DONALD C. COOK NUCLEAR PLANT UNIT 1 CYCLE 14
CORE OPERATING LIMITS REPORT

Revision 3

March 1994

COLR for DONALD C. COOK NUCLEAR PLANT UNIT 1 CYCLE 14

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for Donald C. Cook Nuclear Plant Unit 1 Cycle 14 has been prepared in accordance with the requirements of Technical Specification 6.9.1.11.

The Technical Specifications affected by this report are listed below:

3/4.1.1.4	Moderator Temperature Coefficient
3/4.1.3.1	Movable Control Assemblies Group Height
3/4.1.3.3	Rod Drop Time
3/4.1.3.4	Shutdown Rod Insertion Limits
3/4.1.3.5	Control Rod Insertion Limits
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor
3/4.2.3	Nuclear Enthalpy Hot Channel Factor
3/4.2.6	Allowable Power Level

2.0 OPERATING LIMITS

The cycle-specific parameter limits for the specifications listed in Section 1.0 are presented in the following subsections. These limits have been developed using the NRC-approved methodologies specified in Technical Specification 6.9.1.11.

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.4)

2.1.1 The Moderator Temperature Coefficient (MTC) Limits are:

The BOL/ARO-MTC shall be less positive than the value given in Figure 1.

The EOL/ARO/RTP-MTC shall be less negative than -4.54E-4 $\Delta k/k/^{o}F$.

This limit is based on a T_{avg} program with HFP T_{avg} of $553^{o}F$

where: ARO stands for All Rods Out
BOL stands for Beginning of Cycle Life
EOL stands for End of Cycle Life
RTP stands for Rated Thermal Power
HFP stands for Hot Full Thermal Power

2.1.2 The MTC Surveillance limit is:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to -3.84E-4 $\Delta k/k/^{o}F$ at a vessel average temperature of $553^{o}F$.

2.2 Rod Drop Time Drop Height (Specification 3/4.1.3.3)

2.2.1 All rods shall be dropped from 231 steps.

2.3 Shutdown Rod Insertion Limit (Specification 3/4.1.3.4)

2.3.1 The shutdown rods shall be withdrawn to 231 steps.

2.4 Control Rod Insertion Limits (Specifications 3/4.1.3.5 and 3/4.1.3.1)

2.4.1 The control rod banks shall be limited in physical insertion as shown in Figure 2.

2.4.2 Successive Control Banks shall overlap by 103 steps. The sequence for Control Bank withdrawal shall be Control Bank A, Control Bank B, Control Bank C, and Control Bank D.

2.5 Axial Flux Difference (Specification 3/4.2.1)

2.5.1 The Allowable Operation Limits are provided in Figure 3.

2.5.2 The AXIAL FLUX DIFFERENCE (AFD) target band during base load operations is +3%, -3% (not applicable for this cycle).

