

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

Revision 3

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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

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

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 $-3.84\text{E-}4 \Delta k/k/^{\circ}\text{F}$ 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2.3.1 The shutdown rods shall be withdrawn to 231 steps.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

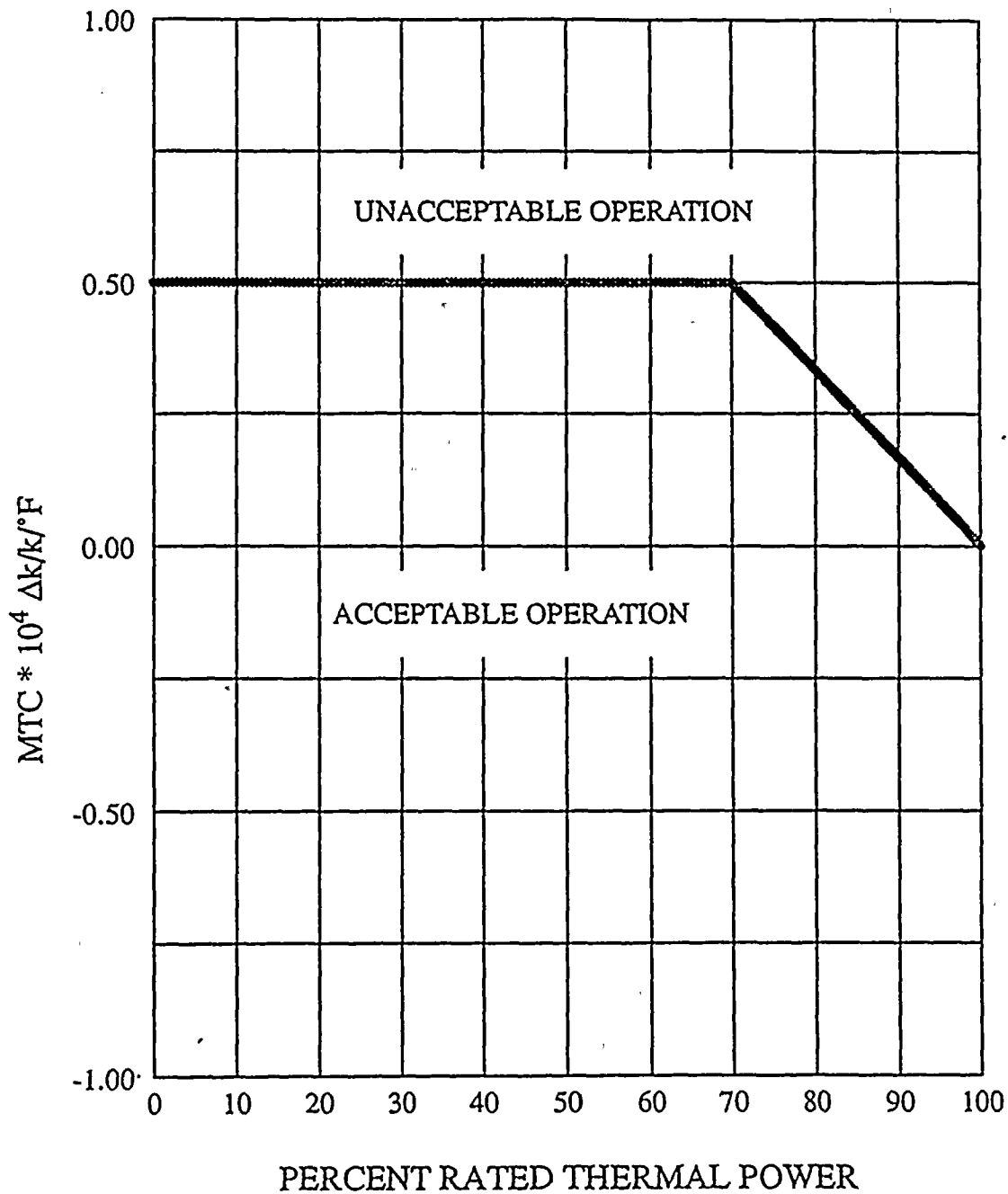
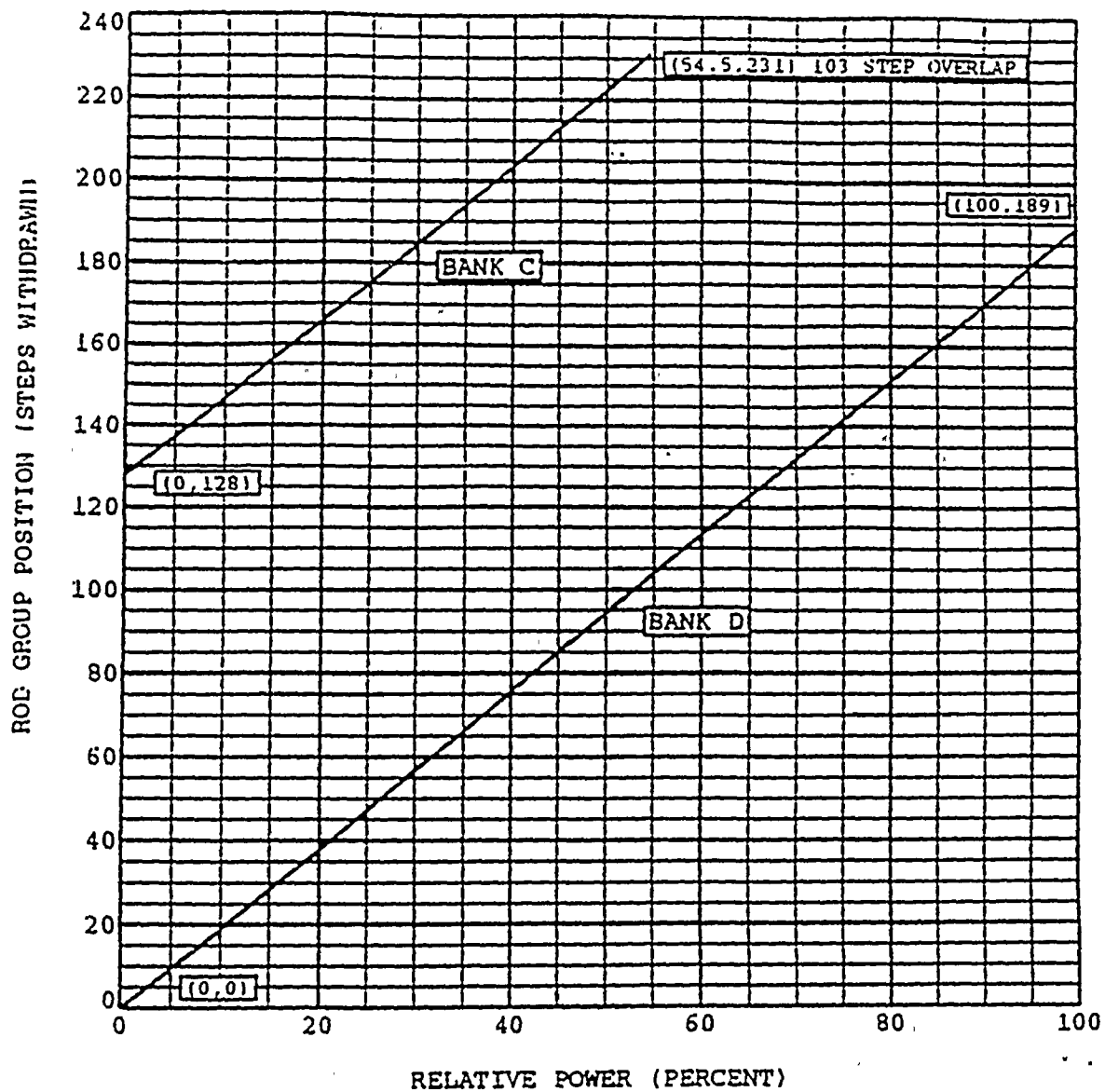


