Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

April 15, 2021
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STI: 35152704

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

South Texas Project
Unit 2
Docket No. STN 50-499
Unit 2 Cycle 22 Core Operating Limits Report

In accordance with Technical Specification 6.9.1.6.d, STP Nuclear Operating Company submits the attached Core Operating Limits Report (COLR) for Unit 2 Cycle 22. The report covers the core design changes made during the 2RE21 refueling outage.

There are no commitments in this letter.

If there are any questions regarding this report, please contact Zachary Dibbern at (361) 972-4336 or me at (361) 972-7806.

Christopher H. Georgeson
General Manager, Engineering
Michael Chandler for Chris Georgeson
STI:35139871 NOCNOC21035153

zed

Attachment: South Texas Project Unit 2 Cycle 22 Core Operating Limits Report, Revision 0

cc: Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
1600 E. Lamar Boulevard
Arlington, TX 76011-4511

Attachment

South Texas Project
Unit 2 Cycle 22
Core Operating Limits Report, Revision 0

SOUTH TEXAS PROJECT

Unit 2 Cycle 22

CORE OPERATING LIMITS REPORT

U2C22-0

Revision 0

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for STPEGS Unit 2 Cycle 22 has been prepared in accordance with the requirements of Technical Specification 6.9.1.6. The core operating limits have been developed using the NRC-approved methodologies specified in Technical Specification 6.9.1.6.

The Technical Specifications affected by this report are:

1)	2.1	SAFETY LIMITS
2)	2.2	LIMITING SAFETY SYSTEM SETTINGS
3)	3/4.1.1.1	SHUTDOWN MARGIN
4)	3/4.1.1.3	MODERATOR TEMPERATURE COEFFICIENT LIMITS
5)	3/4.1.3.5	SHUTDOWN ROD INSERTION LIMITS
6)	3/4.1.3.6	CONTROL ROD INSERTION LIMITS
7)	3/4.2.1	AFD LIMITS
8)	3/4.2.2	HEAT FLUX HOT CHANNEL FACTOR
9)	3/4.2.3	NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR
10)	3/4.2.5	DNB PARAMETERS

2.0 OPERATING LIMITS

The cycle-specific parameter limits for the specifications listed in Section 1.0 are presented below.

2.1 SAFETY LIMITS (Specification 2.1):

2.1.1 The combination of THERMAL POWER, pressurizer pressure, and the highest operating loop coolant temperature (T_{avg}) shall not exceed the limits shown in Figure 1.

2.2 LIMITING SAFETY SYSTEM SETTINGS (Specification 2.2):

2.2.1 The Loop design flow for Reactor Coolant Flow-Low is 98,000 gpm.

2.2.2 The Over-temperature ΔT and Over-power ΔT setpoint parameter values are listed below:

Over-temperature ΔT Setpoint Parameter Values

τ_1 measured reactor vessel ΔT lead/lag time constant, $\tau_1 = 8$ sec
τ_2 measured reactor vessel ΔT lead/lag time constant, $\tau_2 = 3$ sec
τ_3 measured reactor vessel ΔT lag time constant, $\tau_3 = 2$ sec
τ_4 measured reactor vessel average temperature lead/lag time constant, $\tau_4 = 28$ sec
τ_5 measured reactor vessel average temperature lead/lag time constant, $\tau_5 = 4$ sec
τ_6 measured reactor vessel average temperature lag time constant, $\tau_6 = 2$ sec
K_1 Overtemperature ΔT reactor trip setpoint, $K_1 = 1.14$
K_2 Overtemperature ΔT reactor trip setpoint T_{avg} coefficient, $K_2 = 0.028/°F$
K_3 Overtemperature ΔT reactor trip setpoint pressure coefficient, $K_3 = 0.00143/psi$
T' Nominal full power T_{avg}, $T' \leq 592.0$ °F
P' Nominal RCS pressure, P' = 2235 psig
$f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with gains to be selected based on measured instrument response during plant startup tests such that:

(1) For $q_t - q_b$ between -70% and +8%, $f_1(\Delta I) = 0$, where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent of RATED THERMAL POWER;

(2) For each percent that $q_t - q_b$ is more negative than -70%, the ΔT Trip Setpoint shall be automatically reduced by 0.0% of its value at RATED THERMAL POWER; and

(3) For each percent that $q_t - q_b$ is more positive than +8%, the ΔT Trip Setpoint shall be automatically reduced by 2.65% of its value at RATED THERMAL POWER. (Reference 3.6 and Section 4.4.1.2 of Reference 3.7)

Over-power ΔT Setpoint Parameter Values

τ_1 measured reactor vessel ΔT lead/lag time constant, $\tau_1 = 8$ sec
τ_2 measured reactor vessel ΔT lead/lag time constant, $\tau_2 = 3$ sec
τ_3 measured reactor vessel ΔT lag time constant, $\tau_3 = 2$ sec
τ_6 measured reactor vessel average temperature lag time constant, $\tau_6 = 2$ sec
τ_7 Time constant utilized in the rate-lag compensator for T_{avg}, $\tau_7 = 10$ sec
K_4 Overpower ΔT reactor trip setpoint, $K_4 = 1.08$
K_5 Overpower ΔT reactor trip setpoint T_{avg} rate/lag coefficient,
$K_5 = 0.02/°F$ for increasing average temperature, and
$K_5 = 0$ for decreasing average temperature
K_6 Overpower ΔT reactor trip setpoint T_{avg} heatup coefficient
$K_6 = 0.002/°F$ for T > T", and
$K_6 = 0$ for $T \leq$ T"
T" Indicated full power T_{avg}, T"$\leq$ 592.0 °F
$f_2(\Delta I) = 0$ for all (ΔI)

2.3 SHUTDOWN MARGIN (Specification 3.1.1.1):

The SHUTDOWN MARGIN shall be:

2.3.1 Greater than 1.3% $\Delta\rho$ for MODES 1 and 2*
*See Special Test Exception 3.10.1

2.3.2 Greater than the limits in Figure 2 for MODES 3 and 4.

2.3.3 Greater than the limits in Figure 3 for MODE 5.

2.4 MODERATOR TEMPERATURE COEFFICIENT (Specification 3.1.1.3):

2.4.1 The BOL, ARO, MTC shall be less positive than the limits shown in Figure 4.

2.4.2 The EOL, ARO, HFP, MTC shall be less negative than –62.6 pcm/°F.

2.4.3 The 300 ppm, ARO, HFP, MTC shall be less negative than –53.6 pcm/°F (300 ppm Surveillance Limit).

Where: BOL stands for Beginning-of-Cycle Life,
EOL stands for End-of-Cycle Life,
ARO stands for All Rods Out,
HFP stands for Hot Full Power (100% RATED THERMAL POWER),
HFP vessel average temperature is 592 °F.

