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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

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

Indiana Michigan Power Company, the licensee for Donald C. Cook Nuclear Plant Unit 2, is submitting a revised Core Operating Limits Report (COLR) for Unit 2 Cycle 19 in accordance with Technical Specification 5.6.5. The Unit 2 Cycle 19 COLR has been revised to reflect a new large-break-loss-of-coolant accident analysis approved by the Nuclear Regulatory Commission as License Amendment 297, (ADAMS Accession No. ML110730783). Revision 1 of the Unit 2 Cycle 19 COLR is provided as an enclosure to this letter.

There are no new or revised commitments in this submittal. Should you have any questions, please contact Mr. Michael K. Scarpello, Regulatory Affairs Manager, at (269) 466-2649.

Sincerely,

Joel P. Gebbie
Site Vice President

JRW/jen

Enclosure:

Donald C. Cook Nuclear Plant Unit 2 Cycle 19 Core Operating Limits Report, Revision 1

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ENCLOSURE TO AEP-NRC-2011-49

Donald C. Cook Nuclear Plant Unit 2 Cycle 19

Core Operating Limits Report
Revision 1

Donald C. Cook Nuclear Plant
Unit 2 Cycle 19

Core Operating Limits Report (COLR)

Revision 1

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for the Donald C. Cook Nuclear Plant Unit 2 Cycle 19 has been prepared in accordance with the requirements of Technical Specification 5.6.5.

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the Nuclear Regulatory Commission (NRC) in:

a. WCAP-9272-P-A, Westinghouse Reload Safety Evaluation Methodology, July 1985

b. WCAP-8385, Power Distribution Control and Load Following Procedures – Topical Report, September 1974

c. WCAP-10216-P-A, Rev. 1A, Relaxation of Constant Axial Offset Control/F_Q Surveillance Technical Specification, February 1994

d. Plant-specific adaptation (approved by Amendment 297, dated March 31, 2011) of WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," Revision 0 (Westinghouse Proprietary), approved by letter from H. N. Berkow, NRC, to J. A. Gresham, Westinghouse Electric Company, dated November 5, 2004

e. WCAP-12610-P-A, VANTAGE+ Fuel Assembly Reference Core Report, April 1995

f. WCAP-8745-P-A, Design Bases for the Thermal Overpower ΔT and Thermal Overtemperature ΔT Trip Functions, September 1986

g. WCAP-13749-P-A, Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement, March 1997

The Technical Specifications affected by this report are listed below:

2.1.1	Reactor Core SLs [Safety Limits]
3.1.1	SHUTDOWN MARGIN (SDM)
3.1.3	Moderator Temperature Coefficient (MTC)
3.1.5	Shutdown Bank Insertion Limits
3.1.6	Control Bank Insertion Limits
3.2.1	Heat Flux Hot Channel Factor ($\mathbf{F_Q(Z)}$)
3.2.2	Nuclear Enthalpy Rise Hot Channel Factor ($\mathbf{F^N_{\Delta H}}$)
3.2.3	AXIAL FLUX DIFFERENCE (AFD)
3.3.1	Reactor Trip System (RTS) Instrumentation
3.4.1	RCS [Reactor Coolant System] Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits
3.9.1	Boron Concentration

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 5.6.5.

2.1 SAFETY LIMITS

2.1.1 Reactor Core SLs (Specification 2.1.1)

In Modes 1 and 2, the combination of thermal power, pressurizer pressure, and the highest loop average temperature ($\mathbf{T_{avg}}$) shall not exceed the limits as shown in Figure 6 for 4 loop operation.

2.2 REACTIVITY CONTROL

2.2.1 SHUTDOWN MARGIN (SDM) (Specification 3.1.1)

Shutdown margin shall be greater than or equal to 1.8% $\Delta k/k$ for $T_{avg} > 200°F$
Shutdown margin shall be greater than or equal to 1.0% $\Delta k/k$ for $T_{avg} \leq 200°F$

2.2.2 Moderator Temperature Coefficient (MTC) (Specification 3.1.3)

a. The MTC limits are:

The BOL/ARO-MTC shall be less positive or equal to the value given in Figure 1.

The EOL/ARO/RTP-MTC shall be less negative or equal to -4.10E-4 **$\Delta k/k/°F$**.

This limit is based on a $\mathbf{T_{avg}}$ program with HFP vessel $\mathbf{T_{avg}}$ of 571.0 to 576.0 °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

b. The MTC Surveillance limit is:
The 300 ppm/ARO/RTP-MTC should be less negative or equal to -3.20E-4 **Δk/k/°F** at a HFP vessel $\mathbf{T_{avg}}$ of 571.0 to 576.0 °F

c. The Revised Predicted near-EOL 300 ppm MTC shall be calculated using Figure 7 and the following algorithm:

Revised Predicted MTC = Predicted MTC + AFD Correction + Predicted Correction*

* Predicted Correction is -0.30E-4 **Δk/k/°F**.

If the Revised Predicted MTC is less negative than the Surveillance Requirement 3.1.3.2 limit (COLR 2.2.2.b) and all of the benchmark data contained in the surveillance procedure are met, then a MTC measurement in accordance with SR 3.1.3.2 is not required.

d. The MTC Surveillance limit is:
The 60 ppm/ARO/RTP-MTC should be less negative or equal to -3.90E-4 **Δk/k/°F** at a HFP vessel $\mathbf{T_{avg}}$ of 571.0 to 576.0 °F

2.2.3 Shutdown Bank Insertion Limits (Specification 3.1.5)

The shutdown rods shall be withdrawn to at least 228 steps.

2.2.4 Control Bank Insertion Limits (Specifications 3.1.6)

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

b. 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.

2.3 POWER DISTRIBUTION LIMITS

2.3.1 AXIAL FLUX DIFFERENCE (AFD) (Specification 3.2.3)

a. The Allowable Operation Limits are provided in Figure 3.

b. The AFD target band is $\pm$5% for a cycle average accumulated burnup $\geq$0.0 MWD/MTU [Megawatt Days/Metric Ton Uranium].

