

UNIT 2 CORE OPERATING LIMITS REPORT

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DONALD C. COOK NUCLEAR PLANT UNIT 2 CYCLE 8  
CORE OPERATING LIMITS REPORT (COLR)

Revision 0

SEPTEMBER 4, 1990

COLR for DONALD C. COOK NUCLEAR PLANT UNIT 2 CYCLE 8

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for Donald C. Cook Nuclear Plant Unit 2 Cycle 8 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
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.

### 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  $-3.80\text{E-}4 \Delta\text{k/k/}^{\circ}\text{F}$ .

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  $-3.10\text{E-}4 \Delta\text{k/k/}^{\circ}\text{F}$  at a HFP vessel average temperature 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 228 steps.

2.3 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.3.1 The shutdown rods shall be withdrawn to 228 steps.

2.4 Control Rod Insertion Limits (Specification 3/4.1.3.6, and 3/4.1.3.1)

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

2.4.2 Successive Control Banks shall overlap by 100 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

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

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

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

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, Westinghouse VANTAGE 5 fuel  
                  PFDH - 0.2, 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) is provided in COLR Section 2.6.1

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

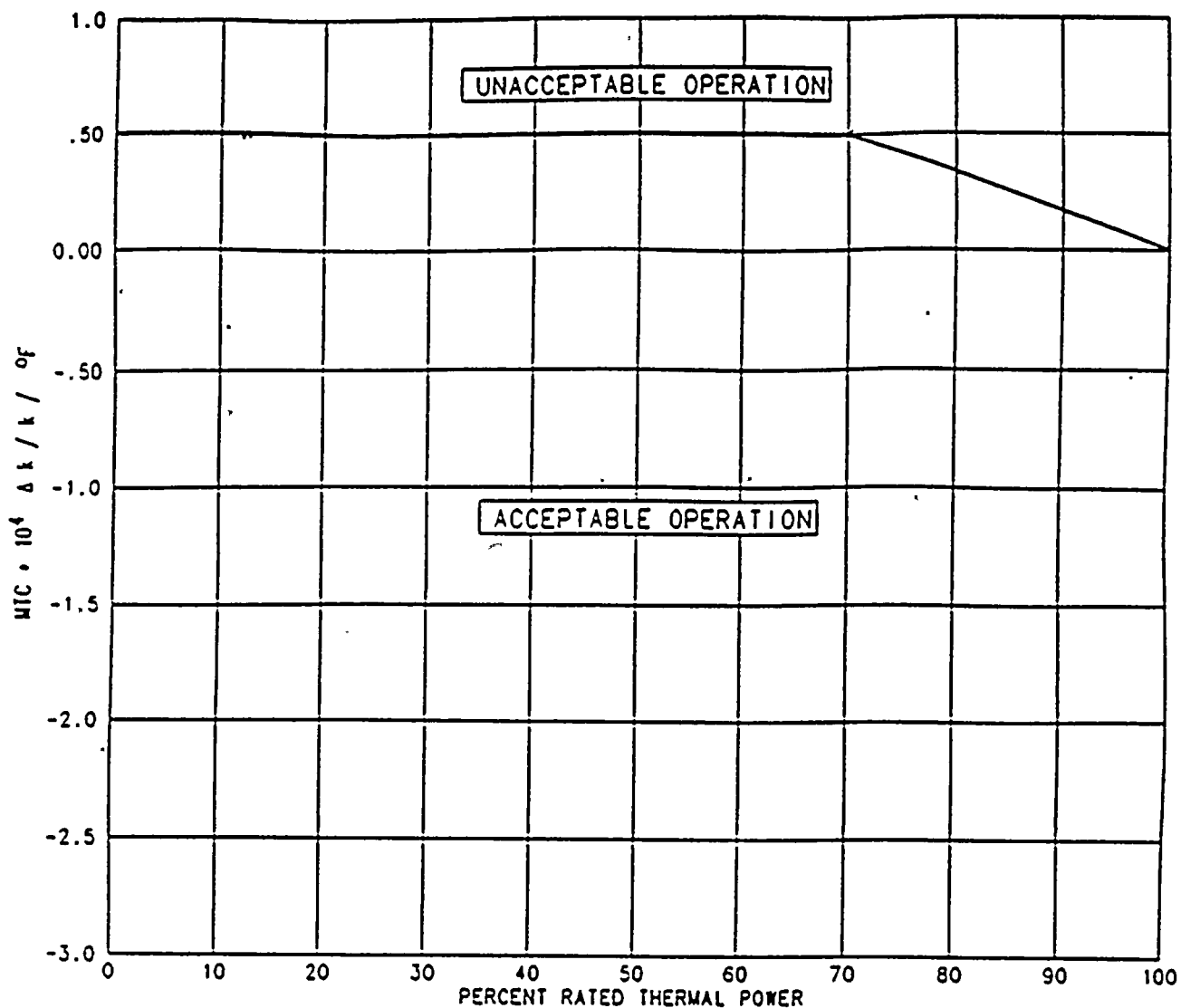


FIGURE 1  
MODERATOR TEMPERATURE COEFFICIENT (MTC)

