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SUBJECT: "Susquehanna SES Unit 2 Cycle 4 Startup Test Summary."
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SUSQUEHANNA STEAM ELECTRIC STATION
UNIT 2 CYCLE 4 STARTUP REPORT
PLA-3352 FILE R41-2A

Docket No. 50-388

Dear Mr. Russell:

Attached is a copy of the Susquehanna SES Unit 2 Startup Report for the Unit 2 Cycle 4 startup. This report is submitted in accordance with Technical Specifications Section 6.9.1.1 through 6.9.1.3. The report addresses those startup tests described in our application for reload dated June 16, 1989 (PLA-3209).

Very truly yours,

H. W. Keiser

Attachment

cc: NRC Document Control Desk (w/original)
NRC Region I
Mr. M. C. Thadani - NRC Project Manager
Mr. G. S. Barber - NRC Sr. Resident Inspector

IE26
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SUSQUEHANNA SES UNIT 2 CYCLE 4

STARTUP TEST SUMMARY

Prepared by: J. B. Forgie

Approved by: ____________________

Approved by: ____________________
Technical Section Supervisor

st: Steck20

ABSTRACT

Susquehanna Unit 2
Cycle 4
Startup Test Summary

Susquehanna Unit 2 resumed commercial operation for Cycle 4 on November 23, 1989 following a 10 1/2 week refueling and maintenance outage. The Unit 2 Cycle 4 (hereafter referred to as S2C4) reload included:

4 ANF 9 x 9	All natural Uranium bundles
4 ANF 9 x 9	Once burned reinserted bundles
316 ANF 9 x 9	twice burned
236 ANF 9 x 9	once burned
204 ANF 9 x 9	unirradiated fuel assemblies

The following startup tests, identified in the S2C4 Reload Licensing Submittal, are discussed in this report:

1. Core Loading Verification
2. POWERPLEX Input Deck Validation
3. Control Rod Functional (Insert and Withdrawal Checks)
4. Subcritical Shutdown Margin Demonstration
5. In-Sequence Critical and Shutdown Margin Demonstration
6. Control Rod Scram Time Testing
7. Tip Asymmetry

In addition, the startup program included core flow and LPRM calibrations, thermal limits monitoring and baseline recirculation data acquisition. A summary of these activities is also included in this report.

Susquehanna Unit 2
Cycle 4
Startup Test No. 1
Core Verification and Audit

Purpose

The purpose of this test is to visually verify that the core is loaded per the analyzed designs.

Criteria

Upon completion of core alterations during the refueling outage, the core must be verified to conform with the reference core design used in the various licensing analyses. The verifications to be performed include fuel bundle location, fuel bundle orientation, and proper seating of the fuel bundles within the core. The verifications will be performed by the Reactor Engineering Group utilizing an underwater television camera. The verification will be videotaped so that an independent verification may be performed. Any discrepancies discovered in the loading will be promptly corrected and the affected bundles shall be reverified prior to unit startup.

Results

The U2C4 core was analyzed to have a 2.13%ΔK/K shutdown Margin with the strongest rod fully withdrawn at BOC 4. (Startup and Operations Letter Report, Susquehanna Unit 2 Cycle 4). The following precautions were taken to prevent a misloaded fuel bundle. During the offload all bundles were placed in the fuel pool in the order in which they were to be reloaded, and a pool verification was performed (9/30/89) of all fuel before the reload commenced. A partial core verification was performed (10/19/89) after all irradiated bundles were placed in the core, before any control rod motion to preclude the possibility of inadvertant criticality if any bundles were misloaded. Finally, all new fuel was loaded.

The Cycle 4 final core verification consisted of two videotaped passes over the core. During the first pass, the fuel bundle serial numbers were recorded on the videotape to verify proper location. The second pass was performed to verify proper fuel assembly seating (assembly height check) and correct orientation.

The core tapes were independently verified to be correct by the Reactor Engineering Supervisor designee and a representative of Quality Control on (10/21/89). Therefore, the as-loaded core configuration is consistent with the core design Advanced Nuclear Fuels used in the evaluation of the S2C4 Reload Licensing Analyses. The S2C4 core map is included as Figure 1.

