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U. S. Nuclear Regulatory Commission  
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Washington, DC 20555-0001

Donald C. Cook Nuclear Plant Unit 1  
CORE OPERATING LIMITS REPORT

Indiana Michigan Power Company, the licensee for Donald C. Cook Nuclear Plant Unit 1, is submitting the Core Operating Limits Report (COLR) for Unit 1, Cycle 19, in accordance with Technical Specification 6.9.1.9.4.

The Unit 1 Cycle 19 COLR is provided as an attachment to this letter.

There are no new commitments made in this submittal. Should you have any questions, please contact Mr. Brian D. Mann, Acting Manager of Regulatory Affairs, at (269) 697-5806.

Sincerely,

A handwritten signature in black ink, appearing to read 'John A. Zwolinski', is written over a faint, larger version of the same signature.

John A. Zwolinski  
Director of Design Engineering and Regulatory Affairs

Attachment

DB/rdw

c: K. D. Curry, Ft. Wayne AEP, w/o attachment  
J. L. Caldwell, NRC Region III  
J. T. King, MPSC, w/o attachment  
MDEQ – WHMD/HWRPS, w/o attachment  
M. A. Shuaibi, NRC Washington, DC

A001

bc: M. J. Finissi, w/o attachment  
D. W. Jenkins, w/o attachment  
J. N. Jensen  
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M. K. Nazar  
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M. K. Scarpello, w/o attachment  
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J. A. Zwolinski

**Donald C. Cook Nuclear Plant**  
**Unit 1 Cycle 19**  
**Core Operating Limits Report**

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Donald C. Cook Nuclear Plant Unit 1 Cycle 19 design 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 Limit
3/4.1.3.5	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)

## 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 Specifications 6.9.1.9.

### 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  $-4.54 \times 10^{-4} \Delta k/k/^\circ F$ .

This limit is based on a  $T_{avg}$  program with HFP  $T_{avg}$  of 554.0 - 558.0 °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  $-3.84 \times 10^{-4} \Delta k/k/^\circ F$  at a vessel average temperature of 554.0 – 558.0 °F.

### 2.2 Rod Drop Time Drop Height (Specification 3/4.1.3.3)

#### 2.2.1 All rods shall be dropped from 228 steps.

### 2.3 Shutdown Rod Insertion Limit (Specification 3/4.1.3.4)

#### 2.3.1 The shutdown rods shall be withdrawn to 228 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 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 (AFD) (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.
- 2.6 Heat Flux Hot Channel Factor -  $F_Q(Z)$  (Specification 3.2.2)
- $$F_Q(Z) \leq \frac{CF_Q}{P} * K(Z) \quad \text{for } P > 0.5$$
- $$F_Q(Z) \leq 2 * CF_Q * K(Z) \quad \text{for } P \leq 0.5$$
- where:  $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$
- 2.6.1  $CF_Q = 2.15$  for Westinghouse Fuel.
- 2.6.2  $K(Z)$  is provided in Figure 4 for Westinghouse Fuel.

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

$$F_{\Delta H}^N \leq CF_{\Delta H} * (1 + PF_{\Delta H} *(1-P))$$

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

2.7.1  $CF_{\Delta H} = 1.49$  for Westinghouse Fuel.2.7.2  $PF_{\Delta H} = 0.3$ 

