

DONALD C. COOK NUCLEAR PLANT UNIT 2 CYCLE 10  
CORE OPERATING LIMITS REPORT

Revision 2

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9411010166 941028  
PDR ADOCK 05000316  
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COLR for DONALD C. COOK NUCLEAR PLANT UNIT 2 CYCLE 10

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for Donald C. Cook Nuclear Plant Unit 2 Cycle 10 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
3/4.1.3.4	Rod Drop Time
3/4.1.3.5	Shutdown Rod Insertion Limit
3/4.1.3.6	Control Rod Insertion Limits
3/4.2.1	Axial Flux Difference (AFD)
3/4.2.2	Heat Flux Hot Channel Factor - $F_Q(Z)$
3/4.2.3	Nuclear Enthalpy Hot Channel Factor - $F_{\Delta H}^N$
3/4.2.6	Allowable Power Level - (APL)

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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.

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  $-5.00\text{E-}4 \Delta\text{k/k/}^{\circ}\text{F}$ .

This limit is based on a  $T_{\text{avg}}$  program with HFP vessel  $T_{\text{avg}}$  of  $574^{\circ}\text{F}$

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  $-4.15\text{E-}4 \Delta\text{k/k/}^{\circ}\text{F}$  at a HFP vessel  $T_{\text{avg}}$  of  $574^{\circ}\text{F}$ .

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2.2 Rod Drop Time Drop Height (Specification 3/4.1.3.4)

2.2.1 All rods shall be dropped from 231 steps.

2.3 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.3.1 The shutdown rods shall be withdrawn to 231 steps.

2.4 Control Rod Insertion Limits (Specifications 3/4.1.3.6 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 Rod Banks shall overlap by 103 steps. The sequence for Control Rod Bank withdrawal shall be Bank A, Bank B, Bank C, and 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 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

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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  $CFQ = 2.335$

2.6.2  $K(Z)$  is provided in Figure 4

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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             $\text{CFDH} = 1.56$

2.7.2             $\text{PFDH} = 0.3$

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2.8 Allowable Power Level - APL (Specification 3.2.6)

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

- 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
- 2.8.3  $\text{F}_P$  is provided in Technical Specification 3.2.6