2.3.2 Heat Flux Hot Channel Factor ($F_Q(Z)$) (Specification 3.2.1)

$$F_Q^C(Z) \le \frac{CF_Q}{P} * K(Z) \qquad for\ P > 0.5$$

$$F_Q^C(Z) \le 2 * CF_Q * K(Z) \qquad for\ P \le 0.5$$

$$F_Q^W(Z) \le \frac{CF_Q}{P} * K(Z) \qquad for\ P > 0.5$$

$$F_Q^W(Z) \le 2 * CF_Q * K(Z) \qquad for\ P \le 0.5$$

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

a. $\mathbf{CF_Q}$ = 2.335

b. **K(Z)** is provided in Figures 4.

c. $\mathbf{F_Q^C(Z)}$ is the measured hot channel factor including a 3% manufacturing tolerance uncertainty and a 5% measurement uncertainty.

d. **W(Z)** is provided in Table 1 for ±5% AFD target band.

e. $\mathbf{F_Q^W(Z) = F_Q^C(Z) \times W(Z) \times F_P}$

The W(z) values are generated assuming that they will be used for a full power surveillance. When a part power surveillance is performed, the W(z) values should be multiplied by the factor 1/P, when P is > 0.5. When P is ≤ 0.5, the W(z) values should be multiplied by the factor 1/(0.5), or 2.0. This is consistent with the adjustment in the $F_Q(z)$ limit at part power conditions.

f. For Cycle 19, $\mathbf{F_P}$ = 1.02 for all burnups associated with Note 2a of SR 3.2.1.2, except as shown in the table below. When no penalty is required, $\mathbf{F_P}$ = 1.00.

Cycle Burnup (MWD/MTU)	F_P Penalty Multiplier
0	1.020
150	1.032
317	1.040
484	1.039
651	1.037
818	1.035
985	1.032
1153	1.030
1320	1.028
1487	1.026
1654	1.026
1821	1.027
1988	1.029
2155	1.032
2322	1.034
2489	1.036
2656	1.038
2824	1.039
2991	1.039
3158	1.037
3325	1.035
3492	1.031
3659	1.028
3826	1.023
4000	1.020

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

2.3.3 Nuclear Enthalpy Rise Hot Channel Factor ($\mathbf{F^N_{\Delta H}}$) (Specification 3.2.2)

$$\mathbf{F^N_{\Delta H} \leq CF_{\Delta H} * (1 + PF_{\Delta H} * (1-P))}$$

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

a. $\mathbf{CF_{\Delta H}}$ = 1.58

b. $\mathbf{PF_{\Delta H}}$ = 0.3

2.4 INSTRUMENTATION

2.4.1 Reactor Trip System (RTS) Instrumentation (Specification 3.3.1)

The Overtemperature **ΔT** and Overpower **ΔT** setpoints are as shown in Figure 5.

2.5 REACTOR COOLANT SYSTEM

2.5.1 RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits (Specification 3.4.1)

a. Pressurizer Pressure shall be ≥ 2172.4 psig [+]

b. RCS $\mathbf{T_{avg}}$ shall be ≤ 580.1 °F [+]

c. RCS Total Flow Rate shall be ≥ 366,400 gpm

2.6 REFUELING OPERATIONS

2.6.1 Boron Concentration (Specification 3.9.1)

The boron concentration of all filled portions of the RCS, the refueling canal and the refueling cavity shall be greater than or equal to 2400 ppm[++].

[+] These are Safety Analysis values. With readability allowance, the corresponding values are 577.8°F for $\mathbf{T_{avg}}$, and 2200 psig for Pressurizer Pressure.

[++] This concentration bounds the condition of $K_{eff} \leq 0.95$ which includes a 1% Δk/k conservative allowance for uncertainties. The boron concentration of 2400 ppm includes a 50 ppm conservative allowance for uncertainties.

