

DONALD C. COOK NUCLEAR PLANT UNIT 2 CYCLE 9
CORE OPERATING LIMITS REPORT

Revision 1

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9205180280 920515
PDR ADOCK 05000316
P PDR

COLR for DONALD C. COOK NUCLEAR PLANT UNIT 2 CYCLE 9.

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for Donald C. Cook Nuclear Plant Unit 2 Cycle 9 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_{AH}^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 $-5.00E-4 \Delta k/k/^\circ F$.

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

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

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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2.3.1 The shutdown rods shall be withdrawn to 231 steps.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 ≥ 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 for Westinghouse VANTAGE 5 fuel. CFQ= 2.10 for ANF fuel

2.6.2 K(Z) is provided in Figure 4 for Westinghouse VANTAGE 5 fuel
K(Z) is provided in Figure 5 for ANF 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 = 1.56 for Westinghouse VANTAGE 5 fuel
 = 1.49 for ANF fuel

2.7.2 PFDH = 0.3 for Westinghouse VANTAGE 5 fuel
 PFDH = 0.2 for ANF fuel

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2.8 Allowable Power Level - APL (Specification 3.2.6)

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

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 F_P is provided in Technical Specification 3.2.6

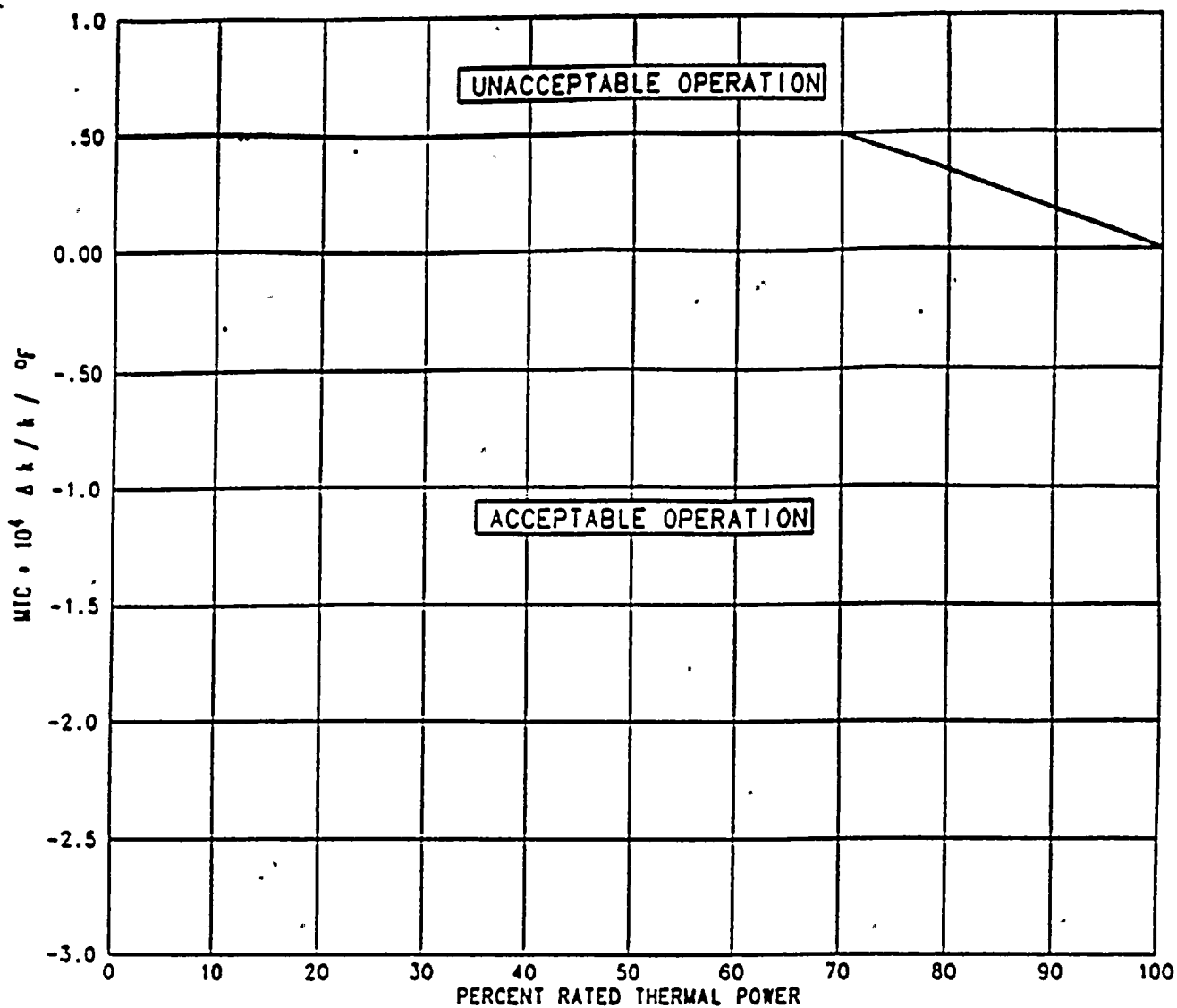


FIGURE 1
MODERATOR TEMPERATURE COEFFICIENT (MTC) LIMITS

FULLY WITHDRAWN

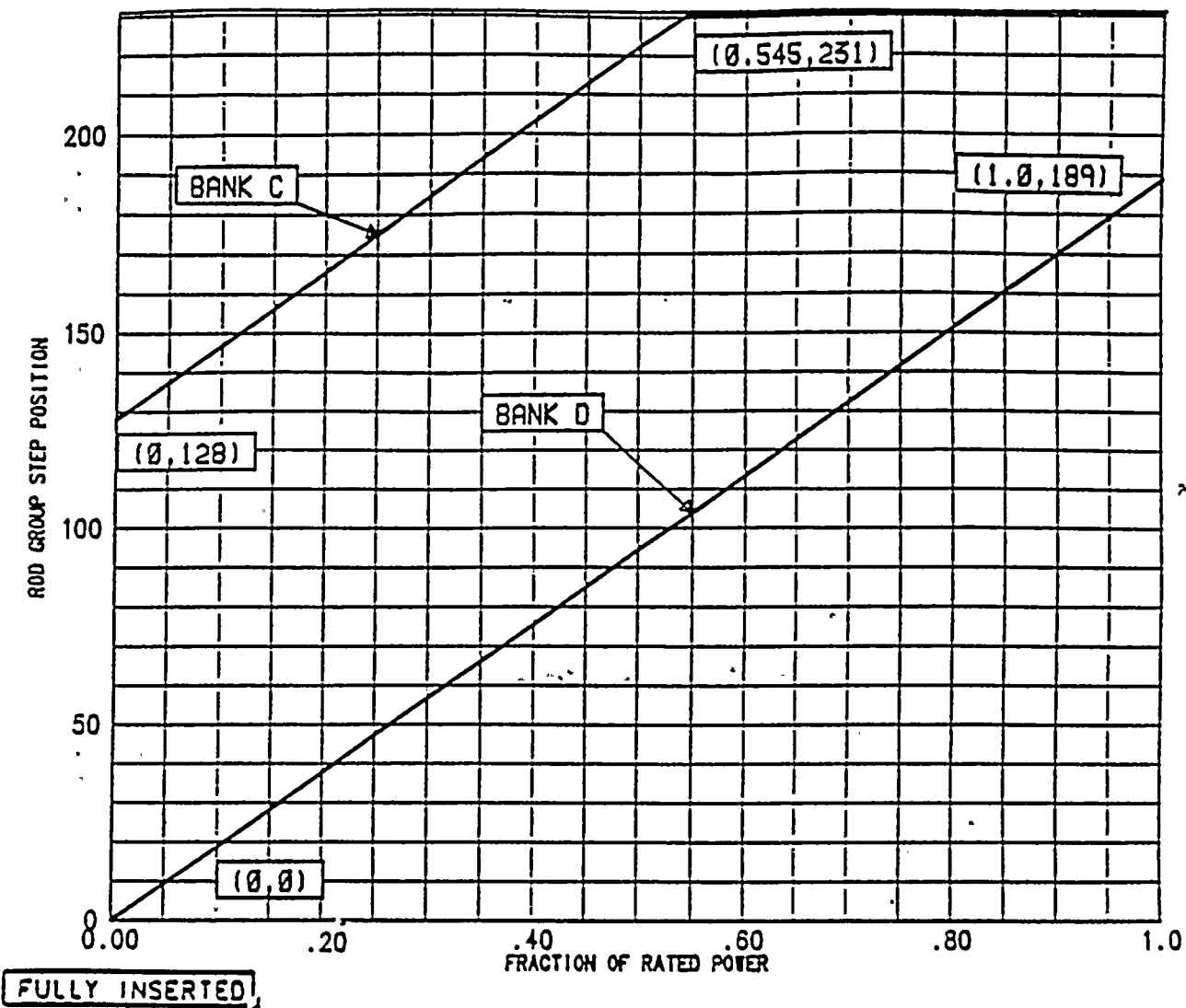


FIGURE 2

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

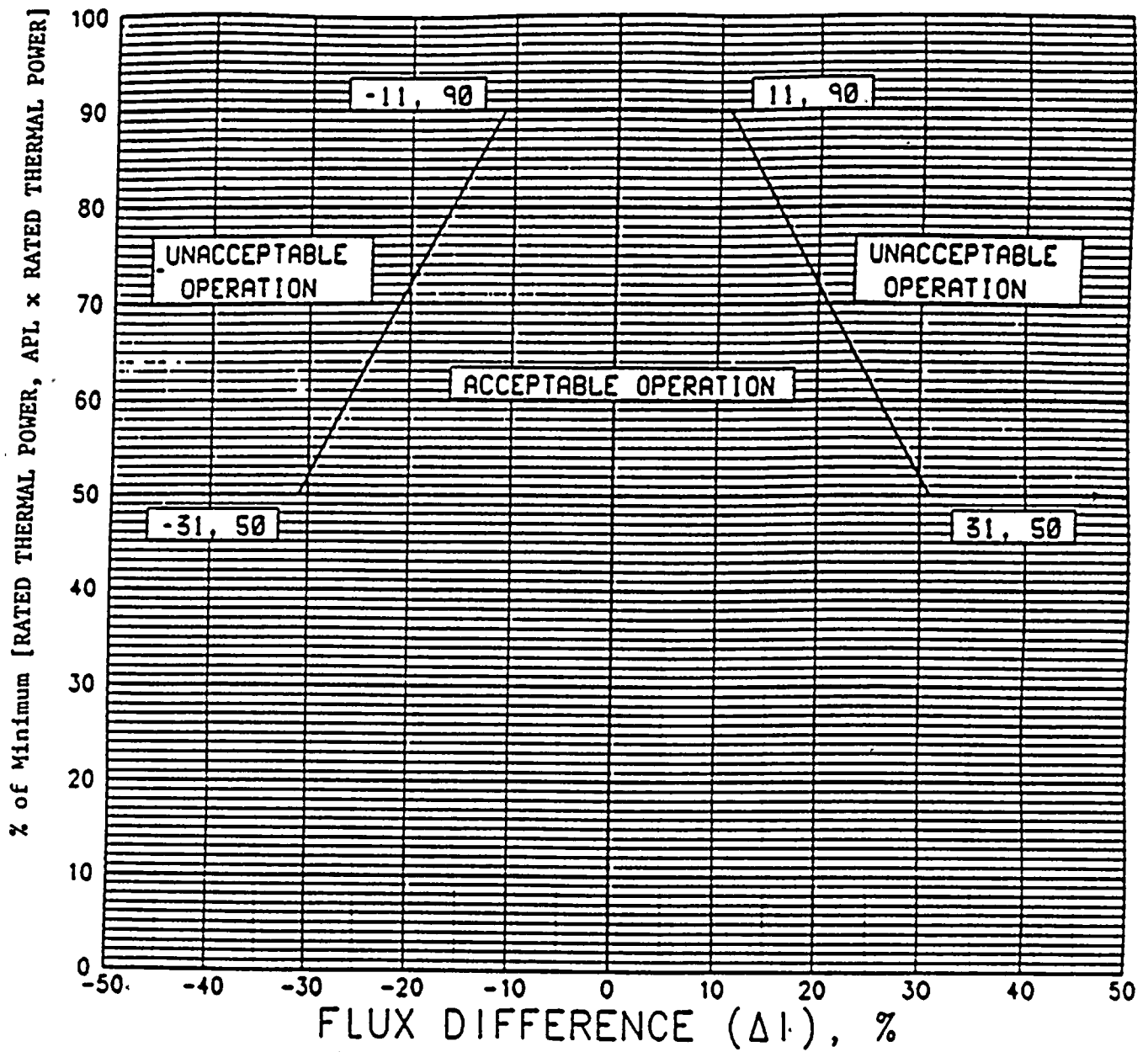


