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

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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Unit 1
Docket No. STN 50-498
Unit 1 Cycle 17 Core Operating Limits Report

Pursuant to Technical Specification 6.9.1.6.d, STP Nuclear Operating Company submits the attached Core Operating Limits Report for Unit 1 Cycle 17. The report covers the core design changes made during the 1RE16 refueling outage.

There are no commitments included in this report.

If there are any questions on this report, please contact either Philip Walker at (361) 972-8392 or me at (361) 972-7743.

[signature]

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PLW

Attachment: Unit 1 Cycle 17 Core Operating Limits

A001
NRR

STI: 32862265

cc:

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ATTACHMENT

South Texas Project

Unit 1 Cycle 17 Core Operating Limits Report

SOUTH TEXAS PROJECT

Unit 1 Cycle 17

CORE OPERATING LIMITS REPORT

Revision 0

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for STPEGS Unit 1 Cycle 17 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, $K_3 = 0.00143$/psig
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 the magnitude of $q_t - q_b$ exceeds -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 the magnitude of $q_t - q_b$ exceeds +8%, the ΔT Trip Setpoint shall be automatically reduced by 2.65% of its value at RATED THERMAL POWER.

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

2.7.4.1 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 BEACON computer code.

2.7.4.2 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 $F_{\Delta H}^{RTP} = 1.62$ [1]

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 by Technical Specification 6.9.1.6.b.11.

This uncertainty is calculated and applied automatically by the BEACON computer code.

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

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

1 Applies to all fuel in the Unit 1 Cycle 17 Core.

2.9 DNB PARAMETERS (Specification 3.2.5):

2.9.1 The following DNB-related parameters shall be maintained within the following limits: [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 J. M. Ralston (Westinghouse) to D. F. Hoppes (STPNOC), "South Texas Project Electric Generating Station Unit 1 Cycle 17 Final Reload Evaluation (RE)" NF-TG-11-6 (ST-UB-NOC-11003139) dated January 25, 2011.

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, effective July 22, 2003.

3.4 STPNOC Calculation ZC-7032, Rev. 4, "Loop Uncertainty Calculation for Narrow Range Pressurizer Pressure Monitoring Instrumentation," Section 2.3, Page 9, effective July 22, 2003.

3.5 Condition Report Engineering Evaluation 09-16959-9, "Unit 1 Cycle 17 Reload Safety Evaluation and Core Operating Limits Report Modes 1, 2, 3, 4, and 5."

3.6 5Z529ZB01025 Rev. 4, Design Basis Document, Technical Specifications /LCO, Tech Spec Section 3.2.5.c

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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.

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. Includes a 9.6 psi measurement uncertainty as read on QDPS display per Reference 3.4.