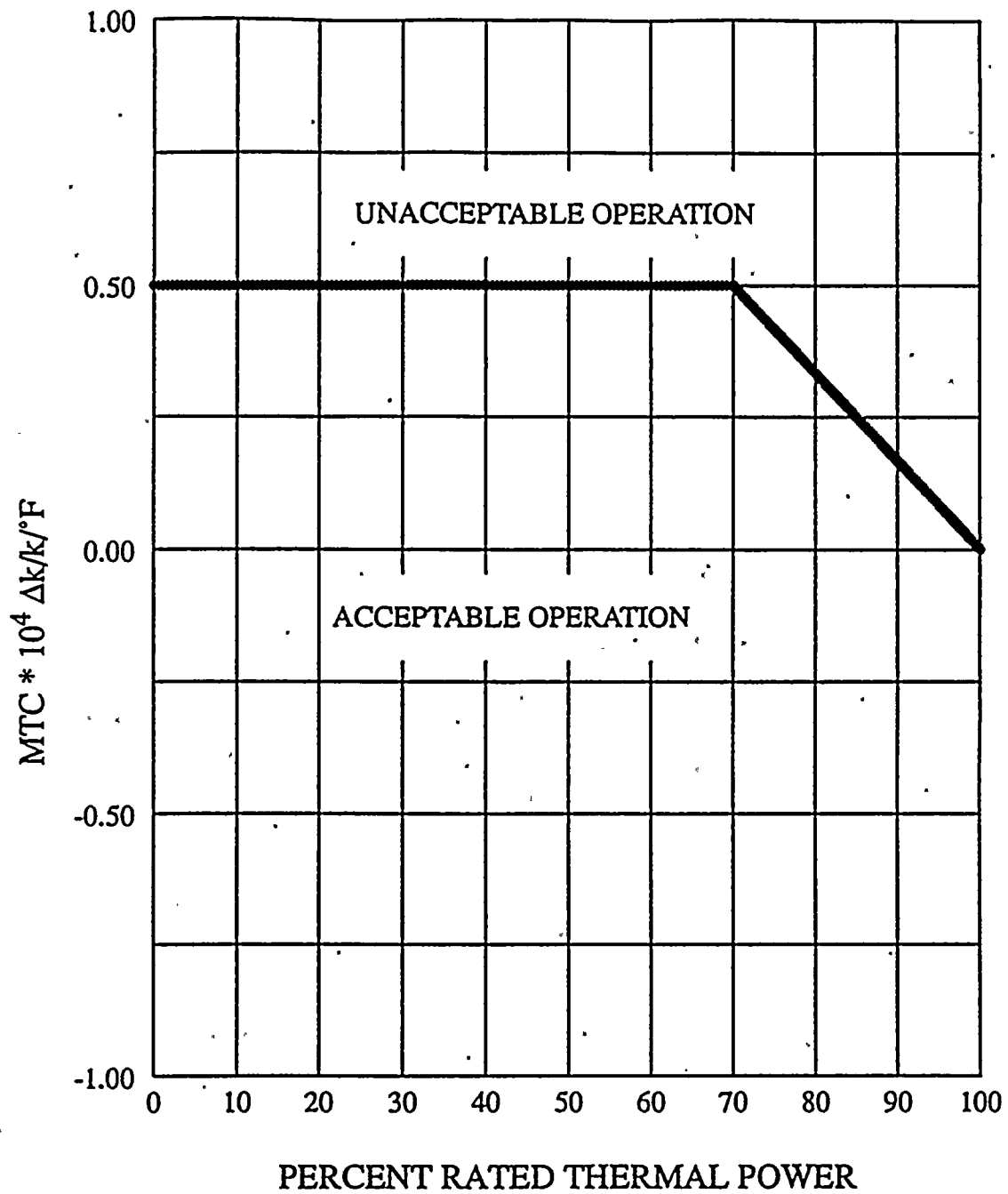