FIGURE 3
AXIAL FLUX DIFFERENCE LIMITS
AS A FUNCTION OF RATED THERMAL POWER

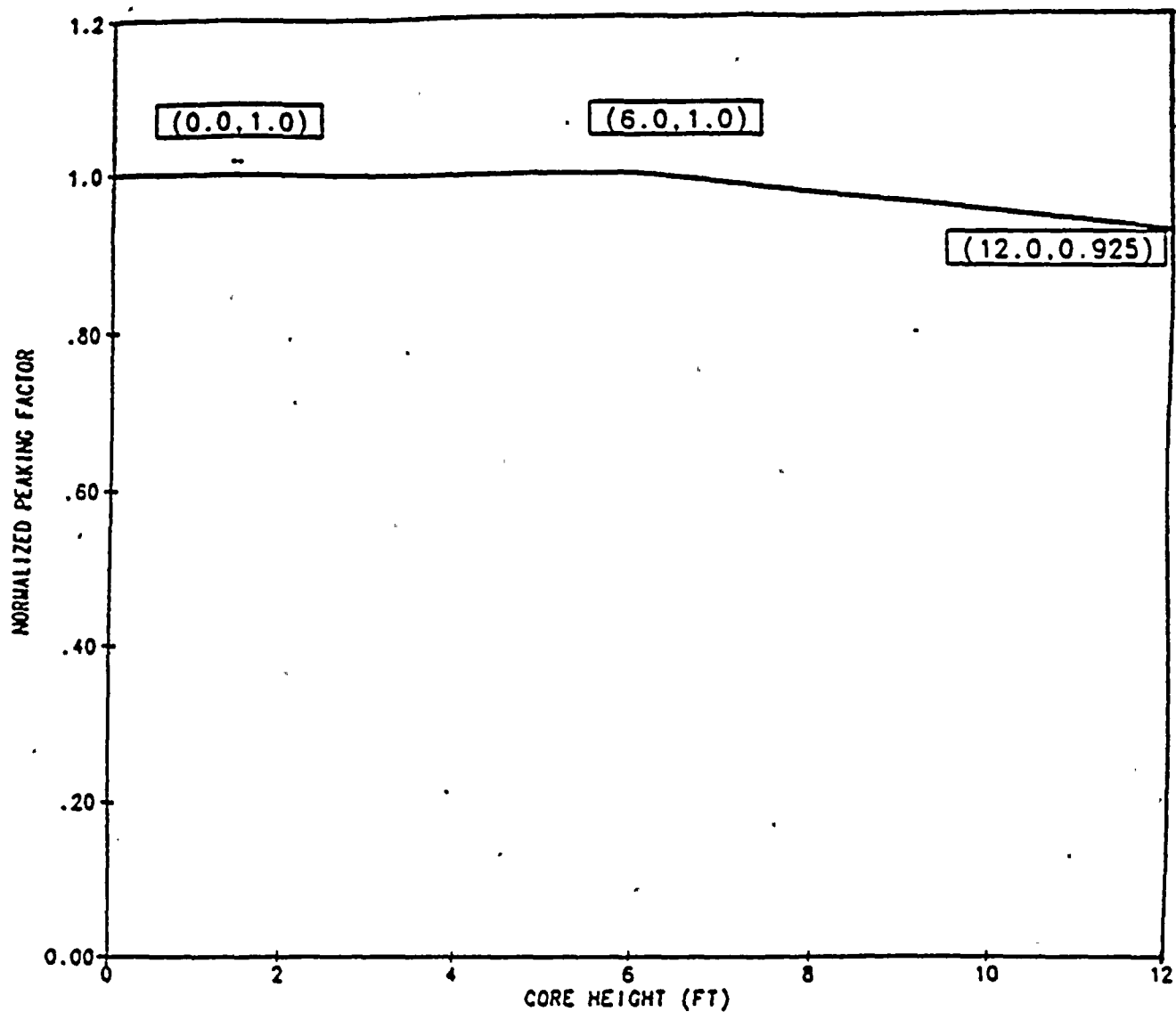


FIGURE 4
 $K(Z)$ - NORMALIZED $F_0(Z)$ AS A FUNCTION
OF CORE HEIGHT FOR WESTINGHOUSE VANTAGE 5 FUEL

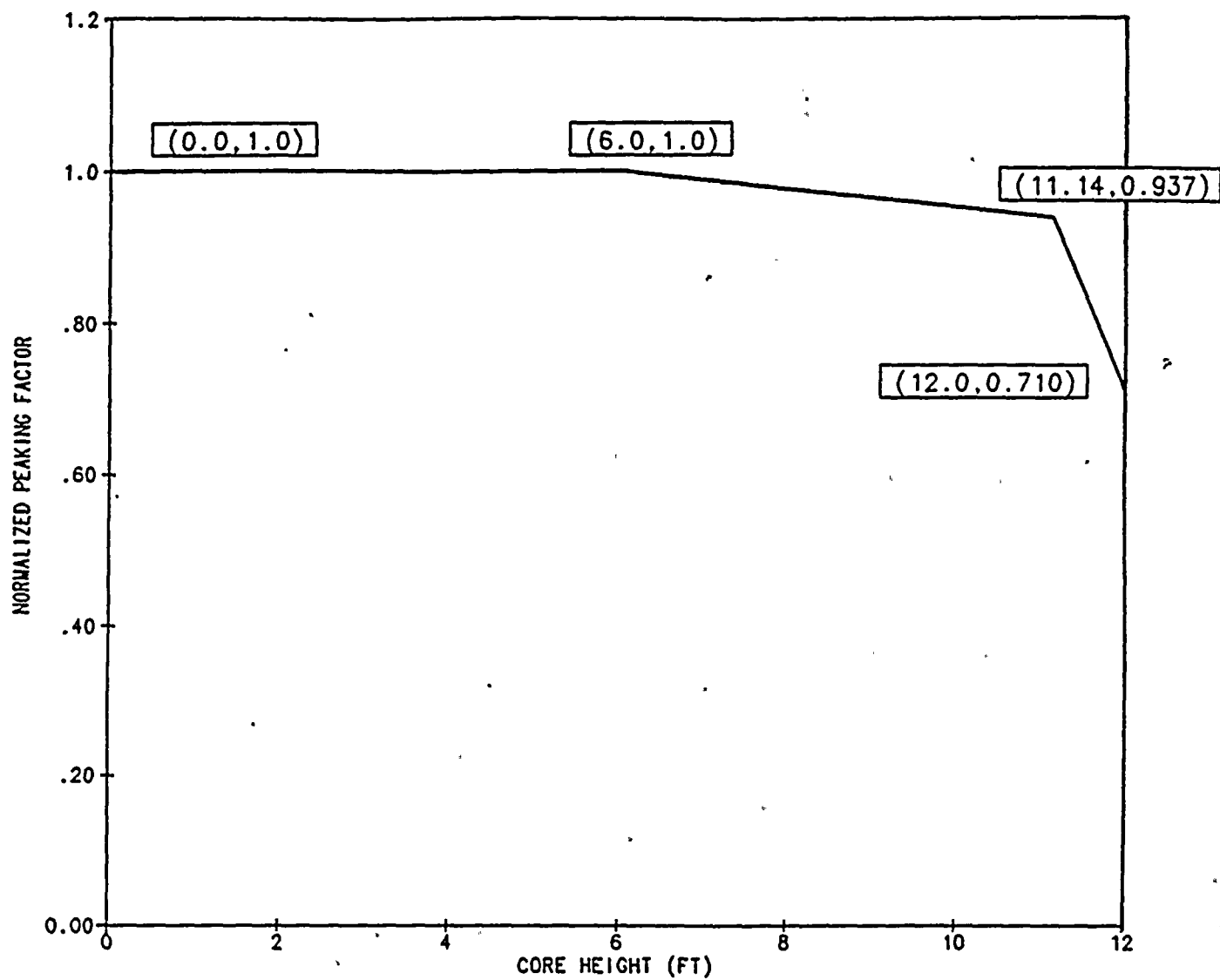


FIGURE 5
 $K(Z)$ - NORMALIZED $F_Q(Z)$ AS A FUNCTION
OF CORE HEIGHT FOR ANF FUEL



10-10-10

TABLE 1
DONALD C. COOK UNIT 2 CYCLE 9
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 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	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.4	1.0981	1.0981	1.0984	1.1008	1.1052	1.1119	1.1207	1.1317	1.1448	1.1641
9	1.6	1.0982	1.0982	1.0985	1.1008	1.1050	1.1113	1.1198	1.1303	1.1428	1.1612
10	1.8	1.0981	1.0981	1.0983	1.1004	1.1044	1.1103	1.1183	1.1282	1.1399	1.1573
11	2.0	1.0977	1.0977	1.0979	1.0998	1.1034	1.1089	1.1163	1.1254	1.1363	1.1525