FIGURE 1

MODERATOR TEMPERATURE COEFFICIENT (MTC)



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

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

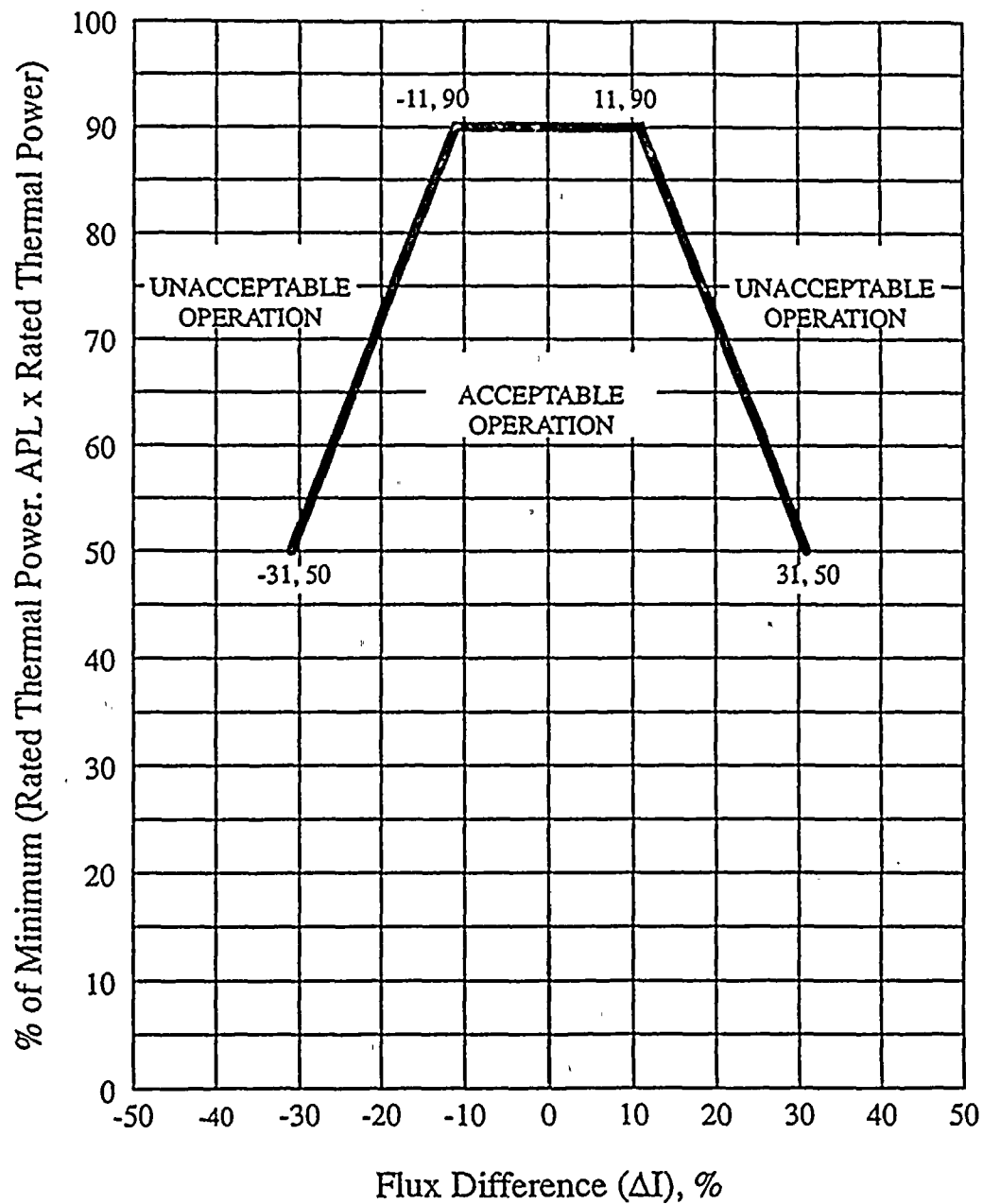


FIGURE 3

AXIAL FLUX DIFFERENCE LIMITS
AS A FUNCTION OF RATED THERMAL POWER

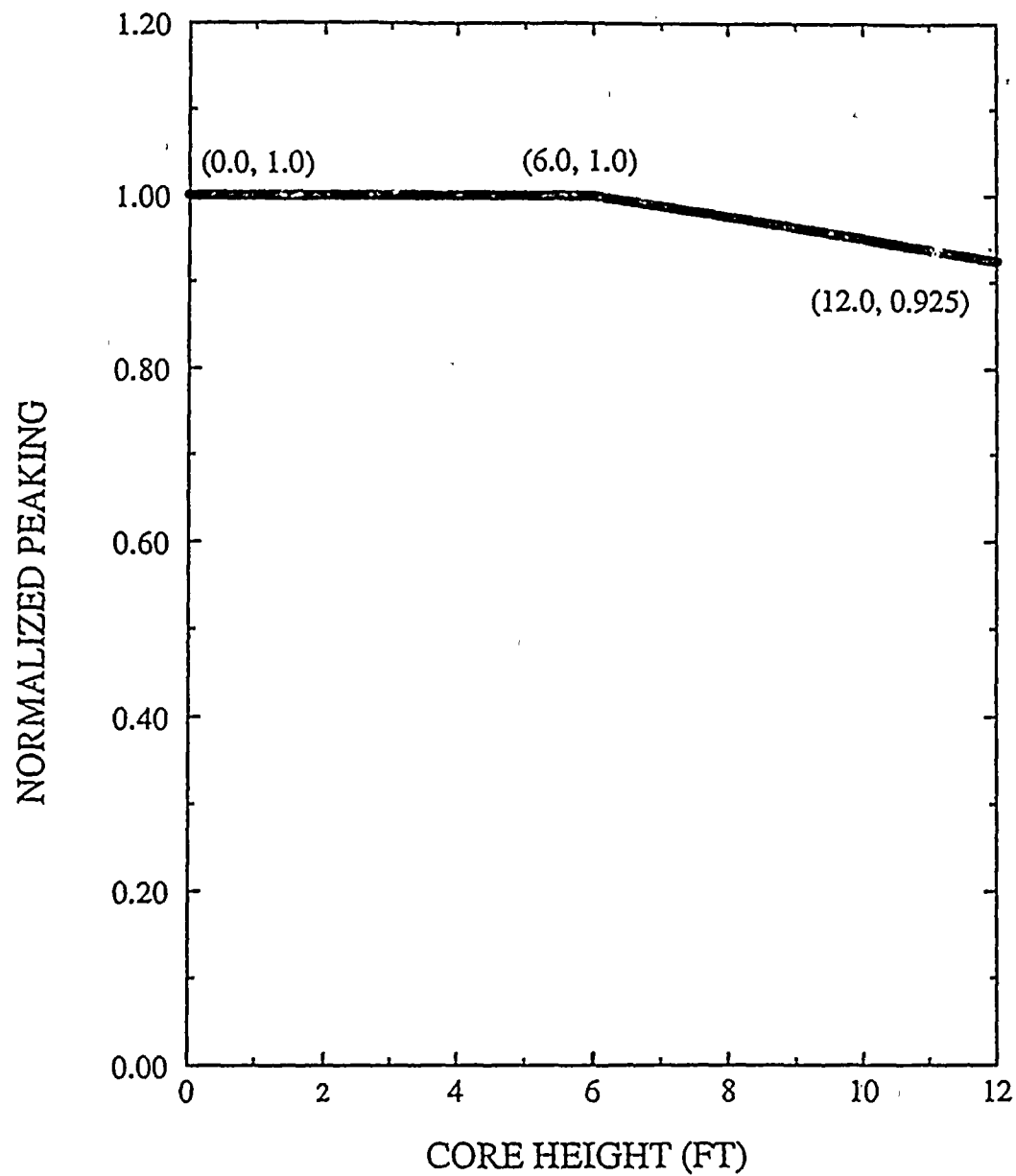


FIGURE 4

$K(Z)$ - NORMALIZED $F_0(Z)$ AS A FUNCTION
OF CORE HEIGHT FOR WESTINGHOUSE FUEL

HOLE NO.	ACTUAL ELEV. (FT)	BURNUP RANGES (MW/D/MT)										
		0	150	1000	2000	4000	6000	8000	10000	12000	14000	EOL
		150	1000	2000	4000	6000	8000	10000	12000	14000		
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	1.0855	1.0855	
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	1.1311	1.1311	
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