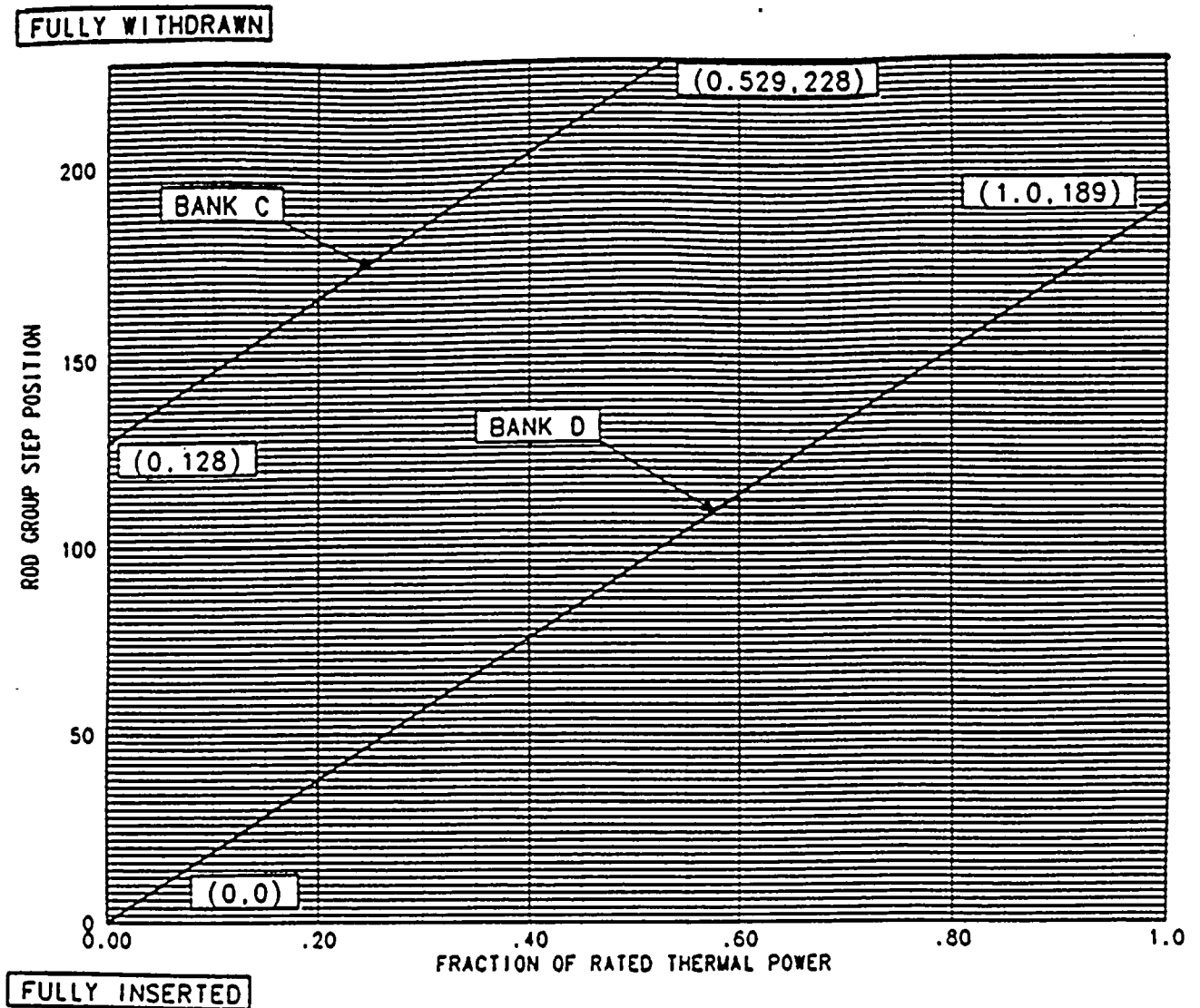


FIGURE 2  
ROD BANK INSERTION LIMITS VERSUS  
THERMAL POWER FOUR LOOP OPERATION



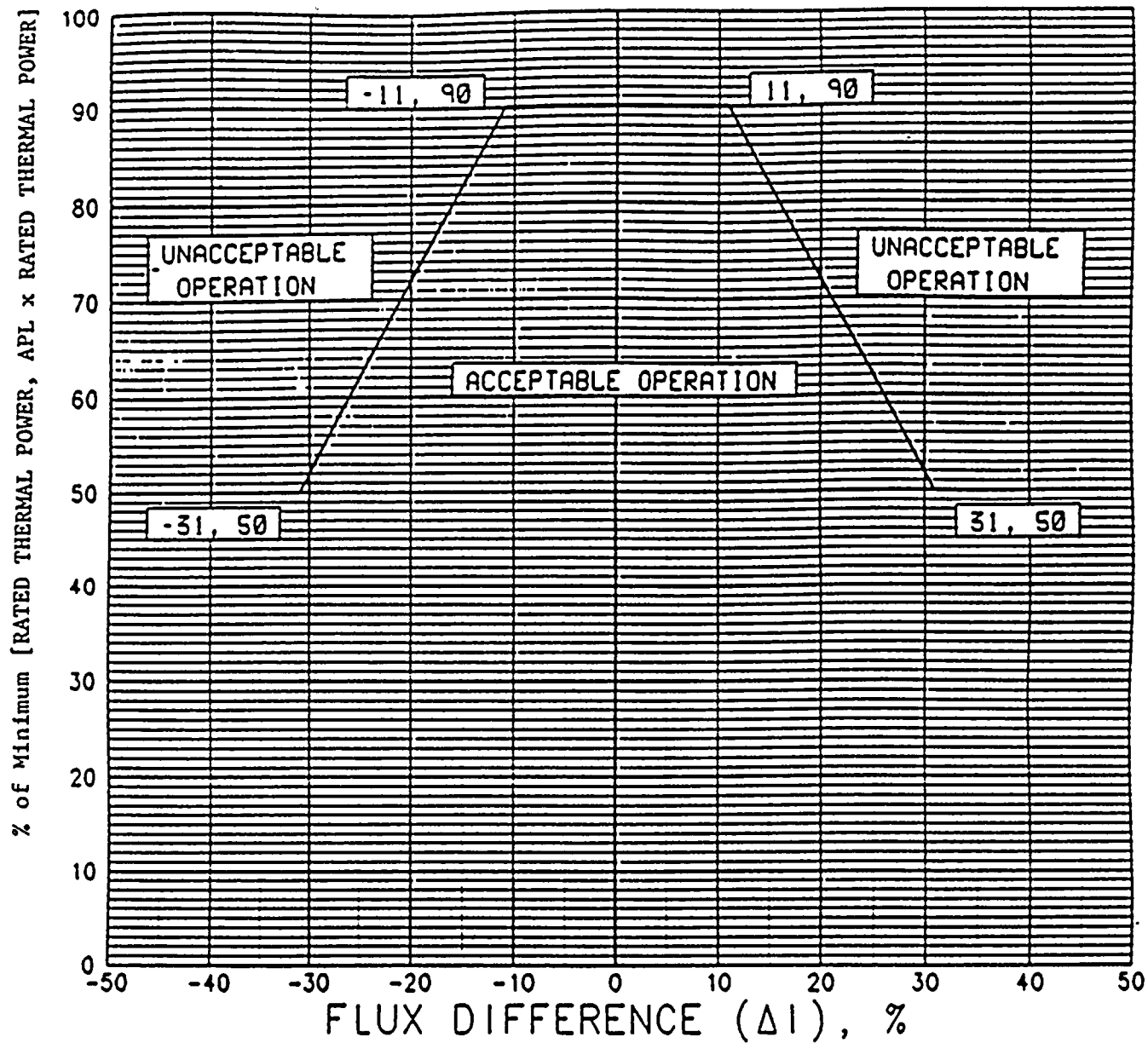


FIGURE 3  
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER

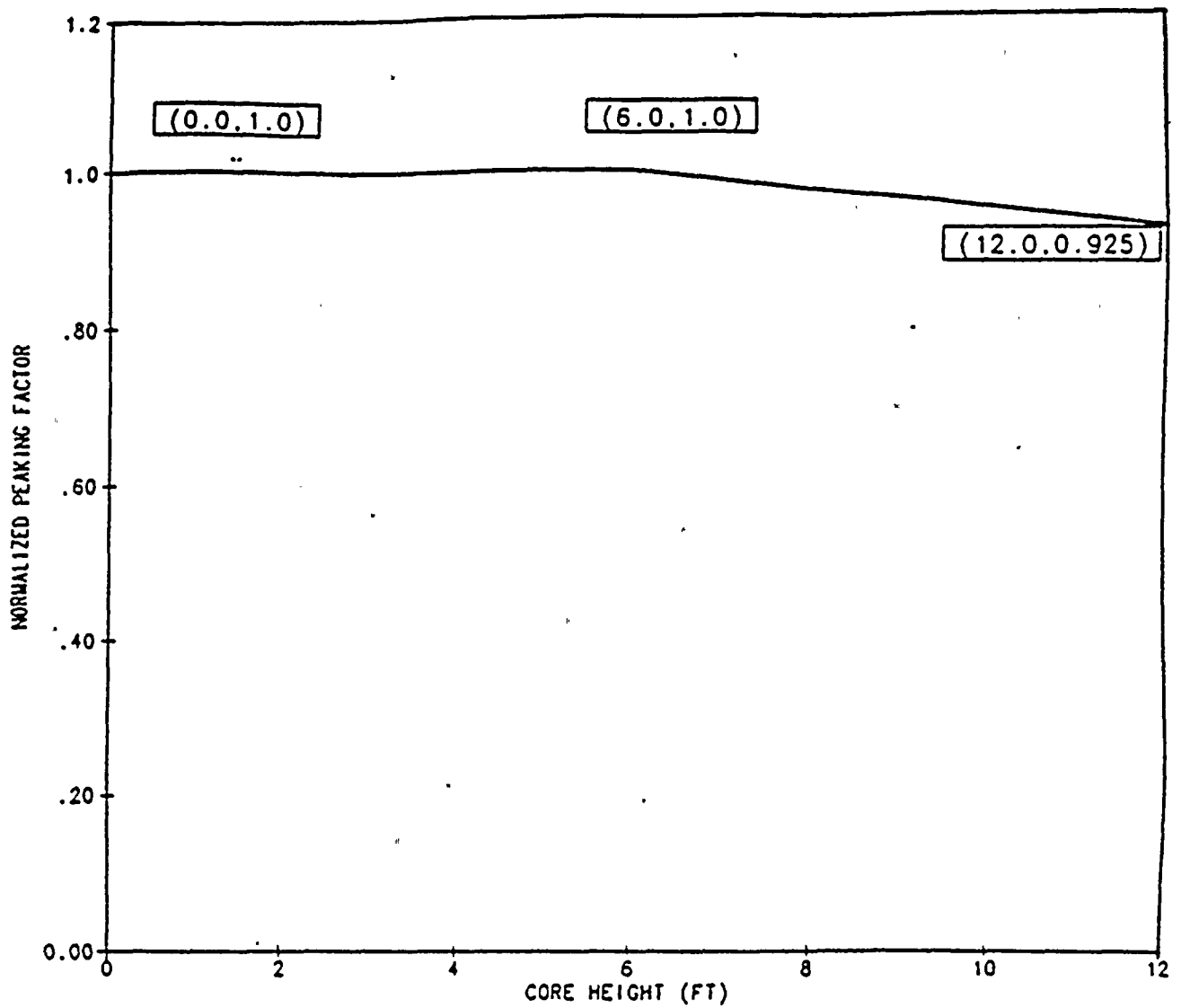


FIGURE 4

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

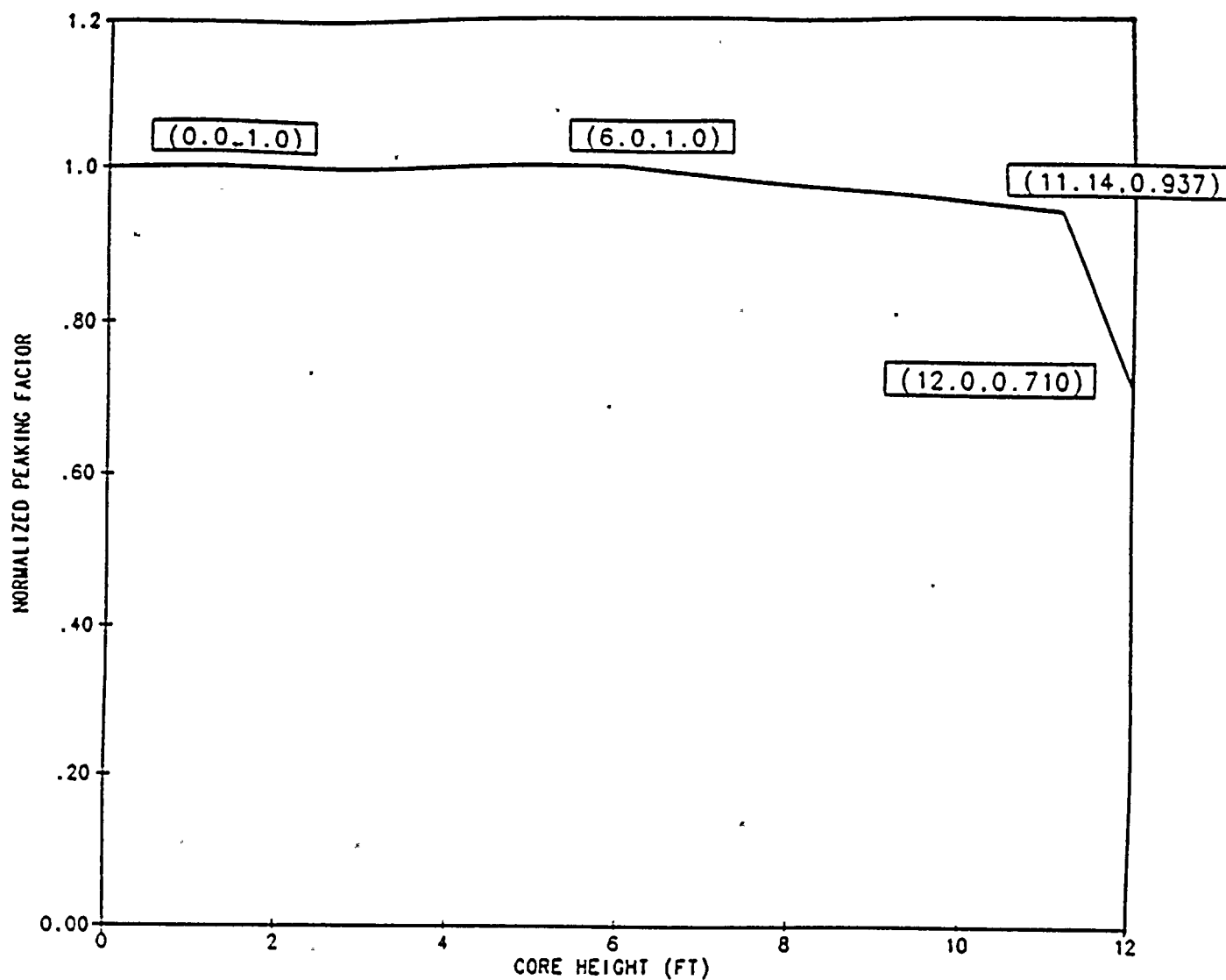


FIGURE 5  
K(Z) - NORMALIZED FQ(Z) AS A FUNCTION  
OF CORE HEIGHT FOR ANF FUEL

TABLE 1  
D. C. COOK UNIT 2 CYCLE 8  
V(Z) FUNCTION

MESH NO.	AXIAL HEIGHT	BURNUP RANGES (MWD/MTU)										
		0 150	150 1000	1000 2000	2000 4000	4000 6000	6000 8000	8000 10000	10000 12000	12000 14000	14000 16500	16500 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	1.1003	1.1003	1.1002	1.1027	1.1078	1.1154	1.1258	1.1388	1.1543	1.1774	1.1774
