Nuclear Operating Company

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

November 12, 2015
NOC-AE-15003304
10 CFR 50.36

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

South Texas Project
Unit 1
Docket No. STN 50-498
Unit 1 Cycle 20 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 for Unit 1 Cycle 20. The report covers the core design changes made during the 1RE19 refueling outage.

There are no commitments in this letter.

If there are any questions regarding this report, please contact Marilyn Kistler at (361) 972-8385 or me at (361) 972-7743.

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Attachment: South Texas Project Unit 1 Cycle 20 Core Operating Limits Report, Revision 0

A001
NRR

STI: 34235347

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SOUTH TEXAS PROJECT

Unit 1 Cycle 20

CORE OPERATING LIMITS REPORT

Revision 0

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for STPEGS Unit 1 Cycle 20 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'≤ 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. (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 ≤ T"
T" Indicated full power T_{avg}, T"≤ 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 254 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 Power Distribution Monitoring System (PDMS).

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

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: [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 20 Final Reload Evaluation" NF-TG-15-62 (ST-UB-NOC-15003490 dated September 22, 2015.

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

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-U1, Rev. 4, "Unit 1 Cycle 20 Reload Safety Evaluation and Core Operating Limits Report." (CR Action 14-10332-9)

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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 is bounded by the 9.6 psi averaged measurement calculated in Reference 3.4.

