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

Report Nos.: 50-250/90-16 and 50-251/90-16

Licensee: Florida Power and Light Company
9250 West Flagler Street
Miami, FL 33102

Docket Nos.: 50-250 and 50-251 License Nos.: DPR-31 and DPR-41

Facility Name: Turkey Point 3 and 4

Inspection Conducted: May 22 - 25 and May 30 - June 1, 1990

Inspector: P. T. Burnett — 14 June 1990 Date Signed

Accompanying Personnel: G. A. Belisle (May 23 - 25, 1990)

Approved by: G. A. Belisle, Chief — 6/15/90 Date Signed
Test Programs Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This routine, unannounced inspection addressed the areas of witnessing initial criticality and low power physics testing of Unit 3, cycle 12, and closeout of open items.

Results:

Initial criticality for Unit 3, cycle 12 and the subsequent zero power tests were performed adequately with acceptable results. Two instances were identified in which insufficient briefing of off-site personnel led to portions of tests not being performed as well as they should have been. (Paragraphs 3.b and 4.0)

Two open items related to the cross-calibration of incore and excore nuclear instruments were closed. (Paragraph 5.b)

No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

   Licensee Employees

    J. A. Arias, Jr., Assistant to the Plant Manager
    L. W. Bladow, Plant Quality Assurance Superintendent
    T. J. Cahill, Nuclear Engineer, General Offices
   *A. O. Costa, Reactor Engineer
   *A. R. Dyches, Reactor Engineer
    K. N. Harris, Site Vice President
   *J. P. Hendrickson, Reactor Engineer
   *V. A. Kaminskas, Operations Superintendent
    J. E. Knorr, Licensing Engineer
   *G. L. Marsh, Reactor Engineering Supervisor
   *L. W. Pearce, Plant Manager

   Other licensee employees contacted included engineers, operators, and office personnel.

   NRC Resident Inspectors

    R. C. Butcher, Senior Resident Inspector
    T. F. McElhinney, Resident Inspector
   *G. A. Schnebli, Resident Inspector

   *Attended exit interview on June 1, 1990.

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

2. Documents Reviewed Prior to Unit 3 Startup (72700)

   Prior to the start of cycle 12 testing and witnessing those activities discussed below, the inspector reviewed the following documents:

   a. Reload Safety Evaluation Report, Turkey Point Plant, Unit 3, Cycle 12.

   b. Letter dated March 22, 1990, Turkey Point 3 Cycle 12 Reload Safety Evaluation, transmitted the 10CFR50.59 determination that reload for cycle 12 does not create an unreviewed safety question.

   c. ATTACHMENT TO FORM QI-FR-7.2 OF QI-FR-7 REVISION 3: Turkey Point 3, Cycle 12 FSAR Fuel Design Change Checklist.

d. WCAP-12538, The Nuclear Design and Core Management of the Turkey Point Unit 3 Nuclear Power Plant, Cycle 12 (April 1990).

3. Unit 3, Cycle 12, Initial Criticality (72700)

a. Precritical Tests

The inspector reviewed the following precritical tests after they were completed:

(1) 3-PMI-028.3, RPI Hot Calibration, CRDM Stepping Test, and Rod Drop Test (Attachment 7, only), confirmed that all rod drop times were less than the TS 3.2.3 limit of 2.4 seconds. The measured times ranged from 1.30 to 1.78 seconds, with an average drop time of 1.36±0.07 seconds. The licensee did not investigate or further review the reason for the rod in core location H8 (control bank D) having a drop time six standard deviations greater than the average. Only one other rod was as much as one standard deviation greater than the mean, and none were as much as one standard deviation less than the mean. In contrast, the rod drop times reported for Unit 4, cycle 12 (see paragraph 6 below) showed no such extremes. All rod drop times were bounded by the mean ± 3 standard deviations and all but five rod drop times were bounded by the mean ± 2 standard deviations. The licensee has not been trending rod drop times from cycle to cycle by rod or by location.

(2) 0-OP-059.7, Normal Alignment and Use of the Digital Reactivity Computer, was performed on May 22, 1990.

b. The Approach to Criticality

The approach to initial criticality for Unit 3, cycle 12, began on May 24, 1990, under the guidance of OP 0204.3, Initial Critical after Refueling. After confirming operability of the SRNIs, by successful completion of chi-squared tests on each, first the safety rod banks and then the control rod banks were withdrawn in fifty-step increments until D bank was at 160 steps. ICRR was calculated and plotted after each increment of rod movement. Preferably, the successive rod withdrawal would not be performed until the plot was evaluated to confirm that criticality would not occur during the next increment. After the engineering shift change at 0600, the inspector noted that the replacement data plotter was not keeping up with the plotting and, hence, was performing no evaluations. The cause appeared to be the lack of briefing of a relatively inexperienced person on the point and purpose of the test.

