs. Internal circuits simulate neutron flux levels and an output is run to each trip level, then verified for proper response. The functional test causes a half scram on each channel and verifies proper operation of the trip relays, indicators and annunciators. Internal calibration testing of the APRM channels is performed quarterly to verify that all internal parameters are functioning within acceptable limits.

Calibration - APRMs are calibrated once every seven days per Technical Specification Table 4.1.B, Reactor Protection System (SCRAM) Instrument Calibration Minimum Calibration Frequencies for Reactor Protection Instrument Channels. Actual thermal power is obtained from heat balance data, usually using the plant process computer. Gain adjustment factors (GAF), defined as the actual core thermal power divided by the APRM reading, are determined. APRMs are then adjusted so that the GAFs are less than one and rod block and scram functions occur at conservative power levels. LPRM sensors are calibrated every 1000 effective full power hours, in compliance with the same table, by comparison with flux data input to the process computer during TIP sets.

15) Human Factors - Incorporate human factors engineering principles

The APRM instrumentation meets the alternate criteria. The APRM instrumentation was evaluated during the BFN Control Room Design Review for human factors engineering (HFE) deficiencies (e.g., precision, location, and labeling). No safety significant HFEs were identified that would impact the operators use of this equipment. However, as discussed above, labeling improvements were incorporated.

16) Direct Measurement - Direct measurement of neutron flux

The APRMs meet the alternate criteria since the fission chambers directly measure neutron flux in the core. The APRM channels receive input from various Neutron sensitive fission chambers. The fission chambers are located in 43 assemblies in various narrow water gaps throughout the core. The assemblies have 4 detectors at various heights in the region of active fuel, the locations are fixed and these detectors are not retractable. The assemblies are located so each location or it's symmetrical counterpart in another quadrant is monitored.

SUMMARY

In summary, the BFN Average Power Range Monitors (APRMs) meet the alternate criteria contained in NEDO-31558-A, Section 5.2, with the following exceptions. While the APRM power supply is not uninterruptable as required by Criterion 8, the power supply is highly reliable and has redundant and diverse means of supply. TVA requests approval of the proposed deviation to this criterion.

Evaluation of the post-ATWS environment and the survivability of the APRMs (Criterion 4) and the APRM function time (Criterion 5) are not complete. TVA will respond to these criteria by October 29, 1993.

REFERENCES

1) NRC letter to TVA, dated February 8, 1990, Emergency Response Capability - Conformance to Regulatory Guide 1.97, Revision 3

2) NRC letter, dated May 10, 1991, Safety Evaluation of Emergency Response Capability - Conformance to Regulatory Guide 1.97, Revision 3

3) NRC letter to TVA, dated May 27, 1993, Browns Ferry Nuclear Plant, Units 1, 2, and 3: Regulatory Guide 1.97 - Boiling Water Reactor Neutron Flux Monitoring

ENCLOSURE 2

Tennessee Valley Authority

Browns Ferry Nuclear Plant (BFN)

Summary of Commitments

TVA will respond to NEDO-31558-A, Section 5.2, Criterion 4 and 5, by October 29, 1993.