2.4.4 The Revised Predicted near-EOL 300 ppm MTC shall be calculated using the algorithm from the document referenced by Technical Specification 6.9.1.6.b.10:

Revised Predicted MTC = Predicted MTC + AFD Correction - 3 pcm/°F

If the Revised Predicted MTC is less negative than the COLR Section 2.4.3 limit and all of the benchmark data contained in the surveillance procedure are met, then an MTC measurement in accordance with S.R. 4.1.1.3b is not required.

2.5 ROD INSERTION LIMITS (Specification 3.1.3.5 and 3.1.3.6):

2.5.1 All banks shall have the same Full Out Position (FOP) of either 255 or 259 steps withdrawn.

2.5.2 The Control Banks shall be limited in physical insertion as specified in Figure 5.

2.5.3 Individual Shutdown bank rods are fully withdrawn when the Bank Demand Indication is at the FOP and the Rod Group Height Limiting Condition for Operation is satisfied (T.S. 3.1.3.1).

2.6 AXIAL FLUX DIFFERENCE (Specification 3.2.1):

2.6.1 AFD limits as required by Technical Specification 3.2.1 are determined by Constant Axial Offset Control (CAOC) Operations with an AFD target band of +5, -10%.

2.6.2 The AFD shall be maintained within the ACCEPTABLE OPERATION portion of Figure 6, as required by Technical Specifications.

2.7 HEAT FLUX HOT CHANNEL FACTOR (Specification 3.2.2):

2.7.1 $F_Q^{RTP} = 2.55$.

2.7.2 K(Z) is provided in Figure 7.

2.7.3 The F_{xy} limits for RATED THERMAL POWER (F_{xy}^{RTP}) within specific core planes shall be:

2.7.3.1 Less than or equal to 2.102 for all cycle burnups for all core planes containing Bank "D" control rods, and

2.7.3.2 Less than or equal to the appropriate core height-dependent value from Table 1 for all unrodded core planes.

2.7.3.3 $PF_{xy} = 0.2$.

These F_{xy} limits were used to confirm that the heat flux hot channel factor $F_Q(Z)$ will be limited by Technical Specification 3.2.2 assuming the most-limiting axial power distributions expected to result for the insertion and removal of Control Banks C and D during operation, including the accompanying variations in the axial xenon and power distributions, as described in WCAP-8385. Therefore, these F_{xy} limits provide assurance that the initial conditions assumed in the LOCA analysis are met, along with the ECCS acceptance criteria of 10 CFR 50.46.

2.7.4 The F_{xy} limits from Section 2.7.3 above are not applicable in the following core plane regions:

2.7.4.1 Upper and lower core plane regions as presented in Table 2, and

2.7.4.2 Grid plane regions as presented in Table 2, and

2.7.4.3 Core plane regions within ± 2% of core height (± 3.36 inches) about the bank demand position of the bank "D" control rods.

2.7.5 Core Power Distribution Measurement Uncertainty for the Heat Flux Hot Channel Factor

2.7.5.1 If the Power Distribution Monitoring System (PDMS) is operable, as defined in the Technical Requirements Manual Section 3.3.3.12, the core power distribution measurement uncertainty (U_{FQ}) to be applied to the $F_Q(Z)$ and $F_{xy}(Z)$ using the PDMS shall be calculated by:

$$\mathbf{U_{FQ} = (1.0 + (U_Q/100))*U_E}$$

Where:

U_Q = Uncertainty for power peaking factor as defined in Equation 5-19 from the document referenced by Technical Specification 6.9.1.6.b.11

U_E = Engineering uncertainty factor of 1.03.

This uncertainty is calculated and applied automatically by the Power Distribution Monitoring System (PDMS).

2.7.5.2 If the moveable detector system is used, the core power distribution measurement uncertainty (U_{FQ}) to be applied to the $F_Q(Z)$ and $F_{xy}(Z)$ shall be calculated by:

$$\mathbf{U_{FQ} = U_{QU} * U_E}$$

Where:

U_{QU} = Base F_Q measurement uncertainty of 1.05.

U_E = Engineering uncertainty factor of 1.03.

2.8 ENTHALPY RISE HOT CHANNEL FACTOR (Specification 3.2.3):

2.8.1 $F_{\Delta H}^{RTP} = 1.62$

2.8.2 $PF_{\Delta H} = 0.3$

2.8.3 Core Power Distribution Measurement Uncertainty for the Enthalpy Rise Hot Channel Factor

2.8.3.1 If the Power Distribution Monitoring System (PDMS) is operable, as defined in the Technical Requirements Manual Section 3.3.3.12, the core power distribution measurement uncertainty ($U_{F\Delta H}$) to be applied to the $F_{\Delta H}^{N}$ using the PDMS shall be the greater of:

$$\mathbf{U_{F\Delta H} = 1.04}$$

OR

$$\mathbf{U_{F\Delta H} = 1.0 + (U_{\Delta H}/100)}$$

Where:

$U_{\Delta H}$ = Uncertainty for power peaking factor as defined in Equation 5-19 from the document referenced in Technical Specification 6.9.1.6.b.11.

This uncertainty is calculated and applied automatically by the Power Distribution Monitoring System.

