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Donald C. Cook Nuclear Plant Unit 2
CORE OPERATING LIMITS REPORT, REVISION 2

Indiana Michigan Power Company (I&M), the Licensee for Donald C. Cook Nuclear Plant Unit 2, is submitting revision 2 to the Core Operating Limits Report (COLR) for Unit 2, Cycle 12, in accordance with Technical Specification 6.9.1.9.4. The Unit 2 Cycle 12 COLR is updated to account for the change in isotopic inventory of burned assemblies due to radioactive decay during the extended shutdown. The end of life moderator temperature coefficient limits, Fp penalty multiplier, and V(Z) functions specified in the COLR are updated to reflect a recent analysis based on the current core isotopic inventory.

The complete document with this change is provided as an attachment to this letter.

Should you have any questions, please contact Brian McIntyre, Manager of Regulatory Licensing at (616) 697-5806.

Sincerely,

A handwritten signature in black ink, appearing to read 'Robert C. Godley'.

Robert C. Godley
Director of Regulatory Affairs

/dms

Attachments

c: J. E. Dyer
MDEQ - DW & RPD
NRC Resident Inspector
R. Whale

**Donald C. Cook Nuclear Plant
Unit 2 Cycle 12**

**Core Operating Limits Report
Revision 2**

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for the Donald C. Cook Nuclear Plant Unit 2 Cycle 12 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 (MTC)
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)

2.0 OPERATING LIMITS

The cycle-specific parameter limits 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 6.9.1.9.

2.1 Moderator Temperature Coefficient (Technical 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 or equal to the value given in Figure 1.

The EOL/ARO/RTP-MTC shall be less negative than or equal to $-4.40\text{E-}4 \Delta k/k/^{\circ}\text{F}$.

This limit is based on a T_{avg} program with HFP vessel T_{avg} of 571.5 °F to 576.5 °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 $-3.50\text{E-}4 \Delta k/k/^{\circ}\text{F}$ at a HFP vessel T_{avg} of 571.5 °F to 576.5 °F

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

2.2.1 All rods shall be dropped from 225 steps.

2.3 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.3.1 The shutdown rods shall be withdrawn to at least 225 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 Banks shall overlap by 97 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.

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

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

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

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

2.6.1 $CF_Q = 2.335$

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

2.7 Nuclear Enthalpy Rise 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 $CF_{\Delta H} = 1.56$

2.7.2 $PF_{\Delta H} = 0.3$

2.8 Allowable Power Level - APL (Specification 3.2.6)

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

2.8.1 $V(Z)$ is provided in Table 1 for $\pm 5\%$ AFD target band

2.8.2 CF_Q and $K(Z)$ are provided in COLR Sections 2.6.1 and 2.6.2, respectively

2.8.3 The following table shows F_P values which correspond to F_Q margin decreases that are greater than 2% per 31 Effective Full Power Days (EFPD). These values shall be used to adjust APL as per Surveillance Requirement 4.2.6.2. A 1.02 penalty factor shall be used at all cycle burnups that are outside this range.

Cycle Burnup (MWD/MTU)	F_P Penalty Multiplier
0	1.0404
150	1.0404
311	1.0563
472	1.0583
633	1.0567
794	1.0548
955	1.0524
1116	1.0494
1277	1.0459
1438	1.0418
1599	1.0374
1760	1.0326
1921	1.0275
2082	1.0224
2243	1.0200

The burnup range only covers where F_P exceeds 1.02. Linear interpolation is adequate for intermediate cycle burnups.

