BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT

UNIT 1

Docket No. 50-317

License No. DPR-69

SUMMARY OF STARTUP TESTING

FOR CYCLE TEN

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SUMMARY OF STARTUP TESTING FOR

CALVERT CLIFFS UNIT ONE CYCLE TEN

I. The following tests were conducted for the startup of Calvert Cliffs Unit 1 Cycle 10. These are the same tests as performed in the Unit 2 Cycle 8 startup and as described in Reference (1).

A. Control Element Drive Mechanism (CEDM) and Control Element Assembly (CEA) Performance Test

B. Reactor Coolant System Flow Verification

C. Initial Criticality

D. CEA Symmetry Checks

E. Critical Boron Concentration Measurements

F. Isothermal Temperature and Power Coefficient Measurements

G. Group Rod Worth Measurements

H. Power Distribution Measurements

II. The results of these tests and comparison with predictions are as follows:

A. The proper functioning of the CEDM's and CEA position indication was verified through insertion and withdrawal of CEA's. All CEA's reached a 90% insertion in less than 3.1 seconds at hot, full flow conditions. The slowest CEA's (63 & 65) reached 90% insertion in 2.47 seconds.

B. Reactor Coolant Flow was verified to be consistent with previous testing.

C. Initial criticality was achieved as described in the Calvert Cliffs FSAR by boron dilution on July 1, 1988, with all CEAs withdrawn except the lead CEA group at mid-core.

D. The CEA Symmetry Checks verified that all CEAs were attached to their extension shafts. An evaluation of the quantitative reactivity change for dual CEAs yielded a core average tilt within the 10% acceptance limit.

E. Critical Boron Measurement - Table 1.

F. Isothermal Temperature and Power Coefficients - Table 2.

G. CEA Group Worth Measurements - Table 3.

H. Power Distribution Measurements - Table 4, Figure 1 through 4.

Assembly Power Review Criteria

1. Through 30% power
   interior ±15% exterior ±20%;
2. Greater than 30% power
   interior ±10% exterior ±15%

Initial comparisons of relative power densities showed the center assembly outside the 10% review criteria at 60% power. This was determined to be due to the slower than anticipated power ascension. New predictions were performed using the actual power history. Further comparisons met all acceptance and review criteria.

III. All tests were within acceptance limits.

REFERENCES

1. Mr. J. A. Tiernan (BG&E), to NRC, letter dated February 12, 1988, Calvert Cliffs Nuclear Power Plant Unit 1 and 2, Docket No. 50-317 and 50-318. "Request for Amendment, Unit One Cycle Ten License Application, Unit Two Axial Shape Index Region Enlargement."

TABLE 1

CRITICAL BORON MEASUREMENTS

	Measured	Predicted	Review Criteria
Zero Power All Rods Out, 532°F	1750 ppm	1780 ppm	±50 ppm
Zero Power CEA Groups 1 through 5 Inserted, 532°F	1403 ppm	1411 ppm	±50 ppm
Full Power CEA Group 5 105" Withdrawn	1303 ppm	1303 ppm	±50 ppm

TABLE 2

ISOTHERMAL TEMPERATURE COEFFICIENTS AND POWER COEFFICIENTS

ITC

	Measured	Predicted	Review Criteria
Zero Power, CEA Group 5 at 100.5 Withdrawn @ 1750 ppm	$+0.265 \times 10^{-4}$ delta rho/°F	$+0.222 \times 10^{-4}$ delta rho/°F	$\pm 0.3 \times 10^{-4}$ delta rho/°F
Full Power, CEA Group 5 at 105" Withdrawn @ 1303 ppm	-0.346×10^{-4} delta rho/°F	-0.402×10^{-4} delta rho/°F	$\pm 0.3 \times 10^{-4}$ delta rho/°F

POWER COEFFICIENT

100% Power, CEA Group 5 at 105" Withdrawn	-0.904×10^{-4} delta rho/°F	-0.88×10^{-4} delta rho/°F	$\pm 0.3 \times 10^{-4}$ delta rho/°F