2.8.3.2 If the moveable detector system is used, the core power distribution measurement uncertainty ($U_{F\Delta H}$) shall be:

$$\mathbf{U_{F\Delta H} = 1.04}$$

2.9 DNB PARAMETERS (Specification 3.2.5):

2.9.1 The following DNB-related parameters shall be maintained within the following limits (nominal values from Reference 3.1, as annotated below): [1]

2.9.1.1 Reactor Coolant System $T_{avg} \leq 595$ °F [2],

2.9.1.2 Pressurizer Pressure $>$ 2200 psig [3],

2.9.1.3 Minimum Measured Reactor Coolant System Flow $>$ 403,000 gpm[4].

3.0 REFERENCES

3.1 Letter from A. S. Ganey (Westinghouse) to. F. Yilmaz (STPNOC), "South Texas Project Electric Generating Station Unit 2 Cycle 22 Final Reload Evaluation" NF-TG-20-049 (ST-UB-NOC-20000038) dated January 5, 2021.

3.2 NUREG-1346, Technical Specifications, South Texas Project Unit Nos. 1 and 2.

3.3 STPNOC Calculation ZC-7035, Rev. 2, “Loop Uncertainty Calculation for RCS Tavg Instrumentation,” Section 10.1.

3.4 STPNOC Calculation ZC-7032, Rev. 6, “Loop Uncertainty Calculation for Narrow Range Pressurizer Pressure Monitoring Instrumentation,” Section 2.3, Page 9.

3.5 Letter from J. S Wyble (Westinghouse) to T. J. Jordan (STPNOC), “STP Nuclear Operating Company Units 1 & 2 Power Uprate PCWG Parameters,” ST-WN-NOC-00-000072 dated December 15, 2000, STI 31218644.

3.6 Letter from J. M. Ralston (Westinghouse) to D. F. Hoppes (STPNOC), “South Texas Project Electric Generating Station Units 1 and 2 Documentation of the $f_1(\Delta I)$ Function in OTΔT Setpoint Calculation,” NF-TG-11-93 (ST-UB-NOC-11003215) dated November 10, 2011.

3.7 Document RSE-U2, Rev. 10, “Unit 2 Cycle 22 Reload Safety Evaluation and Core Operating Limits Report.” (CR Action 19-9842-55)

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1 A discussion of the processes to be used to take these readings is provided in the basis for Technical Specification 3.2.5.

2 Includes a 1.9 °F measurement uncertainty per Reference 3.3, Page 37.

3 Limit not applicable during either a Thermal Power ramp in excess of 5% of RTP per minute or a Thermal Power step in excess of 10% RTP. Per Technical Specification 3.2.5 Bases, this includes a 10.7 psi measurement uncertainty as read on the QDPS display, which when added to the safety analysis limit of 2189 psig gives the COLR limit listed above. The 10.7 psi uncertainty is bounded by the 9.6 psi averaged measurement calculated in Reference 3.4.