9	1.6	1.1001	1.1001	1.1001	1.1024	1.1071	1.1143	1.1241	1.1363	1.1508	1.1724	1.1724
10	1.8	1.0987	1.0987	1.0987	1.1018	1.1061	1.1127	1.1217	1.1330	1.1464	1.1664	1.1664
11	2.0	1.0991	1.0991	1.0990	1.1008	1.1047	1.1107	1.1188	1.1290	1.1413	1.1595	1.1595
12	2.2	1.0982	1.0982	1.0980	1.0995	1.1029	1.1082	1.1154	1.1245	1.1353	1.1515	1.1515
13	2.4	1.0971	1.0971	1.0967	1.0979	1.1008	1.1052	1.1114	1.1192	1.1286	1.1427	1.1427
14	2.6	1.0957	1.0957	1.0953	1.0960	1.0982	1.1018	1.1069	1.1134	1.1213	1.1331	1.1331
15	2.8	1.0941	1.0941	1.0936	1.0938	1.0954	1.0981	1.1020	1.1071	1.1133	1.1226	1.1226
16	3.0	1.0920	1.0920	1.0915	1.0919	1.0926	1.0938	1.0967	1.1007	1.1058	1.1131	1.1131
17	3.2	1.0901	1.0907	1.0909	1.0909	1.0909	1.0909	1.0912	1.0935	1.0966	1.1014	1.1014