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

Figure 1

Reactor Core Safety Limits - Four Loops in Operation

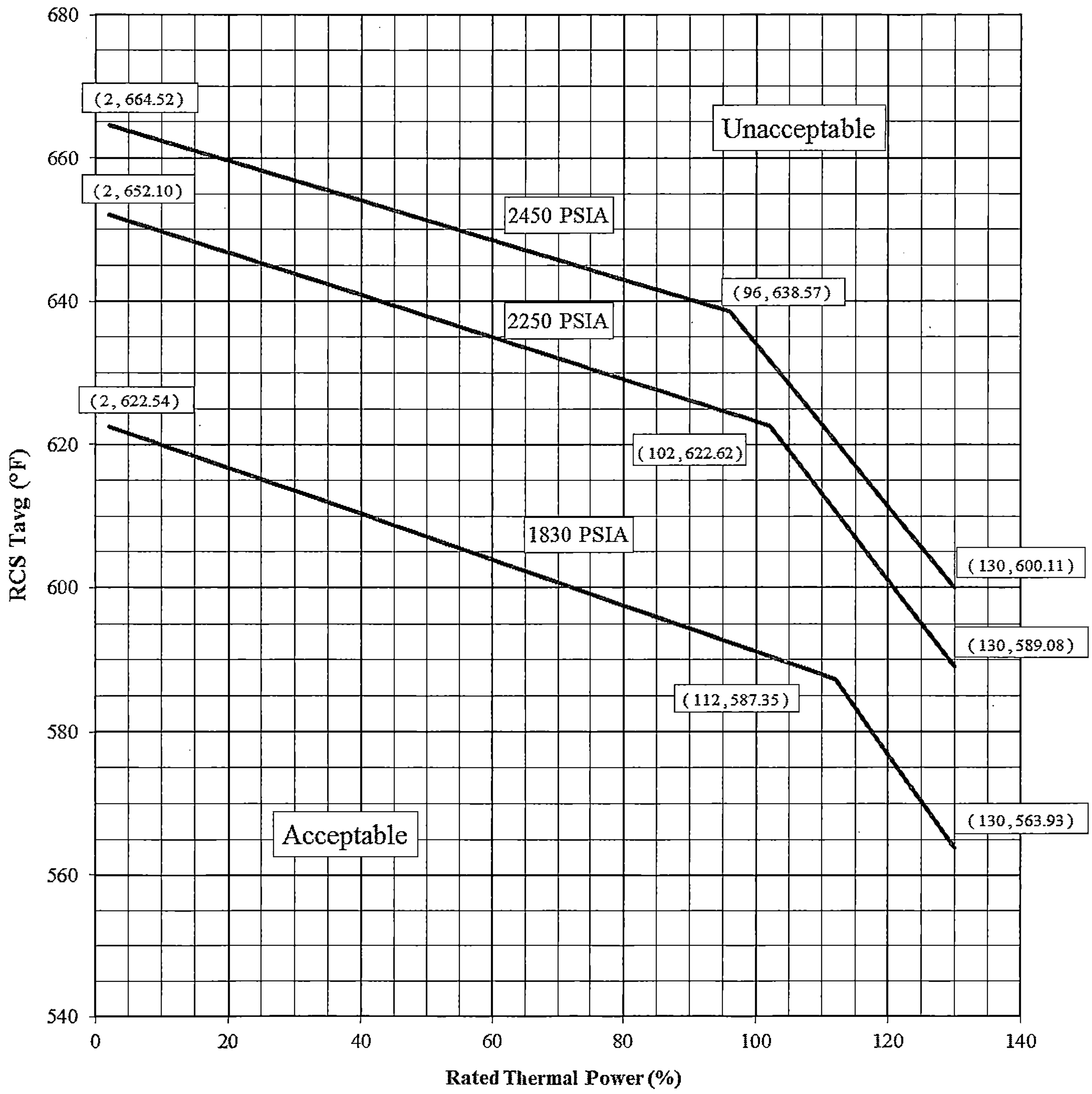


Figure 2

Required Shutdown Margin for Modes 3 & 4