FIGURE 1
MODERATOR TEMPERATURE COEFFICIENT (MTC) LIMITS

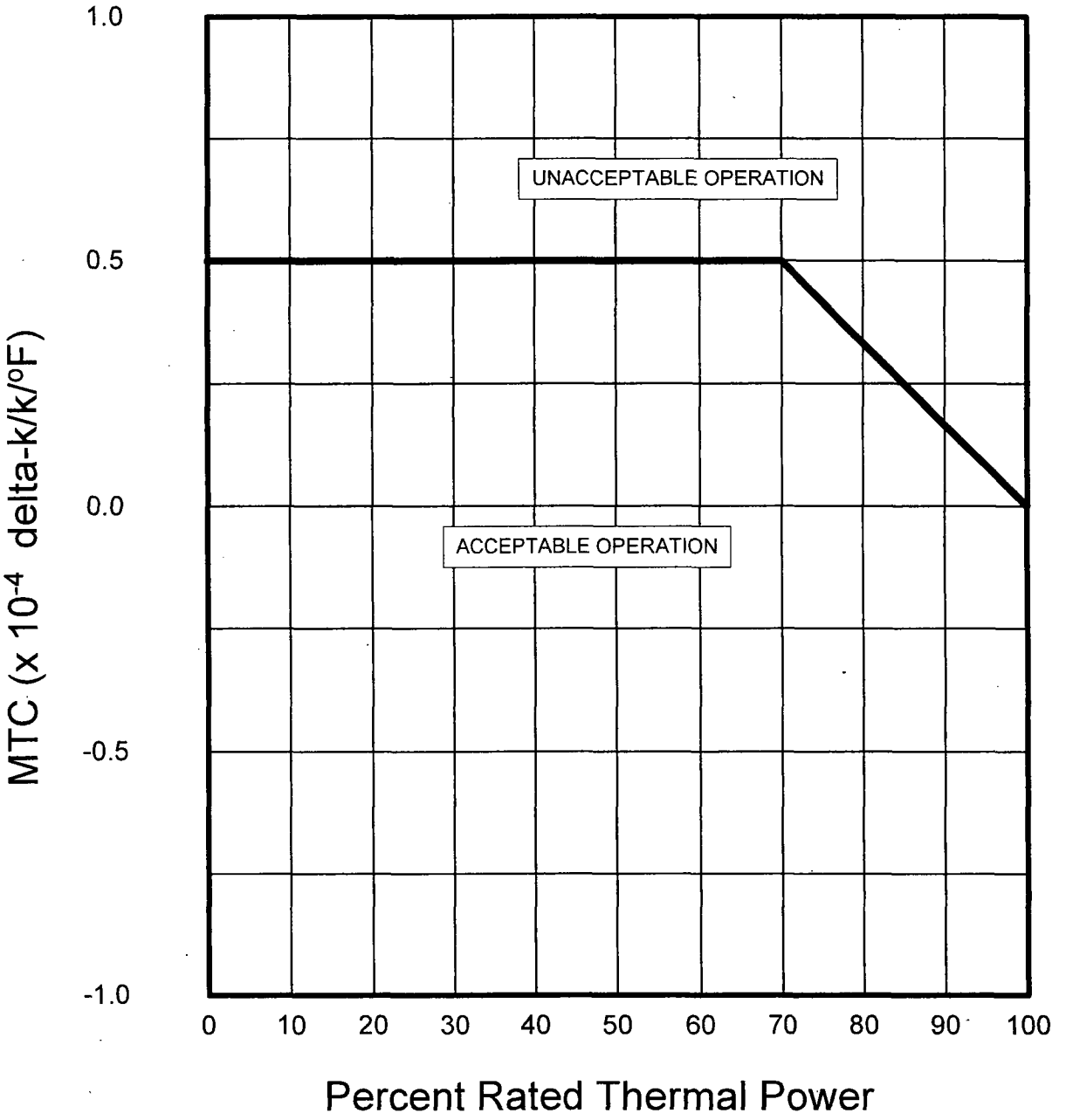


FIGURE 2
ROD BANK INSERTION LIMITS VERSUS THERMAL POWER

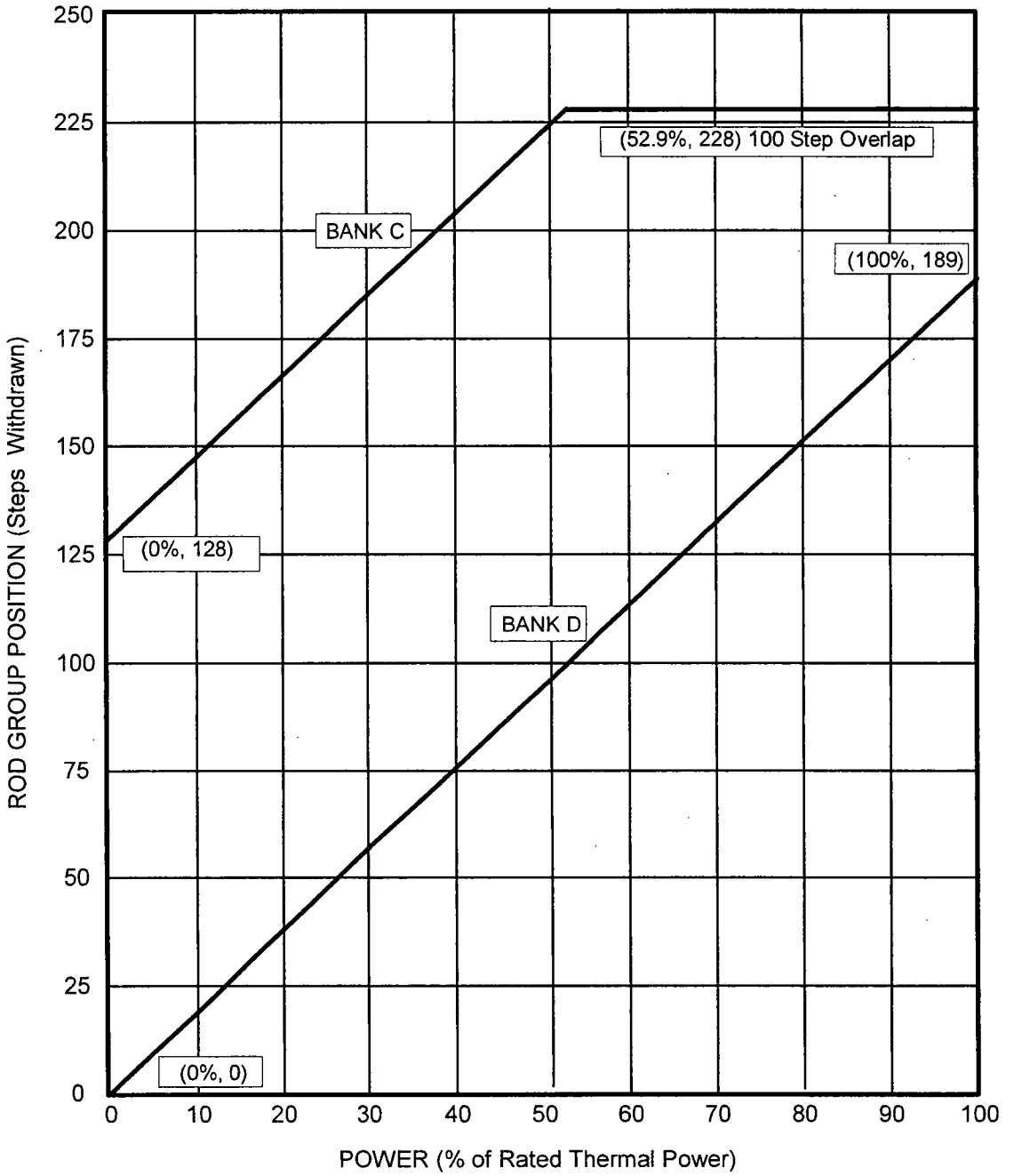


FIGURE 3
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER (RTP)