4 Includes the flow measurement uncertainty of 2.8% from Reference 3.5.

Figure 1

Reactor Core Safety Limits - Four Loops in Operation

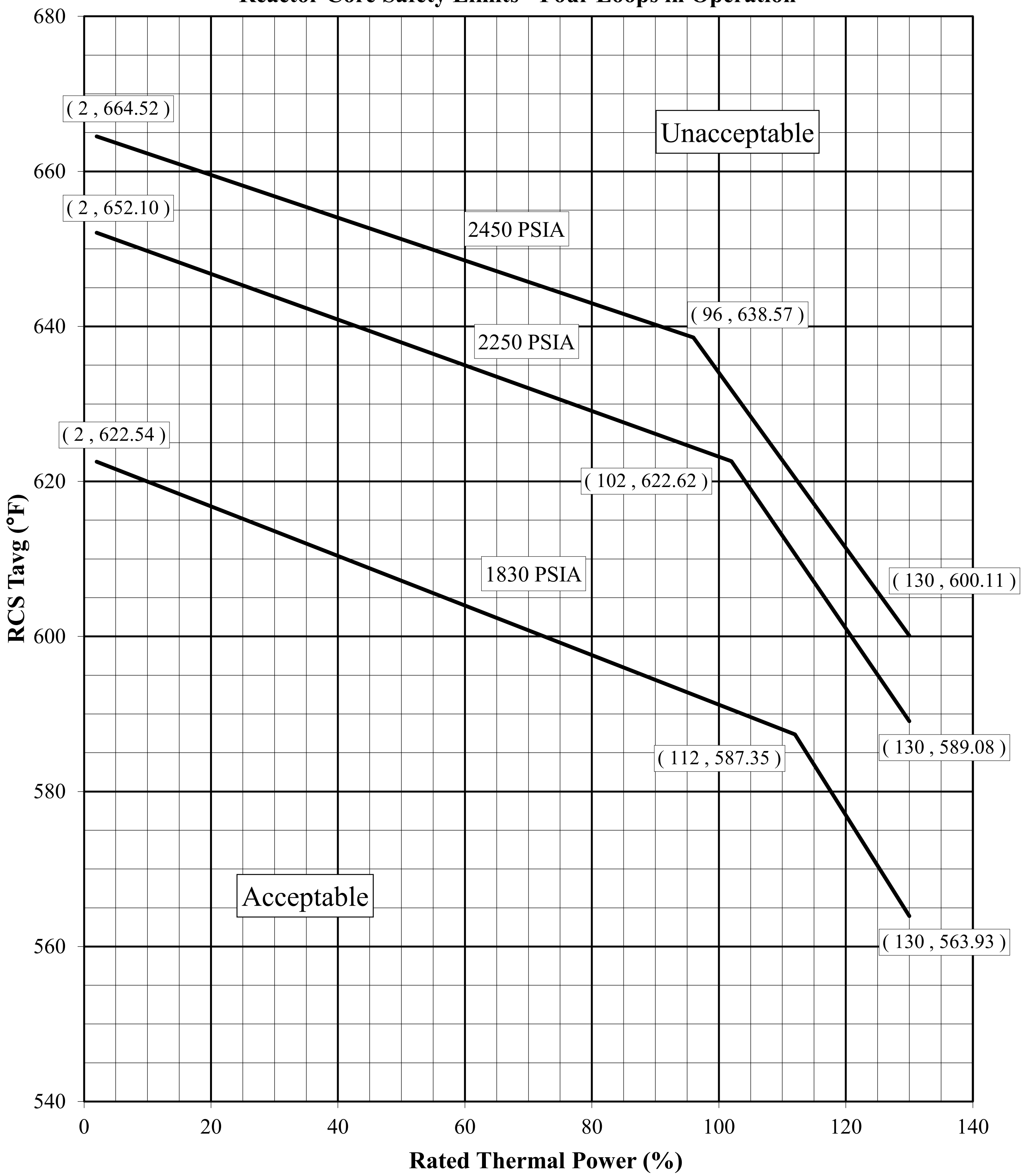