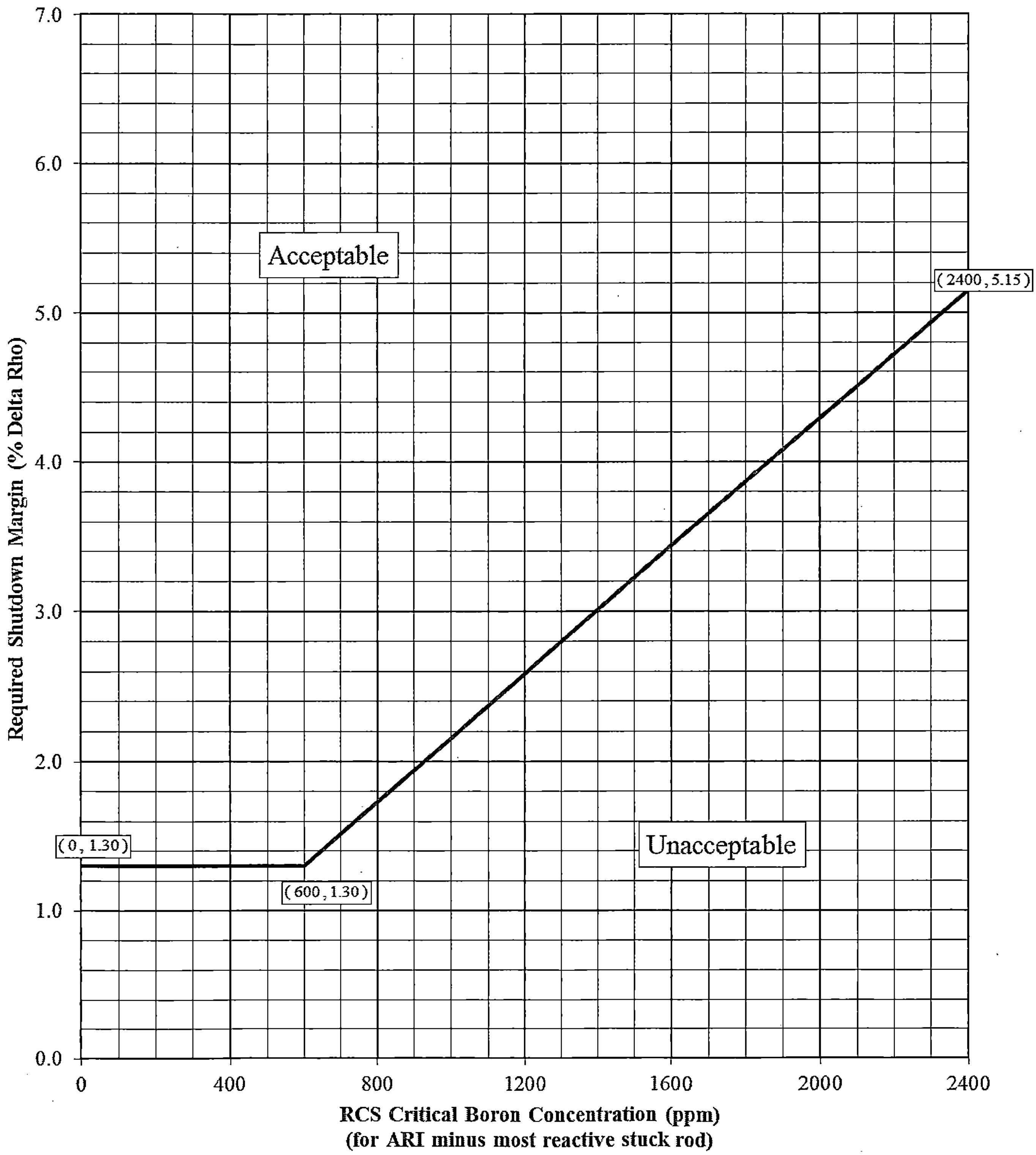


Figure 3

Required Shutdown Margin for Mode 5

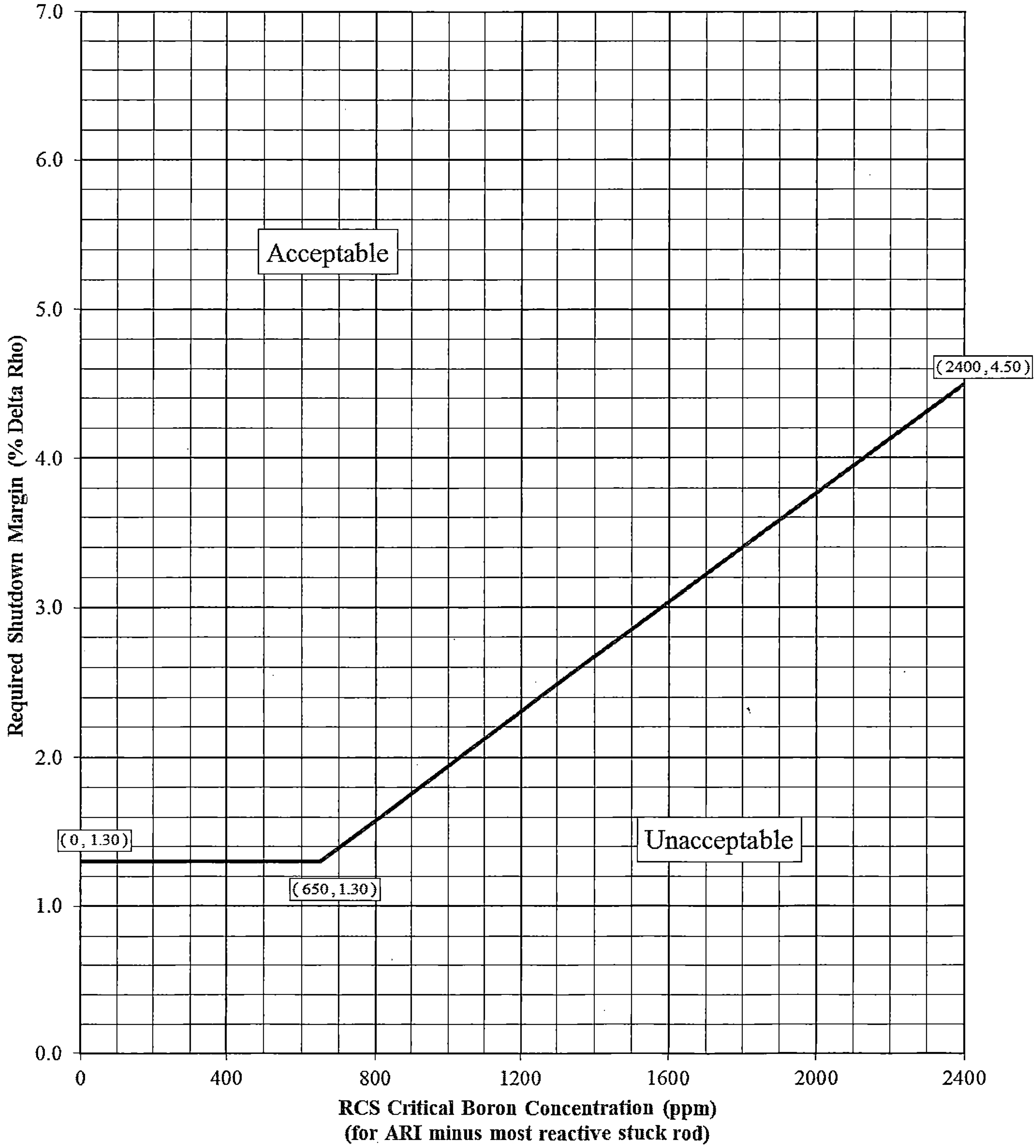


