

DONALD G. COOK NUCLEAR PLANT UNIT 1 CYCLE 15

CORE OPERATING LIMITS REPORT

Revision 4

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COLR for DONALD C. COOK NUCLEAR PLANT UNIT 1 CYCLE 15

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for Donald C. Cook Nuclear Plant Unit 1 Cycle 15 has been prepared in accordance with the requirements of Technical Specification 6.9.1.9.

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

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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 $-4.54\text{E-}4 \Delta\text{k/k/}^{\circ}\text{F}$.

This limit is based on a T_{avg} program with HFP
 T_{avg} of 553°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 $-3.84\text{E-}4 \Delta\text{k/k/}^{\circ}\text{F}$ at a vessel average temperature of 553°F .



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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2.3.1 The shutdown rods shall be withdrawn to 231 steps.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 ≥ 0.0 MWD/MTU.

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

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

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

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

2.6.1 CFQ- 2.15 for Westinghouse fuel

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

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

$$F_{\Delta H}^N \leq \text{CFDH} * (1 + \text{PFDH} * (1-P))$$

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

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2.8 Allowable Power Level - APL (Specification 3.2.6)

$$\text{APL-min over Z for } \frac{\text{CFQ} * \text{K(Z)}}{\text{F}_Q(\text{Z}) * \text{V(Z)} * \text{F}_p}$$