Figure 2

Required Shutdown Margin for Modes 3 & 4

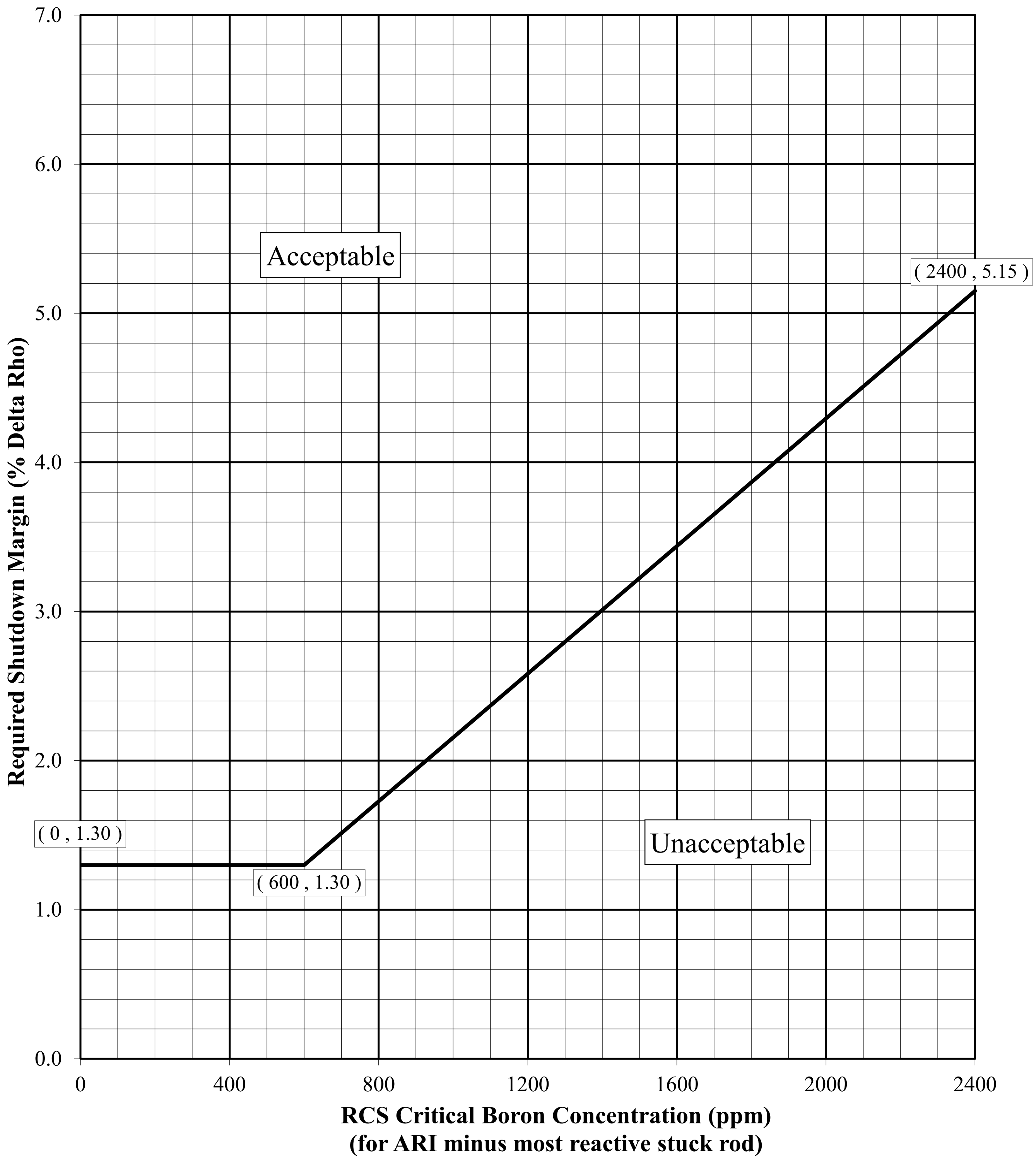


Figure 3

Required Shutdown Margin for Mode 5