At the end of rod withdrawal, a new base countrate for ICRR was obtained for each SRNI. ICRR was then plotted against the amount of

dilution water added to the RCS. The dilution rate was reduced from 100 gpm to 50 gpm, when the ICRR reached 0.35. Dilution was terminated when the ICRR reached 0.10. Criticality was achieved during mixing and then confirmed by withdrawing D bank to establish a more obvious period.

The inspector was in the control room during most of the approach to criticality and independently confirmed, using statistical analysis, that the SRNIs were performing reliably throughout. The permissive P-6, an indication of 10E-10 amperes on both IRNIs, was activated prior to reaching criticality, and power to the SRNIs shutoff, with the countrate near saturation, before criticality was confirmed. The final portion of the approach to criticality was performed using the IRNIs for guidance. This was not an ideal situation; since the true operability of the IRNIs could not be tested and confirmed prior to startup. The countrates of the SRNIs at cold conditions, with refueling boron concentration in the RCS, were more than adequate for monitoring core reactivity; hence, reducing the flux at the SRNIs could assure they monitored core reactivity from cold conditions through criticality. The licensee stated that the SRNI chambers are withdrawn from the core as far as possible; so further desensitization can not be achieved easily.

c. Subsequent Tests

Appendix A of OP 0203.4 was performed to establish the flux level at which nuclear heating is observed, 2E10-7 amperes on the DRC picoammeter, and the upper limit for zero power physics tests was established at 10E10-8 amperes on that same picoammeter. Establishing that upper limit prevented doppler effects in the fuel from invalidating the ZPPTs.

Appendix B was performed to checkout the DRC dynamically. Acceptable agreement between inhour equation solutions and DRC solutions of period and reactivity was obtained for reactivity inputs ranging from -48 pcm to +101 pcm.

Following discussions of these tests with licensee personnel, the inspector had no further questions. No violations or deviations were identified.

4. Zero Power Physics Tests (61708, 61710)

The inspector witnessed portions of the tests discussed below and reviewed the completed test procedures. All were appendices of OP 0204.5, Nuclear Design Check Tests during Startup Sequence after Refueling. The numerical acceptance criteria for the tests are given in document 2.d.

Appendix A, Boron Endpoint Measurement, yielded an ARO RCS C_B of 1376 ppmB, which satisfied the acceptance criterion of 1405 ± 50 ppmB.

Appendix B, Isothermal Moderator Temperature Coefficient, was performed for a cooldown and a heatup of the reactor at ARO. The corresponding ITCs agreed within .1 pcm/°F of each other and averaged -2.73 pcm/°F, which was in satisfactory agreement with the predicted value of -2.0 pcm/°F. After correcting the average ITC for a fuel doppler coefficient of -1.7 pcm/°F, a MTC of -1.03 pcm/°F was obtained. Thus conformance to TS 3.1.2.1 at all power levels was assured. The inspector independently analyzed the test data and obtained results in agreement with the licensee's.

Appendix D, Rod Worth Verification by Rod Swap Method, was performed with control bank C as the reference bank. The differential and integral reactivity worth of control bank C was determined during deboration of the RCS at a constant rate. C bank was then periodically inserted to compensate for the deboration. For each increment of bank insertion, the reactivity inserted by the bank was measured using the DRC. While independently analyzing the DRC recorder traces, the inspector noted that the licensee's method of analysis did not account for a brief reactivity undershoot at the end of rod motion for many of the increments. (This too may be an example of a relatively inexperienced person not being given an adequate briefing or instruction on how to perform a task.) Individually, the incremental reactivity was over estimated by two to three pcm, and total bank worth may have been over estimated by 20 to 50 pcm. Even the larger number would not drop the bank worth below the acceptance criterion. All rod bank worths determined by swapping with the reference bank satisfied the acceptance criterion.