12	2.2	1.0971	1.0971	1.0972	1.0988	1.1021	1.1070	1.1137	1.1220	1.1319	1.1467
13	2.4	1.0962	1.0962	1.0962	1.0976	1.1004	1.1047	1.1106	1.1180	1.1269	1.1400
14	2.6	1.0950	1.0950	1.0949	1.0960	1.0984	1.1020	1.1071	1.1134	1.1211	1.1324
15	2.8	1.0935	1.0935	1.0933	1.0940	1.0966	1.0999	1.1030	1.1083	1.1148	1.1240
16	3.0	1.0917	1.0917	1.0914	1.0917	1.0944	1.0974	1.0997	1.1029	1.1080	1.1156
17	3.2	1.0897	1.0897	1.0895	1.0904	1.0919	1.0919	1.0938	1.0965	1.0997	1.1046
18	3.4	1.0882	1.0889	1.0889	1.0892	1.0892	1.0892	1.0898	1.0914	1.0935	1.0967
19	3.6	1.0874	1.0886	1.0886	1.0883	1.0881	1.0867	1.0892	1.0930	1.0979	1.1058
20	3.8	1.0868	1.0879	1.0879	1.0878	1.0871	1.0859	1.0904	1.0967	1.1049	1.1178
21	4.0	1.0862	1.0871	1.0872	1.0872	1.0860	1.0867	1.0928	1.1012	1.1120	1.1288
22	4.2	1.0854	1.0864	1.0866	1.0866	1.0848	1.0861	1.0958	1.1064	1.1197	1.1402