4 Includes the most limiting flow measurement uncertainty of 2.8% from Reference 3.6.

Figure 1

Reactor Core Safety Limits - Four Loops in Operation

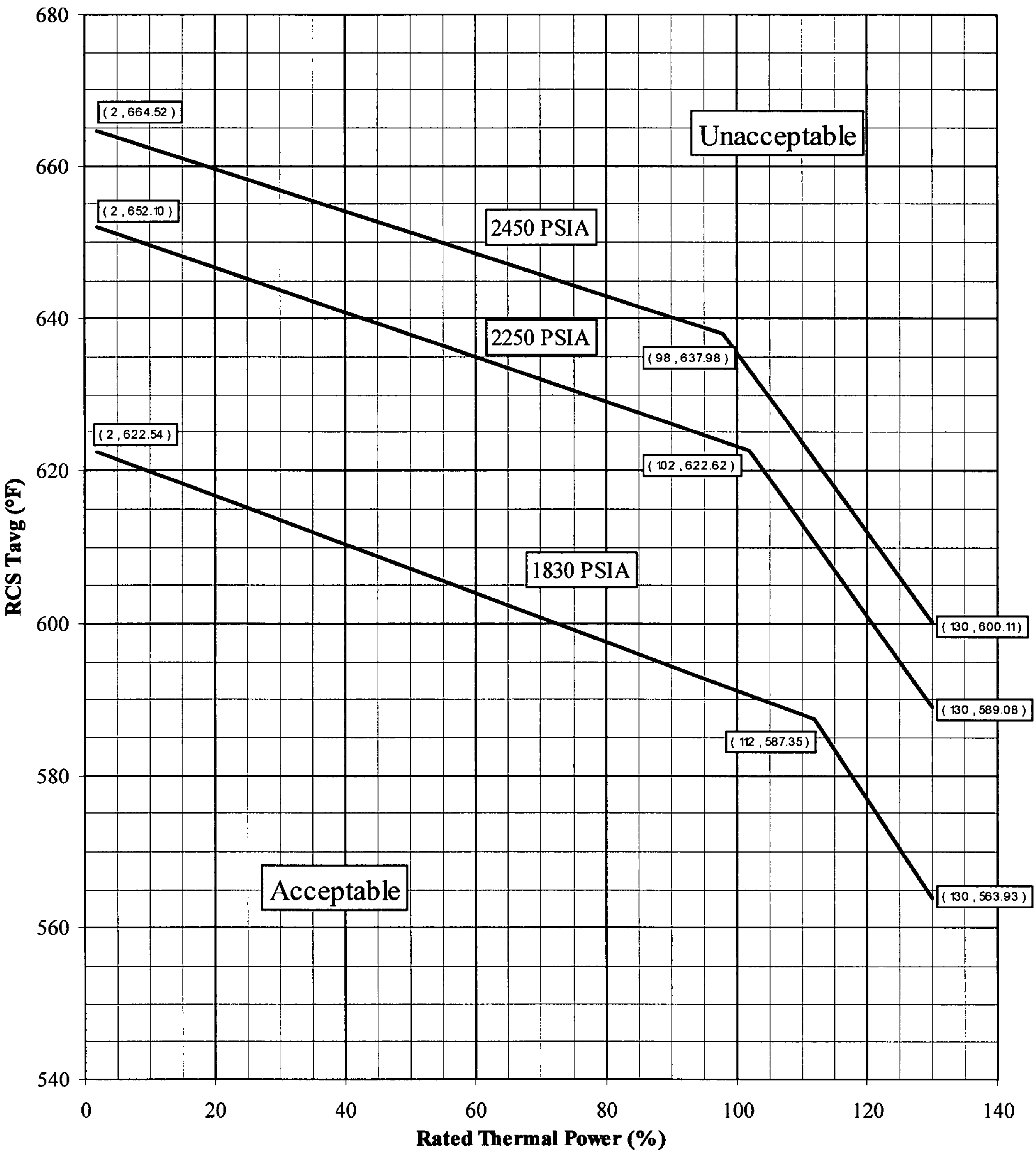


Figure 2

Required Shutdown Margin