TABLE 3

CEA GROUP WORTH MEASUREMENTS

	Measured (% delta rho)	Predicted (% delta rho)
Group 5	0.369	0.388 ±0.100
Group 4	0.521	0.519 ±0.100
Group 3	0.740	0.735 ±0.110
Group 2	0.689	0.652 ±0.100
Group 1	0.686	0.762 +0.114
TOTAL	3.005	3.056 ± .306

TABLE 4

POWER DISTRIBUTION MEASUREMENTS

97% Power

	Measured	Acceptance Limits
F_{xy}^T	1.589	≤1.700
F_t^T	1.583	≤1.650
Upper T_q	.0038	≤0.030
lower T_q	.0073	≤0.030

ASSEMBLY RELATIVE POWER DENSITY FOR 30% POWER

UNIT 1 CYCLE 10

PREDICTED: 29.2% Power, CEA Group 5 @ 135 in. withdrawn, 14 MWD/T
MEASURED: 29.2% Power, CEA Group 5 @ 135 in. withdrawn, 14 MWD/T

FIGURE 1

MEASURED
PREDICTED
% DIFF

% DIFF = $\frac{\text{MEASURED-PREDICTED}}{\text{PREDICTED}} \times 100$

							K 1	M 2			
							0.4245	0.8553			
							0.4283	0.9248			Y
							-0.89	-7.52			
					K 3	M 4	L 5	M* 6	L 7		
					0.4032	0.9342	0.9724	1.1192	1.1515		
					0.3911	0.9249	1.0167	1.1848	1.2240		X
					3.09	-2.17	-4.36	-5.54	-5.92		
				K 8	M* 9	L 10	M* 11	K 12	L* 13		
				0.3981	0.9589	1.2298	1.2589	1.0293	1.0883		
				0.3952	0.9688	1.2476	1.3040	1.0499	1.0915		W
				0.73	-1.02	-1.43	-3.46	-1.96	-0.29		
			K 14	M* 15	L 16	M* 17	K 18	M* 19	K 20		
			0.3981	0.9275	1.1483	1.2428	1.0056	1.2963	1.1084		
			0.3962	0.9419	1.1705	1.2663	0.9965	1.2852	1.0900		V
			0.48	-1.53	-1.90	-1.86	0.91	0.86	1.69		
		K 21	M* 22	L 23	M* 24	K* 25	M* 26	L* 27	M* 28		
		0.4032	0.9589	1.1483	1.2099	0.8405	1.2490	1.1472	1.3279		
		0.3896	0.9726	1.1746	1.2085	0.8137	1.2280	1.0664	1.2696		T
		3.49	-1.41	-2.24	0.12	3.29	1.71	7.58	4.59		
		M 29	L 30	M* 31	K* 32	M* 33	L 34	M* 35	K 36		
		0.9342	1.2298	1.2428	0.8405	1.1846	1.1362	1.2456	1.0440		
		0.9587	1.2572	1.2762	0.8166	1.1722	1.1219	1.1748	0.9793		S
		-2.56	-2.18	-2.62	2.93	1.06	1.27	6.03	6.61		
		L 37	M* 38	K 39	M* 40	L 41	K* 42	K* 43	M* 44		
		0.9724	1.2589	1.0056	1.2490	1.1362	0.7585	0.7391	1.1115		
	K 45	1.0201	1.3129	1.0174	1.2334	1.1216	0.7190	0.7225	1.0786		R
	0.4245	-4.68	-4.11	-1.16	1.26	1.30	5.49	2.30	3.05		
P	0.4280										
	-0.82	M* 46	K 47	M* 48	L* 49	M* 50	K* 51	MX 52	L 53		
		1.1192	1.0293	1.2963	1.1472	1.2456	0.7391	1.0009	1.0947		
	M 54	1.1843	1.0507	1.2844	1.0648	1.1635	0.6972	0.9855	1.0711		N
	0.8553	-5.50	-2.04	0.93	7.74	7.06	6.01	1.56	2.20		
M	0.9240										
	-7.44	L 55	L* 56	K 57	M* 58	K 59	M* 60	L 61	K* 62		
		1.1515	1.0883	1.1084	1.3279	1.0440	1.1115	1.0947	0.8496		
		1.2240	1.0915	1.0900	1.2696	0.9793	1.0786	1.0711	0.8089		L
		-5.92	-0.29	1.69	4.59	6.61	3.05	2.20	5.03		
	1	2	3	4	5	6	7	9	11		
							8	10			

