UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-327/92-16 and 50-328/92-16

Licensee: Tennessee Valley Authority
3B Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-327 and 50-328 License Nos.: DPR-77 and DPR-79

Facility Name: Sequoyah 1 and 2

Inspection Conducted: May 11-15, 18-22, 1992

Inspector: Mark N Miller 7/27/92
M. Miller Date Signed

Approved by: M B Shymlock July 27, 92
M. Shymlock, Chief Date Signed
Plant Systems Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This special, announced inspection was conducted in the area of the licensee's conformance to Regulatory Guide (RG) 1.97, Instrumentation for Light-Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident.

Results:

In the area inspected, violations or deviations were not identified. The licensee either conformed to or was justified in deviating from the guidance with Regulatory Guide [RG] 1.97. Within the conditions of the Safety Evaluation Report and this report, the licensee was in compliance with the design and qualification criteria for instrumentation in RG 1.97, Revision 2.

In the area of the Eagle 21 instrumentation three open items were identified for the Staff's review. The licensee did not maintain controlled documentation for the Eagle 21 EPROMs source code to ensure design configuration control. The calibration methodology did not appear to meet the intent of overlap testing for channel (loop) calibrations as stated in the technical specifications. No external resistance signals were used to simulate the RTD sensors for the calibration of the T hot and T cold channels. The T hot

and T cold calibrations did not appear to meet the intent of the channel functional test for analog channels as specified in the technical specifications.

Weaknesses:

In the area of channel (loop) calibration, two items were identified as weaknesses.

* The instrumentation calibration methodology for separate analog loops (Not Eagle 21) uses only one overlap point from the field transmitter. Therefore, the total channel (loop) calibration over the zero to 100 percent range was not performed using the field transmitter. Consequently, since the total range was not covered with the transmitter, the total loop operation was not verified and loop interaction over the zero to 100 percent range could not be detected. (see paragraph 2.b)

* Eagle 21 instrumentation calibration methodology did not require that the Eagle 21 electronics and outputs (to indicators) be used with the field transmitter during channel (loop) calibration. Therefore, there was no loop calibration using the field transmitter and the Eagle 21 system simultaneously together. Over the zero to 100 percent range, the total loop operation was not verified and loop interaction could not be detected. (see paragraph 2.b)

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*R. J. Beeeken, Plant Manager
*J. Bajarszewski, Compliance Licensing Engineer
*J. M. Campbell, Engineering I&C Manager
*M. Cooper, Site Licensing Manager
*D. C. Craven, Technical Support I&C Supervisor
*D. Dimopoulos, System Engineer
*S. Johnson, Quality Assurance Supervisor
*G. G. Mailen, Instrument Engineer
*C. D. McDuffy, Compliance Licensing Personnel
*R. Poole, Instrument Maintenance Acting
*H. R. Rogers, Technical Support Manager
*R. R. Thompson, Compliance Licensing Manager
*P. G. Teudel, Engineering Manager
*E. H. Turner, Instrument Engineer
*W. A. Vanosdale, Maintenance Program Manager

Other licensee employees contacted during this inspection included engineers, operators, technicians, and administrative personnel.

NRC Resident Inspectors

*W. E. Holland, Senior Resident Inspector
*S. M. Shaeffer, Resident Inspector

*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

2. Inspection of Licensee's Implementation of Multiplant Action Item A-17: Instrumentation for Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident (Regulatory Guide 1.97) (25587)

Criterion 13, "Instrumentation and Control", of Appendix A to 10 CFR Part 50 includes a requirement that instrumentation be provided to monitor variables and systems over their anticipated ranges for accident conditions as appropriate to ensure adequate safety. Regulatory Guide 1.97 describes a method acceptable to the NRC staff for complying with the Commission's regulations to provide instrumentation to monitor plant variables and systems during and following an accident.

The licensee responded to RG 1.97 (NUREG 0737, Supplement 1) in letters dated March 15, 1982; April 15, 1983; December 28, 1983; September 14, 1989; March 12, 1990; and May 7, 1990. The Safety Evaluation Report (SER) for RG 1.97 was issued August 22, 1991.

The SER dated August 22, 1991 concluded that the licensee's instrumentation for RG 1.97, Revision 2 either conformed to or was justified in deviating from RG 1.97 with the exception of accumulator tanks level and pressure. These items will remain open pending the outcome of the staff's generic review of the need for environment qualification. In Section 2.0, Evaluation Criteria, of the SER, it was specifically stated that regional meetings were held in February and March 1983 to answer licensee questions and concerns. At these meetings the NRC policy for RG 1.97 was established that the NRC would only address exceptions taken to RG 1.97. Further, where licensees explicity state that the instrumentation system conform to the provisions, no further staff review would be necessary for those items. Therefore, the review performed and reported by the SER only addresses exceptions to the guidance of RG 1.97.