Figure 1
MODERATOR TEMPERATURE COEFFICIENT (MTC) LIMITS

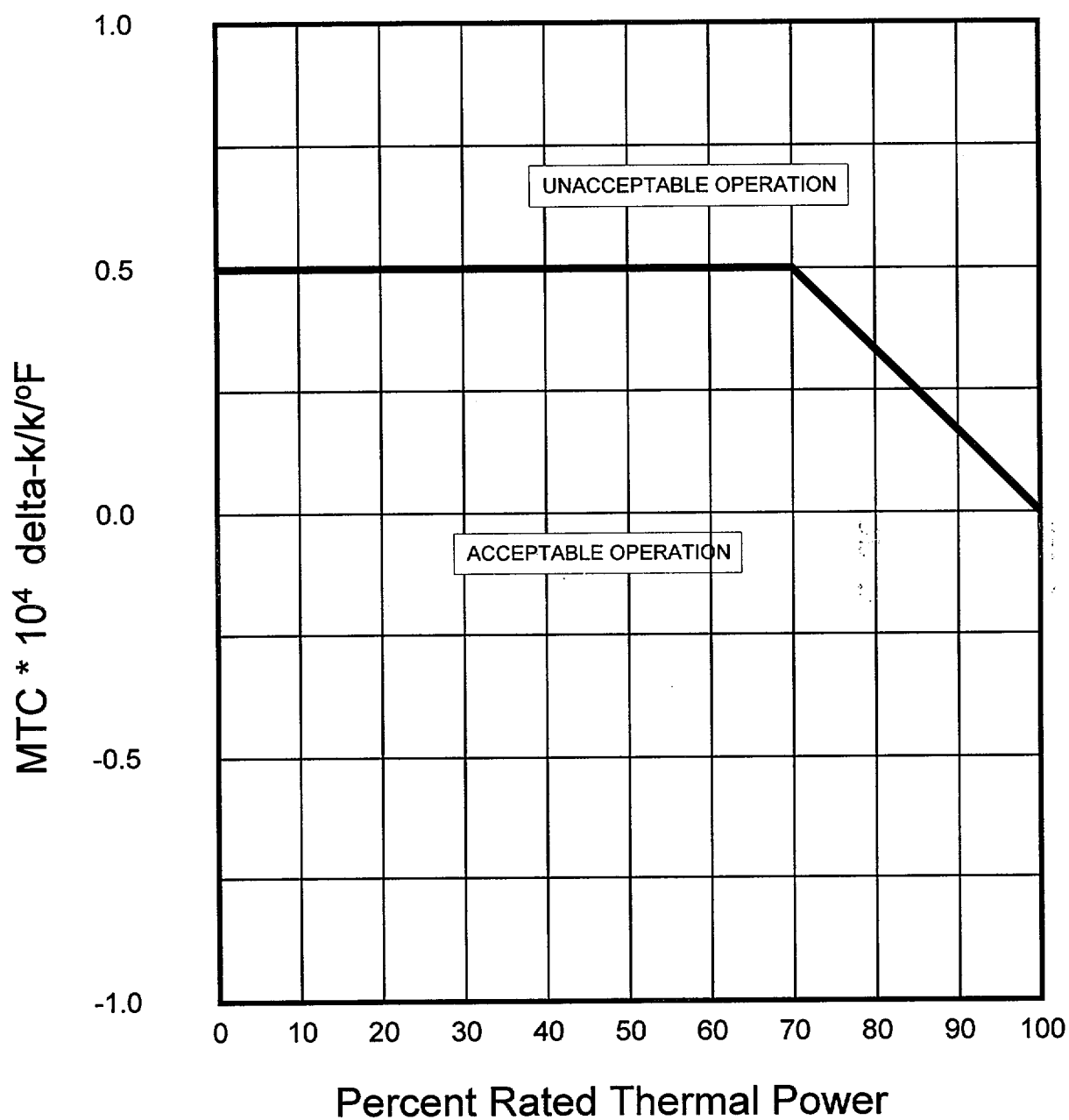


Figure 2
**ROD BANK INSERTION LIMITS VERSUS THERMAL POWER