for Modes 3 & 4

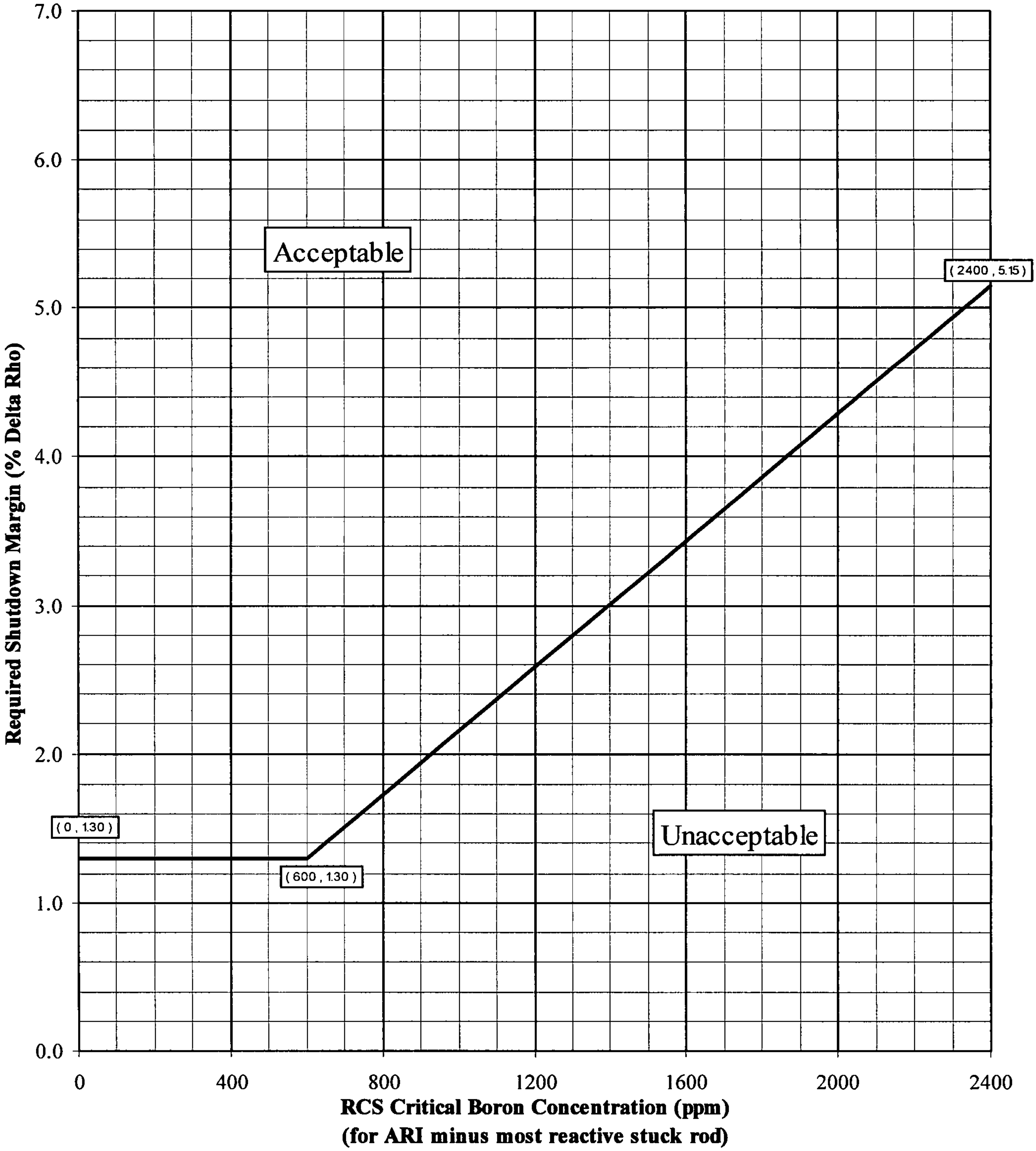


Figure 3

Required Shutdown Margin for Mode 5