2.8.1 V(Z) is provided in Table 1 for $\pm 5\%$ 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

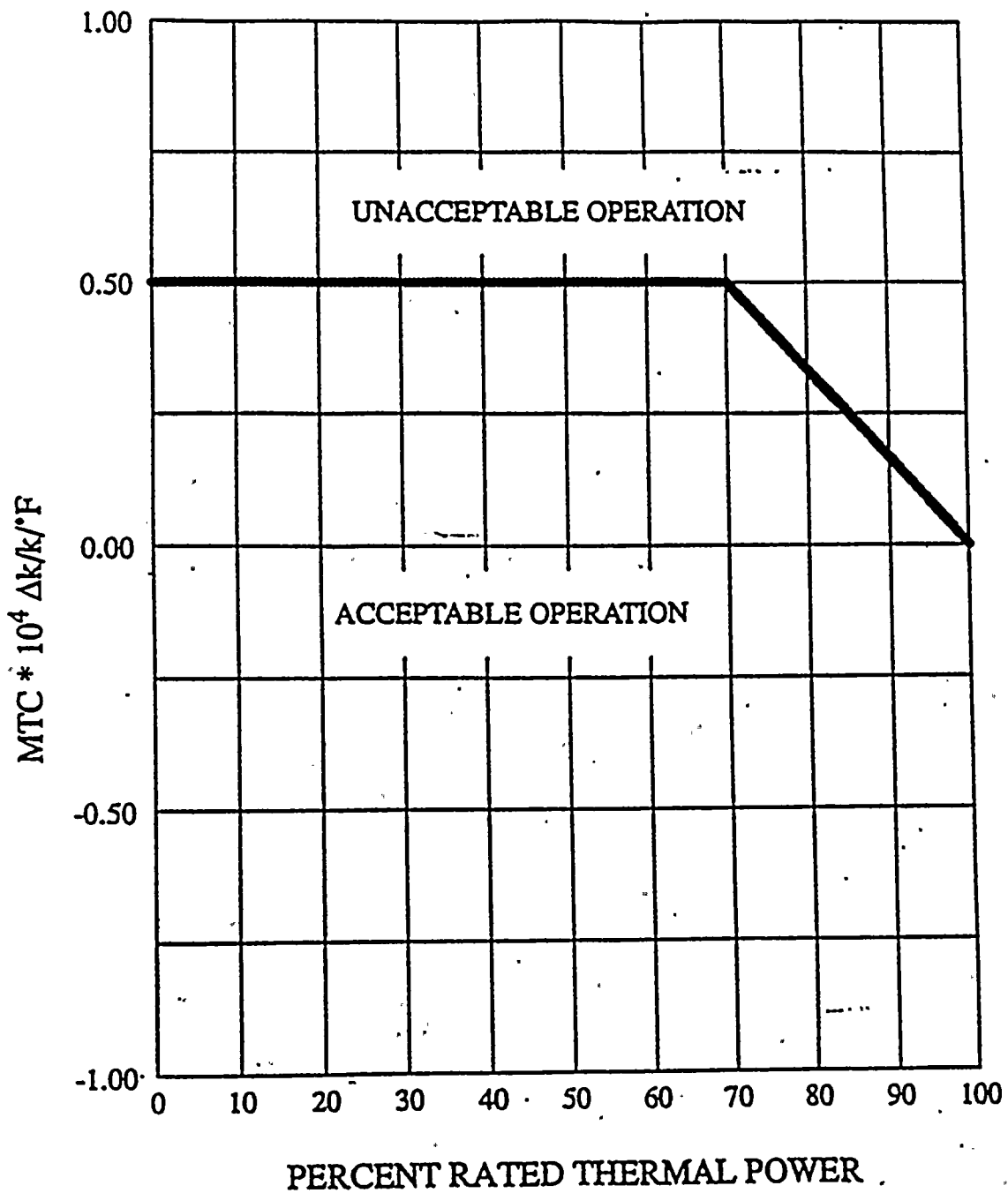
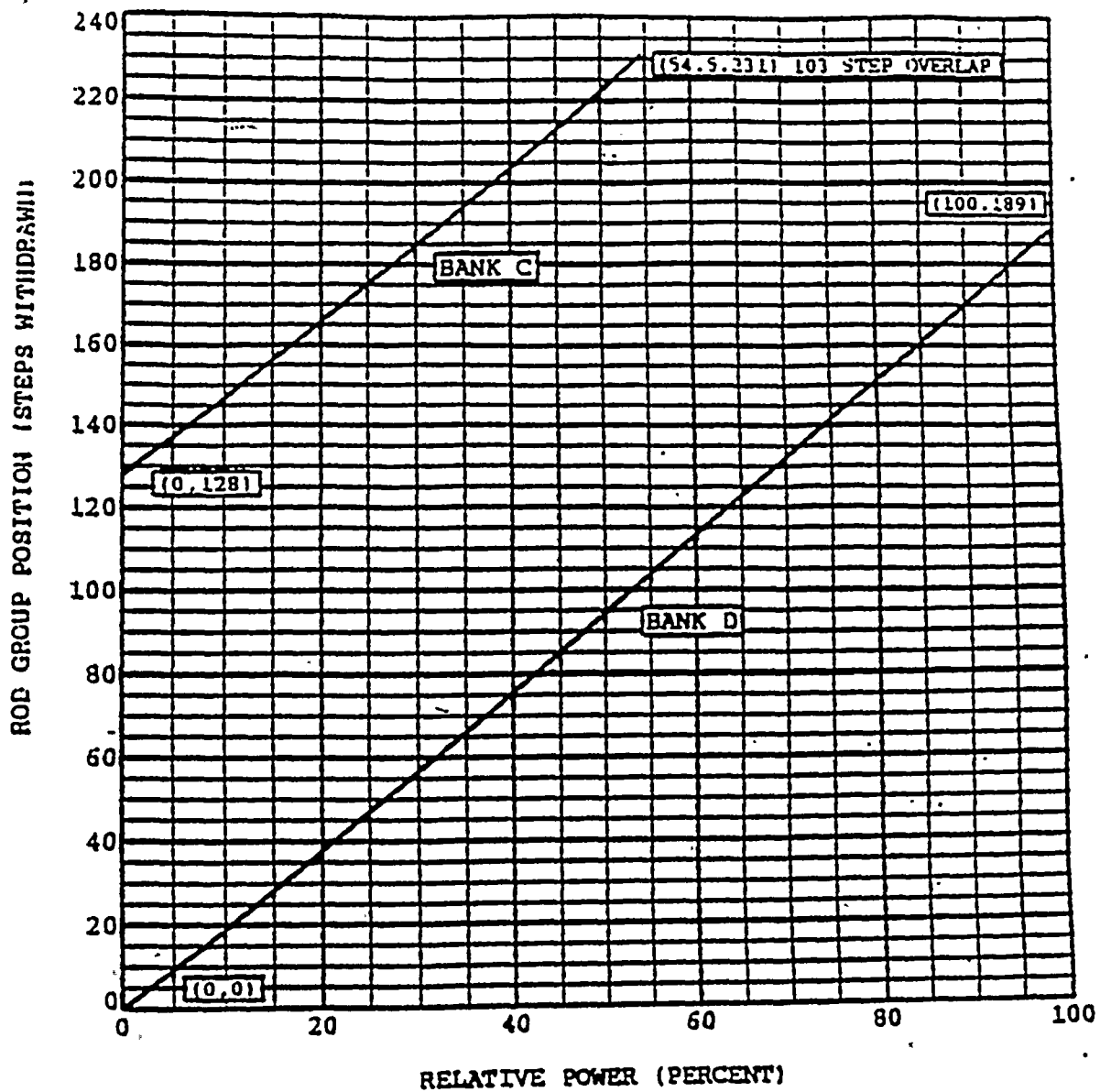