FOUR-
LOOP OPERATION**

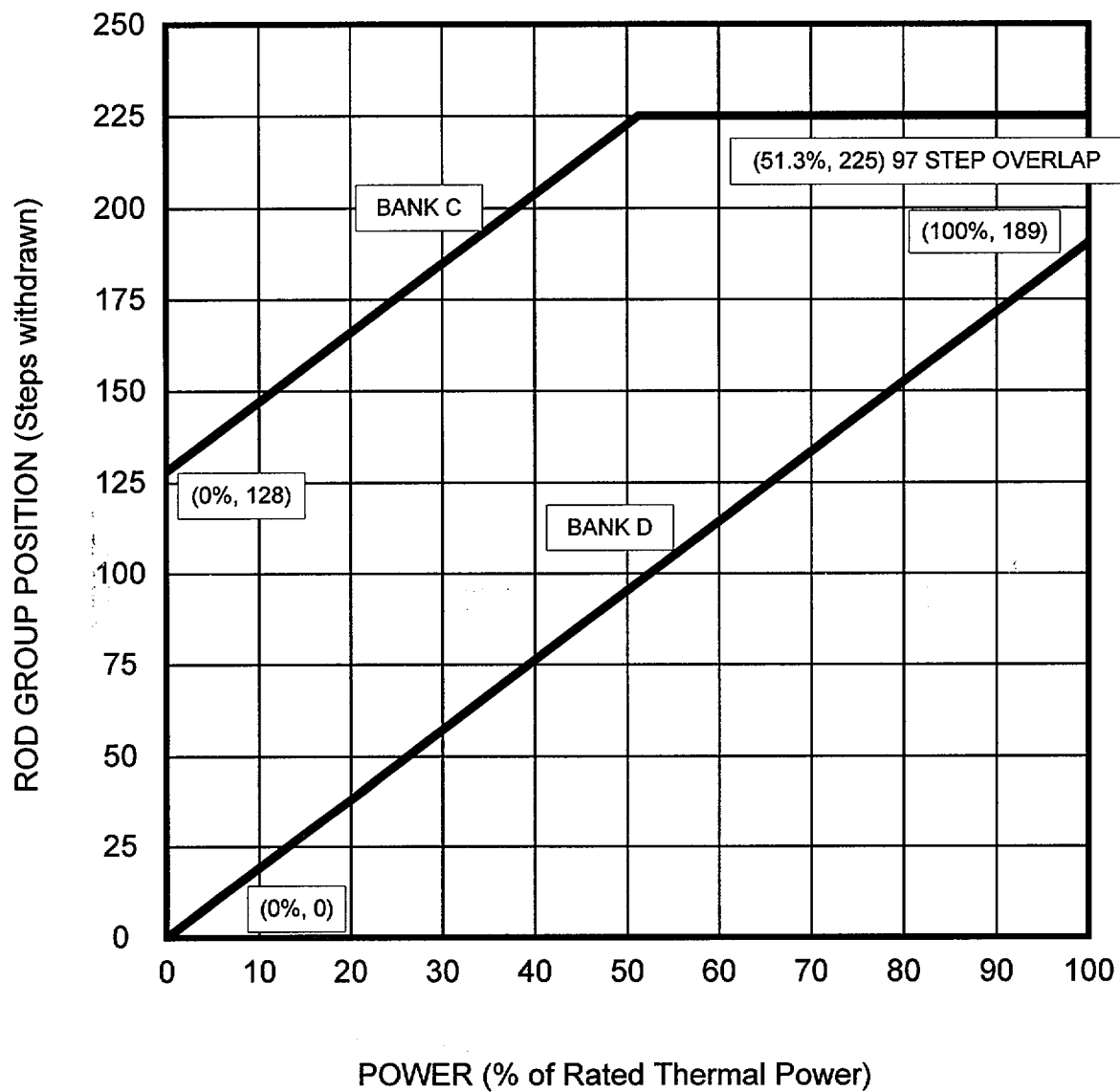


Figure 3
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED
THERMAL POWER (RTP)