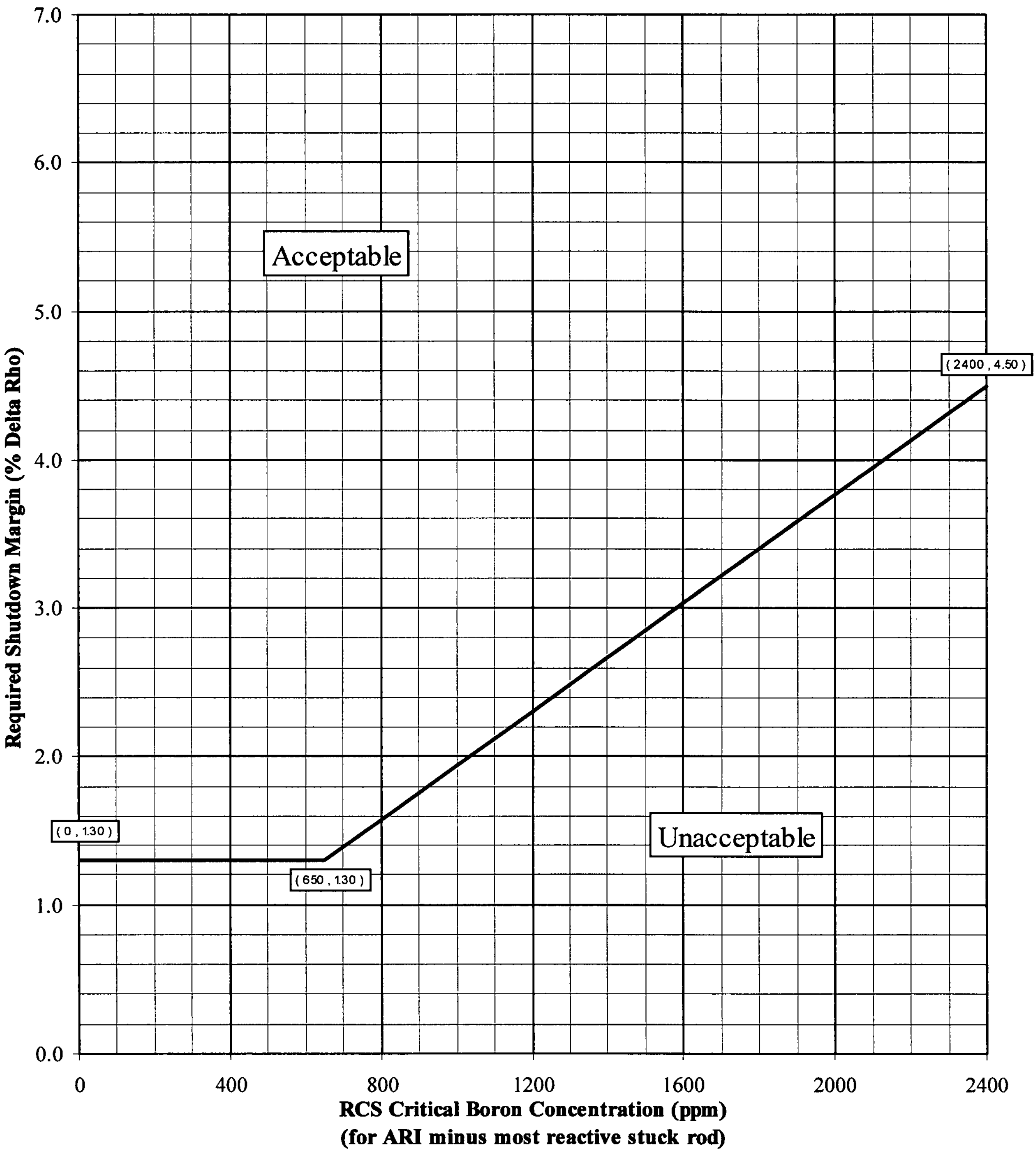


Figure 4

MTC versus Power Level

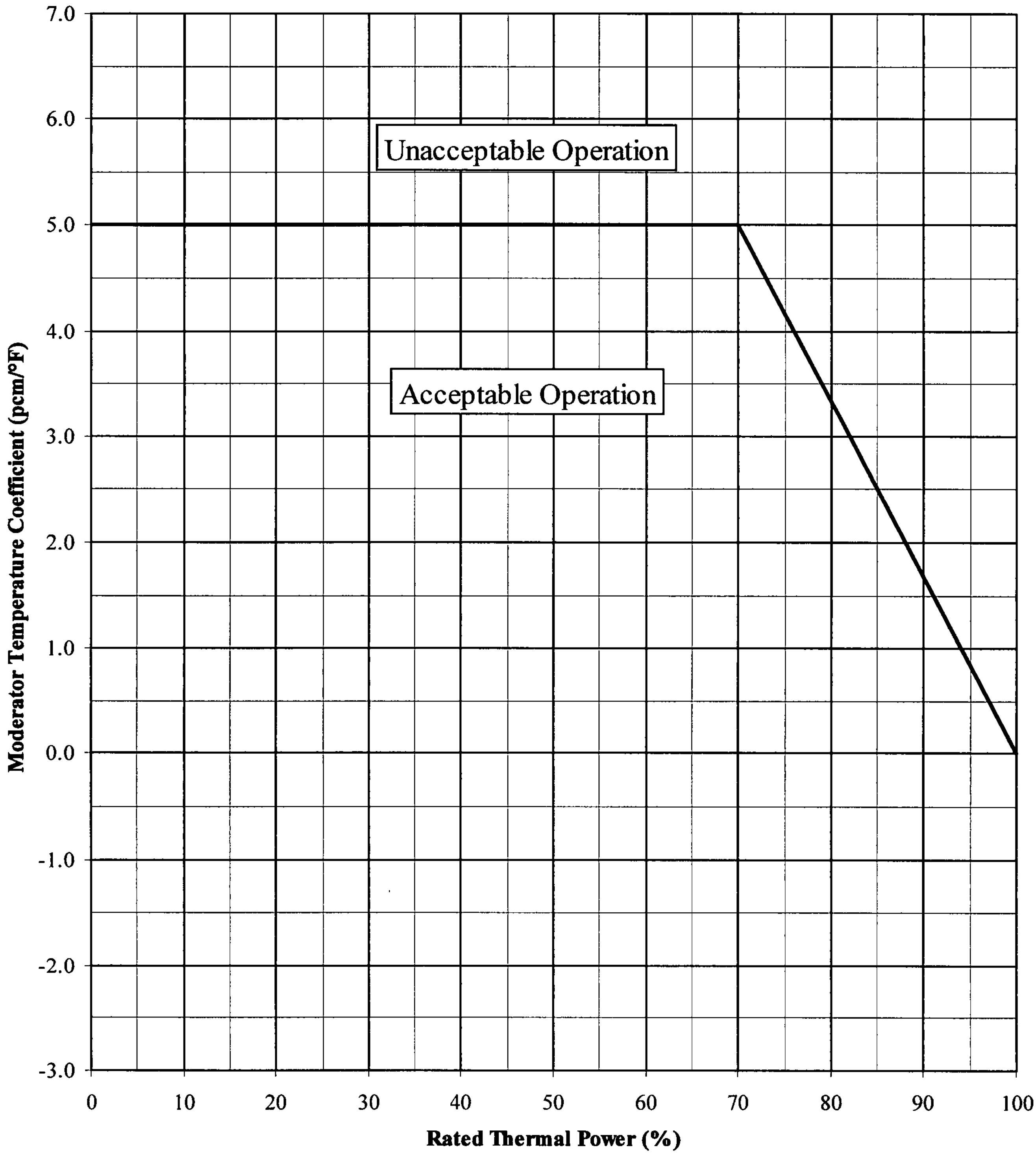