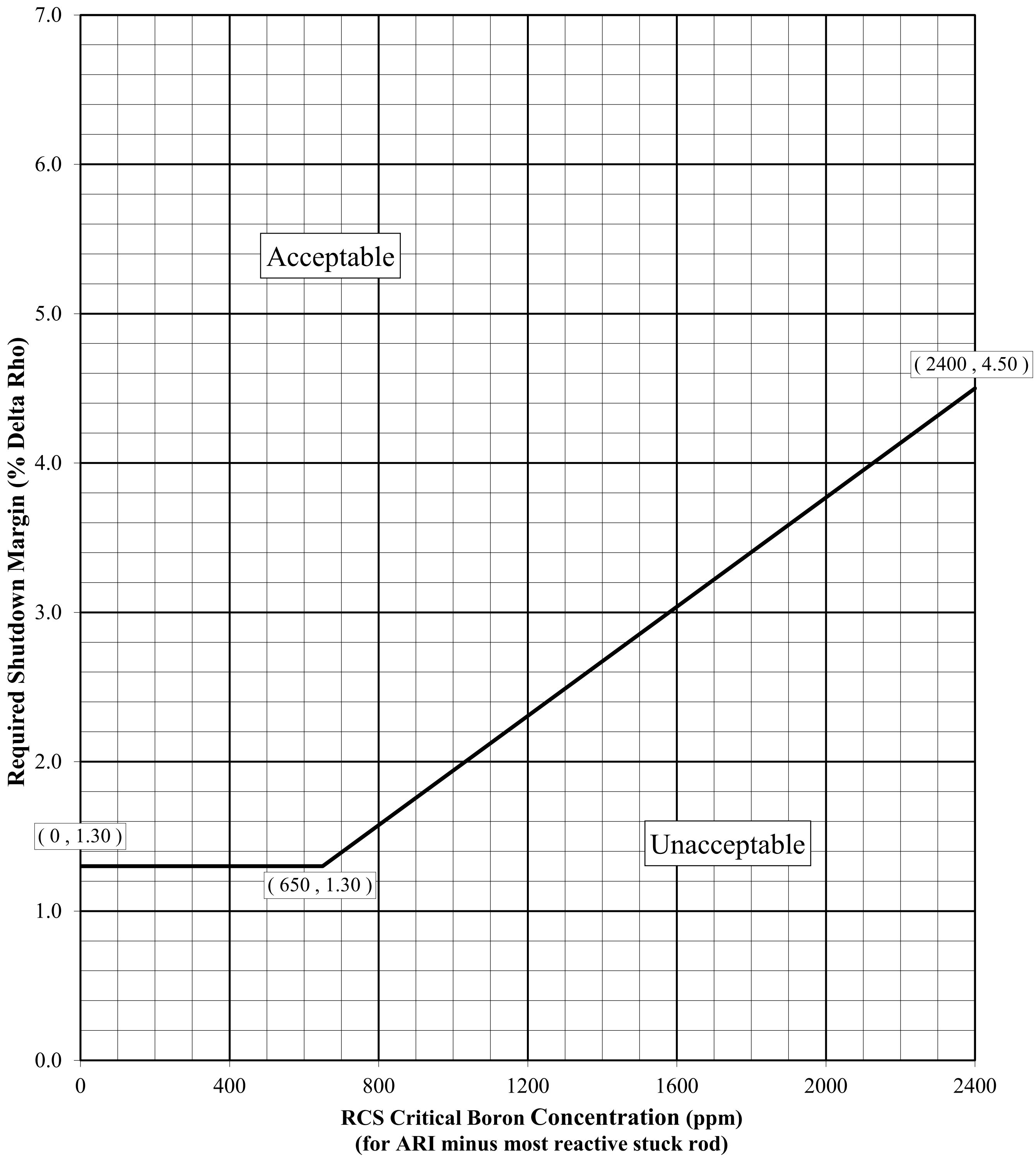


Figure 4

MTC versus Power Level

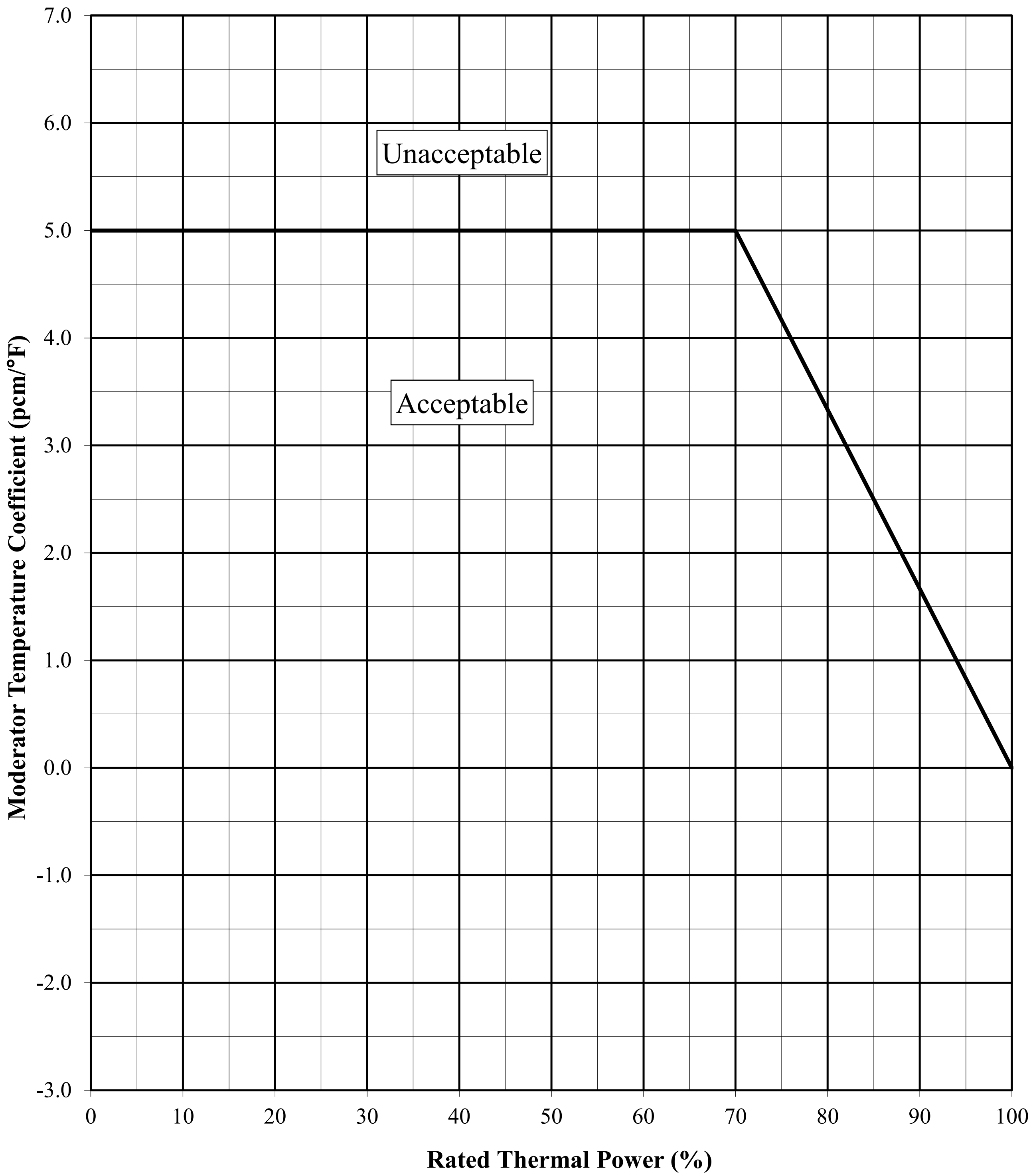
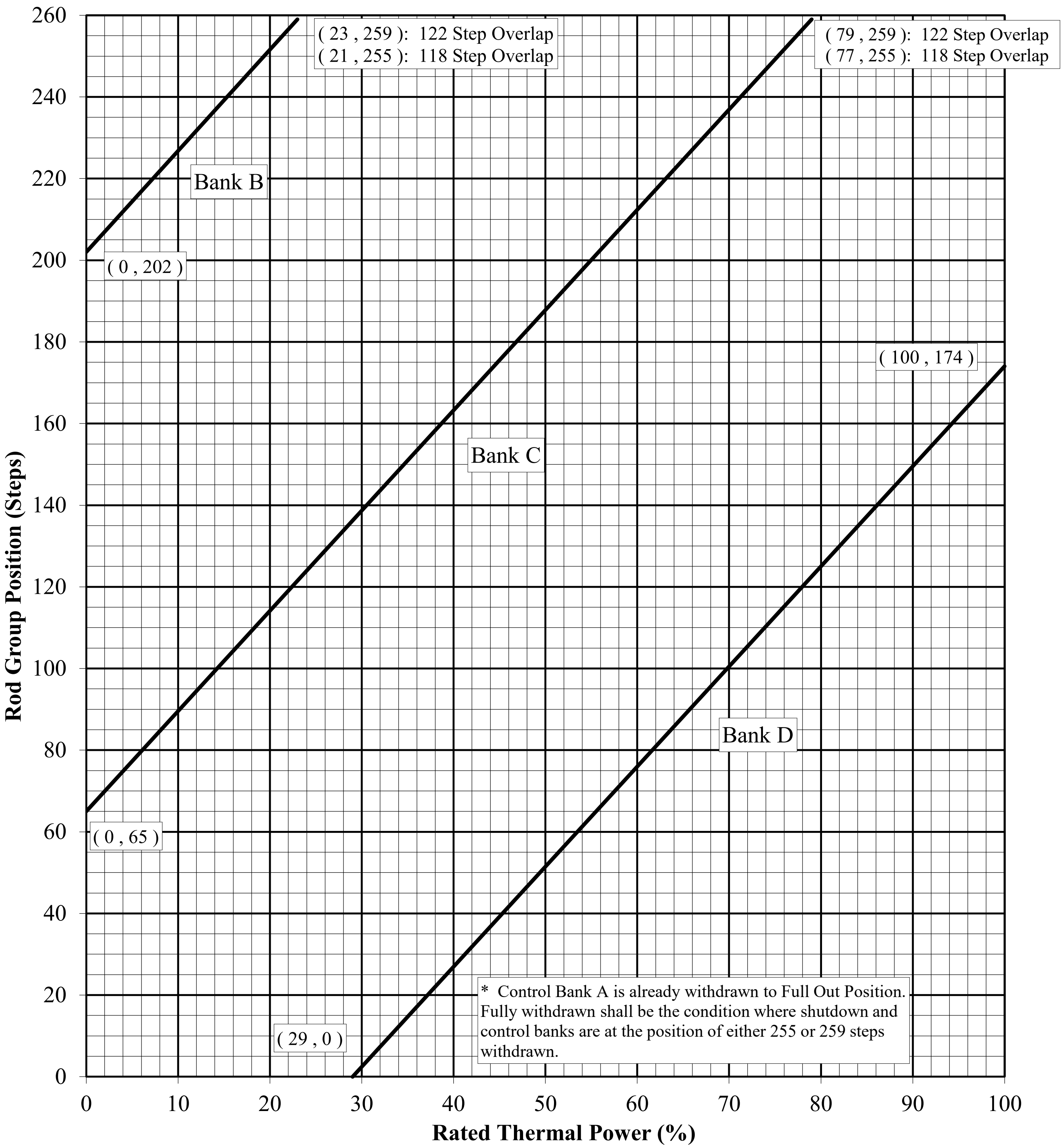