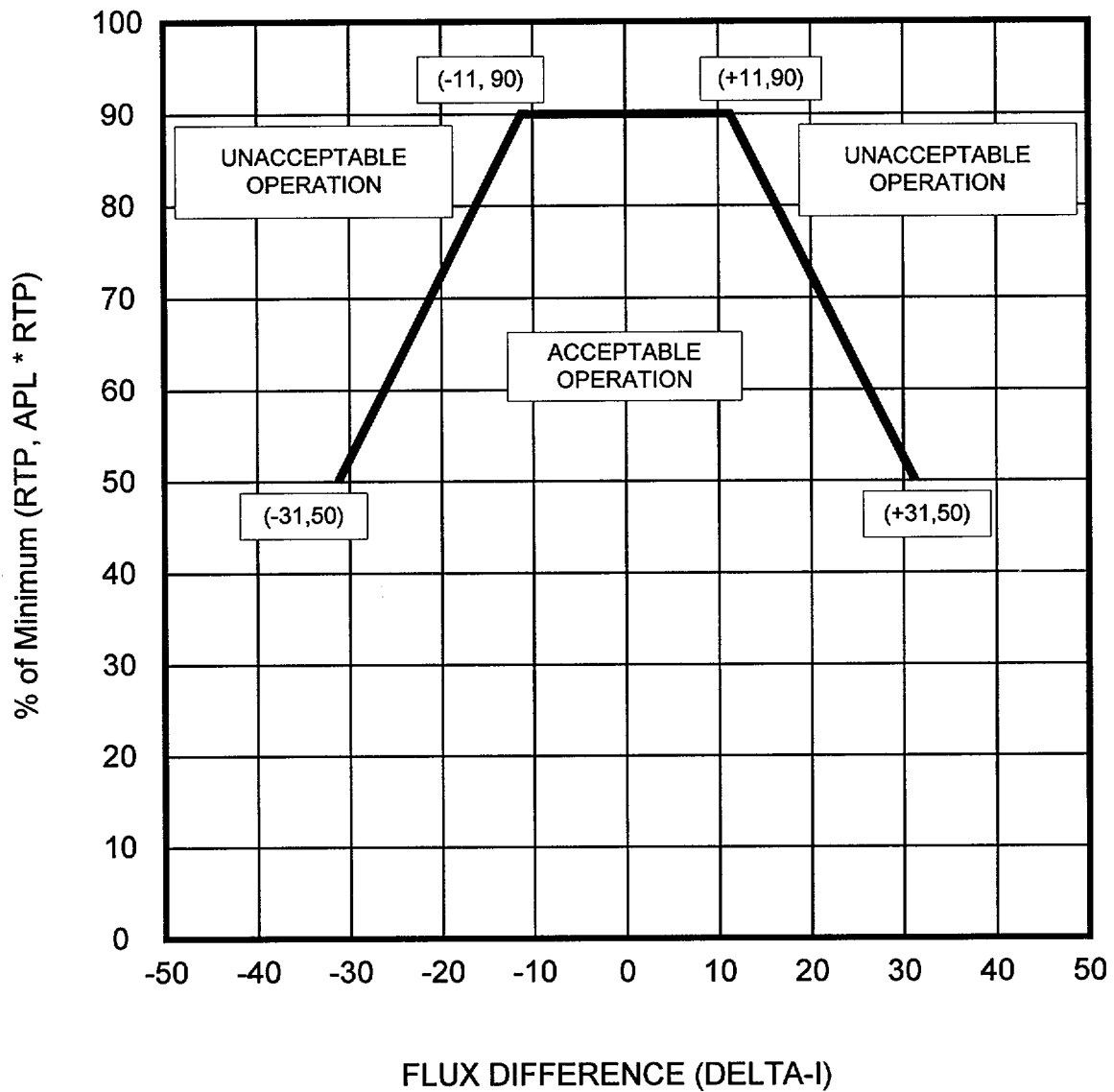


Figure 4
K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT

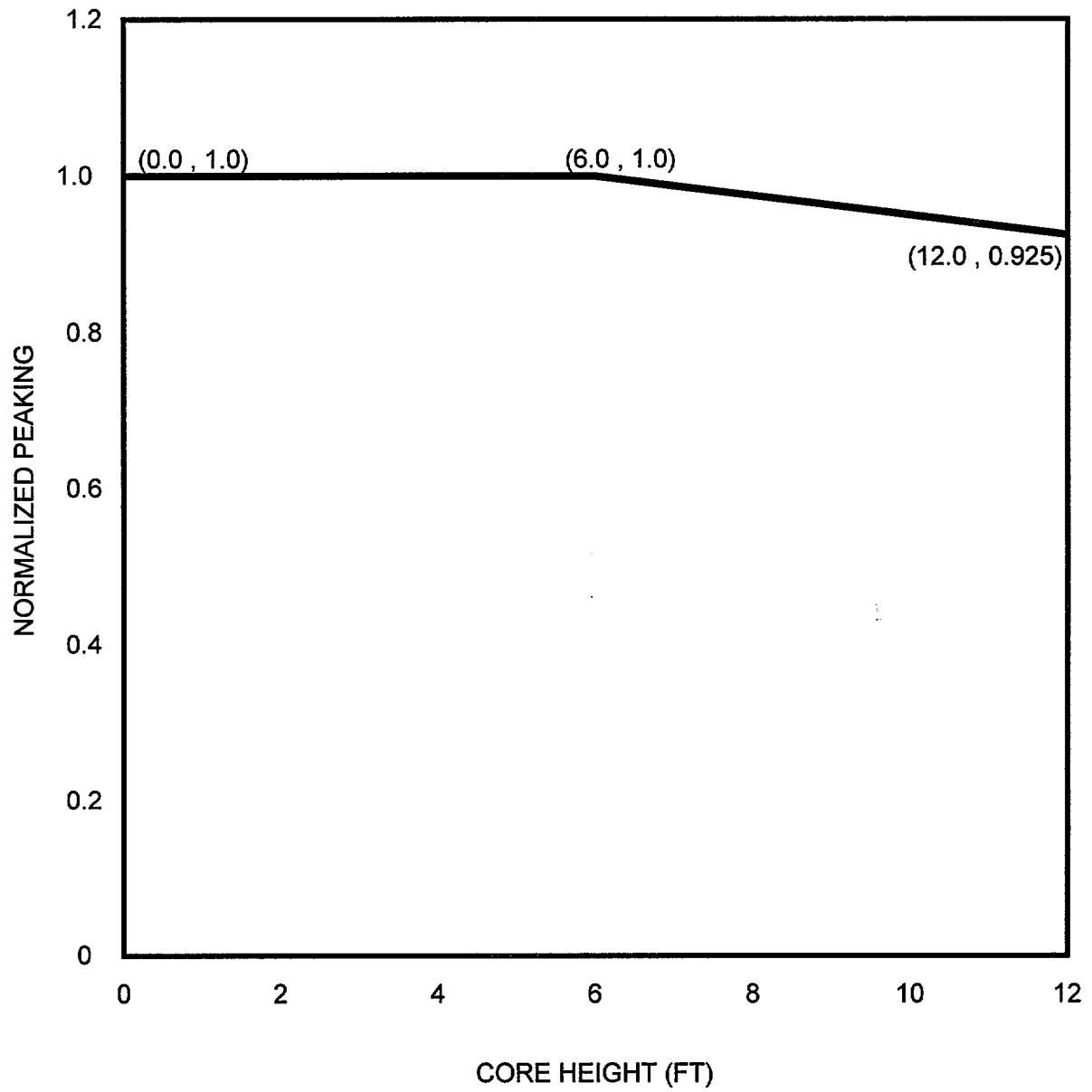


Table 1
Donald C. Cook Unit 2 Cycle 12
IRI Mitigation LP, 3411 MWt, As-Burned Cycle 11
V(Z) Function