FIGURE 1

MODERATOR TEMPERATURE COEFFICIENT (MTC)



D Bank
 $RIL = (1.89)(\% \text{ Power}) + 0$
 C Bank
 $RIL = (1.89)(\% \text{ Power}) + 128$

FIGURE 2
 ROD BANK INSERTION LIMITS VERSUS
 THERMAL POWER FOUR-LOOP OPERATION

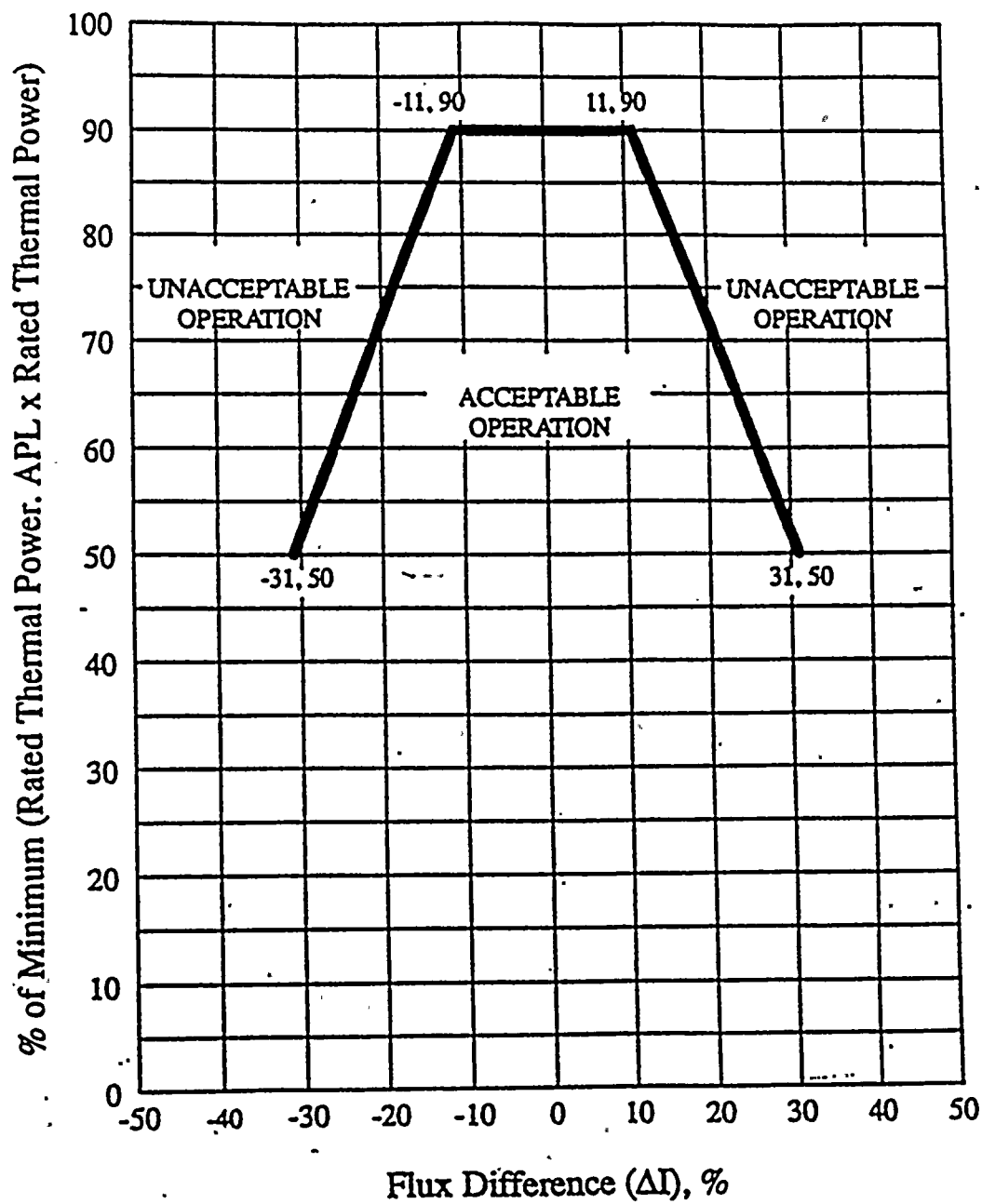


FIGURE 3

AXIAL FLUX DIFFERENCE LIMITS
AS A FUNCTION OF RATED THERMAL POWER

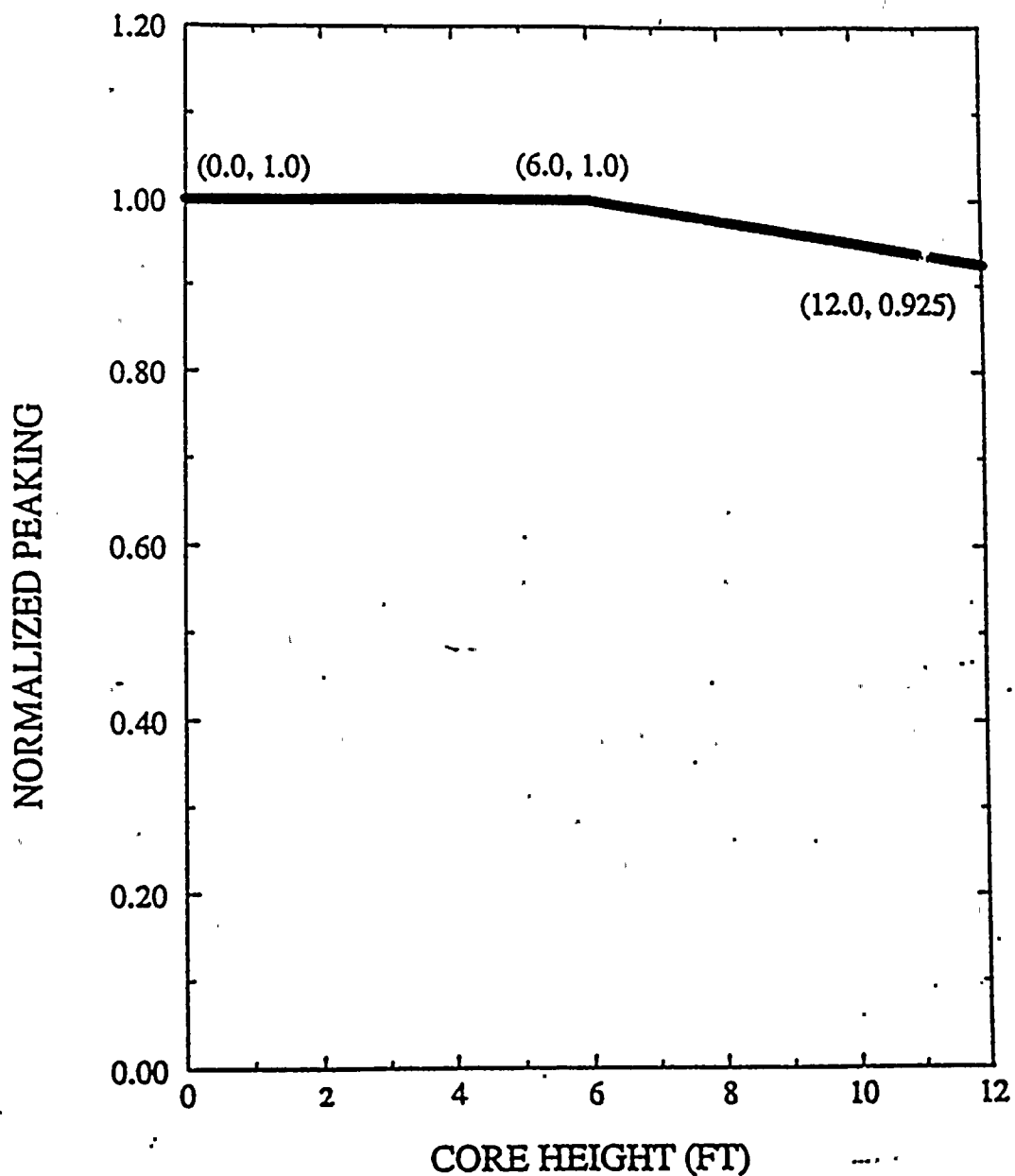


FIGURE 4

$K(Z)$ - NORMALIZED $F_q(Z)$ AS A FUNCTION
OF CORE HEIGHT FOR WESTINGHOUSE FUEL

HOLE NO	AXIAL ELEV. (FT)	Burnup Ranges (MW/MTU)									
		0 150	150 1000	1000 2000	2000 4000	4000 6000	6000 8000	8000 10000	10000 12000	12000 14000	14000 EOL
1.	0.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2.	0.20	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3.	0.40	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4.	0.60	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5.	0.80	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6.	1.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7.	1.20	1.1120	1.1120	1.1118	1.1115	1.1110	1.1105	1.1100	1.1095	1.1090	1.1085
8.	1.40	1.1104	1.1104	1.1103	1.1101	1.1099	1.1096	1.1093	1.1090	1.1087	1.1084
9.	1.60	1.1084	1.1084	1.1084	1.1084	1.1084	1.1084	1.1084	1.1084	1.1084	1.1084
10.	1.80	1.1061	1.1062	1.1064	1.1066	1.1068	1.1071	1.1074	1.1077	1.1080	1.1082
11.	2.00	1.1035	1.1037	1.1039	1.1044	1.1049	1.1054	1.1059	1.1064	1.1069	1.1074
12.	2.20	1.1004	1.1007	1.1011	1.1018	1.1025	1.1033	1.1041	1.1049	1.1057	1.1065
13.	2.40	1.0971	1.0975	1.0980	1.0990	1.1000	1.1009	1.1017	1.1025	1.1033	1.1041
14.	2.60	1.0935	1.0940	1.0945	1.0958	1.0972	1.0988	1.1006	1.1025	1.1046	1.1066
15.	2.80	1.0897	1.0907	1.0918	1.0938	1.0955	1.0988	1.1027	1.1074	1.1129	1.1184
16.	3.00	1.0855	1.0871	1.0888	1.0914	1.0933	1.0964	1.1006	1.1057	1.1116	1.1174