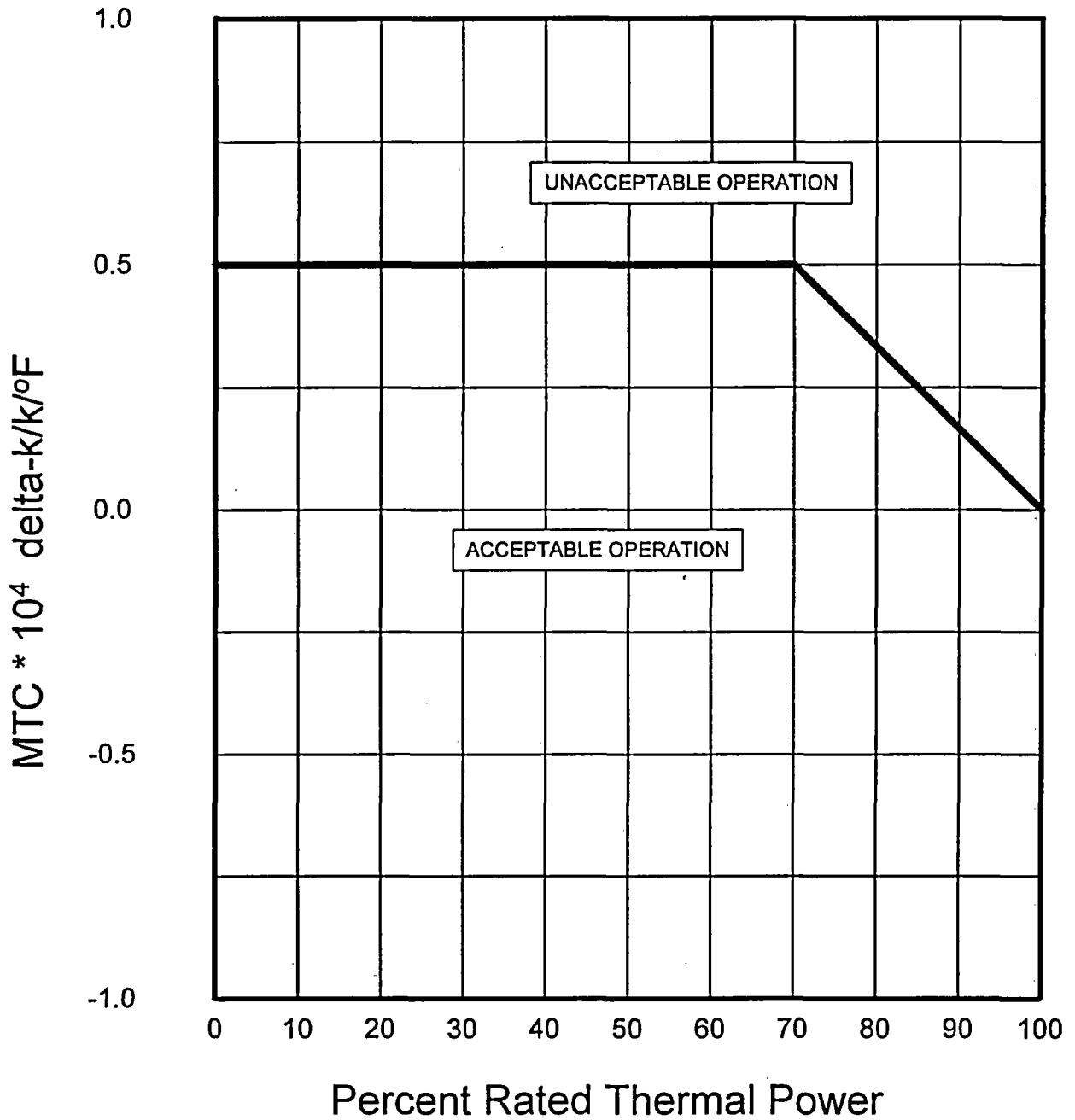
## 2.8 Allowable Power Level - APL (Specification 3.2.6)

$$\text{APL} = \min \text{ over } Z \text{ of } \frac{CF_Q * K(Z)}{F_Q(Z) * V(Z) * F_P} * 100\%$$

2.8.1  $V(Z)$  is provided in Table 1 for  $\pm 5\%$  AFD target band2.8.2  $CF_Q$  and  $K(Z)$  are provided in COLR Sections 2.6.1 and 2.6.2, respectively2.8.3 For Cycle 19,  $F_P = 1.02$  for all burnups.