Figure 5

Control Rod Insertion Limits* versus Power Level

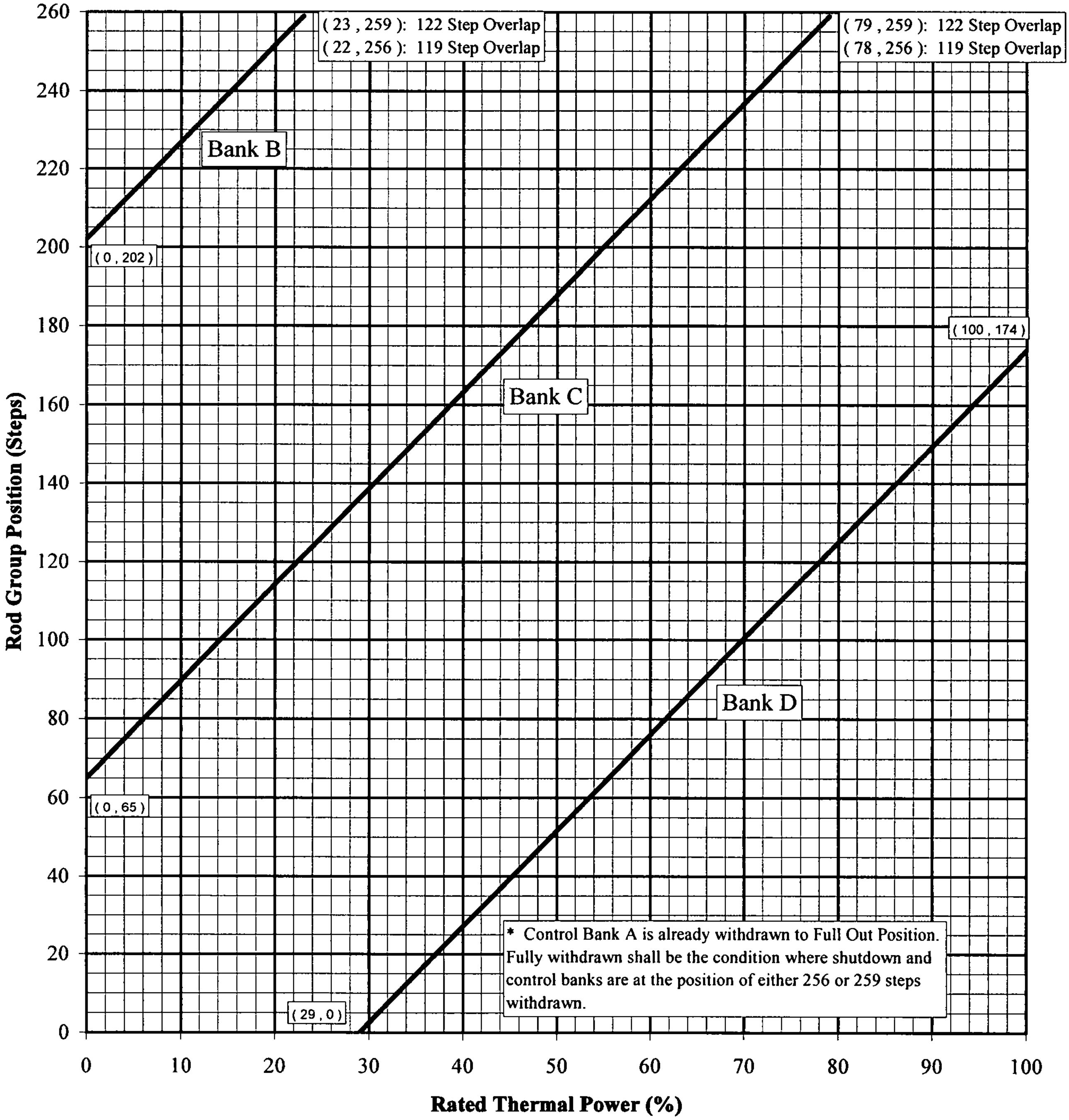


Figure 6