SSES UNIT-2/CYCLE-4 FULL CORE LOADING PATTERN

PREPARED BY/DATE: [signature] 10/20/89 REVIEWED BY/DATE: [signature] 10/20/89 APPROVED BY/DATE: [signature] 10/20/89
RECEIVED BY/DATE (SUPV REACT ENGRG): [signature] 10/20/89

CASE: 19 DATE STORED: 10/05/89 TITLE: SSES UNIT 2 CYCLE 4 FULL CORE LOADING PATTERN

GE-Y/GE-X:	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29
60									X21096	X21124	X21058	X21069	X21097	X21068	X21048
58								X21025	X22335	X22342	X22389	X22343	X22380	X22371	X22488
56						X21036	X21139	X22341	X23761	X21126	X22503	X23661	X22362	X23657	X21017
54						X21085	X22379	X23757	X22350	X21073	X23653	X21156	X23649	X21129	X22500
52					ANU001	X21152	X23753	X22378	X21137	X23749	X22377	X23645	X22331	X23641	X21154
50			X21083	X21111	X21060	X21016	X22475	X21027	X22393	X21128	X23637	X21082	X23633	X21087	X22487
48			X21034	X22351	X23745	X22467	X21010	X23741	X21024	X23629	X21086	X23737	X22505	X23733	X21095
46		X21045	X22325	X23729	X22333	X21099	X23725	X21072	X23625	X22349	X22367	X21114	X23621	X21071	X22484
44	X21035	X22387	X23721	X22361	X21125	X22336	X21008	X23617	X21138	X23717	X21081	X23713	X22359	X23709	X21084
42	X21026	X22368	X21007	X21002	X23705	X21098	X23613	X22369	X23701	X21109	X23697	X21044	X23609	X21112	X22474
40	X21046	X22388	X22466	X23605	X22328	X23601	X21140	X22327	X21001	X23693	X21059	X22511	X22479	X23689	X21101
38	X21056	X22360	X23597	X21155	X23593	X21037	X23685	X21067	X23681	X21033	X22468	X21153	X23589	X21127	X22499
36	X21113	X22381	X22344	X23585	X22356	X23581	X22483	X23577	X22370	X23573	X22492	X23569	X22355	X21003	X21018
34	X21009	X22334	X23565	X21100	X23561	X21141	X23677	X21142	X23673	X21143	X23669	X21055	X21057	X23665	X22495
32	X21151	X22480	X21123	X22509	X21043	X22496	X21115	X22507	X21070	X22491	X21110	X22473	X21023	X22465	X21015
30	X21163	X22544	X21189	X22515	X21271	X22528	X21209	X22517	X21248	X22531	X21204	X22547	X21293	X22553	X21303
28	X21313	X22450	X23568	X21222	X23564	X21179	X23680	X21180	X23676	X21181	X23672	X21259	X21261	X23668	X22527
26	X21207	X22407	X22444	X23588	X22432	X23584	X22539	X23580	X22416	X23576	X22532	X23572	X22431	X21321	X21306
24	X21260	X22424	X23600	X21167	X23596	X21287	X23688	X21245	X23684	X21283	X22556	X21165	X23592	X21193	X22523
22	X21274	X22398	X22554	X23608	X22460	X23604	X21178	X22459	X21319	X23696	X21263	X22513	X22543	X23692	X21223
20	X21296	X22414	X21311	X21320	X23708	X21220	X23616	X22415	X23704	X21203	X23700	X21272	X23612	X21206	X22548
18	X21285	X22397	X23724	X22425	X21191	X22452	X21312	X23620	X21176	X23720	X21231	X23716	X22423	X23712	X21234
16		X21273	X22463	X23732	X22449	X21221	X23728	X21250	X23628	X22435	X22413	X21208	X23624	X21249	X22540
14			X21284	X22437	X23748	X22555	X21314	X23744	X21294	X23632	X21236	X23740	X22519	X23736	X21217
12			X21233	X21205	X21264	X21304	X22549	X21297	X22395	X21194	X23640	X21232	X23636	X21237	X22535
10					ANU004	X21164	X23756	X22404	X21175	X23752	X22403	X23648	X22457	X23644	X21166
8						X21235	X22405	X23760	X22436	X21251	X23656	X21168	X23652	X21195	X22524
6						X21286	X21177	X22441	X23764	X21192	X22521	X23664	X22426	X23660	X21305
4								X21295	X22451	X22442	X22399	X22443	X22406	X22417	X22536
2									X21218	X21190	X21262	X21247	X21219	X21246	X21276

