

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT

UNIT 1

Docket No. 50-317

License No. DPR-53

SUMMARY OF STARTUP TESTING

FOR CYCLE SEVEN

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SUMMARY OF STARTUP TESTING FOR  
CALVERT CLIFFS UNIT ONE CYCLE SEVEN

- I. The following tests were conducted for the Startup at Calvert Cliffs Unit One Cycle Seven. All tests were conducted in a manner similar to Initial Startup (Reference 1).
  - A. CEDM/CEA Performance Test
  - B. RCS Flow Verification
  - C. Initial Criticality
  - D. CEA Symmetry Check
  - 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 CEDMs and CEA position indication was verified through insertion and withdrawal of CEAs. All CEAs reached a 90% insertion in less than 3.1 seconds at hot, full flow conditions. The slowest CEA (54) reached 90% insertion in 2.91 seconds.
  - B. Reactor Coolant Flow was verified to be consistent with previous testing.
  - C. Initial criticality was achieved at 1436 ppm Boron with CEA Group 5 at 70" withdrawn. Predicted value was 1422 ppm Boron.
  - D. The CEA Symmetry Check verified that all CEAs were attached to their extension shafts. An evaluation of the quantitative reactivity change for dual CEAs yielded an azimuthal tilt estimate of about 14% which was greater than the 10% acceptance limit. Investigation with various excor detector combinations confirmed that the asymmetric excor

detector configuration used for this measurement was the cause of the apparent tilt. When a symmetric detector configuration was used, the tilt for a subgroup of peripheral CEAs decreased from about 14% to about 5%. For confirmation, the tilt was remeasured at about 18% power with the incore detector system and found to be about 3%.

E. Critical Boron Measurements - 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 and 2.

III. All tests were within acceptance limits.

**TABLE 1**  
**CRITICAL BORON MEASUREMENTS**

	<u>Measured</u>	<u>Predicted</u>
All Rods Out, 532°F CEA Group's	1466 ppm	1449 ± 100 ppm
Inserted 5,4,3,2,1	1195 ppm	1167 ± 100 ppm

**TABLE 2**  
**ISOTHERMAL TEMPERATURE COEFFICIENTS AND POWER COEFFICIENTS**

	<u>Measured</u>	<u>ITC</u> <u>Predicted</u>
Zero Power, CEA Group 5 at All Rods Out	+0.245 x 10 <sup>-4</sup> delta Rho/°F	+0.18 ± 0.3 x 10 <sup>-4</sup> delta Rho/°F
50% Power, CEA Group 5 at 105" Withdrawn	-0.153 x 10 <sup>-4</sup> delta Rho/°F	-0.07 ± 0.3 x 10 <sup>-4</sup> delta Rho/°F
100% Power, CEA Group 5 at 105" Withdrawn	-0.393 x 10 <sup>-4</sup> delta Rho/°F	-0.33 ± 0.3 x 10 <sup>-4</sup> delta Rho/°F

**POWER COEFFICIENT**

50% Power, CEA Group 5 at 105" Withdrawn	-1.128 x 10 <sup>-4</sup> delta Rho/% Power	-0.99 ± 0.3 x 10 <sup>-4</sup> delta Rho/% Power
100% Power, CEA Group 5 at 105" Withdrawn	-0.932 x 10 <sup>-4</sup> delta Rho/% Power	-0.88 ± 0.3 x 10 <sup>-4</sup> delta Rho/% Power

**TABLE 3**  
**CEA GROUP WORTH MEASUREMENTS**

	<u>Measured</u> <u>(% delta Rho)</u>	<u>Predicted</u> <u>(% delta Rho)</u>
Group 5	0.542	$0.537 \pm 0.081$
Group 4	0.200	$0.201 \pm 0.030$
Group 3	0.792	$0.754 \pm 0.113$
Group 2	0.418	$0.435 \pm 0.065$
Group 1	<u>0.790</u>	<u><math>0.825 \pm 0.124</math></u>
TOTAL	2.742	$2.752 \pm .275$