This inspection assessed the licensee's RG 1.97 instrumentation program using (1) the design and qualification criteria described in Table 1 of RG 1.97, Revision 2; (2) the Technical Evaluation Report No. EGG-NTA-8452 dated June 1990, Conformance to Regulatory Guide 1.97 Sequoyah, (3) the licensee's submittals as discussed previously; and (4) 10 CFR Part 50.

A random sample of 21 variables from the licensee's submittal was selected to evaluate the licensee's program. The variables selected were classified as Category 1 and 2 which have the most stringent design requirements of all RG 1.97 instruments. The instruments examined and the results achieved are discussed in the paragraphs and tables below.

a. Category 1 and 2 Instruments

The instrument loops listed in the following Tables were examined to verify that the design and qualification criteria for RG 1.97, the SER and licensee commitments had been satisfied. The instrumentation was inspected by reviewing drawings; procedures, data sheets and other documentation; and performing walkdowns for visual observation of selected installed equipment including control room indicators and recorders. The following areas were inspected:

(1) Equipment Qualification - The EQ Master Equipment List, Q-list, I&C List, and instrument drawings were reviewed for confirmation that the licensee had addressed environmental qualification requirements and seismic qualification.

(2) Redundancy - Walkdowns were performed to verify by visual observation that selected instruments were installed as specified and that separation requirements were met. In addition, control drawings for all listed Category 1 instrumentation were reviewed to verify redundancy and channel separation.

(3) Power Sources - Electrical drawings were reviewed to verify the instrumentation was energized from a safety-related power source if applicable.

(4) Display and Recording - Walkdowns were performed to verify by visual observation that the specified display and recording instruments were installed. Control drawings were reviewed to verify there was at least one recorder in a redundant channel and two indicators, one per division (channel) for each measured variable.

(5) Range - Walkdowns were performed to verify the actual range of the indicator/recorders was as specified in RG 1.97 or as stated in the licensee's submittal. Review of calibration procedures verified sensitivity and overlapping requirements of RG 1.97 for instruments measuring the same variable.

(6) Interfaces - The control drawings, I&C List, and Q-List were reviewed to verify that safety-related isolation devices were used when required to isolate the circuits from non-safety systems.

(7) Direct Measurement - Control drawings were reviewed to verify that the parameters were directly measured by the sensors.

(8) Service, Testing, and Calibration - The maintenance program for performing calibrations and surveillances was reviewed and discussed with the licensee. Calibration and surveillance procedures and the latest data sheets for each instrument were reviewed to verify the instruments had a valid calibration. Weaknesses were identified in this area as discussed in paragraph 2.b.

(9) Equipment Identification - Walkdowns were performed to verify that Types A, B and C instruments designated as Categories 1 and 2 were specifically identified with a common designation on the control panels.

Note Instrument Loops in this report are applicable to both Units 1 and 2.

TABLE 1

CATEGORY 1 INSTRUMENTS

Variable	Instrument Loop
Steam Generator Pressure	PT-1-2A PT-1-2B PT-1-9A PT-1-9B PT-1-20A PT-1-20B PT-1-27A PT-1-27B
Refueling Water Storage Tank Level (RWST)	LT-63-50 LT-63-51
RCS Hot Leg Temperature	TE-68-1 TE-68-24 TE-88-43 TE-68-65
RCS Cold Leg Temperature	TE-68-18 TE-68-41 TE-68-60 TE-68-83
Core Exit Temperature	TE-94-165 XR-94-101 XR-94-102
Degrees of Subcooling	XR-94-101 XR-94-102
RCS Pressure	PT-68-62 PT-68-66 PT-68-69
Pressurizer Level	LT-68-320 LT-68-335 LT-68-339

Steam Generator Level Narrow Range (S/G)	LT-3-39 LT-3-42 LT-3-52 LT-3-55 LT-3-94 LT-3-97 LT-3-107 LT-3-110
Steam Generator Level Wide Range (S/G)	LT-3-43 LT-3-56 LT-3-98 LT-3-111
Containment Pressure	PDT-30-44 PDT-30-45
Containment Sump Level Wide Range	LT-63-178 LT-63-179
Auxiliary Feedwater Flow (Aux. FW)	FT-3-147 FT-3-155 FT-3-163 FT-3-170
Neutron Flux	XR-92-5001 XR-92-5002
Containment Hydrogen Concentration	H2E-43-200 H2E-43-210