FIGURE 1

MODERATOR TEMPERATURE COEFFICIENT (MTC)





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

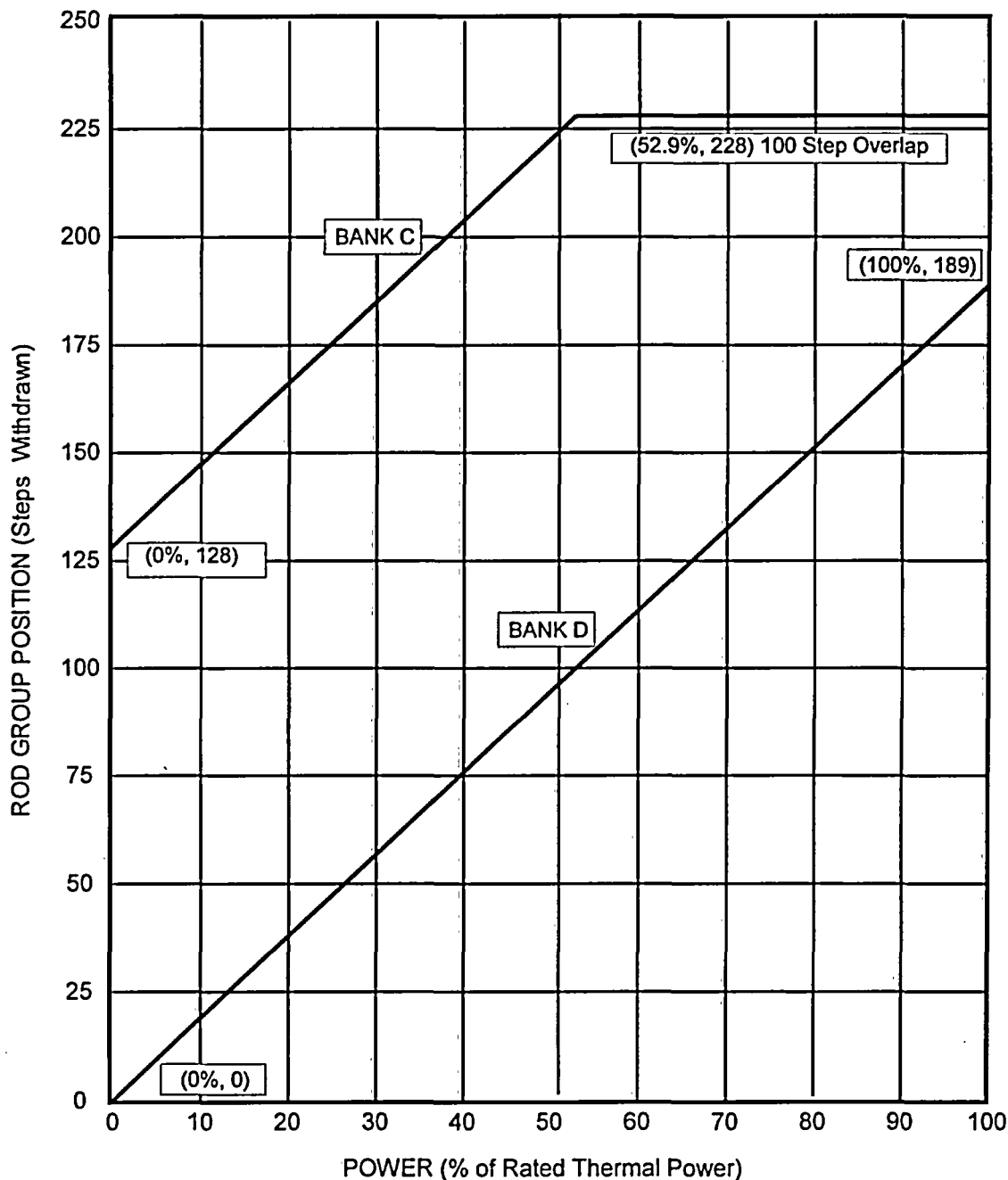