Figure 4

MTC versus Power Level

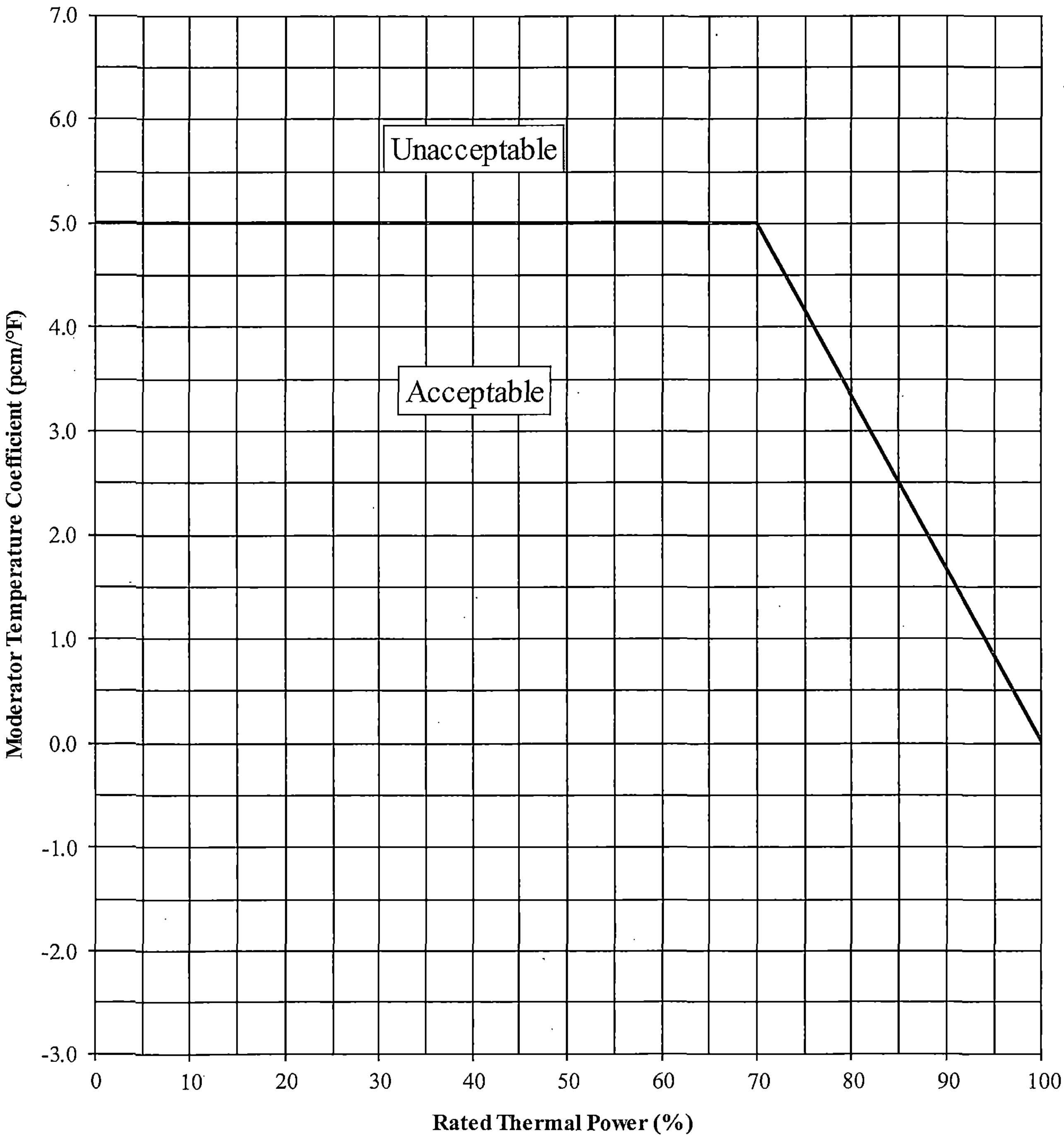


Figure 5