TABLE 2

CATEGORY 2 INSTRUMENTS

Variable	Instrument Loop
Containment Spray Flow	FT-72-13 FT-72-34
Containment Atmosphere Temperature	TE-30-212A TE-30-212B TE 30-212C TE-30-212D
Safety Injection Pump Flow	FT-63-20 FT-63-151

RHR Pump Flow to Cold Legs 1 and 4	FT-63-92A FT-63-92B
RHR Pump Flow to Cold Legs 2 and 3	FT-63-91A FT-63-91B
RHR Heat Exchanger Outlet Temperature	TE-74-29 TE-74-39

b. Discussion and Conclusion

The licensee was prepared and expended considerable effort to assist the inspector in performing the RG 1.97 inspection. Most of the previously requested documentation including the Q-List, EQ-List, electrical drawings, control drawings and calibration data sheets were pulled and available in an organized manner except for several calibration data sheets. Although the licensee was aware since the end of November 1991 that the latest calibration data sheets were needed for the inspection, the calibration data sheets for the containment spray flow loops FT-72-13 and FT-72-34 were never provided. The licensee did not inform the inspector until the last day of the inspection just before the "exit meeting" that the calibration data sheets were not available. The resident inspectors stated the staff would follow up the review and verification of the calibration of the containment spray flow loops.

In addition to reviewing the documentation listed previously, the inspector conducted walkdown inspections in the field. Instrumentation was examined in the auxiliary building, both control rooms, and the simulator control room in the training building. Transmitters and sense lines were examined in the containment building. In the containment building the accumulator and fan rooms were found to be crowded with a maze of pipes and equipment. These conditions were normal for a containment building with an ice condenser. However, moving about was very difficult without stepping on equipment and piping since few provision for passageways were provided. Although the inspector did not identify any damaged instruments or sense lines, the potential for damage to instrumentation in such crowded and poorly lighted areas was recognized.

The inspector also conducted a walkdown and examined the Eagle 21 system since most of the instrument loops for Category 1 variables were processed through it. The Eagle 21 system was an integrated modular

microprocessor-based system installed to replace the separate"origional analog" electronic process protection instrumentation. The Eagle 21 system used microprocessors and programmable read only memory chips (EPROM). The Eagle 21 receives analog signals from the field instruments; converts these signals to digital; the microprocessors then processes these digital signals according to the programs in the EPROMs; then the digital signals are processed for protection functions or converted back to analog signals to drive panel meters and recorders. The programs (software) were converted to source code and written into the EPROM chips. Since the Eagle 21 system had 13 racks and each rack had four EPROMs for a minimun of 52 EPROMs for each unit; the concern was that "design configuration control" would not be maintained over the life of the plant. The inspector was informed by licensee's personnel that the software may be changed (every refueling outage). Software changes would require source code revisions in the EPROMs. The licensee did not have documentation for the software and EPROM source codes stating Westinghouse maintained this documentation. The concern was not with Westinghouse maintaining the software and source codes for the Eagle 21 system. The concern was that the licensee did not have any documents or drawings to verify the source code in the EPROM chips was correct. The inspector stated the NRC Staff would review the licensee's need to have the EPROM source code documentation to maintain design configuration control. This item was identified as Inspector Followup Item 50-327/328/92-16-01, Sequoyah Does Not Maintain Controlled Eagle 21 EPROM Source Code Documentation. In addition to reviewing the Eagle 21 system, the inspector examined the calibration methodology for the RG 1.97 instrumentation.

The channel (loop) calibration methodology and the calibration data sheets were examined for the instrument loops listed in Tables 1 and 2. The RG 1.97 instruments were either in separate analog loops or a loop that was part of the Eagle 21 system. The difference between the loop calibration for the Eagle 21 system and the separate analog loops was the methodology.

In both cases the loop transmitters were calibrated separately. The transmitter calibration data was taken in the field at the transmitter, not at the instrument racks and cabinets where the loop electronics were located (in the process instrumentation and process protection cabinet room). For the separate analog loop

calibration, one overlap voltage reading was taken at the instrument rack (across the current dropping resistor in the rack). This one reading was taken at either zero or 100 percent of range (usually zero). Then the field transmitter wires were disconnected at the instrument rack and a transmitter simulator was connected in its place. The simulator was used to inject current signals into the loop across the same resistor to complete the loop calibration. The resistor where the voltage readings were taken for both the transmitter and the simulator was the overlap point. The use of only one overlap reading was considered a weakness since the total calibration range was not covered and no interaction could be detected over the zero to 100 percent operating range.