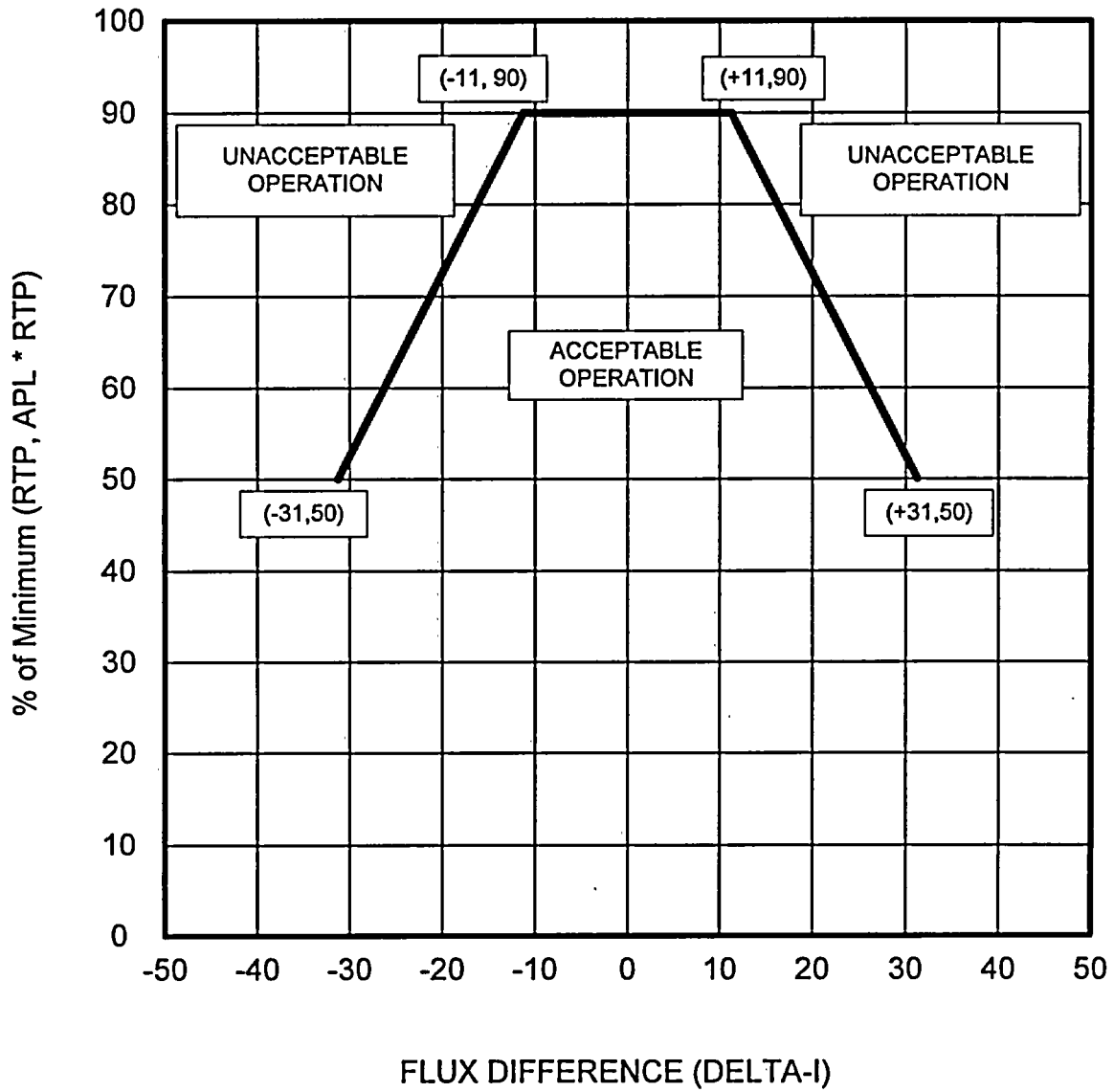
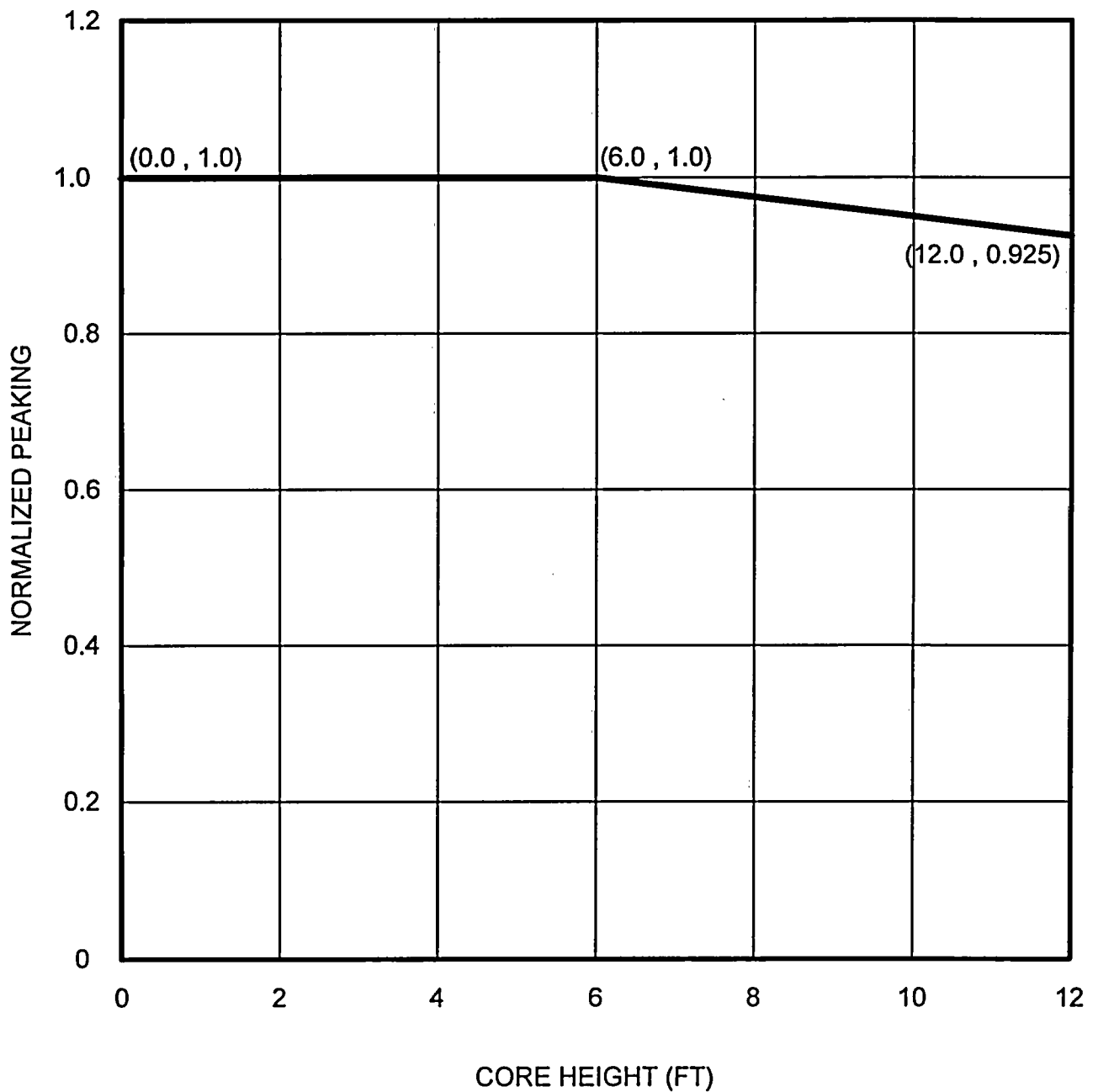