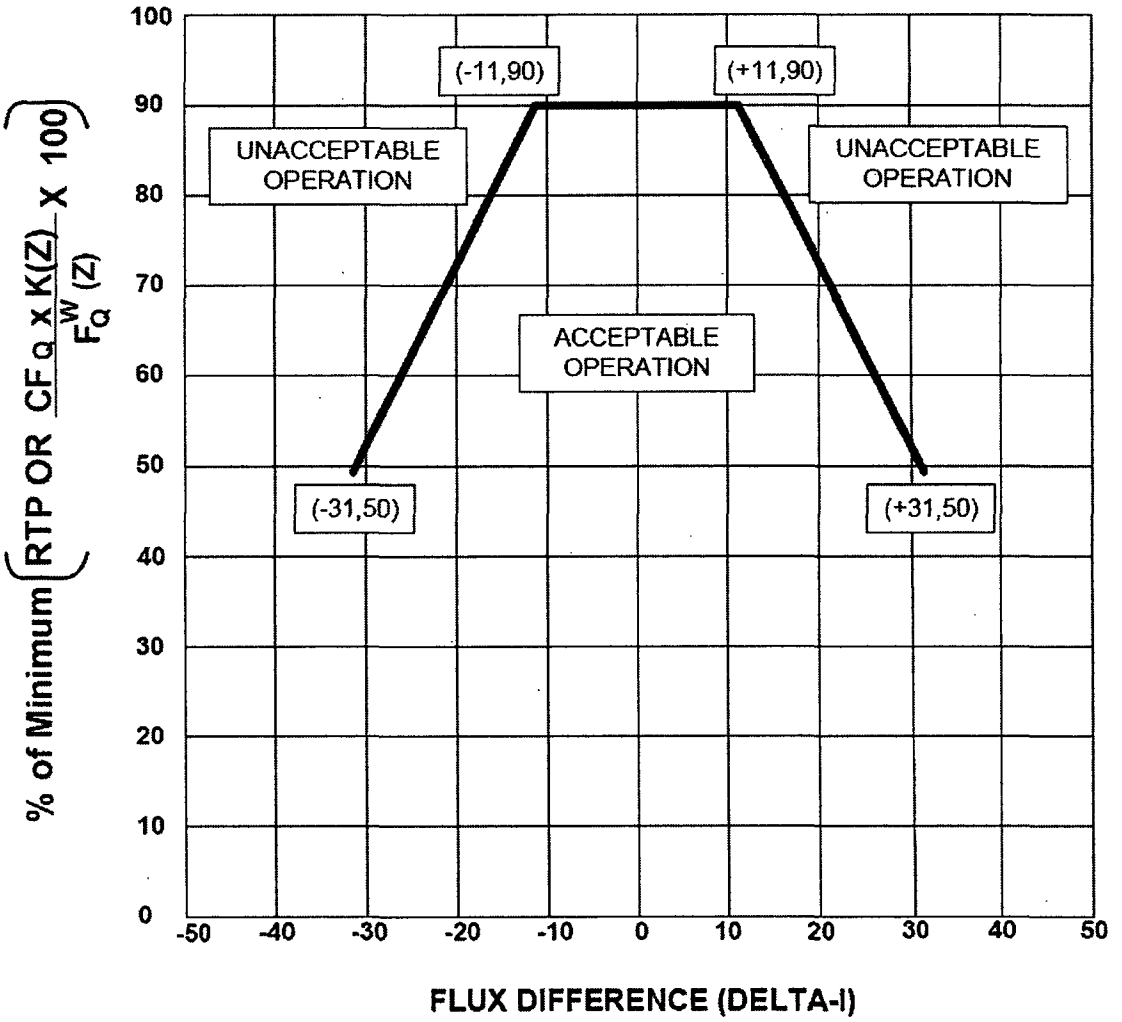


FIGURE 4

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

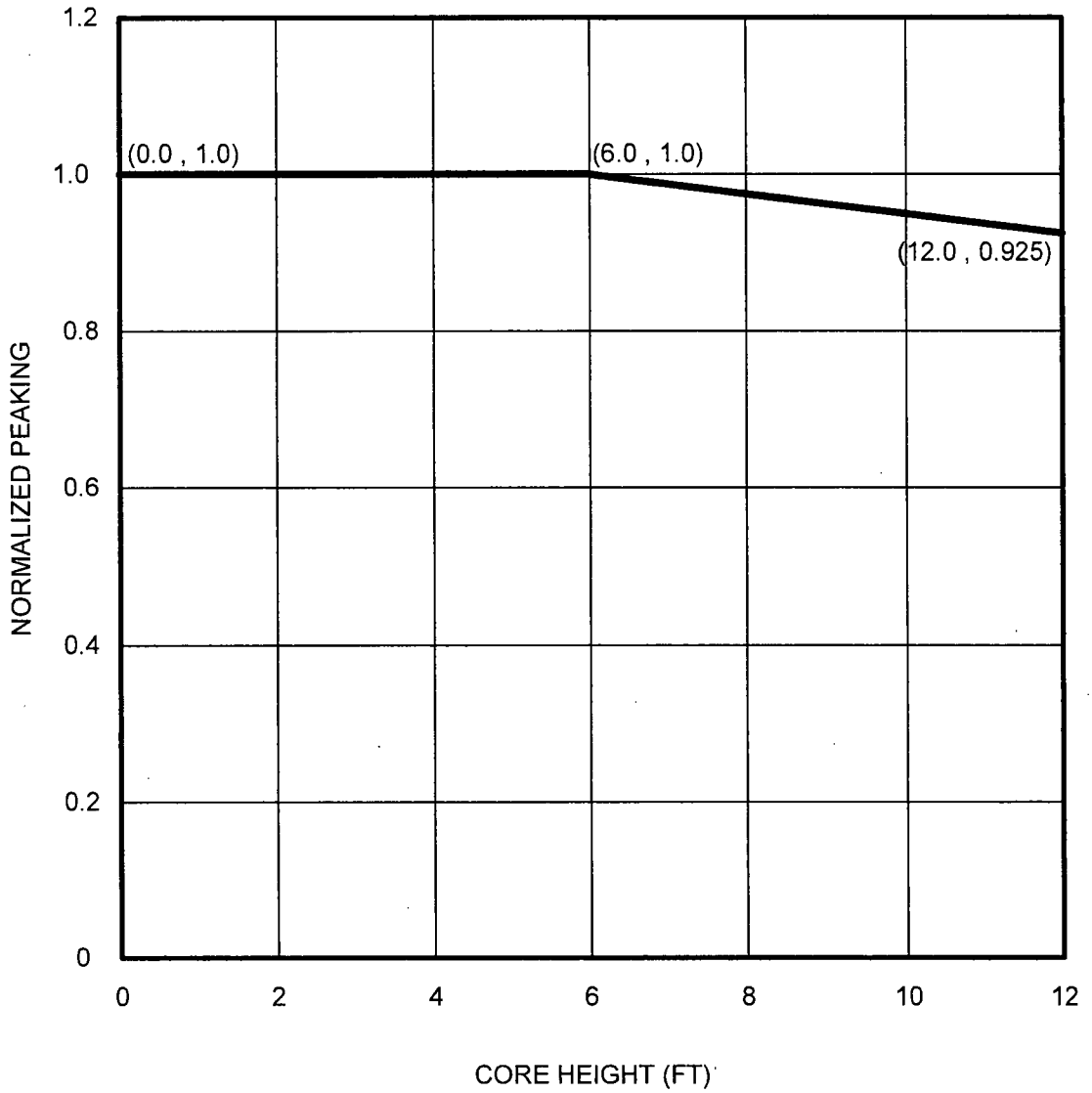


FIGURE 5

(Page 1 of 2)

Reactor Trip System Instrumentation Trip Setpoints

Overtemperature ΔT Trip Setpoint

Overtemperature $\Delta T \leq \Delta T_0 \left[K_1 - K_2 \left[\frac{1+\tau_1 S}{1+\tau_2 S}\right] (T-T') + K_3 (P-P') - f_1(\Delta I)\right]$

Where:

ΔT	=	Measured RCS ΔT, °F
ΔT_0	=	Indicated ΔT at RATED THERMAL POWER, °F
T	=	Average temperature, °F
T'	=	Nominal T_{avg} at RATED THERMAL POWER, (≤ 576.0°F)
P	=	Pressurizer Pressure, psig
P'	=	Nominal RCS operating pressure (2235 psig)
$\left[\frac{1+\tau_1 S}{1+\tau_2 S}\right]$	=	The function generated by the lead-lag controller for T_{avg} dynamic compensation
τ_1, τ_2	=	Time constants utilized in the lead-lag controller for T_{avg} $\tau_1 \geq 28$ secs. $\tau_2 \leq 4$ secs.
S	=	Laplace transform operator, sec^{-1}
K_1	≤	1.19 *
K_2	≥	0.01331/°F
K_3	≥	0.00058/psig
$f_1(\Delta I)$	=	$-3.5\ \{33\% + (q_t - q_b)\}$ when $q_t - q_b \leq -33\%$ RTP 0% of RTP when -33% RTP $< q_t - q_b \leq 6\%$ RTP $+1.0\ \{(q_t - q_b) - 6\%\}$ when $q_t - q_b > 6\%$ RTP

where q_t and q_b are percent RATED THERMAL POWER in the upper and lower halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent RATED THERMAL POWER.

* This is a Safety Analysis value. Refer to Technical Requirements Manual for nominal value of this coefficient used in programming the trip setpoint.

FIGURE 5
(Page 2 of 2)
Overpower ΔT Trip Setpoint

Overpower ΔT ≤ ΔT$_0$ [K$_4$ - K$_5$ $\left[\frac{\tau_3 S}{1+\tau_3 S}\right]$ **T - K$_6$ (T – T") -f$_2$ (ΔI)]**

