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Downers Grove, Illinois 60515

May 6, 1991

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Dresden Nuclear Power Station Unit 2
Unit 2 Cycle 13 Startup Test Report
NRC Docket No. 50-237

Dr. Murley:

The Attachment to this letter presents the Dresden Unit 2 Cycle 13 Startup Test Report. This report is being submitted in accordance with Technical Specification 6.6.A.1, and contains summaries of those startup tests identified in Draft Regulatory Guide SC 521-4 for Light Water Reactor reloads. Additional startup test results are available at Dresden Station.

Please contact this office should further information be required.

Respectfully,

Milton H. Richter

M. H. Richter
Nuclear Licensing Administrator

Attachment - Dresden Unit 2 Cycle 13 Startup Test Report

cc: A.B. Davis - Regional Administrator, Region III
B.L. Siegel - NRR Project Manager
D.E. Hills - Senior Resident Inspector, Dresden

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ZNLD/861/19

ATTACHMENT

DRESDEN UNIT 2

CYCLE 13

STARTUP TEST REPORT

ZNLD/861/20

DRESDEN UNIT 2

CYCLE 13

STARTUP TEST REPORT

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DRESDEN UNIT 2

CYCLE 13

STARTUP TESTING SUMMARY

Dresden Unit 2 resumed commercial operation for Cycle 13 on February 10, 1991, following a refueling and maintenance outage. During the outage, the fifth reload of Advanced Nuclear Fuels Corporation (formerly Exxon Nuclear Company) fuel was installed. The reload consisted of 168 9x9 fuel assemblies. This was the third reload of 9x9 fuel for Unit 2.

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. No unusual conditions were noted during the performance of these tests and the test results were as expected.

Summaries of the startup tests identified in the Draft Regulatory Guide SC 521-4 on refueling and startup tests for LWR reloads are attached per DPR-19 Technical Specification 6.6.A.1. Additional test results are available at the site.

DRESDEN UNIT 2

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 video-taped version prior to unit startup. Any discrepancies discovered in the loading will be promptly corrected and the affected areas reverified to ensure proper core loading 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 video-taped passes over the core by the nuclear group. The height check verifies the proper seating of an assembly in the fuel support piece while the video-tapes verify proper assembly orientation and location. On December 14, 1990, the core was verified as being properly loaded and consistent with the Advanced Nuclear Fuels Cycle 13 core reload design. Therefore, the as-loaded core configuration is consistent with that assumed in the evaluation of the Dresden Unit 2 Cycle 13 Reload Licensing Analyses.

DRESDEN UNIT 2

CYCLE 13

STARTUP TEST NO. 2

CONTROL ROD OPERABILITY AND SUBCRITICALITY CHECK

PURPOSE

The purpose 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:

1. Following the core reload, each control blade will be withdrawn and reinserted. This will guarantee that the mobility of the control blade is not impaired.

2. During control blade movement, the process computer or an alternate method is utilized to time the travel of the blade between notch positions in order to verify proper withdrawal and insertion times.

3. After the core is fully loaded, each control blade will be withdrawn and inserted individually to assure that criticality will not occur. As it is withdrawn, nuclear instrumentation will be monitored to verify subcriticality. Once withdrawn, each control blade is tested for overtravel by continually applying a withdrawal signal. A blade fails this check if rod position indication is not evident or if an overtravel alarm is received.

RESULTS AND DISCUSSION

All control rod drive functional tests were completed by November 24, 1990. These tests demonstrated acceptable mobility, proper withdrawal and insertion times, and subcriticality. In addition, all blades but one passed their overtravel checks.

Control rod L-09 was found to be uncoupled when withdrawn to position 48. The rod was recoupled and inserted to position 00. Subsequently several tests were performed including multiple overtravel checks at higher than normal drive pressures both before and after a cold scram test. Based on the favorable results of these tests, it was determined that replacement of rod and/or drive L-09 was unnecessary.

DRESDEN UNIT 2

CYCLE 13

STARTUP TEST NO. 3

TIP SYSTEM SYMMETRY AND TOTAL 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

The calculated χ^2 of the integrated TIP responses should be less than 34.81.