2.5.3 The AFD target band is +5%, -5% for a cycle average accumulated burnup $\geq$ 0.0 MWD/MTU.

2.6 Heat Flux Hot Channel Factor - $F_Q(Z)$ (Specification 3.2.2)

$$F_Q(Z) \leq \frac{CFQ}{P} * K(Z) \qquad \text{for } P > 0.5$$

$$F_Q(Z) \leq 2 * CFQ * K(Z) \qquad \text{for } P \leq 0.5$$

where: $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

2.6.1 CFQ= 2.15 for Westinghouse fuel

2.6.2 K(Z) is provided in Figure 4 for Westinghouse fuel

2.7 Nuclear Enthalpy Rise Hot Channel Factor - $F^N_{\Delta H}$
(Specification 3/4.2.3)

$$F^N_{\Delta H} \leq CFDH * (1 + PFDH * (1-P))$$

$$\text{where: } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

2.7.1 CFDH = 1.49 for Westinghouse fuel

2.7.2 PFDH = 0.3

2.8 Allowable Power Level - APL (Specification 3.2.6)

$$\text{APL-min over Z for } \frac{CFQ * K(Z)}{F_Q(Z) * V(Z) * F_P}$$

2.8.1 V(Z) is provided in Table 1 for ± 5% AFD target band

2.8.2 CFQ and K(Z) are provided in COLR Sections 2.6.1 and 2.6.2, respectively

2.8.3 F_P is provided in Technical Specification 3.2.6

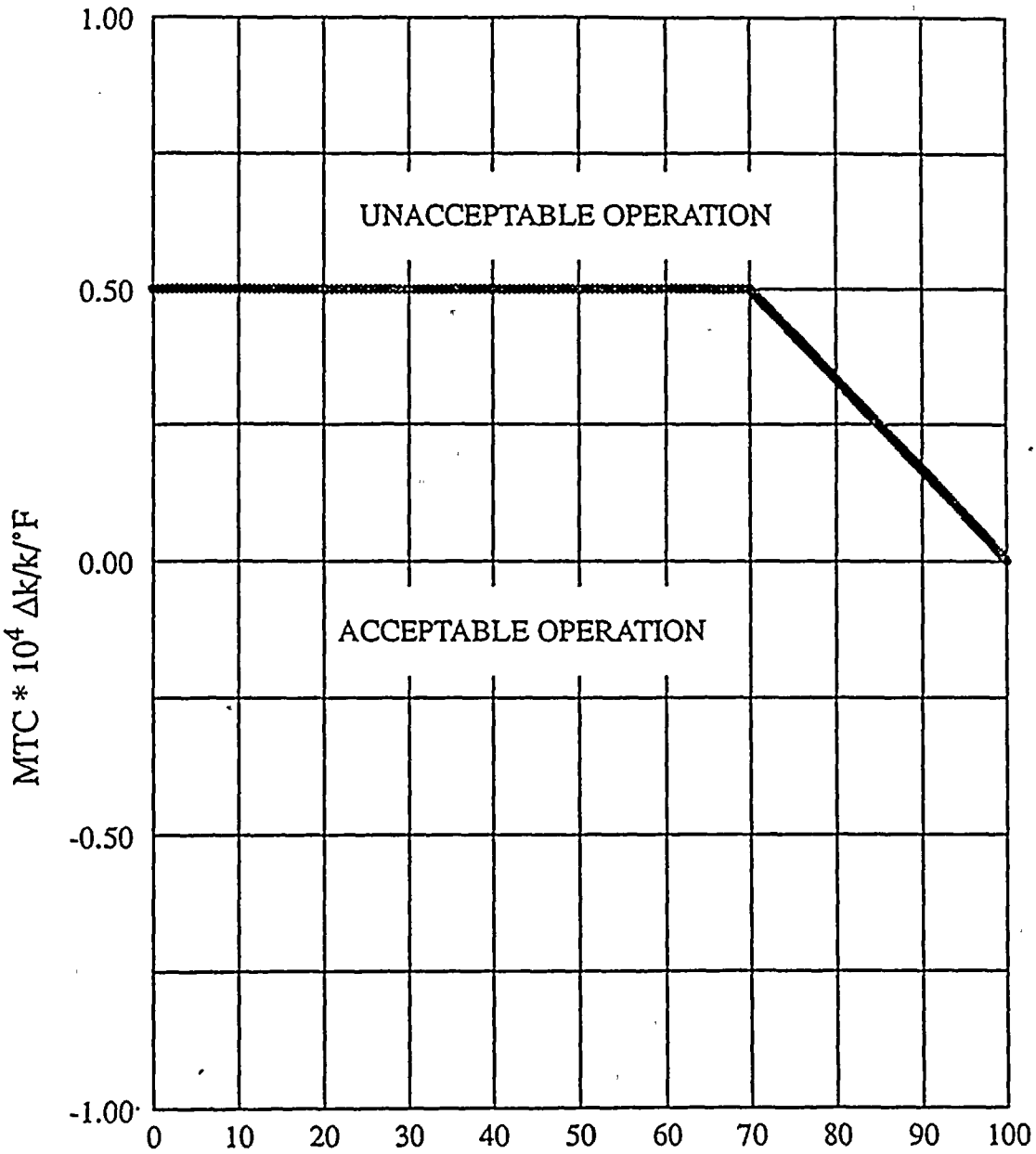
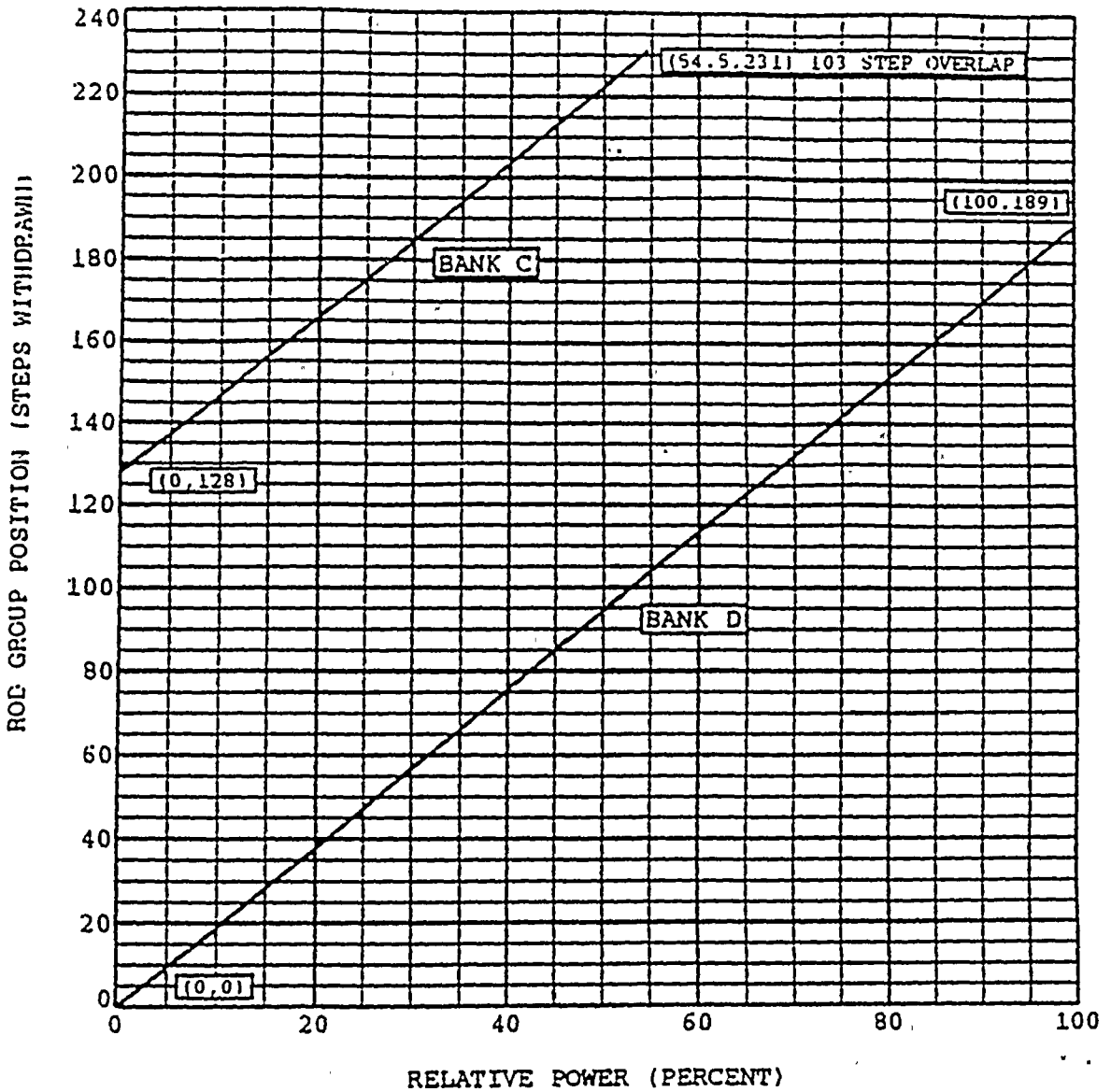