Control Rod Insertion Limits* versus Power Level

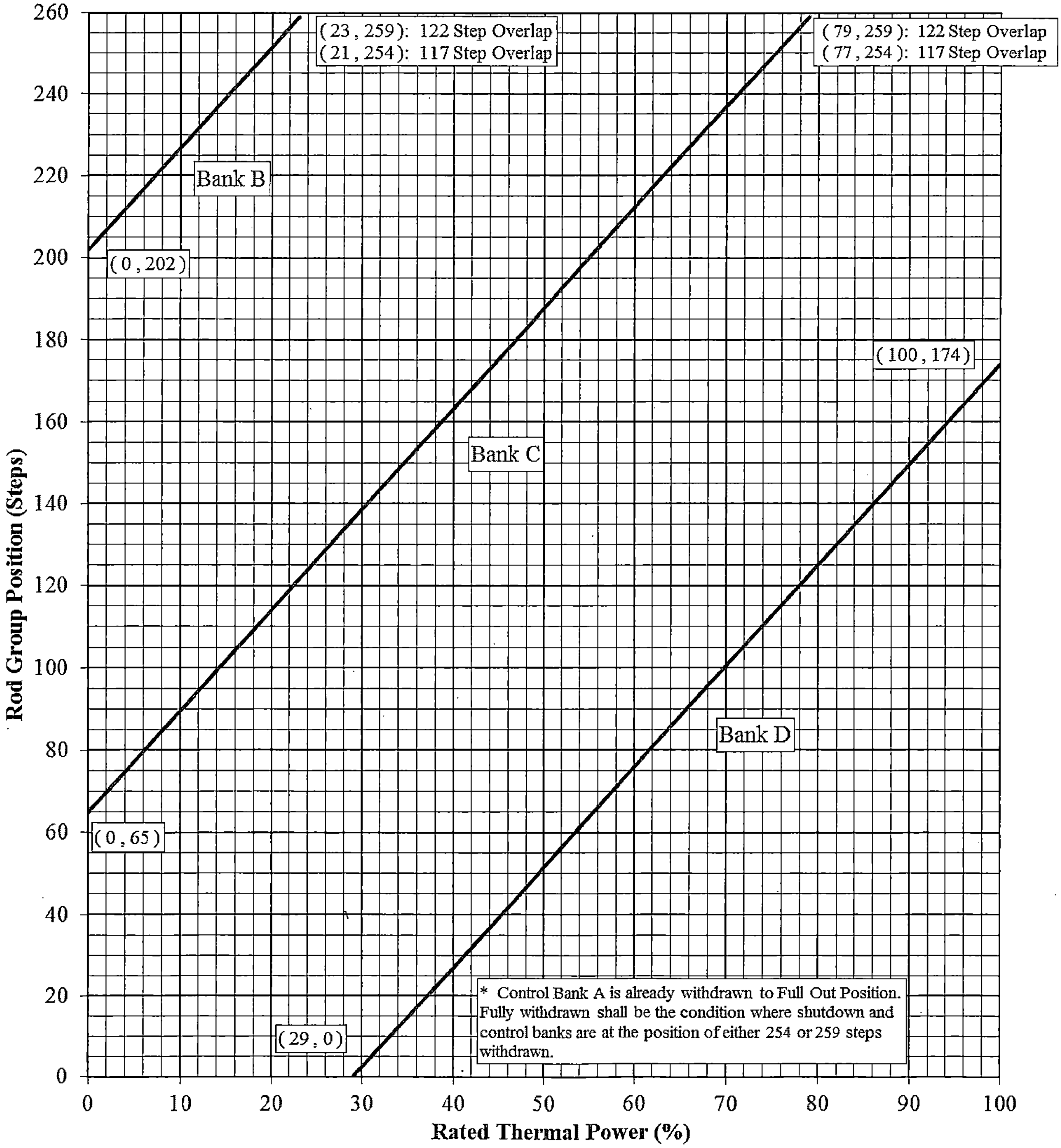


Figure 6

