DRESDEN UNIT 3

CYCLE 13

STARTUP TESTING SUMMARY

Dresden Unit 3 resumed commercial operation for Cycle 13 on April 25, 1992, following a refueling outage. During the outage, the sixth reload of Advanced Nuclear Fuels (Siemens Nuclear Power) fuel was installed. The reload consisted of 216 9x9-2 fuel assemblies.

The startup test program was similar to that performed for previous reloads at Dresden 2 and 3. The program consisted of various physics tests (shutdown margin, critical eigenvalue comparison, etc.), and instrument calibrations (LPRM, TIP's, flow instrumentation) as addressed by the Technical Specifications, Final Safety Analysis Report, and previous commitments to the Nuclear Regulatory Commission. The startup tests identified in the Draft Regulatory Guide SC 521-4 on refueling and startup tests for LWR reloads have been completed. To date, no unusual conditions were noted and the test results were as expected.

Summaries of the startup tests identified in the Draft Regulatory Guide SC 521-4 are attached per DPR-25 Technical Specification 6.6.A.1. Additional test results are available at the site.

DRESDEN UNIT 3
CYCLE 13
STARTUP TEST NO. 1
CORE VERIFICATION AND AUDIT

PURPOSE

The purpose of this test is to visually verify that the core is loaded as intended.

CRITERIA

The as-loaded core must conform to the reference core design used in the various licensing analyses. At least one independent party must either participate in performing the core verification or review a videotaped version prior to unit startup. Any discrepancies discovered in the loading will be promptly corrected and the affected areas reverified to be properly loaded prior to unit startup.

Conformance to the reference core design will be documented by a permanent core serial number map signed by the audit participants.

RESULTS AND DISCUSSION

The Cycle 13 core verification consisted of a core height check performed by the fuel handlers and two videotaped passes over the core. The height check verifies the proper seating of an assembly in the fuel support piece while the serial number/orientation visual check (which is videotaped) verifies proper assembly orientation and location.

It was reported that at least one of three thrice burnt Siemens Nuclear Power 9x9 fuel assemblies a peripheral core location did not pass the core height check verification. Reseating the assemblies had no impact on their heights. Furthermore, inspection of the cell showed approximately a half inch of height difference between the thrice burnt assemblies and the new assembly in the cell. After discussions with C.E.Co. Nuclear Fuel Services, the Station unloaded the fuel assemblies from this cell, inspected one of the three thrice burnt assemblies and removed the fuel support piece. Finding nothing unusual, the cell was reassembled. The as-left condition was essentially the same as the as-found condition with the thrice burnt assemblies still higher than the new assembly and slightly higher than surrounding cell assemblies.

Consultations with Nuclear Fuel Services and Siemens Nuclear Power identified that the maximum height difference one would see in the core would occur in a cell loaded with high burn-up fuel and a new fuel assembly. Expected height differences would be in the general range of one half to one inch between a new 9x9 fuel assembly and one with 30 GWD/MT exposure. Hence, Nuclear Fuel Services and Siemens Nuclear Power considered the relative height difference observed in the peripheral cell to be well within the expected range.

With a member of the C.E.Co. Audit Staff present, the core was verified as being properly loaded and consistent with Siemens Nuclear Power Cycle 13 core design on January 17, 1992. Therefore, the as-loaded core configuration is consistent with what Siemens Nuclear Power used in their evaluation of Dresden Unit 3 Cycle 13 Reload Licensing Analyses.

DRESDEN UNIT 3
CYCLE 13
STARTUP TEST NO. 2
CONTROL ROD OPERABILITY AND SUBCRITICALITY CHECK

PURPOSE

The intent of this test is to ensure that no gross local reactivity irregularities exist, that each control blade is latched to its control rod drive, and that all control blades are functioning properly.