FIGURE 1. SUSQUEHANNA UNIT 2 CYCLE 4 CORE LOADING MAP

** PENNSYLVANIA POWER & LIGHT - NUCLEAR FUELS & SYSTEMS ENGINEERING RUN 889-5227 PAGE 4. **
** CLASP - CORE LOADING AND SHUFFLE PROGRAM 10/18/89 **

SSES UNIT-2/CYCLE-4 FULL CORE LOADING PATTERN

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CASE: 19 DATE STORED: 10/05/89 TITLE: SSES UNIT 2 CYCLE 4 FULL CORE LOADING PATTERN

GE-Y/GE-X:	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59
60	X21049	X21079	X21106	X21078	X21063	X21135	X21107								
58	X22489	X22372	X22383	X22346	X22390	X22347	X22338	X21030							
56	X21020	X23658	X22363	X23662	X22504	X21133	X23762	X22348	X21148	X21039					
54	X22501	X21130	X23650	X21157	X23654	X21074	X22353	X23758	X22384	X21090					
52	X21159	X23642	X22332	X23646	X22386	X23750	X21150	X22385	X23754	X21161	ANU002				
50	X22490	X21088	X23634	X21093	X23638	X21131	X22394	X21028	X22476	X21021	X21061	X21120	X21092		
48	X21108	X23734	X22506	X23738	X21089	X23630	X21031	X23742	X21011	X22470	X23746	X22352	X21041		
46	X22485	X21076	X23622	X21117	X22376	X22354	X23626	X21075	X23726	X21104	X22340	X23730	X22326	X21052	
44	X21091	X23710	X22366	X23714	X21094	X23718	X21149	X23618	X21013	X22337	X21134	X22364	X23722	X22392	X21040
42	X22477	X21119	X23610	X21053	X23698	X21122	X23702	X22374	X23614	X21105	X23706	X21005	X21014	X22375	X21029
40	X21102	X23690	X22482	X22512	X21062	X23694	X21006	X22330	X21147	X23602	X22329	X23606	X22471	X22391	X21051
38	X22502	X21132	X23590	X21160	X22469	X21042	X23682	X21080	X23686	X21038	X23594	X21158	X23598	X22365	X21065
36	X21019	X21004	X22358	X23570	X22493	X23574	X22373	X23578	X22486	X23582	X22357	X23586	X22345	X22382	X21118
34	X22498	X23666	X21064	X21066	X23670	X21144	X23674	X21145	X23678	X21146	X23562	X21103	X23566	X22339	X21012
32	X21022	X22472	X21032	X22478	X21121	X22494	X21077	X22508	X21116	X22497	X21054	X22510	X21136	X22481	X21162
30	X21310	X22560	X21302	X22552	X21215	X22534	X21255	X22518	X21210	X22529	X21282	X22516	X21202	X22545	X21174
28	X22530	X23667	X21268	X21270	X23671	X21182	X23675	X21183	X23679	X21184	X23563	X21225	X23567	X22455	X21316
26	X21307	X21322	X22434	X23571	X22533	X23575	X22419	X23579	X22542	X23583	X22433	X23587	X22445	X22408	X21212
24	X22526	X21198	X23591	X21172	X22557	X21292	X23683	X21258	X23687	X21288	X23595	X21170	X23599	X22429	X21269
22	X21224	X23691	X22546	X22514	X21266	X23695	X21324	X22462	X21185	X23603	X22461	X23607	X22559	X22401	X21279
20	X22551	X21213	X23611	X21281	X23699	X21216	X23703	X22420	X23615	X21227	X23707	X21323	X21318	X22421	X21299
18	X21241	X23711	X22430	X23715	X21244	X23719	X21187	X23619	X21317	X22453	X21200	X22428	X23723	X22402	X21290
16	X22541	X21254	X23623	X21211	X22422	X22440	X23627	X21253	X23727	X21226	X22456	X23731	X22464	X21280	
14	X21230	X23735	X22520	X23739	X21239	X23631	X21301	X23743	X21315	X22558	X23747	X22438	X21291		
12	X22538	X21238	X23635	X21243	X23639	X21197	X22396	X21298	X22550	X21309	X21265	X21214	X21242		
10	X21171	X23643	X22458	X23647	X22412	X23751	X21188	X22411	X23755	X21173	ANU003				
8	X22525	X21196	X23651	X21169	X23655	X21252	X22439	X23759	X22410	X21240					
6	X21308	X23659	X22427	X23663	X22522	X21199	X23763	X22448	X21186	X21289					
4	X22537	X22418	X22409	X22446	X22400	X22447	X22454	X21300							
2	X21277	X21257	X21228	X21256	X21267	X21201	X21229								