AFD Limits versus Power Level

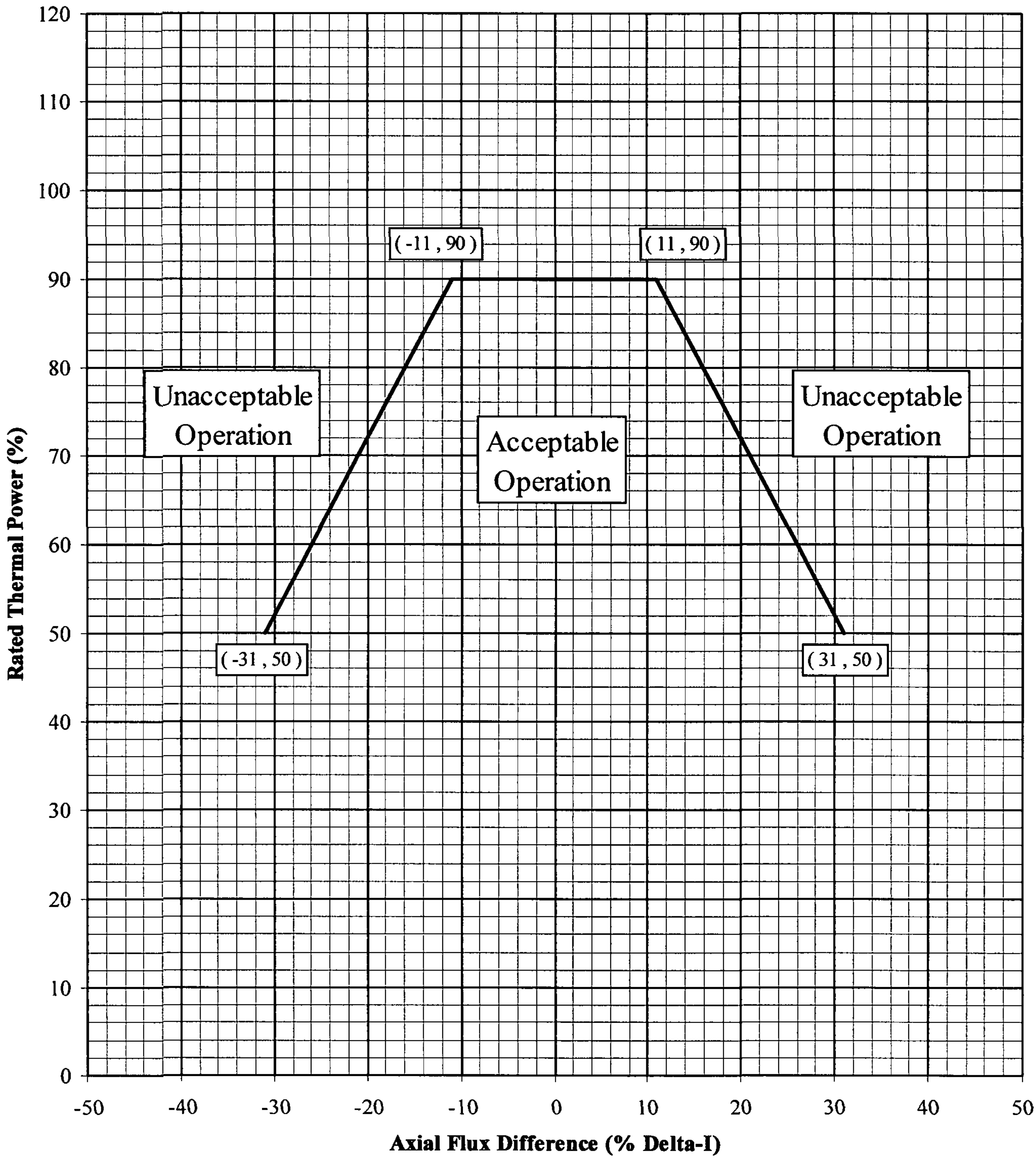
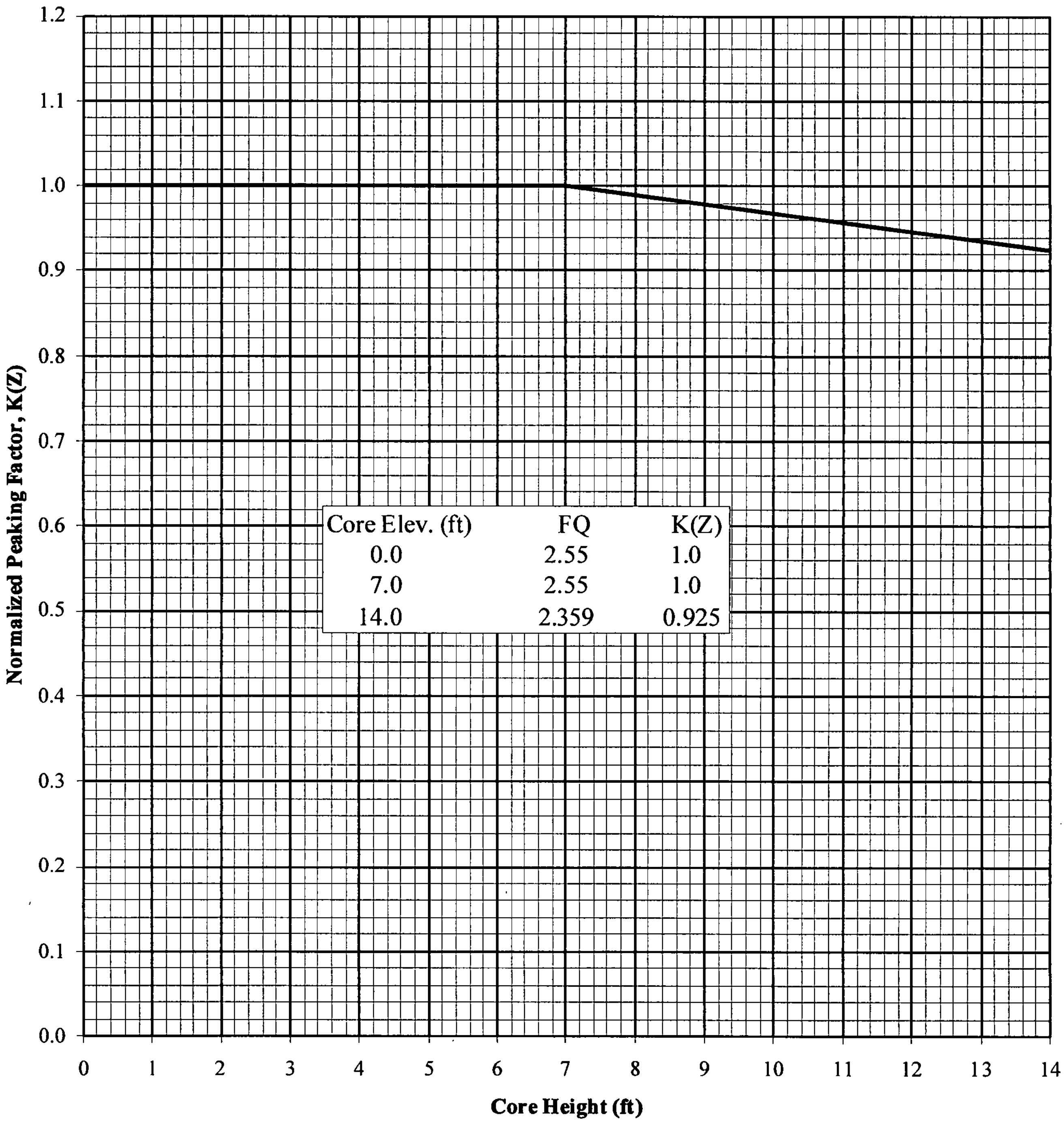