23	4.4	1.0844	1.0858	1.0860	1.0860	1.0860	1.0894	1.0991	1.1121	1.1284	1.1534
24	4.6	1.0841	1.0850	1.0853	1.0853	1.0872	1.0910	1.1028	1.1185	1.1381	1.1682
25	4.8	1.0840	1.0840	1.0841	1.0841	1.0881	1.0924	1.1061	1.1244	1.1471	1.1820
26	5.0	1.0839	1.0839	1.0833	1.0833	1.0887	1.0934	1.1090	1.1299	1.1559	1.1957
27	5.2	1.0838	1.0838	1.0828	1.0828	1.0890	1.0940	1.1114	1.1348	1.1638	1.2084
28	5.4	1.0839	1.0839	1.0820	1.0816	1.0890	1.0941	1.1131	1.1387	1.1705	1.2195
29	5.6	1.0836	1.0836	1.0808	1.0804	1.0885	1.0937	1.1147	1.1429	1.1762	1.2325
30	5.8	1.0830	1.0830	1.0794	1.0789	1.0875	1.0928	1.1158	1.1471	1.1854	1.2459
31	6.0	1.0819	1.0819	1.0776	1.0769	1.0861	1.0912	1.1163	1.1503	1.1931	1.2591
32	6.2	1.0803	1.0803	1.0759	1.0748	1.0840	1.0888	1.1156	1.1523	1.1985	1.2701
33	6.4	1.0782	1.0782	1.0744	1.0732	1.0814	1.0861	1.1149	1.1543	1.2040	1.2811