ASSEMBLY RELATIVE POWER DENSITY FOR 60% POWER

UNIT 1 CYCLE 10

PREDICTED: 59.4% Power, CEA Group 5 @ 135 in. withdrawn, 23 MWD/T
MEASURED: 59.4% Power, CEA Group 5 @ 135 in. withdrawn, 23 MWD/T

FIGURE 2

MEASURED
PREDICTED
% DIFF

% DIFF = $\frac{\text{MEASURED-PREDICTED}}{\text{PREDICTED}} \times 100$

								K 1	M 2							
								0.4211	0.8448							
								0.4270	0.9111							Y
								-1.38	-7.28							
						K 3	M 4	L 5	M* 6	L 7						
						0.4011	0.9252	0.9654	1.1100	1.1394						
						0.3900	0.9415	1.0043	1.1700	1.2087						X
						2.85	-1.73	-3.87	-5.13	-5.73						
				K 8	M* 9	L 10	M* 11	K 12	L* 13							
				0.3985	0.9508	1.2137	1.2511	1.0260	1.0847							
				0.3953	0.9579	1.2298	1.2892	1.0478	1.0910							W
				0.81	-0.74	-1.31	-2.96	-2.08	-0.58							
			K 14	M* 15	L 16	M* 17	K 18	M* 19	K 20							
			0.3985	0.9222	1.1390	1.2367	1.0054	1.2990	1.1132							
			0.3963	0.9331	1.1582	1.2563	0.9983	1.2855	1.0956							V
			0.56	-1.17	-1.66	-1.56	0.71	1.05	1.61							
		K 21	M* 22	L 23	M* 24	K* 25	M* 26	L* 27	M* 28							
		0.4011	0.9508	1.1390	1.2077	0.8448	1.2557	1.1545	1.3384							
		0.3886	0.9614	1.1621	1.2022	0.8208	1.2333	1.0766	1.2781							T
		3.22	-1.10	-1.99	0.46	2.92	1.82	7.24	4.72							
		M 29	L 30	M* 31	K* 32	M* 33	L 34	M* 35	K 36							
		0.9252	1.2137	1.2367	0.8448	1.1934	1.1463	1.2318	1.0595							
		0.9450	1.2388	1.2657	0.8236	1.1806	1.1345	1.1897	0.9960							S
		-2.10	-2.03	-2.29	2.57	1.08	1.04	3.54	6.38							
		L 37	M* 38	K 39	M* 40	L 41	K* 42	K* 43	M* 44							
		0.9654	1.2511	1.0054	1.2557	1.1463	0.7707	0.7596	1.1343							
	K 45	1.0075	1.2977	1.0186	1.2384	1.1342	0.7381	0.7433	1.1009							R
	0.4211	-4.18	-3.59	-1.30	1.40	1.07	4.42	2.19	3.22							
P	0.4267															
	-1.31	M* 46	K 47	M* 48	L* 49	M* 50	K* 51	MX 52	L 53							
		1.1100	1.0260	1.2990	1.1545	1.2318	0.7596	1.0250	1.1180							
	M 54	1.1694	1.0486	1.2846	1.0750	1.1786	0.7177	1.0089	1.0961							N
	0.8448	-5.08	-2.16	1.12	7.40	4.51	5.84	1.60	2.00							
M	0.9103															
	-7.20	L 55	L* 56	K 57	M* 58	K 59	M* 60	L 61	K* 62							
		1.1394	1.0847	1.1132	1.3384	1.0595	1.1363	1.1180	0.8676							
		1.2087	1.0910	1.0956	1.2781	0.9960	1.1009	1.0961	0.8335							L
		-5.73	-0.58	1.61	4.72	6.38	3.22	2.00	4.09							
	1	2	3	4	5	6	7	8	9	10	11					