**TABLE 4**  
**POWER DISTRIBUTION MEASUREMENTS**

	<u>50% Power</u>		<u>100% Power</u>	
	<u>Measured</u>	<u>Acceptance</u> <u>Limits</u>	<u>Measured</u>	<u>Acceptance</u> <u>Limits</u>
$F_{xy}^T$	1.7699	$< 1.785$	1.6860	$< 1.700$
$F_r^T$	1.6112	$< 1.720$	1.5370	$< 1.650$
$T_q$	0.0142	$< 0.030$	0.0144	$< 0.030$

# ASSEMBLY RELATIVE POWER DENSITY FOR 50% POWER

UNIT 1 CYCLE 7

PREDICTED: 50% POWER, EQUILIBRIUM XENON, BANK 5 @ 105 IN. WITHDRAWN, 40MWD/T

MEASURED: 51.3% POWER, EQUILIBRIUM XENON, BANK 5 @ 105.0 IN. WITHDRAWN, 57.5MWD/T

MEASURED  
PREDICTED  
% DIFF.

J 1 J 2  
0.7937 0.9881  
0.7900 1.0300  
0.47 -4.07

Y

% DIFF. = MEASURED-PREDICTED X100  
PREDICTED

J 3 J 4 J 5 F 6 H 7  
0.8012 1.0827 1.2440 0.7855 1.1158  
0.8200 1.1000 1.2400 0.7900 1.1000  
-2.29 -1.57 0.32 -0.57 1.44

X

J 8 H 9 D/ 10 H/ 11 G 12 H/ 13  
0.9482 1.1194 0.8261 1.0832 0.8830 0.9474  
0.9700 1.1200 0.8400 1.0600 0.8700 0.9400  
-2.25 -0.05 -1.65 2.19 1.49 0.79

W

J 14 J\* 15 G 16 H 17 G 18 J\* 19 E/ 20  
0.9482 1.2776 0.9930 1.2861 0.9733 1.2734 0.7923  
0.9700 1.3200 1.0200 1.2600 0.9800 1.2800 0.7900  
-2.25 -3.21 -2.65 2.07 -0.68 -0.52 0.29

V

J 21 H 22 G 23 H/ 24 G 25 H 26 G 27 H 28  
0.8012 1.1194 0.9930 1.1311 1.0403 1.0521 0.8849 1.1521  
0.8200 1.1200 1.0200 1.1400 1.0200 1.0500 0.9100 1.1300  
-2.29 -0.05 -2.65 -0.78 1.99 0.20 -2.76 1.96

T

J 29 D/ 30 H 31 G 32 H 33 B 34 H 35 B 36  
1.0827 0.8261 1.2861 1.0403 1.2215 0.8107 1.0988 0.8555  
1.1000 0.8400 1.2700 1.0200 1.1900 0.8400 1.1000 0.8500  
-1.57 -1.65 1.27 1.99 2.65 -3.49 -0.11 0.65

S

J 37 H/ 38 G 39 H/ 40 B 41 J\* 42 E/ 43 H 44  
1.2440 1.0832 0.9733 1.0521 0.8107 1.1941 0.7394 1.1156  
J 45 1.2400 1.0700 0.9800 1.0500 0.8400 1.1800 0.7200 1.0500  
0.7937 0.32 1.23 -0.68 0.20 -3.49 1.19 2.69 6.25

R

P

0.7800  
1.76

D/ 46 GX 47 J\* 48 G 49 H 50 E/ 51 H/ 52 H/ 53  
0.7855 0.8830 1.2734 0.8849 1.0988 0.7394 0.9489 0.9230  
J 54 0.7700 0.8700 1.2800 0.9100 1.1000 0.7300 0.8900 0.8800  
0.9881 2.01 1.49 -0.52\* -2.76 -0.11 1.29 6.62 4.89

N

M

1.0300  
-4.07

H 55 H/ 56 E/ 57 H 58 B 59 H 60 H/ 61 F 62  
1.1158 0.9474 0.7923 1.1521 0.8555 1.1156 0.9230 0.5423  
1.1000 0.9400 0.7900 1.1300 0.8500 1.0500 0.8800 0.5400  
1.44 0.79 0.29 1.96 0.65 6.25 4.89 0.43

