STP Nuclear Operating Company

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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South Texas Project
Unit 2
Docket No. STN 50-499
Unit 2 Cycle 9 Core Operating Limits Report

In accordance with Technical Specification 6.9.1.6.d, the attached Core Operating Limits Report is submitted for South Texas Project Unit 2 Cycle 9. The report is identified as revision 1, but there are no technical changes from the original report. Revision 0 was issued for internal use by the South Texas Project. Revision 1 only reconstructed some of the figures to improve the quality of the graphics.

If there are any questions concerning this report, please contact Mr. A. W. Harrison at (361) 972-7298, or me at (361) 972-7795.

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for David A. Leazar
Director,
Nuclear Fuel & Analysis

kaw

Attachment: Unit 2 Cycle 9 Core Operating Limits Report

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Nuclear Operating Company

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION UNIT 2 CYCLE 9 CORE OPERATING LIMITS REPORT

March 2001

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for STPEGS Unit 2 Cycle 9 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)	3/4.1.1.3	MODERATOR TEMPERATURE COEFFICIENT LIMITS
4)	3/4.1.3.5	SHUTDOWN ROD INSERTION LIMITS
5)	3/4.1.3.6	CONTROL ROD INSERTION LIMITS
6)	3/4.2.1	AFD LIMITS
7)	3/4.2.2	HEAT FLUX HOT CHANNEL FACTOR
8)	3/4.2.3	NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR
9)	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.

COLR Section 2.8 provides for an alternate Minimum Measured Reactor Coolant System Flow limit consistent with plugging up to 10% of steam generator tubes and Departure from Nucleate Boiling (DNB) requirements. When using the alternate minimum flow limit, the T_{avg} limit is reduced. The setpoint and constant values for OPΔT and OTΔT are also revised accordingly when this alternate mode of operation is entered.

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, or in Figure 2 when operating under alternate operating criteria consistent with reduced Reactor Coolant System Flow as addressed in COLR Section 2.8.

2.2 LIMITING SAFETY SYSTEM SETTINGS (Specification 2.2):

2.2.1 The Loop design flow for Reactor Coolant Flow-Low is 95,400 gpm (or 92,500 gpm for alternate operation with reduced RCS flow).

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, τ_1 = 8 sec

τ_2 measured reactor vessel ΔT lead/lag time constant, τ_2 = 3 sec

τ_3 measured reactor vessel ΔT lag time constant, τ_3 = 0 sec

τ_4 measured reactor vessel average temperature lead/lag time constant, τ_4 = 28 sec

τ_5 measured reactor vessel average temperature lead/lag time constant, τ_5 = 4 sec

τ_6 measured reactor vessel average temperature lag time constant, τ_6 = 0 sec

K_1 Overtemperature ΔT reactor trip setpoint, K_1 = 1.14 or K_1 = 1.13 for alternate operation with reduced RCS flow

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' $\leq$ 590.0 °F (including alternate operation with reduced RCS flow)

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%, or +6% for alternate operation with reduced RCS flow, $f_1(\Delta I) = 0$, 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%, or +6% for alternate operation with reduced RCS flow, 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, τ_1 = 8 sec
τ_2	measured reactor vessel ΔT lead/lag time constant, τ_2 = 3 sec
τ_3	measured reactor vessel ΔT lag time constant, τ_3 = 0 sec
τ_6	measured reactor vessel average temperature lag time constant, τ_6 = 0 sec
τ_7	Time constant utilized in the rate-lag compensator for T_{avg}, τ_7 = 10 sec
K_4	Overpower ΔT reactor trip setpoint, K_4 = 1.08 or K_4 = 1.07 for alternate operation with reduced RCS flow)
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}, $T'' \leq 590.0$ °F (including alternate operation with reduced RCS flow)
$f_2(\Delta I)$	= 0 for all (ΔI)

2.3 MODERATOR TEMPERATURE COEFFICIENT (Specification 3.1.1.3):

2.3.1 The BOL, ARO, MTC shall be less positive than the limits shown in Figure 3.

2.3.2 The EOL, ARO, HFP, MTC shall be less negative than -6.12×10^{-4} Δk/k/°F.

2.3.3 The 300 ppm, ARO, HFP, MTC shall be less negative than -5.26×10^{-4} Δk/k/°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 590 °F

2.4 ROD INSERTION LIMITS (Specification 3.1.3.5 and 3.1.3.6):

2.4.1 All banks shall have the same Full Out Position (FOP) of at least 249 steps withdrawn but not exceeding 259 steps withdrawn.