AFD Limits versus Power Level

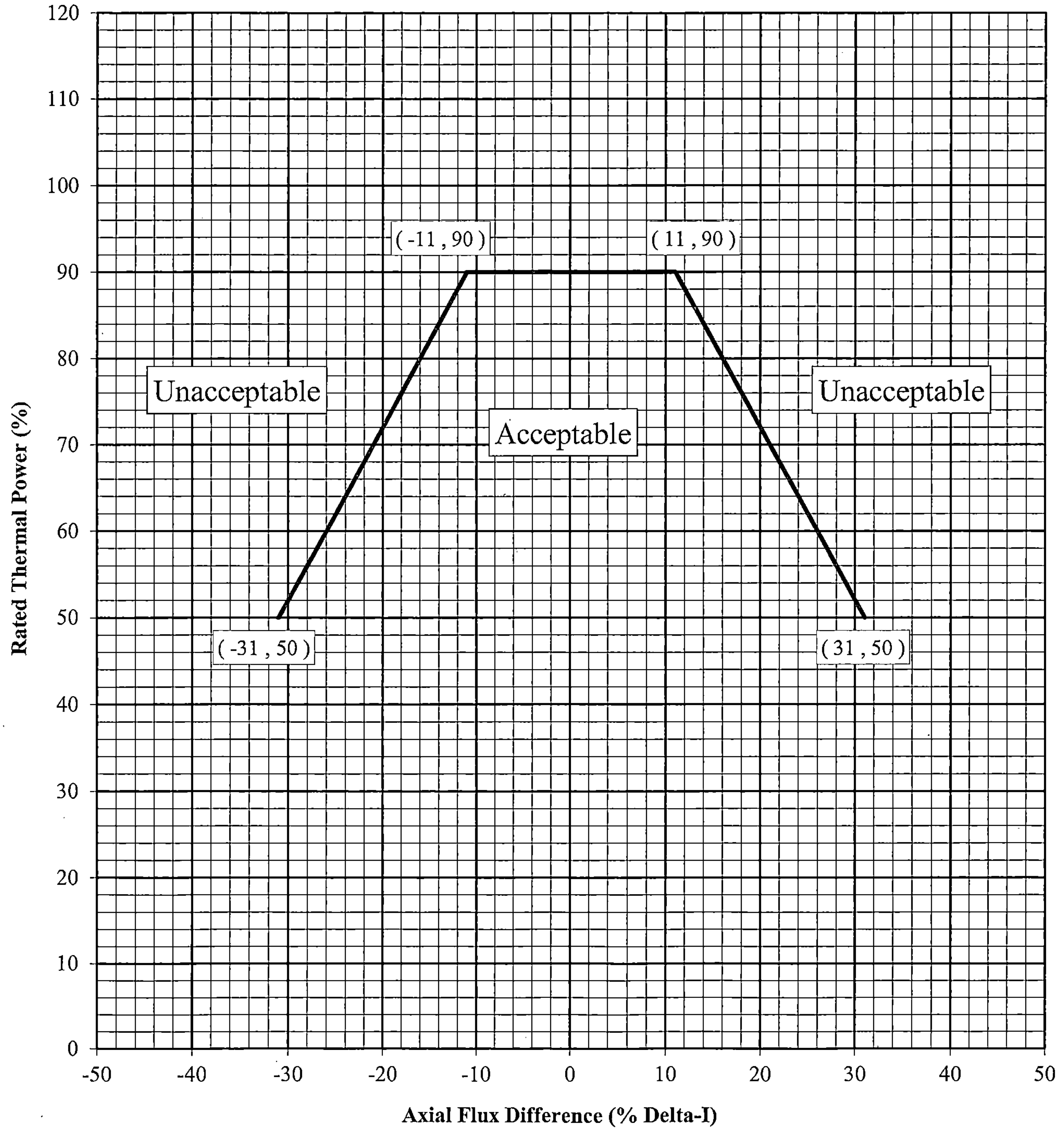
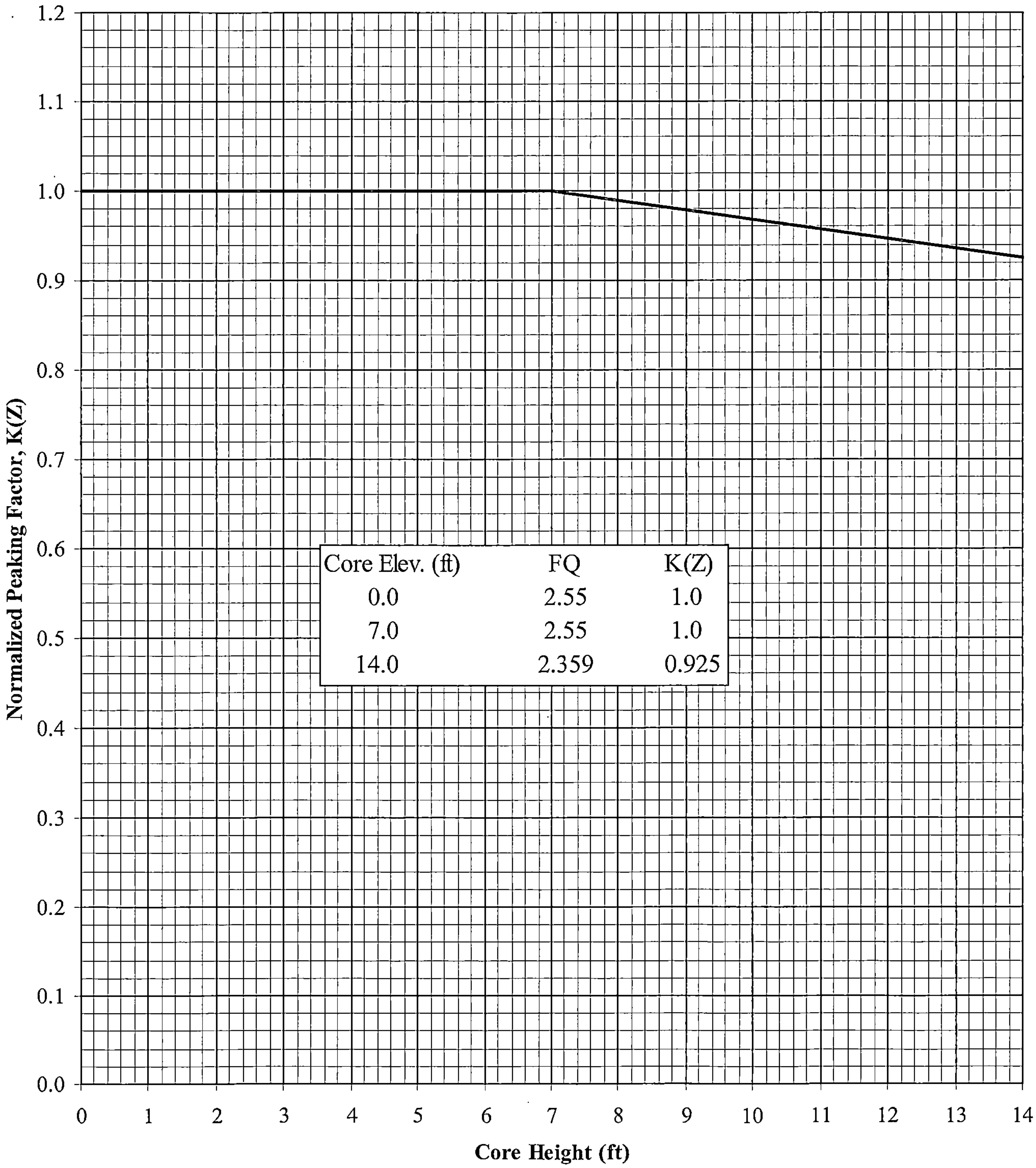