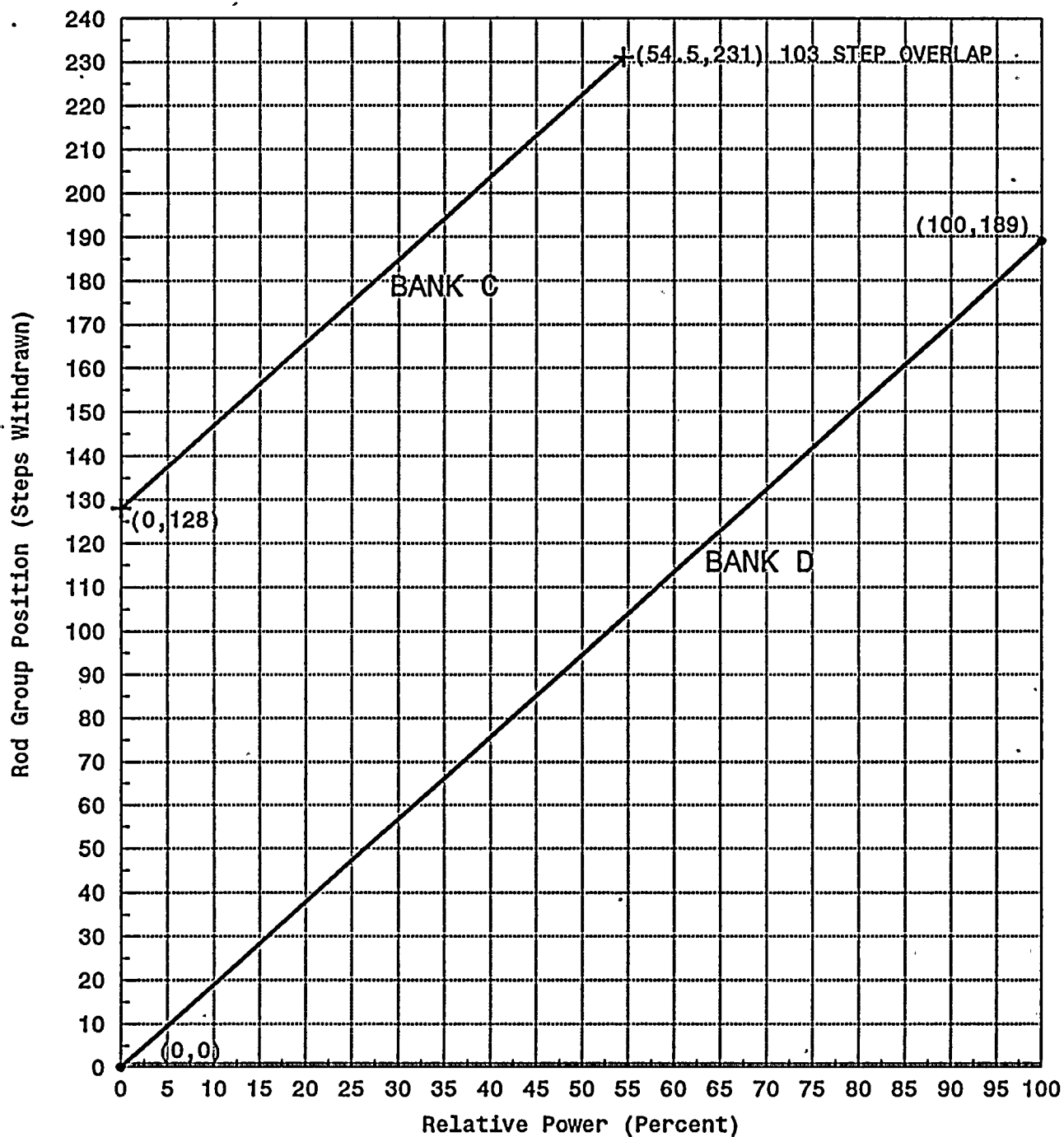