PT	Height (FT.)	Burnup (MWD/MTU)												
		150	1000	2000	3000	4000	6000	8000	10000	12000	14000	16000	18000	22860
1	.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	.2000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	.4000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	.6000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	.8000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.2000	1.1070	1.0976	1.0888	1.0831	1.0811	1.0857	1.0968	1.1090	1.1184	1.1255	1.1316	1.1382	1.1560
8	1.4000	1.1062	1.0976	1.0896	1.0845	1.0827	1.0871	1.0973	1.1087	1.1174	1.1240	1.1298	1.1360	1.1525
9	1.6000	1.1051	1.0975	1.0903	1.0857	1.0842	1.0883	1.0977	1.1081	1.1161	1.1221	1.1274	1.1330	1.1481
10	1.8000	1.1037	1.0970	1.0908	1.0869	1.0856	1.0893	1.0978	1.1070	1.1141	1.1195	1.1242	1.1292	1.1426
11	2.0000	1.1020	1.0963	1.0911	1.0878	1.0868	1.0902	1.0975	1.1055	1.1117	1.1164	1.1204	1.1246	1.1362
12	2.2000	1.0999	1.0954	1.0912	1.0887	1.0879	1.0909	1.0970	1.1037	1.1089	1.1127	1.1160	1.1194	1.1289
13	2.4000	1.0976	1.0943	1.0912	1.0893	1.0888	1.0913	1.0963	1.1016	1.1056	1.1086	1.1110	1.1135	1.1207
14	2.6000	1.0951	1.0929	1.0908	1.0897	1.0896	1.0916	1.0953	1.0992	1.1021	1.1041	1.1056	1.1071	1.1118
15	2.8000	1.0922	1.0912	1.0903	1.0899	1.0900	1.0916	1.0941	1.0965	1.0983	1.0994	1.1002	1.1008	1.1035
16	3.0000	1.0893	1.0894	1.0896	1.0899	1.0903	1.0914	1.0926	1.0936	1.0942	1.0943	1.0941	1.0936	1.0936
17	3.2000	1.0862	1.0874	1.0886	1.0896	1.0902	1.0908	1.0908	1.0906	1.0905	1.0904	1.0902	1.0899	1.0895
18	3.4000	1.0842	1.0860	1.0878	1.0890	1.0897	1.0896	1.0886	1.0877	1.0877	1.0884	1.0895	1.0909	1.0928
19	3.6000	1.0844	1.0860	1.0874	1.0884	1.0886	1.0877	1.0861	1.0854	1.0865	1.0895	1.0937	1.0989	1.1072
20	3.8000	1.0854	1.0863	1.0871	1.0876	1.0874	1.0859	1.0843	1.0842	1.0867	1.0916	1.0985	1.1069	1.1208
21	4.0000	1.0865	1.0867	1.0869	1.0868	1.0863	1.0848	1.0837	1.0844	1.0882	1.0947	1.1035	1.1143	1.1324
22	4.2000	1.0875	1.0870	1.0866	1.0861	1.0855	1.0843	1.0841	1.0859	1.0909	1.0987	1.1089	1.1214	1.1430
23	4.4000	1.0883	1.0871	1.0861	1.0853	1.0846	1.0839	1.0847	1.0879	1.0940	1.1029	1.1142	1.1279	1.1522
24	4.6000	1.0889	1.0871	1.0854	1.0842	1.0835	1.0834	1.0853	1.0897	1.0969	1.1067	1.1190	1.1337	1.1605
25	4.8000	1.0896	1.0871	1.0848	1.0832	1.0824	1.0828	1.0857	1.0913	1.0995	1.1101	1.1232	1.1387	1.1676
26	5.0000	1.0902	1.0870	1.0841	1.0822	1.0813	1.0821	1.0860	1.0926	1.1016	1.1130	1.1266	1.1428	1.1734
27	5.2000	1.0904	1.0868	1.0834	1.0812	1.0802	1.0815	1.0862	1.0936	1.1033	1.1151	1.1292	1.1459	1.1777
28	5.4000	1.0903	1.0863	1.0826	1.0802	1.0792	1.0808	1.0861	1.0942	1.1044	1.1166	1.1309	1.1479	1.1806
29	5.6000	1.0899	1.0855	1.0816	1.0790	1.0779	1.0799	1.0857	1.0943	1.1048	1.1172	1.1317	1.1488	1.1819
30	5.8000	1.0890	1.0844	1.0801	1.0774	1.0764	1.0786	1.0849	1.0939	1.1047	1.1171	1.1315	1.1484	1.1815