FIGURE 1

MODERATOR TEMPERATURE COEFFICIENT (MTC)



D Bank

$$RIL = (1.89)(\%\ Power) + 0$$

C Bank

$$RIL = (1.89)(\%\ Power) + 128$$

FIGURE 2

ROD BANK INSERTION LIMITS VERSUS
THERMAL POWER FOUR-LOOP OPERATION

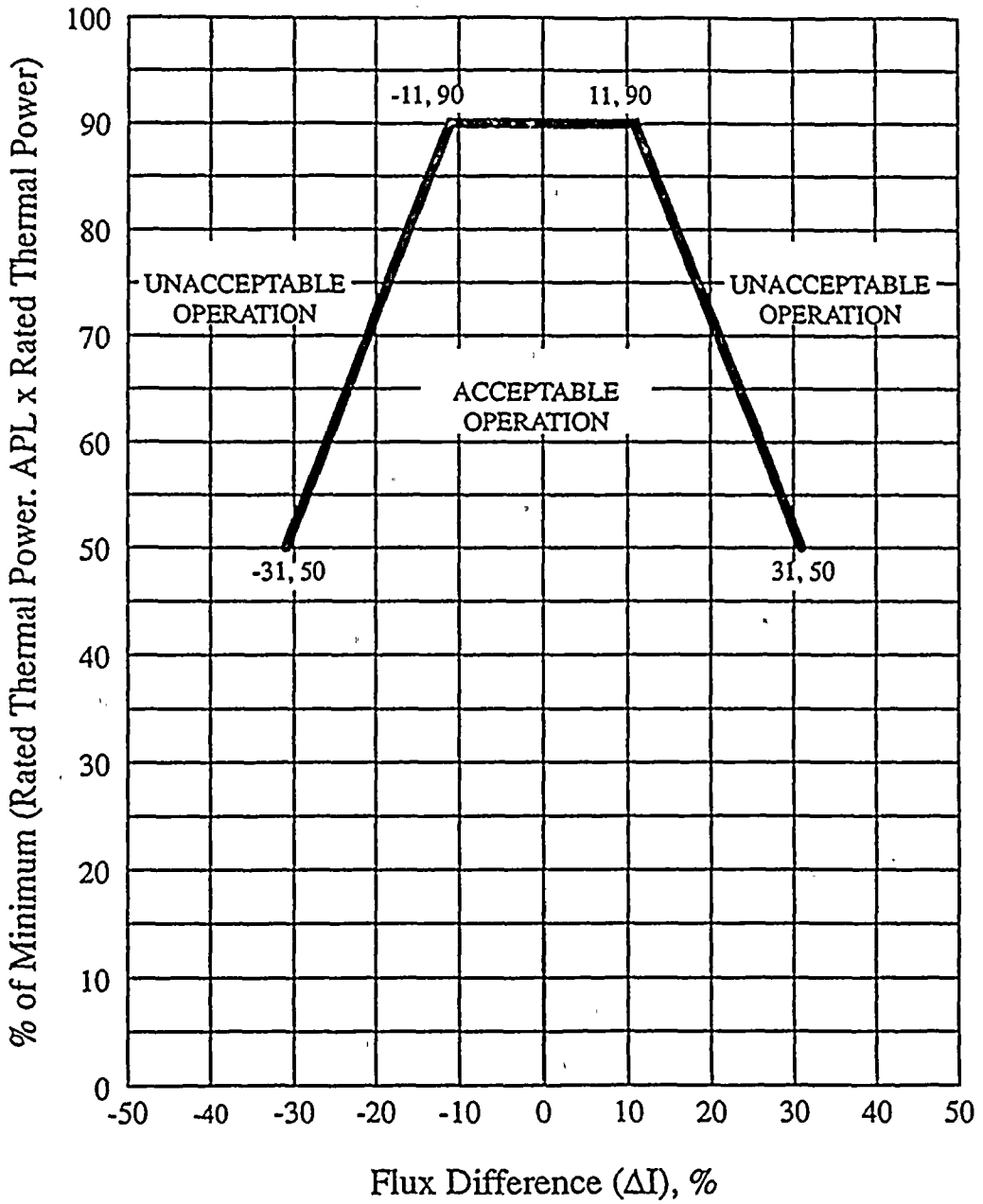


FIGURE 3

AXIAL FLUX DIFFERENCE LIMITS
AS A FUNCTION OF RATED THERMAL POWER

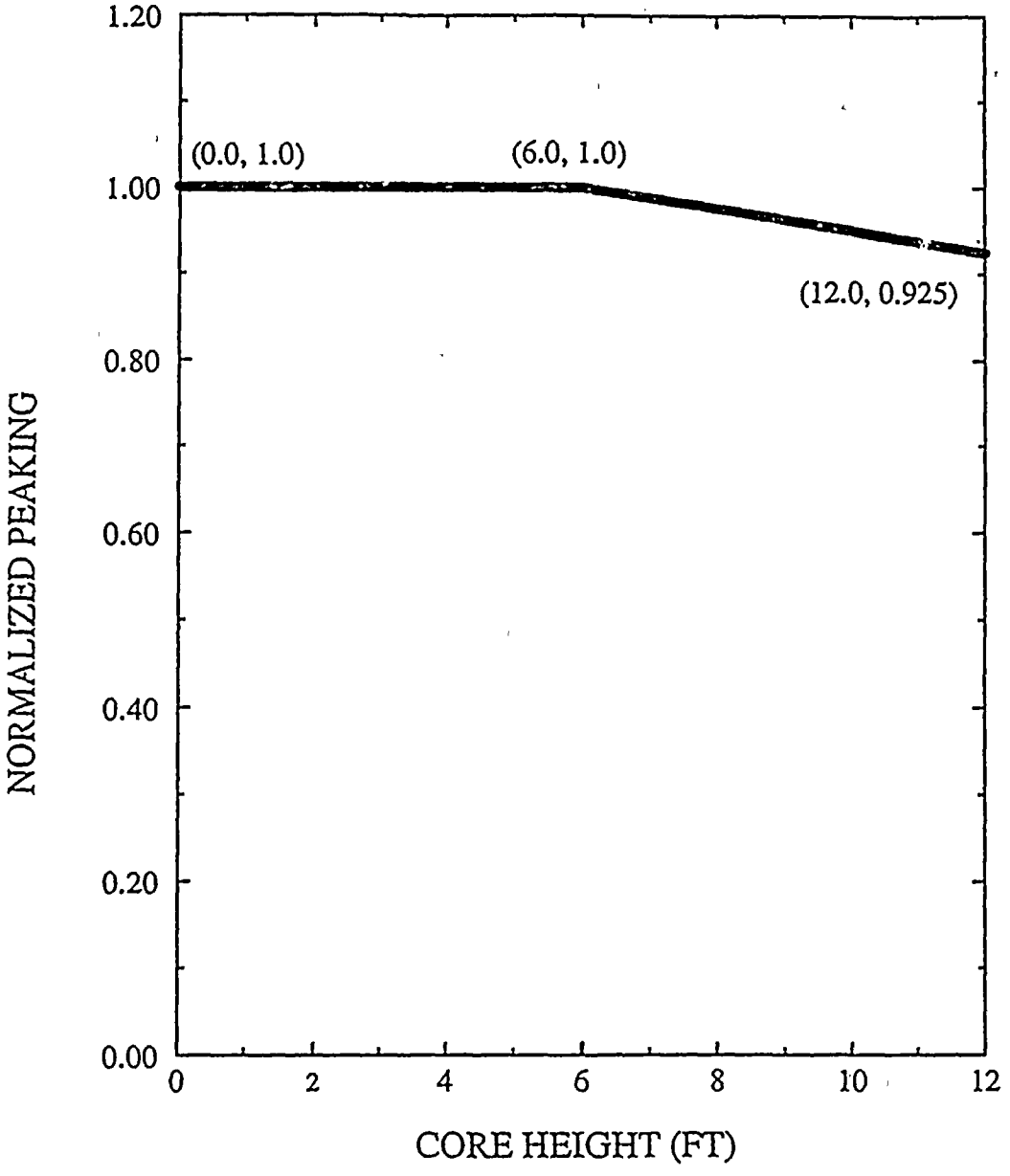


FIGURE 4

K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION

OF CORE HEIGHT FOR WESTINGHOUSE FUEL

MESH NO.	AXIAL ELEV. (FT)	BURNUP RANGES (MWD/MT) 0 150	150 1000	1000 2000	2000 4000	4000 6000	6000 8000	8000 10000	10000 12000	12000 14000	14000 EOL
1.	0.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2.	0.2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3.	0.4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4.	0.6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5.	0.8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6.	1.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7.	1.2	1.0973	1.0973	1.0922	1.0921	1.1007	1.1105	1.1182	1.1260	1.1356	1.1356
8.	1.4	1.0977	1.0977	1.0926	1.0928	1.1008	1.1100	1.1171	1.1242	1.1329	1.1329
9.	1.6	1.0980	1.0980	1.0929	1.0933	1.1007	1.1091	1.1154	1.1218	1.1296	1.1296
10.	1.8	1.0982	1.0982	1.0930	1.0936	1.1004	1.1078	1.1133	1.1188	1.1256	1.1256