2.4.2 The Control Banks shall be limited in physical insertion as specified in Figure 4.

2.4.3 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).

2.5 AXIAL FLUX DIFFERENCE (Specification 3.2.1):

2.5.1 AFD limits as required by Technical Specification 3.2.1 are determined by CAOC Operations with an AFD target band of +5, -10%.

2.5.2 The AFD shall be maintained within the ACCEPTABLE OPERATION portion of Figure 5, as required by Technical Specifications.

2.6 HEAT FLUX HOT CHANNEL FACTOR (Specification 3.2.2):

2.6.1 $F_Q^{RTP} = 2.55$.

2.6.2 K(Z) is provided in Figure 6.

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

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

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

2.6.3.3 $PF_{xy} = 0.2$.

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.

For Unit 2 Cycle 9, the L(Z) penalty is not applied (i.e., L(Z) = 1.0 for all core elevations).

2.7 ENTHALPY RISE HOT CHANNEL FACTOR (Specification 3.2.3):

	Standard Fuel +	VANTAGE 5H / RFA Fuel ++
2.7.1	WITHOUT RCS Loop-specific Temperature Calibrations:	
	$F_{\Delta H}^{RTP} = 1.46$	$F_{\Delta H}^{RTP} = 1.53$
	WITH RCS Loop-specific Temperature Calibrations:	
	$F_{\Delta H}^{RTP} = 1.49$	$F_{\Delta H}^{RTP} = 1.557$
2.7.2	$PF_{\Delta H} = 0.3$	$PF_{\Delta H} = 0.3$

\+ **Applies to fuel Region 5B.**

++ **Applies to fuel Regions 9A, 9B, 10A, 10B, 11A and 11B.**

2.8 DNB PARAMETERS (Specification 3.2.5):

2.8.1 The following DNB-related parameters shall be maintained within the following limits****:

a. Reactor Coolant System T_{avg}, $\leq$ 595 °F*,

(or $\leq$ 593°F* with reduced RCS flow of COLR 2.8.1.c)

b. Pressurizer Pressure, > 2200 psig**,

c. Minimum Measured Reactor Coolant System Flow:

Precision calorimetric RCS flow measurement

$\geq$ 392,300 gpm***

(or $\geq$ 380,500 gpm*** with reduced RCS T_{avg} of COLR 2.8.1.a)

OR

Elbow tap RCS flow measurement

$\geq$ 389,700 gpm###

(or $\geq$ 377,800 gpm### with reduced RCS T_{avg} of COLR 2.8.1.a)

* Includes a 1.9 °F measurement uncertainty per Reference 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 10.7 psi measurement uncertainty as read on QDPS display per Reference 3.4.

*** Includes a 2.8% flow measurement uncertainty, which is supported by the safety analyses bases. Applicable to Model E and Delta 94 Steam Generators.

\### Includes a 2.1% flow measurement uncertainty, which is supported by evaluation to the safety analyses bases. Applicable to Model E Steam Generators.

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

3.0 REFERENCES

3.1 Letter from R. A. Wiley (Westinghouse) to D. F. Hoppes (STPNOC), "South Texas Project Nuclear Operating Company, South Texas Project Electric Generating Station Unit 2 Cycle 9 Final Unbound Core Operating Limits Report (COLR)," 01TG-G-016 (ST-UB-NOC-01002113), March 2001.

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

3.3 STPNOC Calculation ZC-7035, Rev. 1, "Loop Uncertainty Calculation for RCS Tavg Instrumentation," October 19, 1998.

3.4 STPNOC Calculation ZC-7032, Rev. 2, "Loop Uncertainty Calculation for Narrow Range Pressurizer Pressure Monitoring Instrumentation," October 17, 2000.