Figure 7

K(Z) - Normalized $F_Q(Z)$ versus Core Height



Core Elev. (ft)	FQ	K(Z)
0.0	2.55	1.0
7.0	2.55	1.0
14.0	2.359	0.925

Table 1 (Part 1 of 2)

Unrodded F_{xy} for Each Core Height

for Cycle Burnups Less Than 10000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded Fxy	Core Height (Ft.)	Axial Point	Unrodded Fxy
14.00	1	4.867	6.80	37	1.986
13.80	2	4.107	6.60	38	1.985
13.60	3	3.347	6.40	39	1.980
13.40	4	2.587	6.20	40	1.978
13.20	5	2.230	6.00	41	1.978
13.00	6	1.999	5.80	42	1.981
12.80	7	1.999	5.60	43	1.984
12.60	8	1.976	5.40	44	1.987
12.40	9	1.960	5.20	45	1.989
12.20	10	1.946	5.00	46	1.991
12.00	11	1.934	4.80	47	1.991
11.80	12	1.926	4.60	48	1.991
11.60	13	1.922	4.40	49	1.990
11.40	14	1.916	4.20	50	1.982
11.20	15	1.907	4.00	51	1.975
11.00	16	1.894	3.80	52	1.968
10.80	17	1.887	3.60	53	1.962
10.60	18	1.882	3.40	54	1.956
10.40	19	1.879	3.20	55	1.955
10.20	20	1.885	3.00	56	1.947
10.00	21	1.895	2.80	57	1.942
9.80	22	1.903	2.60	58	1.943
9.60	23	1.914	2.40	59	1.949
9.40	24	1.924	2.20	60	1.957
9.20	25	1.938	2.00	61	1.937
9.00	26	1.957	1.80	62	1.899
8.80	27	1.982	1.60	63	1.846
8.60	28	2.009	1.40	64	1.823
8.40	29	2.028	1.20	65	1.829
8.20	30	2.043	1.00	66	1.871
8.00	31	2.052	0.80	67	2.036
7.80	32	2.050	0.60	68	2.468
7.60	33	2.026	0.40	69	3.033
7.40	34	2.005	0.20	70	3.598
7.20	35	1.990	0.00	71	4.163
7.00	36	1.987			

Table 1 (Part 2 of 2)
Unrodded Fxy for Each Core Height
for Cycle Burnups Greater Than or Equal to 10000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded Fxy	Core Height (Ft.)	Axial Point	Unrodded Fxy
14.00	1	4.672	6.80	37	2.167
13.80	2	4.098	6.60	38	2.161
13.60	3	3.525	6.40	39	2.146
13.40	4	2.951	6.20	40	2.131
13.20	5	2.577	6.00	41	2.116
13.00	6	2.265	5.80	42	2.104
12.80	7	2.183	5.60	43	2.092
12.60	8	2.112	5.40	44	2.080
12.40	9	2.056	5.20	45	2.069
12.20	10	2.016	5.00	46	2.058
12.00	11	2.011	4.80	47	2.047
11.80	12	2.006	4.60	48	2.036
11.60	13	2.005	4.40	49	2.024
11.40	14	2.009	4.20	50	2.011
11.20	15	2.012	4.00	51	1.998
11.00	16	2.018	3.80	52	1.985
10.80	17	2.022	3.60	53	1.974
10.60	18	2.027	3.40	54	1.964
10.40	19	2.031	3.20	55	1.953
10.20	20	2.046	3.00	56	1.940
10.00	21	2.065	2.80	57	1.926
9.80	22	2.087	2.60	58	1.903
9.60	23	2.106	2.40	59	1.875
9.40	24	2.120	2.20	60	1.852
9.20	25	2.129	2.00	61	1.846
9.00	26	2.130	1.80	62	1.844
8.80	27	2.130	1.60	63	1.845
8.60	28	2.129	1.40	64	1.868
8.40	29	2.130	1.20	65	1.920
8.20	30	2.131	1.00	66	2.009
8.00	31	2.134	0.80	67	2.208
7.80	32	2.140	0.60	68	2.531
7.60	33	2.147	0.40	69	2.915
7.40	34	2.155	0.20	70	3.299
7.20	35	2.163	0.00	71	3.683
7.00	36	2.167			