FIGURE 1. SUSQUEHANNA UNIT 2 CYCLE 4 CORE LOADING MAP

Susquehanna Unit 2
Cycle 4
Startup Test No. 2
POWERPLEX Input Deck Validation

Purpose

To ensure the POWERPLEX input deck is updated correctly before the start of every new fuel cycle.

Criteria

POWERPLEX is the ANF software system designed to perform in-core monitoring of BWR cores. Core monitoring is performed by the module, XTGBWR, a three-dimensional reactor simulator code which calculates bundle nodal powers. The POWERPLEX input deck consists of all constants needed for the execution of this code and subsequent calculation of the margin to thermal limits. These constants must be updated prior to the start of every new fuel cycle in order to ensure satisfactory core monitoring of the new core configuration. The deck is updated by an ANF core management engineer and validated jointly by members of the Reactor Engineering Group at Susquehanna and the Nuclear Fuels Group in Allentown.

Results

The POWERPLEX input deck was verified to be correct and successfully loaded into the POWERPLEX system prior to S2C4 startup.

Susquehanna Unit 2
Cycle 4
Startup Test No. 3
Control Rod Functional (Insert and Withdrawal Checks)

Purpose

The purpose of this startup test is to assure proper control rod function and demonstrate that criticality will not occur due to the withdrawal of a single rod.

Criteria

Control Rod Functionals include mobility, overtravel and subcritical checks. These may be performed as each control cell is loaded in its final configuration.

Each control rod will be cycled individually to ensure mobility. As each rod is fully withdrawn, it will be checked for overtravel by continually applying a withdrawal signal. Subcriticality will also be verified with the rod withdrawn.

Results

Due to Shutdown Margin considerations, no control rod functionals were performed on fully loaded control cells until the partial core verification was completed on 10/19/89. No control rods overtraveled and subcriticality was maintained as each rod was individually fully withdrawn and reinserted.

Susquehanna Unit 2
Cycle 4
Startup Test No. 4
Subcritical Shutdown Margin Demonstration

Purpose

The purpose of this startup test is to assure at least the minimum required shutdown margin exists with the strongest worth control rod fully withdrawn.

Criteria

The minimum required shutdown margin at BOC for Susquehanna Unit 2 Cycle 4 is 0.95% Δ K/K. This test will verify at least this amount by performance of a subcritical shutdown margin demonstration. The highest (strongest) worth control rod is fully withdrawn, then a diagonally adjacent rod is slowly notched out verifying subcriticality at each step until the analytically determined reactivity worth of the control rods at their respective notch position equals or slightly exceeds the required amount of SDM.

Results

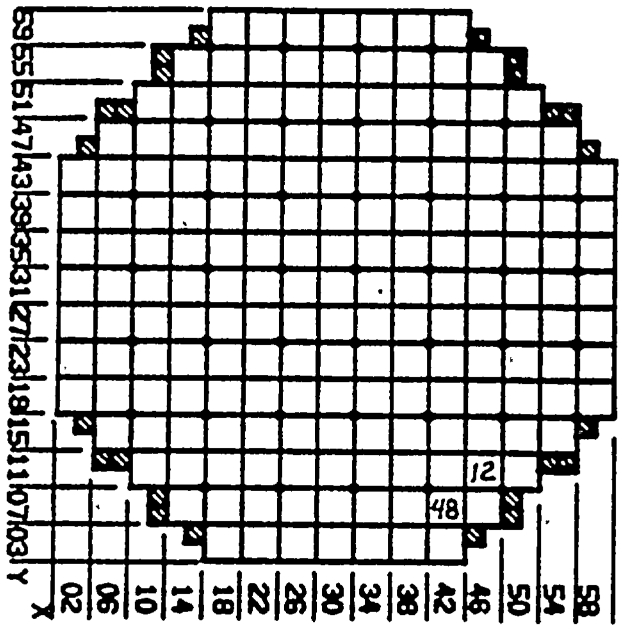
The reactor remained subcritical with the highest worth control rod fully withdrawn and an additional diagonally adjacent rod pulled to a notch position with a calculated worth of 1.229% Δ K/K. The required shutdown margin to be demonstrated was calculated to be 1.180% Δ K/K. This is 0.95% Δ K/K plus a correction factor for the recirculation loop temperature (134.3 degrees F) at the time of the test. Using data supplied by ANF it was determined that the following rods pulled to the indicated position would demonstrate a shutdown margin of 1.229% Δ K/K. (or 0.999% Δ k/k at 68 degrees F).