Figure 5

Control Rod Insertion Limits* versus Power Level



* Control Bank A is already withdrawn to Full Out Position. Fully withdrawn shall be the condition where shutdown and control banks are at the position of either 255 or 259 steps withdrawn.

Figure 6

AFD Limits versus Power Level

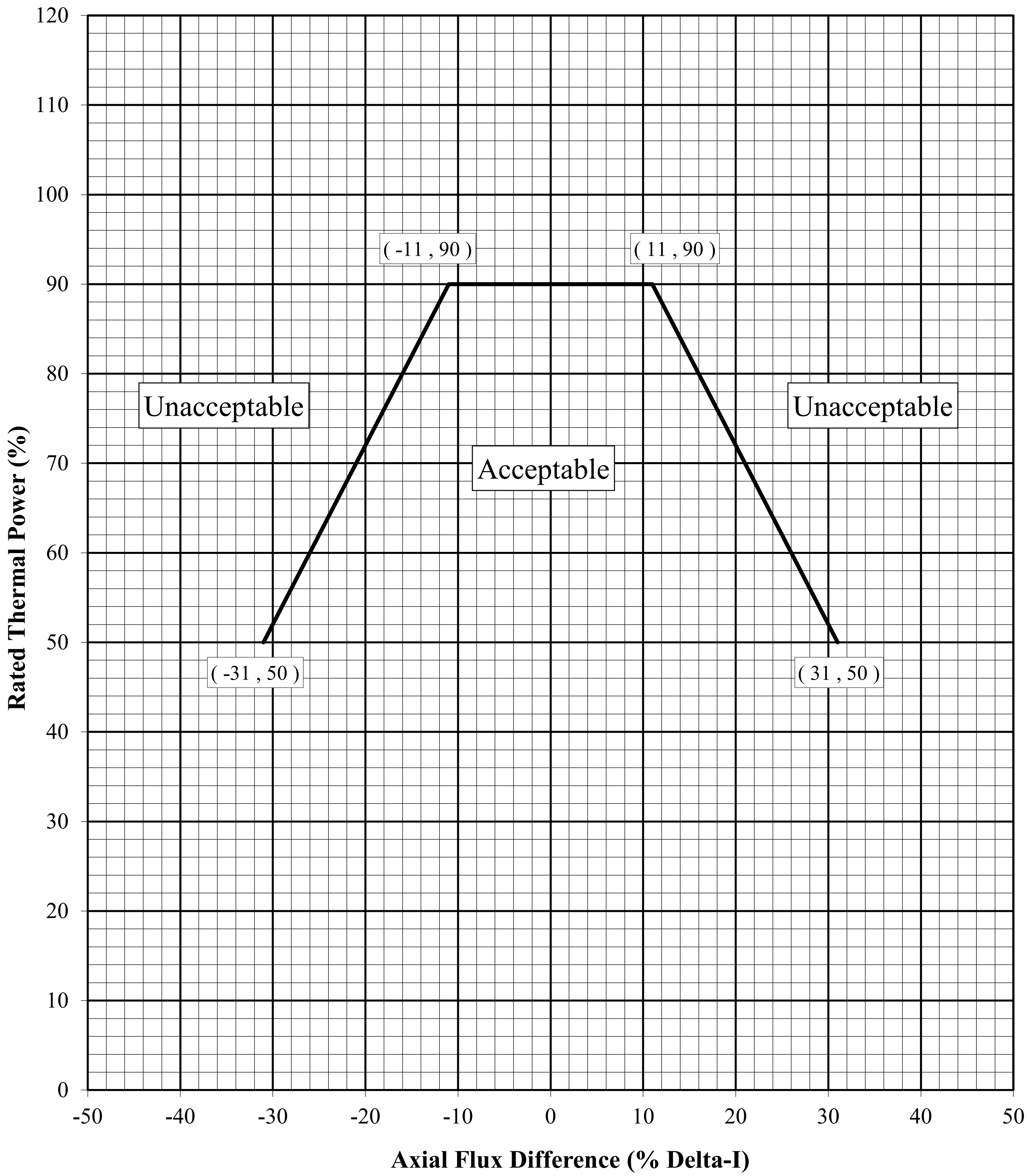


Figure 7

K(Z) - Normalized FQ(Z) versus Core Height

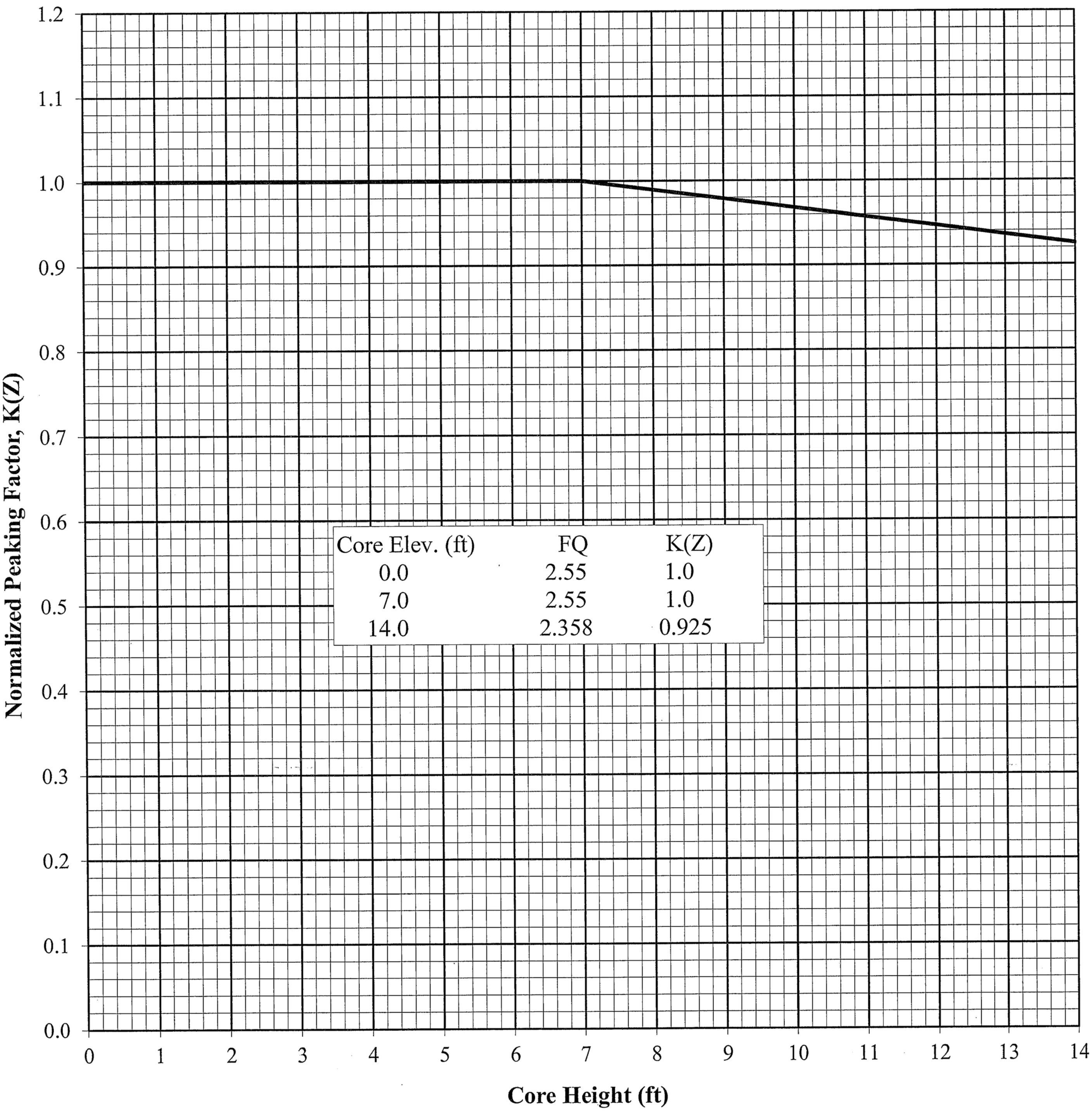


Table 1 (Part 1 of 2)
Unrodded F_{xy} for Each Core Height
for Cycle Burnups Less Than 10000 MWD/MTU

(Subject to the exclusion zones of COLR Section 2.7.4)