18	3.4	1.0889	1.0900	1.0902	1.0902	1.0898	1.0878	1.0873	1.0888	1.0908	1.0941	1.0941
19	3.6	1.0884	1.0894	1.0897	1.0897	1.0889	1.0861	1.0855	1.0878	1.0895	1.1076	1.1076
20	3.8	1.0879	1.0890	1.0890	1.0890	1.0881	1.0872	1.0921	1.0992	1.1082	1.1223	1.1223
21	4.0	1.0873	1.0885	1.0885	1.0884	1.0872	1.0902	1.0969	1.1061	1.1176	1.1253	1.1253
22	4.2	1.0866	1.0879	1.0880	1.0880	1.0877	1.0933	1.1019	1.1132	1.1271	1.1483	1.1483
23	4.4	1.0863	1.0873	1.0876	1.0876	1.0893	1.0962	1.1064	1.1197	1.1359	1.1604	1.1604
24	4.6	1.0862	1.0866	1.0870	1.0870	1.0908	1.0989	1.1106	1.1256	1.1439	1.1715	1.1715
25	4.8	1.0857	1.0862	1.0863	1.0865	1.0921	1.1012	1.1142	1.1308	1.1508	1.1809	1.1809
26	5.0	1.0858	1.0858	1.0858	1.0867	1.0930	1.1032	1.1176	1.1360	1.1582	1.1915	1.1915
27	5.2	1.0861	1.0861	1.0850	1.0865	1.0933	1.1047	1.1208	1.1415	1.1667	1.2044	1.2044