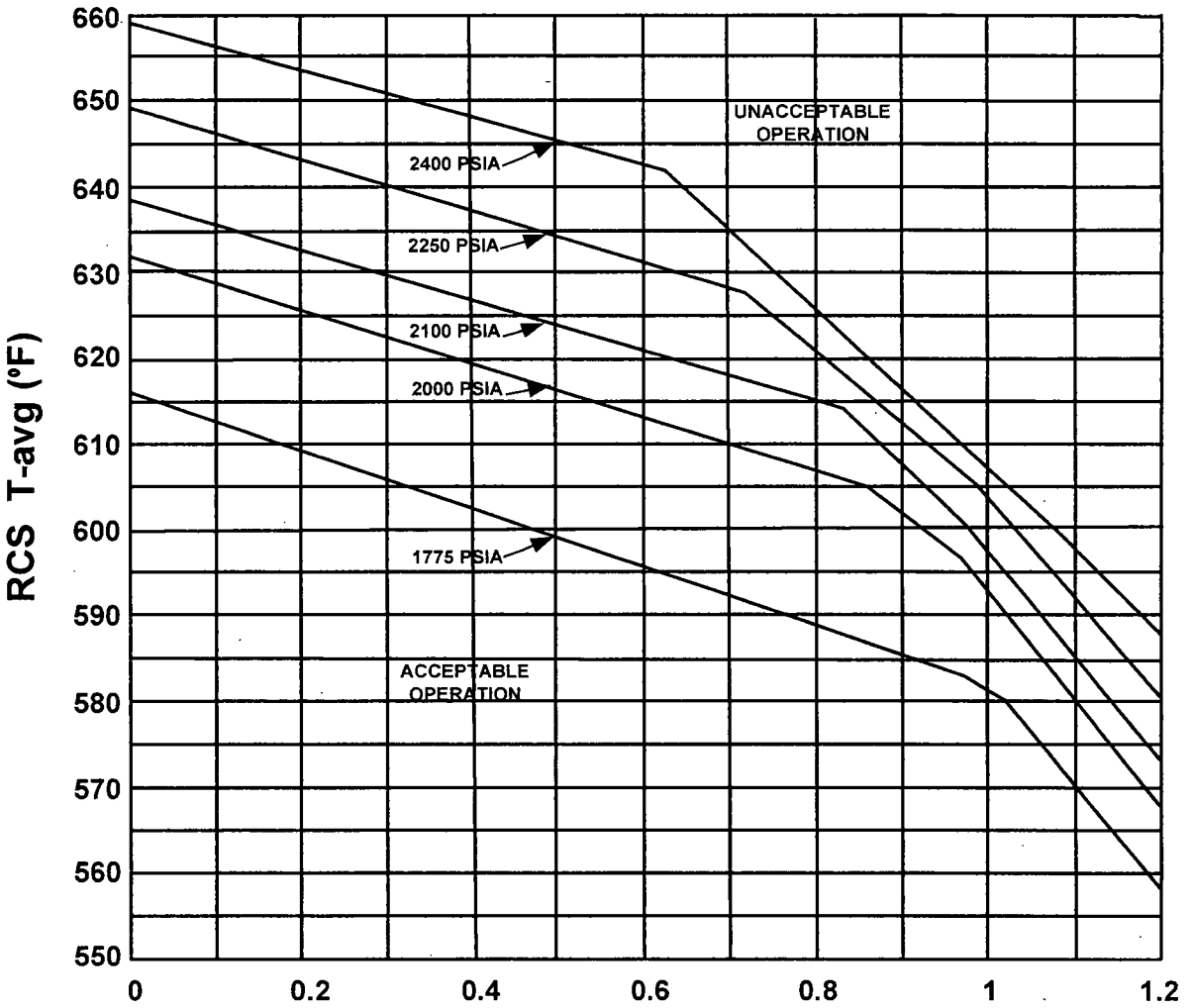
Where:

	ΔT	=	Measured RCS **ΔT**, °F
	ΔT$_0$	=	Indicated **ΔT** at RATED THERMAL POWER, °F
	T	=	Average temperature, °F
	T"	=	Nominal **T$_{avg}$** at RATED THERMAL POWER, (≤ 576.0 °F)
	K$_4$	≤	1.16 *
	K$_5$	≥	0.02/°F for increasing average temperature; **K$_5$** = 0 for decreasing average temperature
	K$_6$	≥	0.00197/°F for **T** greater than **T"** ; **K$_6$**=0 for **T** less than or equal to **T"**
	$\frac{\tau_3 S}{1+\tau_3 S}$	=	The function generated by the rate lag controller for **T$_{avg}$** dynamic compensation
	τ$_3$	=	Time constant utilized in the rate lag controller for **T$_{avg}$**; **τ$_3$** ≥ 10 secs.
	S	=	Laplace transform operator, sec^{-1}
	f$_2$ (ΔI)	=	0.0

* This is a Safety Analysis value. Refer to Technical Requirements Manual for nominal value of this coefficient used in programming the trip setpoint.

FIGURE 6

Reactor Core Safety Limits



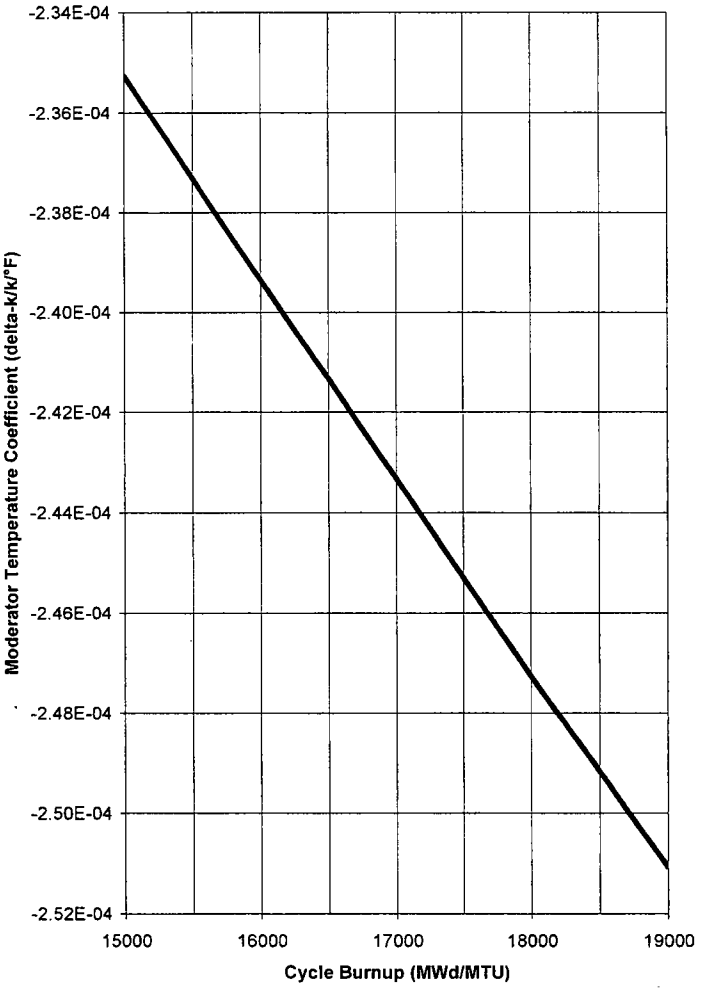
DESCRIPTION OF SAFETY LIMITS

PRESSURE (psia)	Power (frac)	Tavg (° F)	Power (frac)	Tavg (° F)	Power (frac)	Tavg (° F)	Power (frac)	Tavg (° F)
1775	0.00	615.4	0.98	583.8	1.02	580.9	1.2	558.1
2000	0.00	631.8	0.86	605.8	0.96	597.5	1.2	568.5
2100	0.00	639.1	0.82	614.0	0.96	601.6	1.2	573.1
2250	0.00	649.2	0.72	628.6	0.98	605.2	1.2	580.4
2400	0.00	659.0	0.62	642.0	1.1	599.0	1.2	588.1