CRITERIA

The following must be met:

a) After the core is fully loaded, each control blade will be fully withdrawn. This will guarantee that the mobility of the control blade is not impaired.

b) During control blade movement, the process computer is utilized to time the travel of the control blade between notch positions and verify proper withdrawal and insertion times.

c) Each control blade will be withdrawn and inserted individually to assure that criticality will not occur. As it is withdrawn, nuclear instrumentation (SRM's) will be monitored to verify subcriticality. Once withdrawn, each control blade is tested for overtravel as required by Technical Specification 4.3.B. by continually applying a withdrawal signal. A control blade fails this check if rod position indication is not evident or if an overtravel alarm is received.

RESULTS AND DISCUSSION

After core loading, every control blade was withdrawn, checked for overtravel, and inserted to position 00 verifying each control blade's mobility. All control blades passed their overtravel checks. There were no problems found during the testing. Subcriticality was confirmed for every control blade at position 48 by observing the response on SRM's.

DRESDEN UNIT 3
CYCLE 13
STARTUP TEST NO. 3
TIP SYSTEM SYMMETRY - UNCERTAINTY

PURPOSE

The purpose of this test is to perform a gross symmetry check and a detailed statistical uncertainty analysis on the Traversing In-Core Probe (TIP) System.

CRITERIA

1) TIP Symmetry - Gross Check

The maximum deviation between symmetrically located TIP pairs of LPRM strings should be less than 25%.

2) TIP Symmetry - Statistical Check

X^2 is a statistical tool that measures the consistency between the actual (measured) TIP error distribution and that assumed in Siemens Nuclear Power error analysis. The calculated X^2 of the integrated TIP responses should be less than 34.81. X^2 is calculated using equation 3.3.

NOTE: One data set may be used to meet the above criteria. If either criteria is not met, the instrumentation and data processing system should be checked for any problems that could lead to asymmetries. If the problem persists, the fuel vendor should be consulted to assure that the larger than expected TIP asymmetries do not significantly affect core monitoring calculations.

RESULTS

One complete set of data required for evaluating TIP uncertainty was obtained during the D3 BOC 13 Startup Testing Program. Data was obtained at a steady state power level of 63% of rated power. Normally this symmetry check is performed above 75% of rated power. However, because of the low operating power held throughout this cycle to-date, performing this symmetry check above 75% of rated power was not possible. A symmetry check at 63% of rated power is acceptable because the resultant uncertainties will be higher at this power level, which is conservative. The results for each method of analysis are summarized below.

1) TIP Symmetry - Gross Check

In order to determine the overall symmetry of the TIP system, machine normalized, power adjusted six inch TIP readings were obtained and averaged for each symmetric TIP pair (the symmetric locations are given in Table 3.1). The absolute percent deviation between each symmetric TIP pair was calculated and summarized in Table 3.2. The maximum absolute deviation was 8.43% for TIP pair #18 which is well below the 25% criteria.

2) TIP Symmetry - Statistical Check.

The TIP symmetry analysis was performed using the standard X^2 test as recommended by Siemens Nuclear Power. Machine normalized, power adjusted six inch TIP values obtained from a whole core LPRM calibration performed during the startup test program were summed (elevations 3 through 22 only) for each TIP location. The absolute relative difference (Dm) for each symmetric TIP pair was then calculated using equation 3.1 - the results are summarized in Table 3.3. From equations 3.2 and 3.3 the variance and X^2 were calculated to be 9.61 and 4.81 respectively. The value for X^2 is well within the limit established by Siemens Nuclear Power of 34.81.

TABLE 3.1. Symmetric TIP Locations

TIP PAIR	LPRM	TIP PAIR	LPRM
1	08-17 16-09	10	24-33 32-25
2	08-25 24-09	11	24-41 40-25
3	08-33 32-09	12	24-49 48-25
4	08-41 40-09	13	24-57 56-25
5	08-49 48-09	14	32-41 40-33
6	16-25 24-17	15	32-49 48-33
7	16-33 32-17	16	32-57 56-33
8	16-41 40-17	17	40-49 48-41
9	16-49 48-17	18	40-57 56-41