11.	2.0	1.0982	1.0982	1.0929	1.0937	1.0997	1.1060	1.1107	1.1153	1.1210	1.1210
12.	2.2	1.0980	1.0980	1.0927	1.0935	1.0988	1.1039	1.1076	1.1113	1.1158	1.1158
13.	2.4	1.0976	1.0976	1.0923	1.0931	1.0974	1.1013	1.1041	1.1068	1.1100	1.1100
14.	2.6	1.0969	1.0969	1.0917	1.0926	1.0958	1.0984	1.1002	1.1018	1.1038	1.1038
15.	2.8	1.0960	1.0960	1.0909	1.0918	1.0939	1.0952	1.0960	1.0965	1.0972	1.0972
16.	3.0	1.0950	1.0950	1.0897	1.0907	1.0918	1.0917	1.0916	1.0912	1.0906	1.0899
17.	3.2	1.0937	1.0937	1.0890	1.0894	1.0896	1.0892	1.0878	1.0868	1.0862	1.0862
18.	3.4	1.0925	1.0925	1.0884	1.0884	1.0877	1.0868	1.0851	1.0859	1.0895	1.0895
19.	3.6	1.0918	1.0918	1.0878	1.0878	1.0869	1.0851	1.0874	1.0908	1.0955	1.0955
20.	3.8	1.0912	1.0912	1.0868	1.0868	1.0858	1.0877	1.0912	1.0958	1.1014	1.1014
21.	4.0	1.0908	1.0908	1.0859	1.0859	1.0855	1.0908	1.0949	1.1003	1.1069	1.1069
22.	4.2	1.0909	1.0909	1.0854	1.0854	1.0869	1.0935	1.0984	1.1047	1.1121	1.1121
23.	4.4	1.0912	1.0912	1.0851	1.0848	1.0887	1.0961	1.1017	1.1086	1.1167	1.1167
24.	4.6	1.0913	1.0913	1.0852	1.0847	1.0902	1.0985	1.1046	1.1122	1.1209	1.1209
25.	4.8	1.0913	1.0913	1.0853	1.0847	1.0915	1.1005	1.1071	1.1152	1.1244	1.1244
26.	5.0	1.0911	1.0911	1.0853	1.0844	1.0926	1.1021	1.1091	1.1177	1.1271	1.1271
27.	5.2	1.0908	1.0908	1.0850	1.0844	1.0933	1.1033	1.1107	1.1195	1.1292	1.1292