L

1 2 3 4 5 6 7 8 9 10 11

TABLE 4 FIGURE 1

# ASSEMBLY RELATIVE POWER DENSITY FOR 100% POWER

UNIT 1 CYCLE 7

PREDICTED: 100% POWER, EQUILIBRIUM XENON, BANK 5 @ 105 IN. WITHDRAWN, 250MWD/T

MEASURED: 96.8% POWER, EQUILIBRIUM XENON, BANK 5 @ 107.1 IN. WITHDRAWN, 195.9MWD/T

MEASURED  
PREDICTED  
% DIFF.

J 1 J 2  
0.7404 0.9396  
0.7400 0.9600  
0.05 -2.12

Y

% DIFF. = MEASURED-PREDICTED X100  
PREDICTED

J 3 J 4 J 5 F 6 H 7  
0.7688 1.0423 1.1871 0.7617 1.1247  
0.7700 1.0300 1.1700 0.7700 1.0600 X  
-0.16 1.19 1.46 -1.08 6.10

J 8 H 9 D/ 10 H/ 11 G 12 H/ 13  
0.9059 1.0843 0.8113 1.0620 0.8767 0.9610  
0.9100 1.0700 0.8200 1.0500 0.8700 0.9500 W  
-0.45 1.34 -1.06 1.14 0.77 1.16

J 14 J\* 15 G 16 H 17 G 18 J\* 19 E/ 20  
0.9059 1.2473 0.9735 1.2742 0.9765 1.2862 0.8110  
0.9100 1.2500 1.0000 1.2500 0.9900 1.2600 0.8200 V  
-0.45 -0.22 -2.65 1.94 -1.36 0.48 -1.10

J 21 H 22 G 23 H/ 24 G 25 H 26 G 27 H 28  
0.7688 1.0843 0.9735 1.1270 1.0408 1.0708 0.9069 1.1882  
0.7700 1.0700 1.0000 1.1400 1.0400 1.0800 0.9500 1.1800 T  
-0.16 1.34 -2.65 -1.14 0.08 -0.85 -4.54 0.69

J 29 D/ 30 H 31 G 32 H 33 B 34 H 35 B 36  
1.0423 0.8113 1.2742 1.0408 1.2476 0.8534 1.1508 0.9061  
1.0400 0.8200 1.2500 1.0400 1.2300 0.9000 1.1600 0.9100 S  
0.22 -1.06 1.94 0.08 1.43 -5.18 -0.79 -0.43

J 37 H/ 38 G 39 H/ 40 B 41 J\* 42 E/ 43 H 44  
1.1871 1.0620 0.9765 1.0708 0.8534 1.2666 0.7920 1.1907  
J 45 1.1700 1.0500 0.9900 1.0900 0.8900 1.2500 0.7800 1.1300 R  
0.7404 1.46 1.14 -1.36 -1.76 -4.11 1.33 1.54 5.37  
0.7400

P

0.05

D/ 46 GX 47 J\* 48 G 49 H 50 E/ 51 H/ 52 H/ 53  
0.7617 0.8767 1.2862 0.9069 1.1508 0.7920 1.0185 0.9926  
J 54 0.7500 0.8700 1.2900 0.9500 1.1700 0.7900 0.9800 0.9700 N  
0.9396 1.56 0.77 -0.29 -4.54 -1.64 0.25 3.93 2.33  
0.9600

M

-2.12

H 55 H/ 56 E/ 57 H 58 B 59 H 60 H/ 61 F 62  
1.1247 0.9610 0.8110 1.1882 0.9061 1.1907 0.9926 0.5946  
1.0600 0.9500 0.8200 1.1800 0.9100 1.1300 0.9700 0.6000 L  
6.10 1.16 -1.10 0.69 -0.43 5.37 2.33 -0.90

1

2

3

4

5

6

7

8

9

10

11

TABLE 4 FIGURE 2

## REFERENCES

1. Calvert Cliffs Nuclear Power Plant Unit 1 Startup Test Report, August 29, 1975.