FIGURE 3

AXIAL FLUX DIFFERENCE AS A FUNCTION OF RATED THERMAL POWER



**FIGURE 4**  
**K(Z) – NORMALIZED  $F_q(Z)$  AS A FUNCTION OF CORE HEIGHT**  
**(FOR WESTINGHOUSE FUEL)**



**TABLE 1**  
**DONALD C. COOK UNIT 1 CYCLE 19**  
**V(Z) FUNCTION**

Node No.	Height (feet)	Burnup (MWD/MTU)										
		150	1000	2000	4000	6000	8000	10000	12000	14000	16000	17900
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	1.0988	1.0992	1.0999	1.1019	1.1047	1.1083	1.1127	1.1180	1.1242	1.1307	1.1364
8	1.4	1.0973	1.0979	1.0988	1.1012	1.1042	1.1078	1.1121	1.1171	1.1229	1.1289	1.1342
9	1.6	1.0972	1.0978	1.0987	1.1010	1.1038	1.1071	1.1111	1.1157	1.1210	1.1265	1.1313
10	1.8	1.0970	1.0976	1.0984	1.1005	1.1030	1.1061	1.1096	1.1138	1.1185	1.1234	1.1278
11	2.0	1.0965	1.0971	1.0978	1.0997	1.1019	1.1046	1.1077	1.1114	1.1155	1.1197	1.1235
12	2.2	1.0959	1.0963	1.0970	1.0986	1.1005	1.1028	1.1055	1.1085	1.1119	1.1155	1.1187
13	2.4	1.0950	1.0954	1.0959	1.0972	1.0988	1.1007	1.1028	1.1052	1.1079	1.1108	1.1133
14	2.6	1.0938	1.0941	1.0945	1.0955	1.0967	1.0981	1.0997	1.1016	1.1036	1.1058	1.1077
15	2.8	1.0925	1.0927	1.0929	1.0935	1.0943	1.0952	1.0963	1.0975	1.0989	1.1004	1.1017
16	3.0	1.0910	1.0911	1.0912	1.0915	1.0919	1.0923	1.0928	1.0933	1.0939	1.0946	1.0951
17	3.2	1.0895	1.0895	1.0896	1.0896	1.0896	1.0896	1.0895	1.0893	1.0892	1.0890	1.0888
18	3.4	1.0883	1.0882	1.0879	1.0875	1.0871	1.0868	1.0865	1.0862	1.0859	1.0856	1.0854
19	3.6	1.0881	1.0873	1.0865	1.0852	1.0844	1.0840	1.0842	1.0849	1.0861	1.0875	1.0885
20	3.8	1.0879	1.0868	1.0857	1.0841	1.0832	1.0832	1.0839	1.0856	1.0880	1.0908	1.0930
21	4.0	1.0875	1.0862	1.0849	1.0832	1.0825	1.0829	1.0843	1.0869	1.0907	1.0949	1.0982
22	4.2	1.0869	1.0855	1.0842	1.0825	1.0821	1.0829	1.0850	1.0884	1.0932	1.0985	1.1028
23	4.4	1.0861	1.0846	1.0833	1.0817	1.0816	1.0828	1.0855	1.0898	1.0955	1.1019	1.1070
24	4.6	1.0853	1.0837	1.0824	1.0809	1.0809	1.0826	1.0858	1.0908	1.0975	1.1049	1.1109
25	4.8	1.0842	1.0828	1.0815	1.0802	1.0806	1.0826	1.0863	1.0919	1.0993	1.1073	1.1140
26	5.0	1.0830	1.0818	1.0808	1.0801	1.0810	1.0834	1.0875	1.0934	1.1009	1.1092	1.1160
27	5.2	1.0817	1.0810	1.0804	1.0805	1.0820	1.0849	1.0892	1.0950	1.1024	1.1104	1.1171
28	5.4	1.0805	1.0801	1.0800	1.0807	1.0827	1.0859	1.0903	1.0961	1.1033	1.1109	1.1175
29	5.6	1.0790	1.0790	1.0793	1.0807	1.0831	1.0865	1.0910	1.0967	1.1036	1.1108	1.1171