34	6.6	1.0755	1.0755	1.0723	1.0714	1.0781	1.0855	1.1157	1.1569	1.2087	1.2890
35	6.8	1.0720	1.0720	1.0692	1.0690	1.0741	1.0862	1.1174	1.1596	1.2125	1.2939
36	7.0	1.0704	1.0704	1.0677	1.0674	1.0694	1.0877	1.1193	1.1617	1.2146	1.2959
37	7.2	1.0701	1.0701	1.0672	1.0662	1.0688	1.0890	1.1204	1.1624	1.2147	1.2948
38	7.4	1.0686	1.0686	1.0659	1.0641	1.0694	1.0896	1.1205	1.1617	1.2126	1.2906
39	7.6	1.0666	1.0666	1.0640	1.0613	1.0696	1.0895	1.1196	1.1594	1.2084	1.2833
40	7.8	1.0640	1.0640	1.0613	1.0591	1.0695	1.0889	1.1177	1.1556	1.2021	1.2729
41	8.0	1.0661	1.0661	1.0620	1.0601	1.0693	1.0871	1.1139	1.1493	1.1930	1.2597
42	8.2	1.0718	1.0718	1.0673	1.0640	1.0705	1.0859	1.1098	1.1419	1.1818	1.2430
43	8.4	1.0766	1.0766	1.0725	1.0694	1.0746	1.0878	1.1085	1.1363	1.1710	1.2243
44	8.6	1.0814	1.0814	1.0781	1.0757	1.0807	1.0921	1.1099	1.1336	1.1631	1.2084
45	8.8	1.0862	1.0862	1.0837	1.0818	1.0865	1.0962	1.1110	1.1308	1.1552	1.1927