Core Height (Ft.)	Axial Point	Unrodded Fxy	Core Height (Ft.)	Axial Point	Unrodded Fxy
14.0	1	7.136	6.8	37	1.913
13.8	2	5.558	6.6	38	1.969
13.6	3	3.983	6.4	39	1.946
13.4	4	2.640	6.2	40	1.893
13.2	5	2.456	6.0	41	1.853
13.0	6	2.183	5.8	42	1.882
12.8	7	2.105	5.6	43	1.899
12.6	8	2.115	5.4	44	1.903
12.4	9	2.080	5.2	45	1.951
12.2	10	2.024	5.0	46	2.025
12.0	11	1.986	4.8	47	2.051
11.8	12	1.999	4.6	48	2.001
11.6	13	2.045	4.4	49	1.934
11.4	14	2.034	4.2	50	1.944
11.2	15	1.984	4.0	51	1.953
11.0	16	1.951	3.8	52	1.944
10.8	17	1.945	3.6	53	1.958
10.6	18	1.935	3.4	54	2.015
10.4	19	1.922	3.2	55	2.051
10.2	20	1.944	3.0	56	1.998
10.0	21	1.978	2.8	57	1.948
9.8	22	1.985	2.6	58	1.954
9.6	23	1.919	2.4	59	1.961
9.4	24	1.887	2.2	60	1.955
9.2	25	1.888	2.0	61	1.958
9.0	26	1.870	1.8	62	1.987
8.8	27	1.869	1.6	63	1.989
8.6	28	1.886	1.4	64	1.899
8.4	29	1.950	1.2	65	1.831
8.2	30	2.011	1.0	66	1.862
8.0	31	1.955	0.8	67	2.166
7.8	32	1.889	0.6	68	2.904
7.6	33	1.867	0.4	69	4.151
7.4	34	1.883	0.2	70	5.907
7.2	35	1.881	0.0	71	8.818
7.0	36	1.867			

Table 1 (Part 2 of 2)

Unrodded Fxy for Each Core Height
for Cycle Burnups Greater Than or Equal to 10000 MWD/MTU

(Subject to the exclusion zones of COLR Section 2.7.4)

Core Height (Ft.)	Axial Point	Unrodded Fxy	Core Height (Ft.)	Axial Point	Unrodded Fxy
14.00	1	6.364	6.80	37	2.195
13.80	2	5.077	6.60	38	2.249
13.60	3	3.790	6.40	39	2.217
13.40	4	2.690	6.20	40	2.150
13.20	5	2.548	6.00	41	2.113
13.00	6	2.277	5.80	42	2.104
12.80	7	2.119	5.60	43	2.092
12.60	8	2.060	5.40	44	2.076
12.40	9	2.003	5.20	45	2.096
12.20	10	1.981	5.00	46	2.137
12.00	11	1.988	4.80	47	2.134
11.80	12	2.019	4.60	48	2.073
11.60	13	2.068	4.40	49	2.023
11.40	14	2.060	4.20	50	2.017
11.20	15	2.021	4.00	51	2.005
11.00	16	1.980	3.80	52	1.989
10.80	17	2.007	3.60	53	1.992
10.60	18	2.015	3.40	54	2.031
10.40	19	2.017	3.20	55	2.059
10.20	20	2.052	3.00	56	2.001
10.00	21	2.112	2.80	57	1.942
9.80	22	2.140	2.60	58	1.913
9.60	23	2.099	2.40	59	1.885
9.40	24	2.064	2.20	60	1.872
9.20	25	2.080	2.00	61	1.880
9.00	26	2.092	1.80	62	1.924
8.80	27	2.096	1.60	63	1.950
8.60	28	2.107	1.40	64	1.926
8.40	29	2.154	1.20	65	1.936
8.20	30	2.199	1.00	66	2.041
8.00	31	2.156	0.80	67	2.398
7.80	32	2.115	0.60	68	3.112
7.60	33	2.115	0.40	69	4.195
7.40	34	2.125	0.20	70	5.678
7.20	35	2.133	0.00	71	8.314
7.00	36	2.141			

Table 2

Core and Grid Plane Fxy Exclusion Zones

Axial Point	Core Height (in.)	Core Height (%)	Top/Bottom	Grid	Axial Point	Core Height (in.)	Core Height (%)	Top/Bottom	Grid
1	168.0	100.0	Excluded		37	81.6	48.6		
2	165.6	98.6	Excluded		38	79.2	47.1		Excluded
3	163.2	97.1	Excluded		39	76.8	45.7		Excluded
4	160.8	95.7	Excluded		40	74.4	44.3		
5	158.4	94.3	Excluded	Excluded	41	72.0	42.9		
6	156.0	92.9	Excluded	Excluded	42	69.6	41.4		
7	153.6	91.4	Excluded		43	67.2	40.0		
8	151.2	90.0	Excluded		44	64.8	38.6		
9	148.8	88.6			45	62.4	37.1		
10	146.4	87.1			46	60.0	35.7		Excluded
11	144.0	85.7			47	57.6	34.3		Excluded
12	141.6	84.3			48	55.2	32.9		Excluded
13	139.2	82.9		Excluded	49	52.8	31.4		
14	136.8	81.4		Excluded	50	50.4	30.0		
15	134.4	80.0		Excluded	51	48.0	28.6		
16	132.0	78.6			52	45.6	27.1		
17	129.6	77.1			53	43.2	25.7		
18	127.2	75.7			54	40.8	24.3		Excluded
19	124.8	74.3			55	38.4	22.9		Excluded
20	122.4	72.9			56	36.0	21.4		Excluded
21	120.0	71.4		Excluded	57	33.6	20.0		
22	117.6	70.0		Excluded	58	31.2	18.6		
23	115.2	68.6		Excluded	59	28.8	17.1		
24	112.8	67.1			60	26.4	15.7		
25	110.4	65.7			61	24.0	14.3		
26	108.0	64.3			62	21.6	12.9		Excluded
27	105.6	62.9			63	19.2	11.4		Excluded
28	103.2	61.4			64	16.8	10.0	Excluded	Excluded
29	100.8	60.0		Excluded	65	14.4	8.6	Excluded	
30	98.4	58.6		Excluded	66	12.0	7.1	Excluded	
31	96.0	57.1		Excluded	67	9.6	5.7	Excluded	
32	93.6	55.7			68	7.2	4.3	Excluded	
33	91.2	54.3			69	4.8	2.9	Excluded	Excluded
34	88.8	52.9			70	2.4	1.4	Excluded	Excluded
35	86.4	51.4			71	0.0	0.0	Excluded	Excluded
36	84.0	50.0							