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

Report Nos.: 50-424/86-73

Licensee: Georgia Power Company
P. O. Box 4545
Atlanta, GA 30302

Docket No.: 50-424 License No.: CPPR-108

Facility Name: Vogtle 1

Inspection Conducted: August 18-22, 1986

Inspectors: A. R. Long for P. T. Burnett 9/9/86
P. T. Burnett Date Signed

A. R. Long 9/9/86
A. R. Long Date Signed

Approved by: Frank Jape 9/9/86
F. Jape, Section Chief Date Signed
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection addressed the review of proposed startup tests for Unit 1.

Results: No violations or deviations were identified.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

*R. M. Bellamy, Manager of Test and Startup
*W. L. Burmeister, Operations Supervisor
*C. L. Cross, Regulatory Compliance Supervisor
*J. A. Edwards, Senior Nuclear Specialist - Operations
*G. R. Frederick, Senior Quality Assurance (QA) Engineer
*D. O. Foster, Vice President, Project Support
*C. W. Hayes, Vogtle QA Manager
C. B. Holland, Operations Startup Engineer
*R. W. McManus, APCM II
C. F. Meyer, Operations
*W. T. Nickerson, Assistant to Project Director
*G. E. Spell, Jr., QA Engineering Support Supervisor
H. P. Walker, Manager Unit Operations

Other licensee employees contacted included security force members, and office personnel.

NRC Resident Inspectors

*H. H. Livermore, Senior Resident Inspector, Construction
*J. F. Rogge, Senior Resident Inspector, Operations
R. J. Schepens, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on August 22, 1986 with those persons indicated in paragraph 1 above. The inspector described the areas inspected and discussed in detail the inspection findings, and the new followup items listed below. No dissenting comments were received from the licensee. Proprietary material was reviewed during this inspection, but is not included in this report.

Inspector followup item 424/86-73-01: Use the statistical reliability factor test to confirm source range nuclear instrumentation (SRNI) capability during fuel loading, initial criticality of a new core, and during low vessel water level - paragraph 5.b.

Inspector followup item 424/86-73-02: In RCS leakage measurements eliminate the effect of a change in T-average by either limiting the change to +/- 0.1 degrees F or making a mathematical correction for the change in density change - paragraph 5.b.

Inspector followup item 424/86-73-03: Eliminate makeup to the VCT during RCS leakrate tests - paragraph 5.b.

Inspector followup item 424/86-73-04: Prevent over-dilution of the VCT by closing the spray valve while in alternate dilute during the approach to initial criticality - paragraph 5.b.

3. Licensee Action on Previous Enforcement Matters

   This subject was not addressed in the inspection.

4. Unresolved Items

   No unresolved items were identified during this inspection.

5. Review of Startup Test Procedures (72400, 72500, 72566, 72570, 72572)

   a. Procedures Reviewed

      The following procedures (all revision zero except as otherwise noted) were reviewed for conformance to FSAR test descriptions and acceptance criteria, for comformance to appropriate regulatory guides, and for technical content.

      Administrative Procedures

      (1) SUA-01, Startup Test Procedure Preparation, Review, Approval and Revision
      (2) SUA-02, Startup Test Program Implementation
      (3) SUA-03, Startup Shift Test Director and Test Supervisor Qualification Checklist
      (4) AP 0052-C (Rev 2), Temporary Changes to Procedures
      (5) AP 0054-C, Rules for Performance of Procedures
      (6) AP 00308-C, Independent Verification Policy

      Test Procedures

      (7) 1-500-01, Initial Fuel Load Test Sequence
      (8) 1-500-02, Inverse Count Rate Ratio Monitoring for Core Loading
      (9) 1-500-03, Determination of Core Power Range for Physics Testing
      (10) 1-500-04, Precritical Test Sequence
      (11) 1-5BB-01, RCS Final Leak Rate
      (12) 1-5BB-02, Pressurizer Heater and Spray Capability and Continuous Flow Verification
      (13) 1-5BB-04, Reactor Coolant System Flow Measurement
      (14) 1-5SC-01, Core Loading Instrumentation & Neutron Source
      (15) 1-600-01, Inverse Count Rate Ratio Monitoring for Approach to Initial Criticality
      (16) 1-600-02, Initial Criticality
      (17) 1-600-04, Initial Criticality and Low Power Test Sequence
      (18) 1-6SF-09, Boron Endpoint Determination

b. Findings

The results of the review were discussed with members of the plant's technical and operations staff. Most of the items noted by the inspectors in the Revision 0 documents had been identified by the staff and corrected in a set of Revision 1 procedures which will soon be issued.

Four areas were identified for which specific commitments for test improvement and modification were requested of the licensee. These commitments were confirmed at the Exit Interview by management, and a completion date of October 15, 1986 was established. The commitments to be tracked as inspector followup items (IFIs) are:

(1) IFI 424/86-73-01: Use the statistical reliability factor test to confirm source range nuclear instrumentation capability during fuel loading, initial criticality of a new core, and lowered reactor vessel water level. The frequency of the test will be once every 24 hours when applicable, whenever fuel loading or the approach to criticality is interrupted for eight hours or more, whenever a detector is moved, and whenever a new reference value for inverse multiplication is obtained.