28.	5.4	1.0902	1.0902	1.0843	1.0847	1.0937	1.1040	1.1116	1.1207	1.1304	1.1304
29.	5.6	1.0894	1.0894	1.0834	1.0847	1.0936	1.1042	1.1119	1.1211	1.1307	1.1307
30.	5.8	1.0882	1.0882	1.0831	1.0843	1.0931	1.1037	1.1115	1.1207	1.1301	1.1301
31.	6.0	1.0865	1.0865	1.0829	1.0835	1.0921	1.1027	1.1104	1.1195	1.1285	1.1285
32.	6.2	1.0848	1.0848	1.0823	1.0823	1.0905	1.1009	1.1085	1.1174	1.1260	1.1260
33.	6.4	1.0837	1.0837	1.0813	1.0806	1.0884	1.0985	1.1058	1.1143	1.1224	1.1224
34.	6.6	1.0827	1.0827	1.0797	1.0783	1.0856	1.0953	1.1023	1.1104	1.1178	1.1178
35.	6.8	1.0811	1.0811	1.0773	1.0753	1.0817	1.0909	1.0978	1.1055	1.1122	1.1122
36.	7.0	1.0793	1.0793	1.0751	1.0729	1.0796	1.0879	1.0932	1.0993	1.1056	1.1056
37.	7.2	1.0783	1.0783	1.0738	1.0717	1.0789	1.0861	1.0896	1.0934	1.0979	1.0979
38.	7.4	1.0778	1.0778	1.0729	1.0709	1.0771	1.0835	1.0863	1.0889	1.0892	1.0892
39.	7.6	1.0765	1.0765	1.0712	1.0693	1.0748	1.0802	1.0821	1.0837	1.0837	1.0795
40.	7.8	1.0746	1.0746	1.0689	1.0670	1.0717	1.0761	1.0774	1.0780	1.0780	1.0688
41.	8.0	1.0721	1.0721	1.0658	1.0642	1.0681	1.0713	1.0713	1.0710	1.0697	1.0651
42.	8.2	1.0688	1.0688	1.0619	1.0600	1.0629	1.0656	1.0667	1.0668	1.0695	1.0695
43.	8.4	1.0648	1.0648	1.0573	1.0562	1.0584	1.0624	1.0691	1.0747	1.0764	1.0764
44.	8.6	1.0614	1.0614	1.0559	1.0579	1.0615	1.0675	1.0750	1.0810	1.0830	1.0830