ROD	POSITION	TOTAL WORTH % Δ K/K
42-07*	48	-
46-11	12	1.229

*analytically determined strongest rod.

As rods were pulled, subcriticality was verified after each notch. Subcriticality was also verified with the rods at the above indicated positions, thus satisfying the purpose of this startup test. Figure 2 is a core map showing the test rod positions.

FIGURE 2. CORE MAP SHOWING TEST ROD POSITIONS FOR SUBCRITICAL SHUTDOWN MARGIN DEMONSTRATION



BLANKS INDICATE RODS AT 00.

Susquehanna Unit 2
Cycle 4
Startup Test No.5
In-Sequence Critical and SDM Determination

Purpose

The purpose of this startup test is to calculate the actual shutdown margin of the cycle 4 core and to demonstrate that no reactivity anomaly existed.

Criteria

1) Shutdown Margin

Technical Specification 3.1.1 requires an adequate shutdown margin to ensure the reactor can be made subcritical from all operating conditions. This value, .38%ΔK/K has been determined to be the minimum required SDM to bring a reactor subcritical under the worst case conditions - a cold, xenon-free core at the most reactive point in the cycle with the highest worth control rod unavailable for reactivity control. At beginning of cycle, the required SDM value must be increased by a factor, R, if it is determined that core shutdown margin is less at another point in the cycle than the initial shutdown margin (for Cycle 4, R = 0.20). A prediction uncertainty of .37%ΔK/K is also added at BOC to assure the validity of the analytical calculations. The required beginning-of-cycle SDM for Susquehanna Unit 2 Cycle 4 is 0.95%ΔK/K; the actual SDM will be calculated from data obtained during the initial startup criticality.

2) Reactivity Anomaly

Core reactivity is monitored to prevent excessive reactivity additions due to unforeseen reactivity changes or reactivity anomalies. At BOC, a 1% Δ K/K difference between predicted and actual critical control rod positions might indicate improper core loading or a computer code that is unreliable. Data gathered during the in-sequence critical, specifically the Keff at the notch position of the control rod at which criticality occurs, is compared to predicted critical control rod position Keff and a % reactivity difference is calculated.

Results

The calculated SDM was 1.732% Δ K/K and the difference between actual Keff and predicted Keff at criticality was -0.401% Δ K/K.

Control rods were withdrawn in the B sequence until the reactor was on a stable, positive period. The notch position at which criticality occurred was rod 22-47, notch 16, step 36. A special log was initiated to record SRM count rates and recirculation loop temperatures. The average period was 277 seconds and the average loop temperature 169.8 degrees F which yield period and temperature corrections of .249 10^{-3} Δ K/K and 3.532 x 10^{-3} Δ K/K, respectively.

1) <u>Shutdown Margin</u>

The equation used to calculate SDM

$$SDM = \frac{Kcrit - Ksro}{Kcrit * Ksro} - \Delta p \text{ (period)} - \Delta p \text{ (temp)}$$

Kcrit is Keff at the actual critical control rod position (0.99977) and Ksro is Keff predicted with the strongest rod out (0.97911).

The minimum required SDM for Unit 2 Cycle 4 at beginning of cycle was 0.95% $\Delta K/K$; the calculated shutdown margin based on this test was 1.732% $\Delta K/K$, thus satisfying the acceptance criteria.