FIGURE 1

MODERATOR TEMPERATURE COEFFICIENT (MTC) LIMITS





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

FIGURE 2

CONTROL ROD BANK INSERTION LIMITS VERSUS  
THERMAL POWER FOUR-LOOP OPERATION

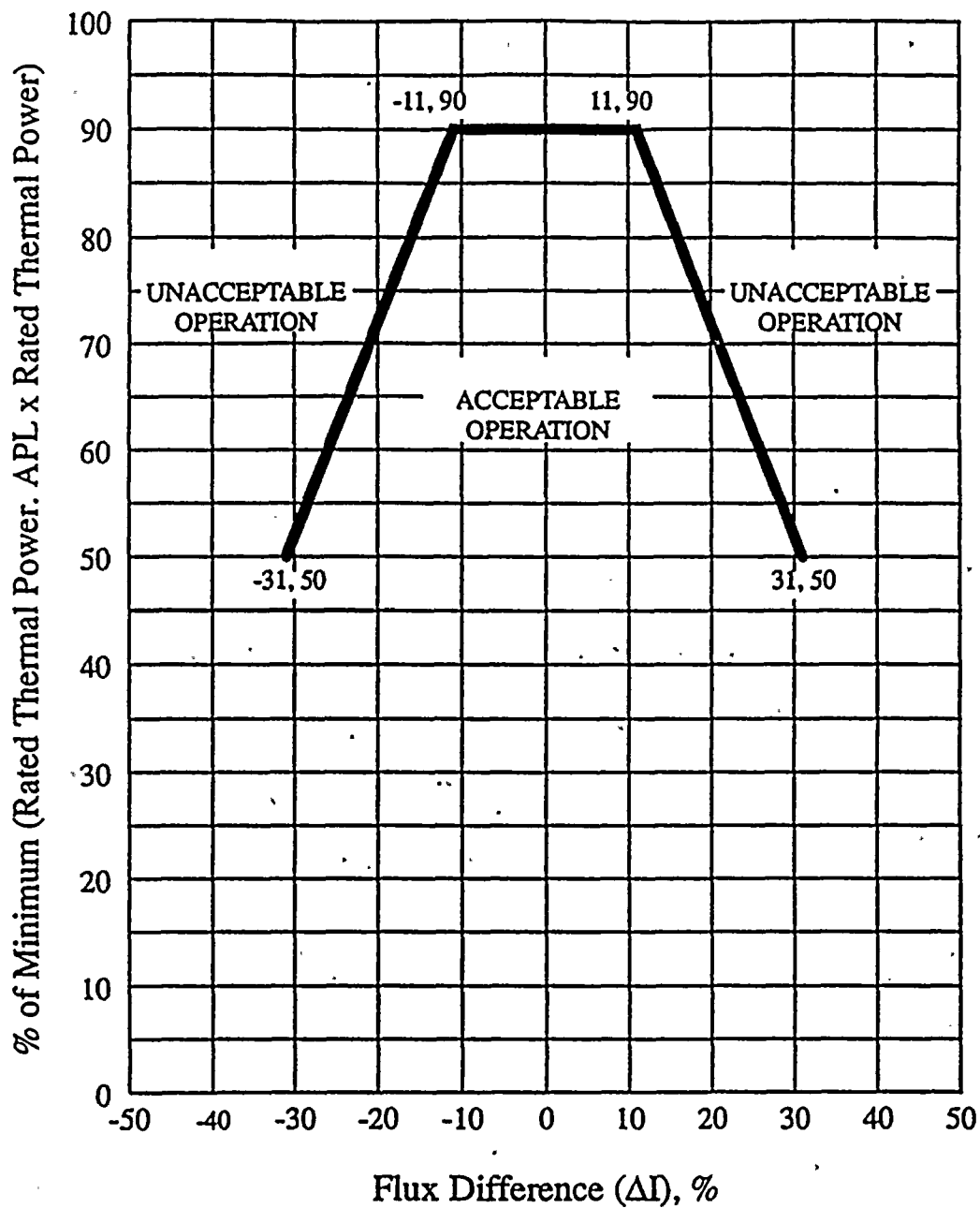


FIGURE 3

AXIAL FLUX DIFFERENCE LIMITS  
AS A FUNCTION OF RATED THERMAL POWER

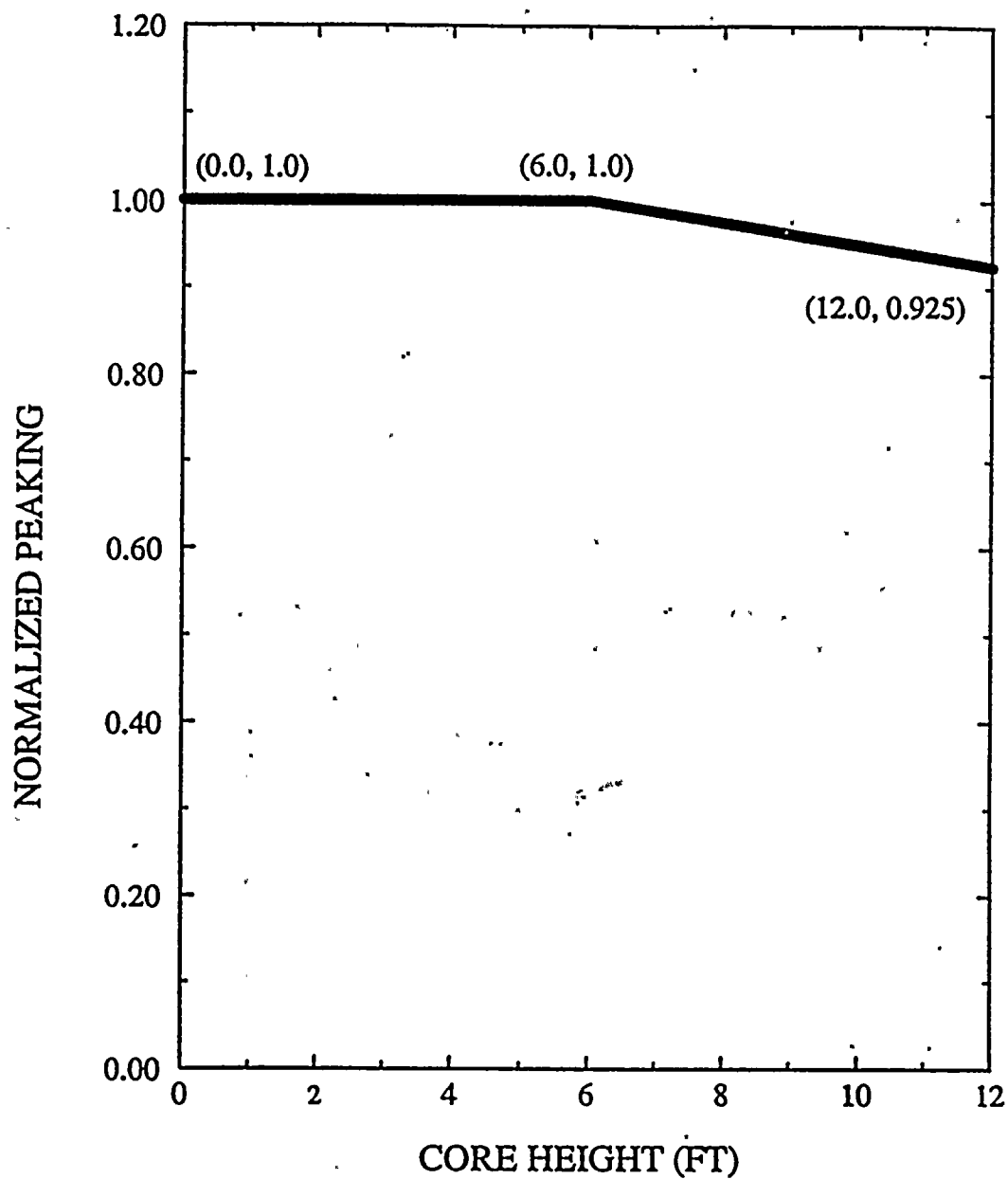


FIGURE 4

$K(Z)$  - NORMALIZED  $F_Q(Z)$  AS A FUNCTION  
OF CORE HEIGHT

TABLE 1  
DONALD C. COOK UNIT 2 CYCLE 10  
V(Z) FUNCTION

MESH NO	AXIAL ELEV. (FT)	BURNUP RANGES (MWD/MTU)										
		0 150	150 1000	1000 2000	2000 4000	4000 6000	6000 8000	8000 10000	10000 12000	12000 14000	14000 16000	16000 EOL
1	0.0	1.0000	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	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	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	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	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	1.0000
7	1.2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.4	1.1011	1.1011	1.0965	1.0935	1.0993	1.1057	1.1106	1.1169	1.1249	1.1417	1.1584
9	1.6	1.1008	1.1008	1.0969	1.0942	1.0996	1.1056	1.1100	1.1161	1.1235	1.1386	1.1538
10	1.8	1.1001	1.1001	1.0971	1.0947	1.0996	1.1050	1.1091	1.1148	1.1214	1.1348	1.1482
11	2.0	1.0992	1.0992	1.0970	1.0949	1.0993	1.1040	1.1078	1.1129	1.1186	1.1302	1.1417
12	2.2	1.0981	1.0981	1.0968	1.0948	1.0986	1.1026	1.1062	1.1104	1.1152	1.1247	1.1343
13	2.4	1.0967	1.0967	1.0964	1.0945	1.0976	1.1010	1.1041	1.1075	1.1112	1.1187	1.1261
14	2.6	1.0950	1.0958	1.0958	1.0939	1.0963	1.0991	1.1016	1.1040	1.1067	1.1121	1.1175
15	2.8	1.0930	1.0950	1.0950	1.0930	1.0948	1.0969	1.0986	1.1000	1.1016	1.1050	1.1084
16	3.0	1.0908	1.0939	1.0939	1.0918	1.0931	1.0943	1.0952	1.0957	1.0962	1.0975	1.0988
17	3.2	1.0883	1.0926	1.0926	1.0903	1.0911	1.0914	1.0914	1.0914	1.0908	1.0900	1.0900
