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

Report No.: 50-395/92-07

Licensee: South Carolina Electric and Gas Company
Columbia, SC 29218

Docket No.: 50-395 License No.: NPF-12

Facility Name: V. C. Summer

Inspection Conducted: March 9-13, 1992

Inspector: [signature] for P. T. Burnett — 4/13/92 Date Signed

Approved by: [signature] R. V. Crlenjak, Chief — 4/13/92 Date Signed
Operational Programs Section
Operations Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection addressed the areas of post refueling startup tests for cycle 7 and subsequent monitoring of core and fuel performance.

Results: The cycle 7 startup tests were performed acceptably and with acceptable results. However, a concern for control of volume control tank dilution, during the approach to criticality, was identified (paragraph 2.b).

Pursuant to Technical Specification requirements, the frequency of surveillance of hot channel factors had to be increased early in the cycle as the limiting heat flux hot channel factor increased. However, the increase was inherent in the core design and was not unexpected. As expected the trend reversed, and surveillance frequency is now back to normal (paragraph 3).

No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

   Licensee Employees

   L. G. Archie, Reactor Engineer
   *M. N. Browne, General Manager, Station Support
   *B. M. Christensen, Manager, Technical Services
   *J. W. Haltiwanger, Senior Reactor Engineer
   *W. R. Higgins, Supervisor, Licensing Support and Operating Experience
   *B. L. Johnson, Supervisor, Core Engineering
   *A. R. Koon, Jr., Manager, Nuclear Licensing and Operating Experience
   *C. C. McKinney, Nuclear Licensing
   *M. D. Quinton, General Manager, Engineering Services
   *J. L. Skolds, Vice President, Nuclear Operations
   G. J. Taylor, General Manager, Nuclear Plant Operations
   *D. C. Warner, Manager, Core Engineering and Nuclear Computer Services

   Other licensee employees contacted included engineers and office personnel.

   NRC Representative

   *R. Haag, Senior Resident Inspector

   *Attended exit interview on March 13, 1992.

   A list of acronyms and initialisms used in this report is given in the final paragraph.

2. Startup Testing for Operating Cycle 7 (72700, 61705, 61708, 61710)

   a. Reference Documents

      Prior to inspecting the completed startup test procedures, the following reference documents were reviewed to determine the design bases and predicted performance parameters for cycle 7:

   - Nuclear Physics Methodology for Reload Design, Virgil C. Summer Nuclear Station (July 1991).

- WCAP-13110, The Nuclear Design and Core Management of Virgil C. Summer Nuclear Station, Cycle 7 (January 1992).

b. Low Power Tests

The following completed low power test procedures were reviewed by the inspector:

(1) REP-107.003 (Revision 4), Beginning of Cycle Dilution to Criticality, was completed on November 15, 1991, with C_B at 1822 ppmB and D bank at 165 steps. Step 3.14 of the procedure states that during the dilution process the VCT will become filled with dilute water and that dilution of the RCS will continue after termination of reactor makeup. This undesirable situation could lead to violation of the PDIL or become one of the precursors of a more severe, but very low probability accident. Procedural controls are available to avoid over diluting the VCT to begin with. This issue was first addressed in IFI 50-395/82-52-03, which was closed in inspection report 50-395/85-45. The current version of this procedure is apparently a diminution of earlier corrective action.

The licensee's review of the bases for the current version of the procedure will be tracked as IFI 50-395/92-07-01: Review control of VCT dilution.

(2) REP-107.008 (Revision 4), Boron Endpoint Measurement, was completed at ARO on November 15, 1991. The measured C_B of 1844 ppmB was in acceptable agreement (±50 ppmB) with the predicted C_B of 1889 ppmB.

(3) STP-0210.002 (Revision 4), Isothermal Temperature Coefficient Measurement, was measured at ARO on November 15, 1991. Measurements were made during a cooldown and during a heatup of the RCS. In both cases, the temperature change was in excess of 4°F. The individual ITCs were +2.37 pcm/°F and +2.67 pcm/°F, respectively. Agreement within 1 pcm/°F reflects good control of the measurement process. The average ITC was corrected for the calculated DTC of -1.8 pcm/°F to yield a MTC of +4.32 pcm/°F, which was in good agreement with the predicted value of +4.14 pcm/°F and less than the TS 3.1.1.3 limit of +7.0 pcm/°F for power ≤ 70% RTP.

(4) REP-10[illegible].001 (Revision 5), Control Rod Worth Measurement, was completed on November 15, 1991, with the results tabulated below:

Reactivity Worth

Rod Bank	Predicted (pcm)	Measured (pcm)	Error(%)
Shutdown A	[illegible]	1136.5	-4.8
Shutdown B	[illegible]	881.4	-6.8
Control A	[illegible]	417.0	+0.5
Control B (ref)	1551	1500.2	-3.3
Control C	754	681.9	-9.6
Control D	912	845.7	-7.3
TOTALS	5772	5462.7	-5.6

All rod worth acceptance criteria were satisfied.