UNIT 2 Reactor Core Safety Limits

FIGURE 7

Unit 2 Cycle 19 Predicted HFP ARO 300 PPM MTC Versus Burnup



Burnup (MWd/MTU)	MTC (pcm/°F)	MTC (Δk/k/°F)
15,000	-23.526	-2.3526E-04
16,000	-23.935	-2.3935E-04
17,000	-24.331	-2.4331E-04
18,000	-24.726	-2.4726E-04
19,000	-25.108	-2.5108E-04

TABLE 1
Donald C. Cook Unit 2 Cycle 19
W(Z) Function

Node Point	Height (ft)	Burnup (MWD/MTU) 150	1000	2000	3000	4000	5000	6000	8000	10000	12000	14000	16000	18000	20000	20790
1	0.00	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	1.0000
2	0.20	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	1.0000
3	0.40	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	1.0000
4	0.60	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	1.0000
5	0.80	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	1.0000
6	1.00	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	1.0000
7	1.20	1.1187	1.1172	1.1156	1.1144	1.1135	1.1129	1.1126	1.1130	1.1151	1.1191	1 1249	1.1324	1.1411	1.1476	1.1502
8	1.40	1.1173	1.1150	1.1129	1.1113	1.1102	1.1097	1.1097	1.1114	1.1146	1.1190	1.1245	1.1312	1.1387	1.1447	1.1471
9	1.60	1.1154	1 1126	1 1100	1.1080	1.1068	1 1063	1.1067	1.1095	1.1138	1.1185	1 1236	1.1293	1.1357	1.1412	1.1433
10	1.80	1.1131	1.1101	1.1072	1.1051	1.1039	1.1035	1.1042	1.1076	1.1124	1.1171	1.1217	1.1266	1.1318	1.1367	1.1386
11	2.00	1.1103	1.1078	1.1054	1.1036	1.1026	1.1024	1.1031	1.1063	1.1106	1.1148	1.1187	1.1229	1.1273	1.1314	1.1331
12	2.20	1.1071	1.1054	1.1039	1.1027	1.1021	1.1021	1.1026	1.1051	1.1083	1.1116	1.1149	1.1183	1.1221	1.1255	1.1268
13	2.40	1.1036	1.1027	1.1019	1.1013	1.1011	1.1012	1.1017	1.1034	1.1057	1.1081	1.1106	1.1133	1.1162	1.1188	1.1199
14	2.60	1.0998	1.0997	1.0996	1.0997	1.0998	1.1001	1.1004	1.1014	1.1026	1.1041	1.1058	1.1076	1.1097	1.1115	1.1122
15	2.80	1.0956	1.0963	1.0971	1.0977	1.0983	1.0986	1.0989	1.0990	1.0991	1.0996	1.1005	1.1015	1.1027	1.1036	1.1040
16	3.00	1.0913	1.0928	1.0944	1.0956	1.0965	1.0970	1.0971	1.0964	1.0955	1.0950	1.0949	1.0951	1.0953	1.0953	1.0952
17	3.20	1.0874	1.0895	1.0916	1.0932	1.0943	1.0949	1.0949	1.0937	1.0920	1.0907	1.0899	1.0892	1.0886	1.0877	1.0874
18	3.40	1.0850	1.0872	1.0894	1.0910	1.0922	1.0927	1.0926	1.0910	1.0890	1.0877	1.0870	1.0867	1.0864	1.0858	1.0855
19	3.60	1 0854	1.0873	1.0891	1.0905	1.0914	1.0916	1.0910	1.0888	1.0867	1.0864	1.0877	1.0903	1.0935	1.0952	1.0959
20	3.80	1.0870	1.0884	1.0898	1.0908	1.0912	1.0910	1.0902	1.0874	1.0854	1.0862	1.0895	1.0948	1.1014	1.1053	1 1069
21	4.00	1.0894	1.0902	1.0909	1.0913	1.0913	1.0909	1.0898	1.0872	1.0857	1.0875	1.0922	1.0995	1.1082	1.1138	1.1160
22	4.20	1.0918	1.0918	1.0918	1.0917	1.0914	1.0908	1.0899	1.0880	1.0876	1.0905	1.0964	1.1048	1.1148	1.1216	1.1243
23	4.40	1.0940	1.0932	1.0924	1.0917	1.0911	1.0905	1.0899	1.0892	1.0904	1.0944	1.1012	1.1102	1.1209	1.1285	1.1315
24	4.60	1.0960	1.0943	1.0927	1.0914	1.0905	1.0899	1.0896	1.0902	1.0929	1.0981	1.1056	1.1152	1.1263	1.1347	1.1380
25	4.80	1.0977	1.0951	1.0927	1.0909	1.0896	1.0890	1.0891	1.0910	1.0952	1.1014	1.1095	1.1196	1.1311	1.1401	1.1436
26	5.00	1.0991	1.0957	1.0924	1.0900	1.0885	1.0879	1.0883	1.0915	1.0971	1.1043	1.1130	1.1234	1.1350	1.1445	1.1482
27	5.20	1.1000	1.0959	1.0919	1.0890	1.0872	1.0866	1.0873	1.0917	1.0987	1.1068	1.1159	1.1264	1.1380	1.1478	1.1517
28	5.40	1.1006	1.0957	1.0910	1.0876	1.0855	1.0849	1.0860	1.0916	1.0998	1.1087	1.1181	1.1286	1.1401	1.1501	1.1541
29	5.60	1.1007	1.0950	1.0897	1.0858	1.0835	1.0829	1.0842	1.0910	1.1004	1.1100	1.1196	1.1298	1.1410	1.1512	1.1552