2) <u>Reactivity Anomaly</u>

The reactor went critical at step 36 with Kcrit of 0.99977. The equation used to calculate reactivity difference was

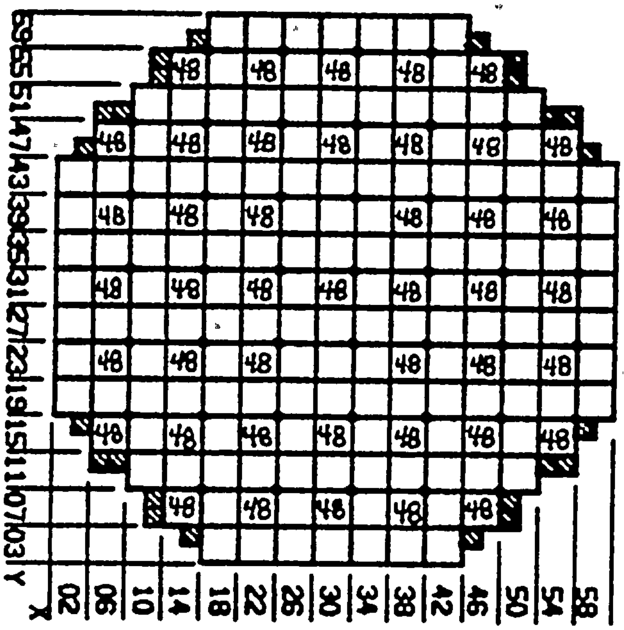
$$\text{Reactivity difference} = \frac{Kcrit - 1}{Kcrit} - \Delta p \text{ (period)} - \Delta p \text{ (temp)}$$

The calculated reactivity difference was -0.401% $\Delta K/K$. This satisfies ± 1% $\Delta K/K$ acceptance criteria.

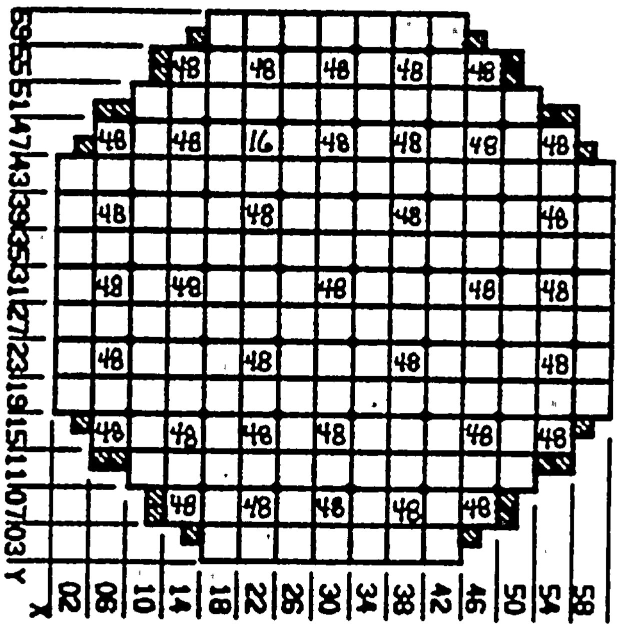
A comparison of the predicted versus actual critical control rod patterns is included as Figure 3.

FIGURE 3. COMPARISON OF PREDICTED VS ACTUAL CRITICAL ROD PATTERNS

PREDICTED CRITICAL PATTERN



ACTUAL CRITICAL PATTERN



BLANKS INDICATE RODS AT 00

Susquehanna Unit 2
Cycle 4
Test No. 6
Control Rod Scram Time Testing

Purpose

To demonstrate the maximum scram insertion times of all rods following core alterations.

Criteria

Susquehanna Technical Specification 4.1.3.2 states that scram insertion times of all control rods shall be demonstrated through measurement with reactor coolant pressure greater than 950 psig prior to exceeding 40% thermal power after core alterations. For Unit 2 cycle 4, one-half of all control rod scram times were to be determined by performing a black-and-white scram from the B sequence and using GETARS scram data. The remaining rods were to be individually scram time tested.

Results

Control rod scram times for 95 rods were obtained through GETARS from the black-and-white scram performed November 19, 1989. The remaining rods were individually scram timed November 25-26, 1989. All scram times were within the acceptance criteria, as shown on Table 2.

	ROD	ROD POSITION	TIME AS FOUND	T.S. LIMIT
MAXIMUM INDIVIDUAL ROD SCRAM INSERTION TIME T.S. 3.1.3.2	42-47	05	2.98	7.00
AVERAGE SCRAM INSERTION TIME OF OPERABLE RODS T.S. 3.1.3.3		45	0.28	0.43
		39	0.60	0.86
		25	1.32	1.93
		05	2.41	3.49
AVERAGE SCRAM INSERTION TIME OF SLOWEST 2x2 ARRAY T.S. 3.1.3.4		45	0.30	0.45
		39	0.64	0.92
		25	1.44	2.05
		05	2.63	3.70

TABLE 2: Results of Scram Time Testing of All Control Rods S2C4.