17.	3.20	1.0818	1.0833	1.0869	1.0895	1.0923	1.0962	1.1016	1.1074	1.1139	1.1204
18.	3.40	1.0847	1.0856	1.0866	1.0884	1.0898	1.0909	1.0917	1.0921	1.0923	1.0923
19.	3.60	1.0892	1.0893	1.0894	1.0896	1.0898	1.0900	1.0903	1.0906	1.0909	1.0912
20.	3.80	1.0937	1.0937	1.0928	1.0928	1.0918	1.0908	1.0897	1.1043	1.1156	1.1256
21.	4.00	1.0978	1.0978	1.0939	1.0940	1.0940	1.0920	1.0901	1.1104	1.1267	1.1427
22.	4.20	1.1018	1.1018	1.0968	1.0966	1.0966	1.0939	1.1014	1.1169	1.1376	1.1576
23.	4.40	1.1055	1.1055	1.0997	1.0997	1.0997	1.0966	1.1057	1.1238	1.1480	1.1740
24.	4.60	1.1089	1.1089	1.1023	1.1024	1.1024	1.0991	1.1095	1.1302	1.1577	1.1877
25.	4.80	1.1118	1.1118	1.1046	1.1048	1.1048	1.1012	1.1129	1.1360	1.1667	1.1967
26.	5.00	1.1143	1.1143	1.1065	1.1069	1.1069	1.1030	1.1160	1.1412	1.1747	1.2047
27.	5.20	1.1163	1.1163	1.1126	1.1126	1.1085	1.1045	1.1185	1.1456	1.1816	1.2116
28.	5.40	1.1178	1.1178	1.1139	1.1139	1.1097	1.1055	1.1206	1.1492	1.1873	1.2173
29.	5.60	1.1186	1.1186	1.1147	1.1147	1.1104	1.1061	1.1219	1.1519	1.1916	1.2216
30.	5.80	1.1188	1.1188	1.1148	1.1148	1.1105	1.1061	1.1226	1.1536	1.1947	1.2247
31.	6.00	1.1183	1.1183	1.1143	1.1143	1.1100	1.1056	1.1228	1.1543	1.1958	1.2258
32.	6.20	1.1170	1.1170	1.1130	1.1130	1.1088	1.1045	1.1219	1.1540	1.1965	1.2265
33.	6.40	1.1149	1.1149	1.1110	1.1110	1.1069	1.1027	1.1212	1.1547	1.1990	1.2290
34.	6.60	1.1120	1.1120	1.1083	1.1083	1.1043	1.1003	1.1205	1.1561	1.2029	1.2329
35.	6.80	1.1082	1.1082	1.1045	1.1045	1.1006	1.0966	1.1187	1.1568	1.2069	1.2369
36.	7.00	1.1036	1.1036	1.1009	1.1009	1.0980	1.0951	1.1192	1.1583	1.2093	1.2393
37.	7.20	1.1017	1.1017	1.1008	1.0998	1.0978	1.0958	1.1208	1.1596	1.2099	1.2399
38.	7.40	1.1026	1.1026	1.1020	1.1013	1.0998	1.0983	1.1229	1.1603	1.2086	1.2386
39.	7.60	1.1049	1.1049	1.1042	1.1035	1.1020	1.1005	1.1239	1.1594	1.2055	1.2355