18	3.4	1.0860	1.0910	1.0910	1.0887	1.0889	1.0889	1.0882	1.0876	1.0865	1.0872	1.0888
19	3.6	1.0849	1.0894	1.0894	1.0872	1.0872	1.0867	1.0853	1.0857	1.0870	1.0946	1.1022
20	3.8	1.0843	1.0888	1.0888	1.0859	1.0859	1.0853	1.0858	1.0871	1.0894	1.1029	1.1165
21	4.0	1.0841	1.0885	1.0885	1.0851	1.0852	1.0859	1.0872	1.0888	1.0915	1.1106	1.1296
22	4.2	1.0845	1.0885	1.0885	1.0848	1.0860	1.0870	1.0883	1.0903	1.0935	1.1180	1.1425
23	4.4	1.0854	1.0890	1.0890	1.0849	1.0867	1.0879	1.0895	1.0917	1.0951	1.1247	1.1544
24	4.6	1.0859	1.0894	1.0894	1.0852	1.0872	1.0886	1.0904	1.0928	1.0964	1.1308	1.1652
25	4.8	1.0863	1.0897	1.0897	1.0854	1.0875	1.0891	1.0910	1.0936	1.0974	1.1361	1.1748
26	5.0	1.0865	1.0897	1.0897	1.0853	1.0876	1.0893	1.0914	1.0940	1.0979	1.1404	1.1828
27	5.2	1.0863	1.0895	1.0895	1.0850	1.0874	1.0892	1.0914	1.0941	1.0981	1.1437	1.1893
28	5.4	1.0859	1.0890	1.0890	1.0844	1.0870	1.0888	1.0910	1.0937	1.0978	1.1459	1.1939
29	5.6	1.0851	1.0882	1.0882	1.0835	1.0861	1.0880	1.0902	1.0929	1.0970	1.1469	1.1967
30	5.8	1.0840	1.0869	1.0869	1.0822	1.0849	1.0868	1.0889	1.0917	1.0949	1.1466	1.1982
31	6.0	1.0824	1.0853	1.0853	1.0806	1.0833	1.0851	1.0872	1.0893	1.0966	1.1450	1.1934
32	6.2	1.0804	1.0832	1.0832	1.0785	1.0812	1.0829	1.0848	1.0891	1.1010	1.1420	1.1830
33	6.4	1.0778	1.0806	1.0806	1.0759	1.0786	1.0803	1.0833	1.0927	1.1039	1.1378	1.1716
34	6.6	1.0746	1.0774	1.0774	1.0727	1.0754	1.0786	1.0857	1.0949	1.1061	1.1322	1.1582
35	6.8	1.0728	1.0755	1.0755	1.0707	1.0733	1.0800	1.0874	1.0964	1.1075	1.1245	1.1416
36	7.0	1.0736	1.0760	1.0760	1.0713	1.0748	1.0828	1.0891	1.0974	1.1079	1.1190	1.1301
37	7.2	1.0752	1.0777	1.0777	1.0732	1.0761	1.0853	1.0912	1.0985	1.1077	1.1154	1.1230
38	7.4	1.0761	1.0784	1.0784	1.0742	1.0802	1.0873	1.0928	1.0998	1.1075	1.1103	1.1131