Susquehanna Unit 2
Cycle 4
Startup Test No. 7
Tip Asymmetry

Purpose

The purpose of this test is to check core symmetry by performing a statistical uncertainty analysis on the Traversing In-Core Probe (TIP) System. Also, by the performance of this test, the proper operation of the TIP system will be assured.

Criteria

The X^2 test of significance will be performed with the significance level fixed at 1%. The test will be performed utilizing an octant symmetric rod pattern at a power level greater than 75% of rated power. The startup test criteria for symmetric TIP differences is that the X^2 value calculated shall be less than the critical X^2 value. Since Susquehanna has 19 symmetric TIP pairs, the calculated X^2 value must be less than a critical X^2 value of 36.19 (as determined by ANF). If the calculated X^2 value exceeds the critical value, the instrumentation and data processing system should be reviewed for any problems which may contribute to abnormal TIP asymmetries. A second determination of X^2 should be then made. If the new measured value of X^2 exceeds the critical value, the fuel vendor shall be consulted and appropriate action taken to assure that a larger than anticipated TIP asymmetry does not adversely affect the safe operation of the reactor.

Results

A complete set of TIP data was obtained at the completion of Susquehanna Unit 2 BOC4 Startup Testing Program at rated thermal power. The nodal TIP values (Nodes 3 through 22) were summed up for each symmetric TIP pair using equation 5.1 with the results summarized in Table 1. Using Equations 5.2 and 5.3, the variance and X^2 were calculated to be 3.735 and 1.971 respectively. The X^2 value of 1.971 is well within the 36.19 limit established by ANF.

Table 1
Absolute Relative Difference

Symmetric TIP Pair	Absolute Relative Difference dm
1	2.113
2	1.436
3	.552
4	.235
5	.244
6	3.525
7	3.165
8	1.447
9	4.368
10	1.752
11	7.655
12	.350
13	1.299
14	.514
15	.613
16	2.910
17	3.591
18	.259
19	2.413

Equation 5.1

$$dm = \frac{100\ (Tm1 - Tm2)}{\frac{Tm1 + Tm2}{2}}$$

Note: $Tm1 = \sum_{K=3}^{22} T(k)$ for TIP1 and $Tm2 = \sum_{K=3}^{22} t(k)$ for TIP2

where TIP1 and TIP2 are symmetric TIP pairs

Equation 5.2 (Variance)

$$S^2TIPij = \frac{\sum_{M=1}^{19} dm^2}{38} = 3.735$$

Equation 5.3

$$X^2 = \frac{19\ S^2TIPij}{36} = 1.971$$

Susquehanna Unit 2
Cycle 4
Startup Program Summary

The following is a short summary of additional Reactor Engineering activities performed during the Startup Testing Program.

Thermal Limit Monitoring

Thermal Limits were checked throughout the startup period through review of the POWERPLEX core monitoring program, MONITOR, output. At no time did thermal limits exceed Technical Specification limits.

TIP System - OD-1 Performance

A full set of TIPS was run at 37% power to update the core power distribution before the first core performance calculation, MONITOR, was initiated. Subsequent TIP sets were performed at 75 and 100% power in conjunction with two LPRM calibrations. The LPRM currents were updated and the LPRM GAFS found to be with the acceptable range.

Power Distribution Comparison with Offline Monitoring

Favorable results were obtained when actual core power distribution data was compared to SIMULATE-E/PPL core modelling code data. The SIMULATE-E/PPL code is used by the Nuclear Fuels core management engineer to predict power/TIP response distributions throughout the cycle. This comparison, at .214 GWD/MTU is included as Figure 4.

Core Flow Calibration

A core flow calibration was performed at 100% core flow. Minor adjustments to the jet pump and recirculation loop flow instrumentation were required.