ASSEMBLY RELATIVE POWER DENSITY FOR 85% POWER

UNIT 1 CYCLE 10

PREDICTED: 85% Power, CEA Group 5 @ 135 in. withdrawn, 68 MWD/T
MEASURED: 85.0% Power, CEA Group 5 @ 135 in. withdrawn, 68 MWD/T

FIGURE 3

MEASURED
PREDICTED
% DIFF

% DIFF = $\frac{\text{MEASURED-PREDICTED}}{\text{PREDICTED}} \times 100$

						K 1 0.4193 0.4274 -1.90	M 2 0.8309 0.9003 -7.71			Y
				K 3 0.3992 0.3903 2.28	M 4 0.9141 0.9301 -1.72	L 5 0.9553 0.9948 -3.97	M* 6 1.1003 1.1584 -5.02	L 7 1.1321 1.1974 -5.45		X
			K 8 0.4005 0.3966 0.98	M* 9 0.9420 0.9488 -0.72	L 10 1.1954 1.2143 -1.56	M* 11 1.2413 1.2761 -2.73	K 12 1.0197 1.0473 -2.64	L* 13 1.0801 1.0929 -1.17		W
		K 14 0.4005 0.3976 0.73	M* 15 0.9165 0.9259 -1.02	L 16 1.1271 1.1475 -1.78	M* 17 1.2294 1.2468 -1.40	K 18 1.0059 0.9999 0.60	M* 19 1.3004 1.2848 1.21	K 20 1.1164 1.1005 1.44		V
	K 21 0.3992 0.3888 2.67	M* 22 0.9420 0.9520 -1.05	L 23 1.1271 1.1511 -2.08	M* 24 1.2042 1.1960 0.69	K* 25 0.8483 0.8277 2.49	M* 26 1.2610 1.2364 1.99	L* 27 1.1601 1.0850 6.92	M* 28 1.3469 1.2831 4.97		T
	M 29 0.9141 0.9333 -2.06	L 30 1.1954 1.2227 -2.23	M* 31 1.2294 1.2555 -2.08	K* 32 0.8483 0.8304 2.16	M* 33 1.1997 1.1869 1.08	L 34 1.1526 1.1449 0.67	M* 35 1.2559 1.2005 4.61	K 36 1.0717 1.0092 6.19		S
	L 37 0.9553 0.9977 -4.25	M* 38 1.2413 1.2839 -3.32	K 39 1.0059 1.0194 -1.32	M* 40 1.2610 1.2412 1.60	L 41 1.1526 1.1445 0.71	K* 42 0.7807 0.7563 3.23	K* 43 0.7778 0.7620 2.07	M* 44 1.1582 1.1176 3.63		R
P	K 45 0.4193 0.4270 -1.80	M* 46 1.1003	K 47 1.0197	M* 48 1.3004	L* 49 1.1601	M* 50 1.2559	K* 51 0.7778	MX 52 1.0471	L 53 1.1394	
	M 54 0.8309	1.1578 -4.97	1.0479 -2.69	1.2837 1.30	1.0833 7.09	1.1897 5.56	0.7362 5.65	1.0264 2.02	1.1149 2.20	N
M	0.8995 -7.63	L 55 1.1321 1.1974 -5.45	L* 56 1.0801 1.0929 -1.17	K 57 1.1164 1.1005 1.44	M* 58 1.3469 1.2831 4.97	K 59 1.0717 1.0092 6.19	M* 60 1.1582 1.1176 3.63	L 61 1.1394 1.1149 2.20	K* 62 0.8843 0.8543 3.51	L
		1	2	3	4	5	6	7	9	11

8 10

ASSEMBLY RELATIVE POWER DENSITY FOR 100% POWER

UNIT 1 CYCLE 10

PREDICTED: 97% Power, CEA Group 5 @ 105 in. withdrawn, 176 MWD/T
MEASURED: 97.4% Power, CEA Group 5 @ 105 in. withdrawn, 154.2 MWD/T