45.	8.8	1.0637	1.0637	1.0591	1.0614	1.0659	1.0730	1.0811	1.0871	1.0893	1.0893
46.	9.0	1.0677	1.0677	1.0621	1.0649	1.0699	1.0777	1.0868	1.0932	1.0954	1.0954
47.	9.2	1.0708	1.0708	1.0652	1.0684	1.0739	1.0827	1.0924	1.0989	1.1012	1.1012
48.	9.4	1.0741	1.0741	1.0682	1.0717	1.0778	1.0873	1.0977	1.1043	1.1070	1.1070
49.	9.6	1.0772	1.0772	1.0714	1.0749	1.0815	1.0918	1.1028	1.1094	1.1122	1.1122
50.	9.8	1.0804	1.0804	1.0746	1.0780	1.0850	1.0960	1.1075	1.1139	1.1169	1.1169
51.	10.0	1.0836	1.0836	1.0779	1.0809	1.0883	1.0998	1.1118	1.1180	1.1211	1.1211
52.	10.2	1.0866	1.0866	1.0811	1.0835	1.0913	1.1033	1.1157	1.1213	1.1247	1.1247
53.	10.4	1.0894	1.0894	1.0841	1.0859	1.0939	1.1064	1.1191	1.1242	1.1280	1.1280
54.	10.6	1.0918	1.0918	1.0867	1.0879	1.0962	1.1090	1.1220	1.1278	1.1312	1.1312
55.	10.8	1.0939	1.0939	1.0889	1.0898	1.0981	1.1111	1.1243	1.1309	1.1342	1.1342
56.	11.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
57.	11.2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
58.	11.4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
59.	11.6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
60.	11.8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
61.	12.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Top and bottom 10% of core are excluded as per Technical Specifications.

TABLE 1

DONALD C. COOK UNIT 1 CYCLE 14
V(Z) FUNCTION