28	5.4	1.0860	1.0860	1.0843	1.0858	1.0934	1.1056	1.1236	1.1468	1.1750	1.2175	1.2175
29	5.6	1.0857	1.0857	1.0836	1.0847	1.0932	1.1060	1.1256	1.1509	1.1817	1.2283	1.2283
30	5.8	1.0850	1.0850	1.0827	1.0837	1.0924	1.1057	1.1266	1.1537	1.1869	1.2370	1.2370
31	6.0	1.0839	1.0839	1.0818	1.0827	1.0911	1.1048	1.1268	1.1554	1.1904	1.2435	1.2435
32	6.2	1.0823	1.0823	1.0804	1.0812	1.0892	1.1031	1.1259	1.1556	1.1922	1.2476	1.2476
33	6.4	1.0803	1.0803	1.0785	1.0792	1.0867	1.1006	1.1239	1.1545	1.1921	1.2493	1.2493
34	6.6	1.0778	1.0778	1.0761	1.0767	1.0835	1.0973	1.1209	1.1520	1.1902	1.2484	1.2484
35	6.8	1.0745	1.0745	1.0732	1.0734	1.0796	1.0927	1.1164	1.1476	1.1862	1.2450	1.2450
36	7.0	1.0715	1.0715	1.0698	1.0703	1.0749	1.0885	1.1127	1.1434	1.1812	1.2389	1.2389
37	7.2	1.0696	1.0696	1.0670	1.0674	1.0726	1.0874	1.1097	1.1390	1.1752	1.2303	1.2303