30	5.8	1.0774	1.0778	1.0784	1.0803	1.0831	1.0868	1.0913	1.0968	1.1032	1.1100	1.1159
31	6.0	1.0756	1.0763	1.0772	1.0797	1.0828	1.0866	1.0911	1.0963	1.1022	1.1084	1.1139
32	6.2	1.0737	1.0746	1.0759	1.0788	1.0821	1.0860	1.0903	1.0951	1.1005	1.1061	1.1111
33	6.4	1.0718	1.0730	1.0744	1.0776	1.0810	1.0848	1.0889	1.0933	1.0981	1.1030	1.1074
34	6.6	1.0701	1.0714	1.0729	1.0762	1.0796	1.0832	1.0869	1.0909	1.0950	1.0992	1.1031
35	6.8	1.0685	1.0694	1.0706	1.0733	1.0764	1.0798	1.0837	1.0880	1.0927	1.0976	1.1020
36	7.0	1.0672	1.0681	1.0693	1.0719	1.0750	1.0784	1.0823	1.0866	1.0914	1.0963	1.1007
37	7.2	1.0655	1.0670	1.0688	1.0724	1.0760	1.0796	1.0831	1.0877	1.0904	1.0940	1.0974
38	7.4	1.0635	1.0658	1.0684	1.0732	1.0776	1.0815	1.0849	1.0887	1.0903	1.0925	1.0949
39	7.6	1.0661	1.0685	1.0711	1.0759	1.0800	1.0834	1.0862	1.0882	1.0895	1.0905	1.0919
40	7.8	1.0711	1.0732	1.0755	1.0795	1.0827	1.0852	1.0869	1.0877	1.0877	1.0874	1.0875
41	8.0	1.0759	1.0776	1.0795	1.0825	1.0848	1.0864	1.0871	1.0869	1.0860	1.0847	1.0839
42	8.2	1.0805	1.0816	1.0827	1.0845	1.0857	1.0865	1.0867	1.0863	1.0853	1.0842	1.0834
43	8.4	1.0849	1.0850	1.0852	1.0854	1.0855	1.0856	1.0856	1.0856	1.0856	1.0855	1.0855
44	8.6	1.0891	1.0885	1.0880	1.0870	1.0863	1.0858	1.0857	1.0859	1.0863	1.0869	1.0872
45	8.8	1.0930	1.0918	1.0906	1.0887	1.0874	1.0868	1.0868	1.0876	1.0891	1.0909	1.0922
46	9.0	1.0966	1.0949	1.0932	1.0907	1.0891	1.0886	1.0891	1.0908	1.0936	1.0968	1.0993
47	9.2	1.0998	1.0977	1.0955	1.0923	1.0905	1.0900	1.0909	1.0934	1.0973	1.1018	1.1052
48	9.4	1.1027	1.1001	1.0975	1.0937	1.0916	1.0911	1.0924	1.0956	1.1006	1.1064	1.1108
49	9.6	1.1051	1.1026	1.1002	1.0967	1.0949	1.0946	1.0960	1.0993	1.1043	1.1100	1.1144
50	9.8	1.1073	1.1053	1.1032	1.1003	1.0989	1.0988	1.1003	1.1034	1.1081	1.1134	1.1175
51	10.0	1.1094	1.1076	1.1058	1.1033	1.1022	1.1024	1.1041	1.1073	1.1119	1.1171	1.1213
52	10.2	1.1109	1.1094	1.1078	1.1058	1.1051	1.1057	1.1076	1.1109	1.1156	1.1209	1.1251
53	10.4	1.1120	1.1107	1.1095	1.1080	1.1076	1.1085	1.1106	1.1141	1.1188	1.1241	1.1283
54	10.6	1.1122	1.1112	1.1103	1.1094	1.1095	1.1108	1.1131	1.1166	1.1213	1.1265	1.1308
55	10.8	1.1157	1.1145	1.1134	1.1121	1.1120	1.1130	1.1152	1.1186	1.1233	1.1284	1.1327
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 excluded as per Technical Specifications.