Data Sheet 10, Differential Boron Worth, used data collected in the test appendices to calculate a differential boron worth. A change in C_B was calculated from two boron endpoint measurements performed at ARO and with control bank C in. The corresponding reactivity change was obtained from the integral worth of bank C. The result was -9.2 pcm/ppmB, which was in acceptable agreement with the predicted value of -8.63 pcm/ppmB. The agreement would have been better if bank C worth had not been slightly over estimated, as discussed under Appendix D.

Following discussions of these tests with licensee personnel, the inspector had no further questions. No violations or deviations were identified.

5. Review of Followup and Unresolved Items (92701)

   a. (Closed)Inspector followup item 50-250 and 50-251/89-32-01: For the incore-excore nuclear instrument correlation measurements, establish an acceptance criterion that the correlation coefficient be at least 0.98. Operating Procedure 12304.4, Power Range Nuclear Instrumentation - Channel Check, was revised to require, in step 8.2.4, that the fit correlation coefficients be greater than 0.98. Review of two procedures completed for Unit 4 since the procedure was revised confirmed that this procedural requirement was satisfied in both cases. The procedure also provides a method of hand calculation of

the correlation coefficient if the computer programs EXCAL or XCALPC are not available.

b. (Closed) Unresolved item 50-250 and 50-251/89-32-02: Review EXCAL calculations of channel voltages as a function of AFD for acceptability. Further review of the program EXCAL and it's replacement, XCALPC, have confirmed that the programs are not direct computer implementations of the hand calculations performed using OP 12304.4, Power Range Nuclear Instrumentation - Channel Check and Calibration. The hand calculation is acceptable and is consistent with the analyses usually performed in determining the correlation between incore axial offset and the response of the excore neutron detecting chambers of the PRNIs. This analysis assumes that the upper chamber responds only to neutrons from the upper half of the core and similarly for the bottom chamber. Thus, the equation for chamber response would be:

$I_k(AO) = I_k(0) + b_k{*}AO$, where
- k = upper or lower chamber
- $I_k(AO)$ = the chamber current at any AO
- $I_k(0)$ = the current for AO = 0
- b_k = a constant
- AO = axial offset in power production

In the computer programs, a more realistic assumption is made that the chambers do not respond solely to neutrons from their half of the core. Bilinear equations are solved in the programs to evaluate the change in chamber current with change in AO. For the examples evaluated by the inspector, the resulting zero-offset currents were essentially the same for both methods of analysis. However, the slopes of the results were quite different, as can be seen in attachment 2 to NRC Inspection Report 50-250 and 50-251/89-32.

The currents were converted to voltages by selecting the resistances to yield 8.33 volts at the zero-offset current. The voltage differentials as a function of AO were virtually independent of the method of analysis, for the cases analyzed. Hence, the delta-flux component of the OTdT trip was properly set by either method. However, the average of the top and bottom subchannel voltages (the channel power indication) was less sensitive to AO using the results of the bilinear analysis. Hence, it was concluded that the bilinear analysis was superior to the simpler methodology and that the differences observed in the slope of chamber voltage with AO were acceptable.

6. Review of Periodic and Special Reports (90713)

The Unit 4, Cycle XII, Startup Report was reviewed in the regional office. The report was a satisfactory description of the test activities performed and the results obtained. The test program and test acceptance criteria were consistent with the requirements of ANSI/ANS-19.6.1-1985, Reload Startup Physics Tests for Pressurized Water Reactors.

No violations or deviations were identified.

7. Exit Interview (30703)

The inspection scope and findings were summarized on June 1, 1990, 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 information was reviewed in the course of the inspection, but is not included in this report.

8. Acronyms and Initialisms Used throughout This Report

AFD	axial flux difference
ANS	American Nuclear Society
ANSI	American National Standards Institute
AO	axial offset
ARO	all rods out
cps	counts per second
CRDM	control rod drive mechanism
DRC	digital reactivity computer
EFPD	effective full power days
FSAR	Final Safety Analysis Report
gpm	gallons per minute
HZP	hot zero power
ICRR	inverse countrate ratio
IRNI	intermediate range nuclear instrument
ITC	isothermal temperature coefficient
MTC	moderator temperature coefficient
OP	operating procedure
OTdT	over temperature delta-temperature
pcm	percent millirho, a unit of reactivity
PMI	preventive maintenance instruction
ppmB	parts per million boron
PRNI	power range nuclear instrument
QI-FR	quality instruction - fuel resources
QPTR	quadrant power tilt ratio
RCS	reactor coolant system
RPI	rod position indication
SRNI	source range nuclear instrument
TS	Technical Specification
ZPPT	zero power physics test