Calculation of differential boron worth from the boron change during the reference bank measurement was an adjunct to this test. The measured worth of -7.8 pcm/ppmB was in acceptable agreement with the predicted worth of -8.1 pcm/ppmB.

c. Power Escalation Tests

The following procedures completed during power escalation for cycle 7 were reviewed:

(1) The procedures listed below were performed at nominal power levels of 50%, 70%, and 100% RTP to confirm that power distributions were as predicted and that hot channel factors were acceptable for the existing power level and for the next power plateau.

- STP-0212.001 (Revision 4), Reactor Core Flux Mapping.
- STP-0204.001 (Revision 6), Heat Flux Hot Channel Factor.
- STP-0205.001 (Revision 8), Reactor Coolant System Flow Rate and R Determination.

Flux map analysis was performed with the INCORE 3D, Version 7.0.0VX, computer code.

(2) STP-0205.002 (Revision 6), Reactor Coolant System Flow Rate Measurement, was performed at 100% RTP. The RCS flow rate was determined by equating primary and secondary side heat balances and solving for the unknown primary side flow. The method requires that primary side temperature rise through the core be known with reasonable precision. Recent observations of hotleg streaming at this and other PWRs, with low-leakage cores, indicate that average hotleg temperatures can not be

measured with confidence. Hence, the core temperature rise can not be measured with certainty.

The only directly observable component of the RCS flow measurement is the dP across the elbow taps in the cold legs of each loop. Data were obtained from the licensee to determine if the changes in elbow tap dPs over the years correlate with the changing number of plugged tubes in the steam generators. That review will be conducted in the Region II office, but is not complete.

(3) STP-0209.002 (Revision 6), Incore vs Excore Axial Offset, was performed using three flux maps obtained between 69 and 72% RTP. The procedure was completed on November 26, 1991. Correlation coefficients for the slopes of ion chamber currents versus axial offset were all >0.99.

This procedure was next completed on March 6, 1992, at a nominal 100% RTP. The correlation coefficients were equally good, but the zero offset currents and slopes were different from the surveillance at 70% RTP in November 1991.

The licensee is considering changing from the multipoint to the single-point method of performing incore-excore nuclear instrument correlations. The document, Utility Resource Associates Report (URA-RP-92-011), One-Point Methodology Applied to the V. C. Summer Station (February 12, 1992), was reviewed by the inspector. The figure of merit derived in the report, delta C_1, was calculated by the inspector for both of the surveillances discussed above. The delta C_1 for each of the PRNIs changed less than 2% between surveillances. Given that result, the inspector concluded that the earlier surveillance was satisfactory for operation above 75% RTP, the usual minimum power level for the surveillance.

No violations or deviations were identified.

3. Routine Monitoring of Core Performance (61702)

The procedures and analyses discussed in paragraph 2.c(1) are performed routinely every 31 EFPD. However, TS 4.2.2.2.e(2) requires increasing the frequency to 7 EFPD if the ratio $F_Q^M(z)/k(z)$ increases between surveillances. An increase was observed between routine surveillances conducted on December 3 and December 27, 1991. Weekly surveillances were continued until January 29, 1992, when two successive weekly surveillances did not show an increase in the ratio. Throughout this period, all hot channel factors were acceptable.

Review of the design bases documents described in paragraph 2.a and discussions with licensee core-design engineers confirmed that the increase in the ratio was expected and as predicted; it is the result of depletion of burnable absorbers at a rate greater than fuel depletion. That situation exists only in the early portion of the fuel cycle.

No violations or deviations were identified.

4. Exit Interview

The inspection scope and findings were summarized on March 13, 1992, with those persons indicated in paragraph 1 above. The inspector described the areas inspected and discussed in detail the inspection findings. No dissenting comments were received from the licensee. Proprietary material was reviewed in the course of the inspection, but is not included in this report.

The following item was discussed with the licensee during a telephone call on April 9, 1992:

- IFI 50-395/92-07-01: Review control of VCT dilution (paragraph 2.b).

5. Acronyms and Initialisms

ARO	All Rods Out
C_B	Boron Concentration
DP	Differential Pressure
DTC	Doppler (fuel) Temperature Coefficient
EFPD	Effective Full Power Days
F_Q	Heat Flux Hot Channel Factor
IFI	Inspector Followup Item
ITC	Isothermal Temperature Coefficient
K(z)	Axial Power Distribution Limit
MTC	Moderator Temperature Coefficient
PCM	Percent Millirho (Reactivity Units)
PDIL	Power Dependent Insertion Limits
ppmB	Parts Per Million Boron
PWR	Pressurized Water Reactor
RCS	Reactor Coolant System
REP	Refueling Procedure
RTP	Rated Thermal Power
STP	Surveillance Test Procedure
VCT	Volume Control Tank