TABLE 3.2. TIP Symmetry - Gross Check

Symmetric TIP Pair	Absolute Percent Deviation
1	4.79
2	1.81
3	6.04
4	6.64
5	5.26
6	4.00
7	1.12
8	3.52
9	2.98
10	4.69
11	3.19
12	1.16
13	4.78
14	1.10
15	4.14
16	2.06
17	2.05
18	8.43

Maximum Absolute Percent Deviation: 8.43

TABLE 3.3. TIP Symmetry - Statistical Check

Symmetric TIP Pair	Relative Difference Dm
1	5.150
2	1.970
3	6.068
4	6.440
5	5.207
6	4.362
7	1.282
8	3.467
9	3.047
10	5.203
11	2.978
12	1.302
13	5.260
14	0.979
15	4.065
16	2.411
17	2.284
18	8.627

Equation 3.1

$$Dm = 100 \frac{(Tm_1 - Tm_2)}{\frac{Tm_1 + Tm_2}{2}}$$

Note: $Tm_1 = \sum_{k=3}^{22} T(k)$ for TIP_1 and $Tm_2 = \sum_{k=3}^{22} T(k)$ for TIP_2 where TIP_1 and TIP_2 are symmetric TIP pairs.

Equation 3.2 (Variance)

$$S^2_{TIP_{ij}} = \sum_{m=1}^{18} \frac{Dm^2}{36} = 9.61$$

Equation 3.3

$$X^2 = \frac{18S^2_{TIP_{ij}}}{36} = 4.81$$

DRESDEN UNIT 3
CYCLE 13
STARTUP TEST NO. 4
INITIAL CRITICALITY COMPARISON

PURPOSE

The intent of this procedure is to perform a critical Eigenvalue comparison as required by Technical Specification 3.3.E. This is done by comparing the predicted control rod pattern to the actual control rod pattern at criticality taking into account period and temperature coefficient corrections.

CRITERIA

The actual cold critical rod pattern shall be within 1.0% $\Delta k/k$ of the predicted control rod pattern. If the difference is greater than $\pm$ 1.0% $\Delta k/k$, Siemens Nuclear Power and Commonwealth Edison Company Core Management Engineers will be promptly notified to investigate the discrepancy.

RESULTS AND DISCUSSION

Unit 3 went critical on April 8, 1992 at 3:40 a.m. utilizing an A-2 sequence. The moderator temperature was 127°F and the reactor period was 194 seconds.

Siemens Nuclear Power predictions and rod worths were calculated using the MICROBURN-B code, which assumed a moderator temperature of 170°F. After corrections were made for temperature and period, the actual critical was within 1.0% $\Delta k/k$ of the predicted critical. Table 4-1 summarizes the results.

TABLE 4-1

INITIAL CRITICALITY COMPARISON CALCULATIONS

Predicted (MICROBURN-B)k_{eff}:

k_{eff} with all rods in adjusted to 170°F	= 0.9441 *
Reactivity inserted by all group 1 rods	= 0.0421 *
Reactivity inserted by all group 2 rods	= 0.0146 *
Reactivity inserted by additional rods from group 3 at criticality	= 0.0054 *
Predicted k_{eff} at critical rod pattern (170°F)	= 1.0062 *

Temperature correction to predicted k_{eff}:

Moderator temperature coefficient = -4.4×10^{-5} (Δ k/k)/°F *

Temperature correction between 127°F and 170°F	= 0.001892
Predicted k_{eff} at critical rod pattern (127°F)	= 1.0081

Period correction to actual k_{eff}:

k_{eff} at time of criticality, infinite period	= 1.000
Period correction for 194 second period	= 0.0003*
Actual k_{eff} with 194 second period	= 1.0003

Difference

$\lvert$MICROBURN-B k_{eff} - actual $k_{eff}\rvert$ x 100%	= 0.78% Δk/k

SOURCES

* Backup Cycle Management Report and Prestartup Operation Plan for Dresden 3 Cycle 13 dated November 18, 1991.