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 AND DISCUSSION

One complete set of data required for evaluating TIP uncertainty was obtained during the D2 BOC13 Startup Testing Program on April 12, 1991. Data was obtained at a steady state power level, 96% of rated. 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, the machine-normalized, power adjusted 6-inch TIP readings were obtained and averaged over nodes 1 through 24 for each symmetric TIP pair (the symmetric locations are given in Table 3.1). The absolute percent deviation for each symmetric TIP pair was calculated and is summarized in Table 3.2. The maximum absolute deviation was 11.26%, which is below the 25% criteria.

2) TIP Symmetry - Statistical Check.

The TIP symmetry statistical analysis was performed using the standard χ^2 test as recommended by Advanced Nuclear Fuels. The machine-normalized, power adjusted 6-inch TIP readings obtained from a TIP set performed on April 12, 1991 were used for the analysis. These TIP readings were summed over nodes 3 through 22 for each TIP tube location. The percent relative difference (Dm) for each symmetric TIP pair was then calculated using equation 3.1 (the results are summarized in Table 3.3). The TIP data variance (S^2TIP_{ij}) was calculated to be 12.19 using equation 3.2 and χ^2 was calculated to be 6.10 using equation 3.3. Note that the value for χ^2 is well within the limit of 34.81 established by Advanced Nuclear Fuels.

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	0.14
2	0.63
3	7.02
4	5.77
5	11.26
6	1.97
7	6.35
8	3.37
9	1.31
10	3.70
11	2.76
12	4.72
13	7.42
14	4.83
15	4.43
16	2.70
17	0.58
18	0.83

Maximum Absolute Percent Deviation: 11.26

TABLE 3.3. TIP Symmetry - Statistical Check

Symmetric TIP Pair	Relative Difference Dm
1	0.185
2	0.887
3	7.094
4	6.055
5	11.531
6	2.916
7	6.621
8	3.612
9	1.343
10	3.210
11	3.292
12	4.576
13	7.917
14	4.383
15	4.461
16	2.214
17	1.007
18	1.080

Equation 3.1 $$Dm = \frac{100\,(Tm_1 - Tm_2)}{\left(\frac{Tm_1 + Tm_2}{2}\right)}$$

Note: $Tm_1 = \sum_{k=3}^{22} T_1(k)$ for TIP_1 and $Tm_2 = \sum_{k=3}^{22} T_2(k)$ for TIP_2

Where TIP_1 and TIP_2 are symmetric TIP pairs, and $T_1(k)$ and $T_2(k)$ are the machine normalized power adjusted, 6-inch TIP readings for the respective TIP pair locations.

Equation 3.2 (Variance)

$$S^2_{TIP_{ij}} = \frac{\sum_{m=1}^{18} Dm2}{36} = 12.19$$

Equation 3.3

$$\chi^2 = \frac{18(S^2_{TIP_{ij}})}{36} = 6.10$$

DRESDEN UNIT 2

CYCLE 13

STARTUP TEST NO. 4

INITIAL CRITICALITY COMPARISON

PURPOSE

The intent of this procedure is to perform a critical Eigenvalue comparison. 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% $\Delta K/K$, Advanced Nuclear Fuels and Commonwealth Edison Company Core Management Engineers will be promptly notified to investigate the discrepancy. The Nuclear Regulatory Commission will be notified within 24 hours.

RESULTS AND DISCUSSION

Unit 2 went critical on January 4, 1991 at 14:08 hours utilizing an A-2 sequence. The moderator temperature was 182°F and the period was 352.8 seconds. Advanced Nuclear Fuels predictions and rod worths were calculated using the XTGBWR 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

ITEM		Δk/k
k_{eff} with all rods in adjusted to 170°F	=	0.9528*
ρ inserted by group 1 rods	=	0.0326*
ρ inserted by group 2 rods at criticality	=	0.0160*
Predicted k_{eff} at critical rod pattern (170°F)	=	1.00140*
Moderator temperature coefficient	=	-4.5×10^{-5} (Δk/k)/°F*
Temperature correction between 182°F and 170°F	=	-0.00054
Predicted k_{eff} with temperature correction at critical rod pattern	=	1.00086
k_{eff} at time of criticality with ∞ period	=	1.000
Period correction for 352.8 second period	=	+0.00020*
Actual k_{eff} with 352.8 second period	=	1.00020
(Predicted k_{eff} - actual k_{eff})	=	0.00066 Δk/k
Percent Difference	=	0.066% Δk/k

SOURCES

* Letter, J. M. Ross to R. J. Chin, dated November 13, 1990, Dresden 2 Cycle 13 Cycle Management Letter Report.