38	7.4	1.0680	1.0680	1.0650	1.0642	1.0706	1.0846	1.1055	1.1331	1.1672	1.2191	1.2191
39	7.6	1.0654	1.0654	1.0625	1.0614	1.0682	1.0811	1.1005	1.1261	1.1575	1.2055	1.2055
40	7.8	1.0672	1.0672	1.0636	1.0609	1.0646	1.0755	1.0926	1.1158	1.1448	1.1894	1.1894
41	8.0	1.0719	1.0719	1.0685	1.0658	1.0677	1.0763	1.0903	1.1094	1.1335	1.1708	1.1708
42	8.2	1.0768	1.0768	1.0748	1.0732	1.0759	1.0828	1.0931	1.1071	1.1246	1.1515	1.1515
43	8.4	1.0815	1.0815	1.0806	1.0804	1.0828	1.0874	1.0941	1.1030	1.1138	1.1303	1.1303
44	8.6	1.0861	1.0864	1.0869	1.0882	1.0899	1.0921	1.0947	1.0978	1.1012	1.1062	1.1062
45	8.8	1.0805	1.0813	1.0822	1.0839	1.0853	1.0885	1.0974	1.0982	1.0987	1.0991	1.0991
46	9.0	1.0948	1.0955	1.0963	1.0979	1.0993	1.1004	1.1014	1.1023	1.1029	1.1035	1.1035