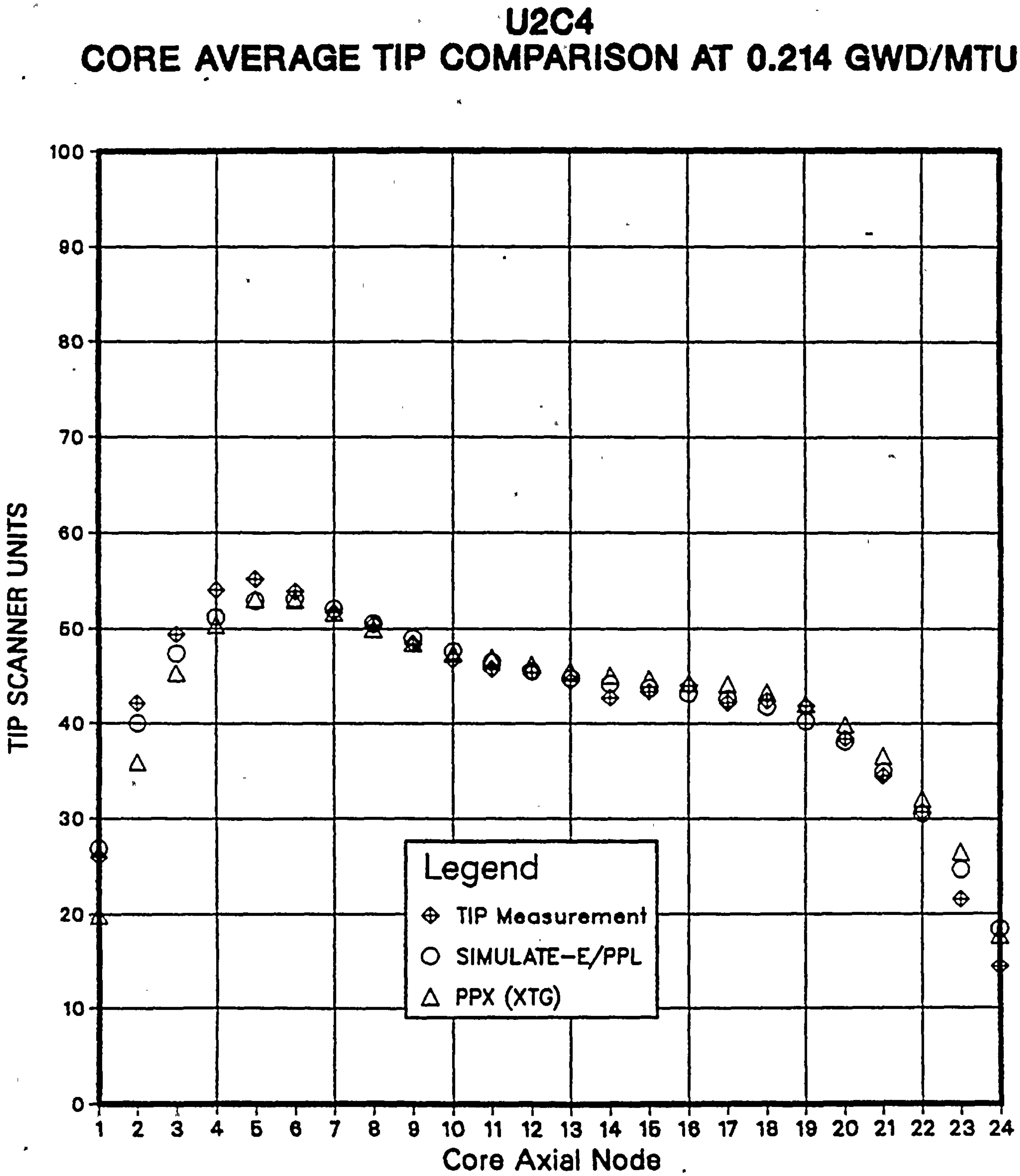
Recirculation Loop Baseline Data Acquisition

Recirculation loop data was collected throughout the startup program to provide baseline data for plant performance monitoring in two loop and single loop operation. This data is used throughout the cycle during the performance of the Technical Specification Jet Pump Operability Surveillance.

Neutron Noise Data Recording

APRM and LPRM neutron flux noise data was collected in order to evaluate the decay ratio for a full core of 9x9 fuel. Initial calculations indicate the core is very stable. (The final results will be transmitted separately at a later date).

FIGURE 4



U2C4
CORE AVERAGE TIP COMPARISON AT 0.214 GWD/MTU
TIP SCANNER UNITS
0
10
20
30
40
50
60
70
80
90
100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Core Axial Node
Legend
TIP Measurement
SIMULATE-E/PPL
PPX (XTG)