46	9.0	1.0909	1.0909	1.0891	1.0881	1.0921	1.0997	1.1112	1.1285	1.1453	1.1741
47	9.2	1.0954	1.0954	1.0944	1.0945	1.0974	1.1029	1.1108	1.1213	1.1340	1.1534
48	9.4	1.0998	1.0998	1.0995	1.1004	1.1025	1.1057	1.1102	1.1159	1.1227	1.1330
49	9.6	1.1039	1.1042	1.1047	1.1057	1.1070	1.1085	1.1102	1.1121	1.1147	1.1171
50	9.8	1.1077	1.1081	1.1085	1.1094	1.1105	1.1117	1.1130	1.1144	1.1161	1.1181
51	10.0	1.1112	1.1114	1.1117	1.1125	1.1136	1.1149	1.1166	1.1185	1.1214	1.1239
52	10.2	1.1144	1.1145	1.1148	1.1155	1.1165	1.1178	1.1194	1.1213	1.1250	1.1286
53	10.4	1.1171	1.1172	1.1173	1.1179	1.1189	1.1202	1.1219	1.1239	1.1285	1.1298
54	10.6	1.1193	1.1193	1.1193	1.1197	1.1206	1.1219	1.1238	1.1261	1.1312	1.1329
55	10.8	1.1210	1.1210	1.1208	1.1209	1.1216	1.1229	1.1249	1.1274	1.1331	1.1352
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 2 CYCLE 9
V(Z) FUNCTION