47	9.2	1.0887	1.0893	1.0899	1.1012	1.1025	1.1038	1.1052	1.1066	1.1079	1.1098	1.1098
48	9.4	1.1024	1.1027	1.1031	1.1042	1.1054	1.1069	1.1087	1.1107	1.1129	1.1160	1.1160
49	9.6	1.1057	1.1059	1.1063	1.1073	1.1086	1.1104	1.1127	1.1153	1.1183	1.1226	1.1226
50	9.8	1.1091	1.1092	1.1095	1.1105	1.1120	1.1141	1.1168	1.1197	1.1233	1.1286	1.1286
51	10.0	1.1122	1.1124	1.1128	1.1138	1.1155	1.1178	1.1208	1.1240	1.1279	1.1338	1.1338
52	10.2	1.1149	1.1152	1.1156	1.1170	1.1188	1.1212	1.1242	1.1277	1.1318	1.1376	1.1376
53	10.4	1.1171	1.1174	1.1180	1.1195	1.1215	1.1240	1.1271	1.1307	1.1348	1.1407	1.1407
54	10.6	1.1187	1.1191	1.1197	1.1214	1.1235	1.1262	1.1294	1.1332	1.1375	1.1436	1.1436
55	10.8	1.1199	1.1203	1.1209	1.1226	1.1249	1.1278	1.1312	1.1352	1.1398	1.1462	1.1462
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 Specifications.