The Statistical Reliability Factor (SRF) Test uses counting statistics to demonstrate that the source range detectors are functioning properly. Additional information on the use of this test and the relationship between the SRF and the more commonly used chi-squared test is provided in Appendix A to this report.

Subsequent to the inspection, the licensee was provided with a list of references on counting statistics. A copy of the list is given in Appendix B to this report.

(2) Inspector followup item 424/86-73-02: In RCS leakage measurements eliminate the effect of a change in T-average by either limiting the change to +/-0.1 degrees F or making a mathematical correction for the change in density.

As written, the RCS leakrate tests would have allowed a temperature variation of +/- 0.5 F, which would have allowed a 5% error in a four hour test and a greater error in a shorter test.

(3) Inspector followup item 424/86-73-03: Eliminate makeup to the VCT during RCS leakrate tests.

A need to makeup to the VCT is not anticipated, and the calibration of the flow integrators is not reliable, based upon experience at other facilities.

(4) Inspector followup item 424/86-73-04: Prevent over-dilution of the VCT by closing the spray valve while in alternate dilute during the approach to initial criticality.

Experience at other facilities has shown that continuing the spray flow to the VCT, in alternate dilute mode, during the lengthy dilution to initial criticality can result in reducing the boron concentration in the VCT below that of the RCS. Hence, the procedural intent to stop dilution and assure a uniform boron concentration by mixing can lead to further dilution.

Attachments:
1. Appendix A:Statistical Test for
   Pulse - Counting Nuclear Instrument
2. Appendix B:Reference List for
   Statistical Tests

APPENDIX A

Statistical Tests for Pulse-Counting Nuclear Instruments

The statistical reliability factor (SRF) test will be used when dependent on the source range nuclear instruments (SRNI) for plant safety:

1. During fuel loading.

2. During initial criticality of a new core.

3. During periods of lowered water level and vulnerability to the dilution accident.

This test can assure true operability of the SRNIs. The capability to respond proportionally to an increase in neutron flux is not confirmed by the calibration tests (surveillances) which confirm OPERABILITY in the technical specification sense.

The more common chi-squared test is directly related to the SRF.

$$(\text{Chi-Squared}) = (n-1)*(\text{SRF})^2$$

and: $$(\text{Chi-Squared}) = [\text{SUM}(i=1,n)[(x_i - x_{avg})^2]]/x_{avg}$$

where x_i is an observed count from the system under test.

Either test is an analysis of variance in which the sample variance, the numerator, is compared with the expected variance, the denominator. Tables of probabilities as a function of the number of observations and value of chi-squared are available in many mathematical and statistical handbooks, and equivalent SRF values can be derived directly from those tables, as shown in Table 1 below. The probability presented is that of a system with the expected variance producing a larger value of chi-squared than the one obtained. Hence, the best result is 50%. An acceptable range of probabilities is 2 to 98%, but narrower ranges are commonly used.

The chi-squared test is the test usually referenced in nuclear instrumentation texts to establish pulse counter operability. The method allows pooling of data from a series of observations. For example, if a set of five observations is not successful, another set of five may be obtained and analyzed independently or merged with the first and the total treated as a set of ten observations. Generally, the greater the number of observations the better the chance of success with a well behaved system, since the odd statistical outlier will have less influence on the result. When the test is being used to establish system stability after a perturbation and is not successful, dropping the first observation and adding another to the set will frequently lead to success if the system is truly stabile.

The SRF test can be programmed with ease on a hand-held calculator. Procedures should require each initiation of the program be checked by entering a standard set of data and confirming the expected result. This evolution should be documented in the procedure requiring the test.

TABLE 1

Statistical Reliability Factor

OBS	P=0.98	P=0.95	P=0.90	P=0.05	P=0.02
5	.327	.422	.516	1.540	1.708
6	.388	.479	.567	1.488	1.636
7	.435	.522	.606	1.449	1.583
8	.473	.556	.636	1.418	1.541
9	.504	.584	.660	1.392	1.507
10	.530	.608	.681	1.371	1.479
11	.551	.626	.696	1.354	1.456
12	.573	.645	.712	1.337	1.434
13	.589	.659	.724	1.324	1.417
14	.605	.673	.736	1.312	1.400
15	.619	.685	.746	1.301	1.385
16	.631	.695	.754	1.291	1.373
17	.643	.705	.763	1.282	1.361
18	.653	.714	.770	1.274	1.351
19	.663	.722	.777	1.266	1.341
20	.671	.729	.783	1.260	1.332
21	.680	.737	.789	1.253	1.323
22	.687	.743	.794	1.247	1.316
23	.694	.749	.799	1.242	1.308
24	.701	.754	.803	1.237	1.302
25	.707	.760	.808	1.232	1.295

OBS = the number of observations
P = the probability

APPENDIX B

Reference List for Statistical Tests

1. A. H. Jaffey, "Statistical Tests for Counting," Nucleonics (November 1960) page 180-184.

2. G. F. Knoll, Radiation Detection and Measurement, John Wiley and Sons, New York, (1979) page 122-127.

3. W. J. Price, Nuclear Radiation Detection, McGraw-Hill, New York, (1964) page 64-65.

4. D. G. Miller, Radioactivity and Radiation DetectionU, Gordon and Breach, New York, page 96-99.