31	6.0000	1.0877	1.0829	1.0784	1.0755	1.0745	1.0769	1.0837	1.0930	1.1038	1.1161	1.1303	1.1468	1.1794
32	6.2000	1.0859	1.0809	1.0763	1.0733	1.0723	1.0749	1.0819	1.0914	1.1022	1.1142	1.1279	1.1438	1.1757
33	6.4000	1.0836	1.0784	1.0737	1.0707	1.0697	1.0725	1.0797	1.0893	1.0998	1.1114	1.1245	1.1396	1.1702
34	6.6000	1.0807	1.0755	1.0706	1.0676	1.0666	1.0695	1.0768	1.0864	1.0967	1.1077	1.1199	1.1341	1.1631
35	6.8000	1.0770	1.0721	1.0677	1.0649	1.0639	1.0666	1.0735	1.0824	1.0920	1.1024	1.1140	1.1274	1.1547
36	7.0000	1.0762	1.0703	1.0650	1.0615	1.0604	1.0635	1.0711	1.0805	1.0896	1.0985	1.1080	1.1189	1.1422
37	7.2000	1.0784	1.0713	1.0646	1.0603	1.0588	1.0622	1.0708	1.0806	1.0890	1.0962	1.1031	1.1109	1.1292
38	7.4000	1.0810	1.0734	1.0663	1.0618	1.0603	1.0643	1.0737	1.0838	1.0915	1.0970	1.1016	1.1065	1.1202
39	7.6000	1.0831	1.0757	1.0687	1.0643	1.0629	1.0670	1.0763	1.0862	1.0933	1.0980	1.1016	1.1052	1.1167
40	7.8000	1.0848	1.0776	1.0708	1.0665	1.0652	1.0694	1.0785	1.0881	1.0946	1.0986	1.1013	1.1038	1.1134
41	8.0000	1.0861	1.0790	1.0724	1.0683	1.0670	1.0713	1.0803	1.0895	1.0955	1.0987	1.1004	1.1017	1.1090
42	8.2000	1.0869	1.0801	1.0737	1.0697	1.0685	1.0728	1.0816	1.0904	1.0958	1.0982	1.0990	1.0992	1.1046
43	8.4000	1.0872	1.0806	1.0744	1.0706	1.0696	1.0738	1.0824	1.0908	1.0955	1.0971	1.0969	1.0958	1.0989
44	8.6000	1.0870	1.0806	1.0747	1.0710	1.0700	1.0743	1.0827	1.0907	1.0948	1.0955	1.0942	1.0918	1.0925
45	8.8000	1.0864	1.0803	1.0747	1.0712	1.0704	1.0747	1.0830	1.0910	1.0955	1.0969	1.0965	1.0952	1.0977
46	9.0000	1.0872	1.0807	1.0747	1.0711	1.0704	1.0753	1.0846	1.0937	1.0991	1.1012	1.1014	1.1008	1.1050
47	9.2000	1.0897	1.0819	1.0746	1.0704	1.0696	1.0762	1.0882	1.0996	1.1059	1.1079	1.1071	1.1049	1.1082
48	9.4000	1.0920	1.0826	1.0740	1.0689	1.0682	1.0763	1.0908	1.1045	1.1120	1.1140	1.1126	1.1095	1.1125
49	9.6000	1.0962	1.0843	1.0733	1.0668	1.0656	1.0751	1.0927	1.1093	1.1182	1.1205	1.1187	1.1147	1.1181
50	9.8000	1.1004	1.0854	1.0714	1.0630	1.0611	1.0723	1.0936	1.1138	1.1246	1.1273	1.1250	1.1202	1.1242
51	10.000	1.1042	1.0873	1.0717	1.0622	1.0600	1.0722	1.0955	1.1178	1.1298	1.1329	1.1305	1.1254	1.1299
52	10.200	1.1078	1.0904	1.0743	1.0645	1.0622	1.0747	1.0986	1.1216	1.1339	1.1371	1.1348	1.1297	1.1346
53	10.400	1.1109	1.0930	1.0764	1.0662	1.0638	1.0766	1.1012	1.1248	1.1375	1.1409	1.1386	1.1335	1.1388
54	10.600	1.1135	1.0952	1.0782	1.0677	1.0653	1.0782	1.1033	1.1273	1.1403	1.1439	1.1417	1.1367	1.1424
55	10.800	1.1157	1.0970	1.0797	1.0691	1.0665	1.0796	1.1050	1.1294	1.1425	1.1461	1.1437	1.1386	1.1441
56	11.000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
57	11.200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
58	11.400	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
59	11.600	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
60	11.800	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
61	12.000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000