30	5.80	1.1002	1.0942	1.0885	1.0844	1.0819	1.0814	1.0829	1.0903	1.1004	1.1103	1.1199	1.1300	1.1408	1.1509	1.1549
31	6.00	1.0992	1.0931	1.0872	1.0830	1.0805	1.0800	1.0816	1.0894	1.0997	1.1097	1.1192	1.1290	1.1394	1.1494	1.1533
32	6.20	1.0976	1.0914	1.0854	1.0811	1.0786	1.0782	1.0799	1.0878	1.0984	1.1083	1.1176	1.1269	1.1369	1.1465	1.1503
33	6.40	1.0954	1.0892	1.0832	1.0789	1.0764	1.0759	1 0777	1.0858	1.0963	1.1061	1.1150	1.1238	1.1332	1.1424	1.1460
34	6.60	1.0926	1.0864	1.0805	1.0762	1.0737	1.0733	1.0750	1.0831	1.0935	1.1030	1.1114	1.1197	1.1284	1.1371	1.1406
35	6.80	1.0889	1.0829	1.0772	1.0731	1.0708	1.0704	1.0721	1.0798	1.0898	1.0987	1.1066	1.1141	1.1219	1.1300	1.1331
36	7.00	1.0853	1.0794	1.0737	1.0696	1.0672	1.0668	1.0684	1.0759	1.0856	1.0941	1.1016	1.1086	1.1161	1.1237	1.1267
37	7.20	1.0843	1.0779	1.0717	1.0672	1.0646	1.0640	1.0657	1.0736	1.0836	1.0922	1.0993	1.1059	1.1127	1.1200	1.1228
38	7.40	1.0871	1.0799	1.0729	1.0678	1.0649	1.0643	1.0663	1.0755	1.0867	1.0953	1.1015	1.1062	1.1108	1.1168	1.1191
39	7.60	1.0895	1.0824	1.0757	1.0708	1.0680	1.0675	1.0695	1.0785	1.0892	1.0972	1.1024	1.1061	1.1094	1.1145	1.1165
40	7.80	1.0911	1.0847	1.0786	1.0741	1.0715	1.0711	1.0730	1.0812	1.0910	1.0980	1.1025	1.1054	1.1079	1.1121	1.1138
41	8.00	1.0925	1.0866	1.0810	1.0769	1.0746	1.0742	1.0759	1.0835	1.0924	1.0986	1.1022	1.1042	1.1057	1.1090	1.1104
42	8.20	1.0934	1.0881	1.0831	1.0794	1.0773	1.0770	1.0786	1.0854	1.0933	1.0985	1.1013	1.1025	1.1031	1.1056	1.1066
43	8.40	1.0938	1.0892	1.0848	1.0816	1.0797	1.0795	1.0809	1.0869	1.0938	1.0981	1.1001	1.1005	1.1003	1.1019	1.1026
44	8.60	1.0938	1.0898	1.0860	1.0832	1.0816	1.0815	1.0828	1.0882	1.0941	1.0974	1.0983	1.0975	1.0960	1.0965	1.0967
45	8.80	1.0928	1.0897	1.0867	1.0846	1.0834	1.0833	1.0844	1.0888	1.0935	1.0963	1.0974	1.0971	1.0964	1.0971	1.0974
46	9.00	1.0929	1.0903	1.0879	1.0861	1.0852	1.0851	1.0861	1.0899	1.0942	1.0972	1.0991	1.1002	1.1010	1.1027	1.1033
47	9.20	1.0962	1.0932	1.0904	1.0884	1.0874	1.0876	1.0890	1.0940	1.0995	1.1031	1.1049	1.1054	1.1054	1.1068	1.1074
48	9.40	1.1015	1.0982	1.0951	1.0929	1.0918	1.0920	1.0934	1.0988	1.1047	1.1083	1.1099	1 1101	1.1096	1.1109	1.1114
49	9.60	1.1066	1.1030	1.0997	1.0974	1.0962	1.0962	1.0977	1.1034	1.1094	1.1132	1.1147	1.1146	1.1139	1.1151	1.1155
50	9.80	1.1112	1.1075	1.1039	1.1014	1.1001	1.1002	1.1017	1.1076	1.1140	1.1178	1.1191	1.1188	1.1177	1.1186	1.1190
51	10.00	1.1156	1.1117	1.1079	1.1053	1.1039	1.1039	1.1055	1.1117	1.1183	1.1221	1.1233	1.1227	1.1213	1.1221	1.1224
52	10.20	1.1196	1.1155	1.1116	1.1088	1.1073	1.1074	1.1090	1.1154	1.1221	1.1260	1.1273	1.1266	1.1251	1.1258	1.1261
53	10.40	1.1231	1.1189	1.1148	1.1120	1.1105	1.1105	1.1122	1.1186	1.1255	1.1294	1.1306	1.1297	1.1280	1.1287	1.1289
54	10.60	1.1258	1.1215	1.1175	1.1146	1.1130	1.1130	1.1147	1.1212	1.1282	1.1322	1.1334	1.1326	1.1309	1.1316	1.1319
55	10.80	1.1283	1.1239	1.1198	1.1168	1.1152	1.1151	1.1168	1.1234	1.1304	1.1343	1.1353	1.1343	1.1323	1.1328	1.1330
56	11.00	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	1.0000
57	11.20	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	1.0000
58	11.40	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	1.0000
59	11.60	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	1.0000
60	11.80	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	1.0000
61	12.00	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	1.0000

Top and bottom 10% of core excluded.