Figure 7

K(Z) - Normalized FQ(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 9000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded Fxy	Core Height (Ft.)	Axial Point	Unrodded Fxy
14.0	1	7.317	6.8	37	1.972
13.8	2	5.739	6.6	38	1.993
13.6	3	4.158	6.4	39	1.975
13.4	4	2.789	6.2	40	1.932
13.2	5	2.495	6.0	41	1.901
13.0	6	2.226	5.8	42	1.938
12.8	7	2.138	5.6	43	1.952
12.6	8	2.118	5.4	44	1.958
12.4	9	2.068	5.2	45	2.001
12.2	10	2.022	5.0	46	2.058
12.0	11	2.002	4.8	47	2.063
11.8	12	2.014	4.6	48	2.009
11.6	13	2.037	4.4	49	1.946
11.4	14	2.014	4.2	50	1.966
11.2	15	1.965	4.0	51	1.973
11.0	16	1.933	3.8	52	1.965
10.8	17	1.925	3.6	53	1.974
10.6	18	1.920	3.4	54	2.014
10.4	19	1.918	3.2	55	2.039
10.2	20	1.938	3.0	56	1.991
10.0	21	1.973	2.8	57	1.938
9.8	22	1.981	2.6	58	1.942
9.6	23	1.943	2.4	59	1.947
9.4	24	1.908	2.2	60	1.952
9.2	25	1.904	2.0	61	1.967
9.0	26	1.895	1.8	62	1.997
8.8	27	1.896	1.6	63	2.004
8.6	28	1.916	1.4	64	1.932
8.4	29	1.983	1.2	65	1.872
8.2	30	2.036	1.0	66	1.912
8.0	31	1.977	0.8	67	2.222
7.8	32	1.925	0.6	68	3.005
7.6	33	1.929	0.4	69	4.318
7.4	34	1.945	0.2	70	6.145
7.2	35	1.947	0.0	71	9.180
7.0	36	1.939			

Table 1 (Part 2 of 2)
Unrodded Fxy for Each Core Height
for Cycle Burnups Greater Than or Equal to 9000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded Fxy	Core Height (Ft.)	Axial Point	Unrodded Fxy
14.0	1	6.495	6.8	37	2.203
13.8	2	5.203	6.6	38	2.238
13.6	3	3.911	6.4	39	2.204
13.4	4	2.790	6.2	40	2.147
13.2	5	2.552	6.0	41	2.114
13.0	6	2.305	5.8	42	2.106
12.8	7	2.160	5.6	43	2.095
12.6	8	2.087	5.4	44	2.081
12.4	9	2.027	5.2	45	2.098
12.2	10	2.021	5.0	46	2.131
12.0	11	2.030	4.8	47	2.125
11.8	12	2.056	4.6	48	2.067
11.6	13	2.082	4.4	49	2.021
11.4	14	2.074	4.2	50	2.016
11.2	15	2.044	4.0	51	2.005
11.0	16	2.009	3.8	52	1.990
10.8	17	2.038	3.6	53	1.992
10.6	18	2.046	3.4	54	2.026
10.4	19	2.053	3.2	55	2.048
10.2	20	2.082	3.0	56	1.990
10.0	21	2.127	2.8	57	1.935
9.8	22	2.145	2.6	58	1.905
9.6	23	2.113	2.4	59	1.875
9.4	24	2.088	2.2	60	1.864
9.2	25	2.102	2.0	61	1.880
9.0	26	2.110	1.8	62	1.926
8.8	27	2.114	1.6	63	1.954
8.6	28	2.124	1.4	64	1.932
8.4	29	2.161	1.2	65	1.945
8.2	30	2.194	1.0	66	2.054
8.0	31	2.157	0.8	67	2.418
7.8	32	2.124	0.6	68	3.143
7.6	33	2.126	0.4	69	4.250
7.4	34	2.137	0.2	70	5.782
7.2	35	2.148	0.0	71	8.469
7.0	36	2.160			