FIGURE 4

MEASURED
PREDICTED
% DIFF

% DIFF = $\frac{\text{MEASURED-PREDICTED}}{\text{PREDICTED}} \times 100$

								K 1	M 2							
								0.4151	0.8130							
								0.4216	0.8764							Y
								-1.54	-7.23							
						K 3	M 4	L 5	M* 6	L 7						
						0.4044	0.9171	0.9491	1.0786	1.0977						
						0.3954	0.9284	0.9846	1.1272	1.1512						X
						2.28	-1.22	-3.61	-4.31	-4.69						
					K 8	M* 9	L 10	M* 11	K 12	L* 13						
					0.4086	0.9526	1.1978	1.2395	0.9981	0.9601						
					0.4051	0.9568	1.2151	1.2652	1.0190	1.0063						W
					0.86	-0.44	-1.42	-2.03	-2.05	-4.59						
				K 14	M* 15	L 16	M* 17	K 18	M* 19	K 20						
				0.4086	0.9306	1.1389	1.2411	1.0056	1.2912	1.0992						
				0.4059	0.9381	1.1590	1.2545	1.0029	1.2697	1.0771						V
				0.67	-0.80	-1.73	-1.07	0.27	1.69	2.05						
			K 21	M* 22	L 23	M* 24	K* 25	M* 26	L* 27	M* 28						
			0.4044	0.9526	1.1389	1.2200	0.8602	1.2733	1.1638	1.3542						
			0.3938	0.9599	1.1625	1.2106	0.8428	1.2400	1.0927	1.2850						T
			2.69	-0.76	-2.03	0.78	2.06	2.03	6.51	5.39						
			M 29	L 30	M* 31	K* 32	M* 33	L 34	M* 35	K 36						
			0.9171	1.1978	1.2411	0.8602	1.2182	1.1660	1.2490	1.0851						
			0.9314	1.2231	1.2628	0.8453	1.2059	1.1644	1.2179	1.0250						S
			-1.54	-2.07	-1.72	1.76	1.02	0.14	2.55	5.86						
			L 37	M* 38	K 39	M* 40	L 41	K* 42	K* 43	M* 44						
			0.9491	1.2395	1.0056	1.2733	1.1660	0.7940	0.7944	1.1813						
		K 45	0.9874	1.2727	1.0218	1.2524	1.1640	0.7775	0.7823	1.1392						R
		0.4151	-3.88	-2.61	-1.59	1.67	0.17	2.12	1.55	3.70						
P		0.4212														
		-1.45	M* 46	K 47	M* 48	L* 49	M* 50	K* 51	MX 52	L 53						
			1.0786	0.9981	1.2912	1.1638	1.2490	0.7944	1.0675	1.1536						
		M 54	1.1266	1.0196	1.2686	1.0910	1.2071	0.7563	1.0464	1.1333						N
		0.8130	-4.26	-2.11	1.78	6.67	3.47	5.04	2.02	1.79						
M		0.8757														
		-7.16	L 55	L* 56	K 57	M* 58	K 59	M* 60	L 61	K* 62						
			1.0972	0.9601	1.0992	1.3542	1.0851	1.1813	1.1536	0.8652						
			1.1512	1.0063	1.0771	1.2850	1.0250	1.1392	1.1333	0.8518						L
			-4.69	-4.59	2.05	5.39	5.86	3.70	1.79	1.57						
	1		2		3		4		5		6		7		9	11
														8		10

BALTIMORE
GAS AND
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JOSEPH A. TIERNAN
VICE PRESIDENT
NUCLEAR ENERGY

September 9, 1988

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 1, Docket No. 50-317
Report of Startup Testing for Unit 1 Cycle 10

Gentlemen:

Startup testing for Calvert Cliffs Unit 1 Cycle 10 was completed on July 11, 1988. A summary of the results from those tests is enclosed.

Very truly yours,

JA Tiernan

JAT/CWD/cew

Enclosure

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