40.	7.80	1.1066	1.1066	1.1059	1.1052	1.1036	1.1020	1.1237	1.1572	1.2006	1.2306
41.	8.00	1.1078	1.1078	1.1071	1.1064	1.1050	1.1035	1.1235	1.1541	1.1938	1.2238
42.	8.20	1.1083	1.1083	1.1079	1.1073	1.1063	1.1052	1.1231	1.1501	1.1852	1.2152
43.	8.40	1.1083	1.1083	1.1080	1.1077	1.1070	1.1063	1.1218	1.1449	1.1747	1.2147
44.	8.60	1.1077	1.1077	1.1076	1.1074	1.1071	1.1068	1.1197	1.1384	1.1626	1.2126
45.	8.80	1.1065	1.1065	1.1065	1.1066	1.1066	1.1067	1.1166	1.1306	1.1486	1.2106
46.	9.00	1.1047	1.1048	1.1050	1.1054	1.1057	1.1061	1.1126	1.1217	1.1332	1.2132
47.	9.20	1.1022	1.1026	1.1030	1.1037	1.1045	1.1053	1.1079	1.1113	1.1154	1.2154
48.	9.40	1.0992	1.1003	1.1014	1.1032	1.1044	1.1050	1.1050	1.1049	1.1042	1.2128
49.	9.60	1.0975	1.0984	1.0994	1.1023	1.1031	1.1047	1.1062	1.1075	1.1087	1.2107
50.	9.80	1.1006	1.1010	1.1015	1.1025	1.1035	1.1045	1.1072	1.1105	1.1145	1.2145
51.	10.00	1.1058	1.1058	1.1052	1.1052	1.1046	1.1040	1.1069	1.1121	1.1190	1.2190
52.	10.20	1.1100	1.1100	1.1073	1.1065	1.1065	1.1047	1.1074	1.1145	1.1241	1.2241
53.	10.40	1.1140	1.1140	1.1106	1.1092	1.1092	1.1067	1.1094	1.1176	1.1289	1.2289
54.	10.60	1.1175	1.1175	1.1141	1.1128	1.1128	1.1103	1.1132	1.1216	1.1332	1.2332
55.	10.80	1.1206	1.1206	1.1172	1.1160	1.1160	1.1136	1.1166	1.1252	1.1369	1.2369
56.	11.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
57.	11.20	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
58.	11.40	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
59.	11.60	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
60.	11.80	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
61.	12.00	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 excluded as per Technical Specifications.

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