39	7.6	1.0764	1.0787	1.0787	1.0747	1.0820	1.0886	1.0938	1.1002	1.1074	1.1074	1.1042
40	7.8	1.0762	1.0784	1.0784	1.0747	1.0833	1.0894	1.0941	1.1000	1.1066	1.1066	1.0987
41	8.0	1.0753	1.0775	1.0775	1.0741	1.0839	1.0896	1.0938	1.0991	1.1051	1.1051	1.0928
42	8.2	1.0737	1.0759	1.0759	1.0728	1.0840	1.0892	1.0928	1.0975	1.1029	1.1029	1.0889
43	8.4	1.0734	1.0735	1.0735	1.0708	1.0835	1.0881	1.0912	1.0953	1.1000	1.1000	1.0905
44	8.6	1.0780	1.0780	1.0703	1.0681	1.0823	1.0863	1.0889	1.0924	1.0966	1.0966	1.0959
45	8.8	1.0827	1.0827	1.0664	1.0649	1.0809	1.0843	1.0867	1.0898	1.0927	1.1009	1.1091
46	9.0	1.0871	1.0871	1.0635	1.0632	1.0794	1.0823	1.0836	1.0862	1.0908	1.1055	1.1202
47	9.2	1.0918	1.0918	1.0641	1.0644	1.0770	1.0794	1.0819	1.0859	1.0934	1.1103	1.1272
48	9.4	1.0964	1.0964	1.0677	1.0680	1.0744	1.0777	1.0844	1.0918	1.0995	1.1153	1.1310
49	9.6	1.1008	1.1008	1.0709	1.0712	1.0747	1.0815	1.0888	1.0965	1.1048	1.1206	1.1363
50	9.8	1.1050	1.1050	1.0739	1.0742	1.0775	1.0854	1.0929	1.1009	1.1096	1.1248	1.1400
51	10.0	1.1088	1.1088	1.0768	1.0771	1.0806	1.0886	1.0966	1.1049	1.1140	1.1291	1.1443
52	10.2	1.1123	1.1123	1.0795	1.0797	1.0832	1.0916	1.1000	1.1085	1.1178	1.1336	1.1494
53	10.4	1.1154	1.1154	1.0820	1.0821	1.0855	1.0942	1.1028	1.1115	1.1210	1.1371	1.1531
54	10.6	1.1180	1.1180	1.0841	1.0841	1.0875	1.0964	1.1052	1.1140	1.1236	1.1397	1.1558
55	10.8	1.1200	1.1200	1.0857	1.0857	1.0890	1.0981	1.1071	1.1159	1.1257	1.1416	1.1576
56	11.0	1.0000	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	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	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	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	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	1.0000

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



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