For a Eagle 21 system channel (loop) calibration, one signal from the field transmitter was monitored at the instrument rack. However, the Eagle 21 electronics were not used with this signal. This one signal was taken at either zero or 100 percent of operating range (usually zero). The calibration signal was a voltage read across an input resistor at the test jacks in the instrument rack. These test jacks were also connected to the input of the Eagle 21 electronics. No external transmitter simulator was connected and used to provide loop calibration signals across the same input resistor. Only one loop signal was used from the transmitter for the loop calibration and it did not use the Eagle 21 electronics. Not reading the transmitter loop calibration signal with the Eagle 21 electronics is considered a weakness with the calibration methodology. In addition, since the loop interaction cannot be detected and the field transmitter calibration signals were not used with the Eagle 21 electronics, the licensee's loop calibration methodology did not appear to meet the intent of overlap testing as stated in the technical specifications (TS). The TS state that the channel calibration may be by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated. The method used by the licensee for performing overlap testing was considered an open item for the Staff's review and identified as Inspector Followup Item 50-327/328/92-16-02, Overlap Testing. In another area concerning Eagle 21 system calibrations, the methodology used for the calibration of T hot and T cold was identified as an open item since it also did not appear to meet the intent of a channel functional test as specified in the technical specifications. The definition of the functional test was "the injection of

a simulated signal into the channel as close to the sensor as practical to verify OPERABILITY...."

The licensee did not inject external resistance calibration signals into the T hot and T cold channels to simulate the resistance temperature detector (RTD) sensors. No external signal source to the Eagle 21 rack such as a decade resistance box was used to verify loop calibration and operation prior to the plant startup. No method was used to verify that the total loop operation from a simulated sensor (RTD) external to the instrument rack to the Eagle 21 output was performed. However, the inspector did verify that the Eagle 21 electronics were internally calibrated and the RTD cross calibration surveillance did verify that the RTDs were "not" out of calibration. However, this verification could only be performed during the plant heat up and T hot narrow range temperature could not be read until approximately 545 degrees F. Since the licensee did not use an external resistance source to simulate the RTD sensor for the channel functional test, this concern was considered an open item for the Staff's review. The calibration methodology for the Eagle 21 RTD temperature channels was identified as Inspector Followup Item 50-327/328/92-16-03 Eagle 21 RTD Channel Calibration.

The licensee disagreed with the inspector's findings concerning the calibration program. The licensee did not believe that there were any weaknesses in the calibration program and that there should be any open items for the Staff's review. The licensee stated that their calibration program and methods for performing overlap testing met established practices and compliance requirements.

Concerning the RG 1.97 inspection, the licensee was considered to meet the intent and be in compliance with RG 1.97, Revision 2.

3. Exit Interview

The licensee was informed that there were weaknesses in their instrumentation calibration program concerning overlap testing for the separate analog loops. In addition, weaknesses with the Eagle 21 channel calibration were identified where the Eagle 21 electronics were not used to monitor the field transmitters calibration signals. Weaknesses were also identified where the operating range of the total loop with the transmitter connected was not verified and interaction could not be detected. (see paragraph 2.b)

The licensee was informed that three open items for the Staff's review were identified. These items were discussed in Paragraph 2.b and are listed below:

* 92-16-01 Sequoyah does not maintain controlled Eagle 21 EPROM source code documentation. (see paragraph 2.b, page 8)

* 92-16-02 Overlap testing. (The calibration program does not appear to meet the intent of overlap testing). (see paragraph 2.b, page 9)

* 92-16-03 Eagle 21 RTD channel calibration. (No external resistance signals are used to verify calibration). (see paragraph 2.b, page 9)

The licensee did not agree that there were weaknesses in the calibration program and that there was a basis for the open items as discussed in this report.

4. Acronyms and Initialisms

EQ - Environmental Qualification
PT - Flow Transmitter
FW - Feedwater
I&C - Instrument and Control
LT - Level Transmitter
NRC - Nuclear Regulatory Commission
PT - Pressure Transmitter
Q-List - Equipment Qualification List
RG - Regulatory Guide
RHR - Residual Heat Removal (System)
RTD - Resistence Temperature Detector
SER - Safety Evaluation Report
S/G - Steam Generator
SI - Safety Injection
TE - Temperature Element
TS - Technical Specifications