Figure 1

Reactor Core Safety Limit - Four Loops in Operation

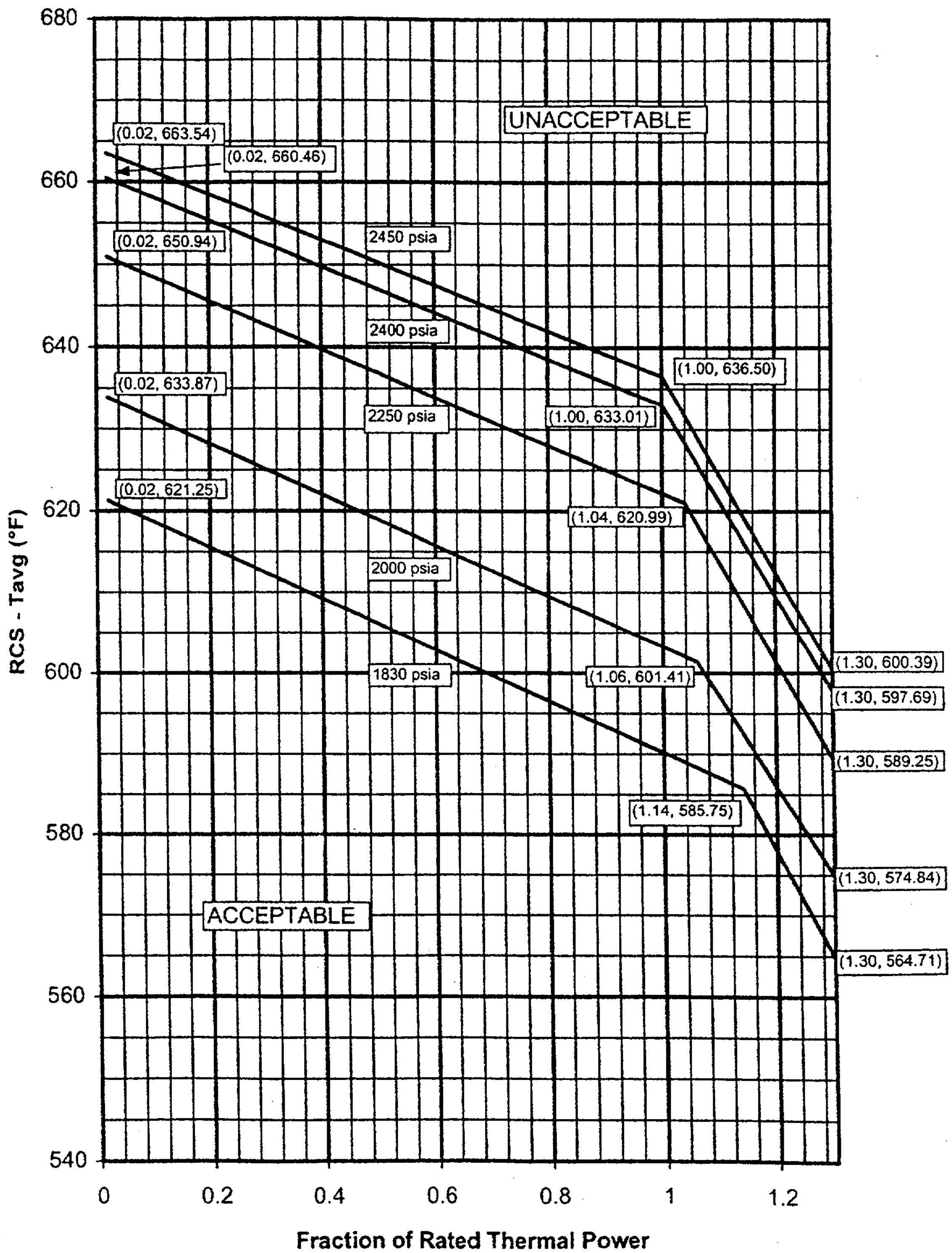


Figure 2

Reactor Core Safety Limit - Four Loops in Operation (Alternate)

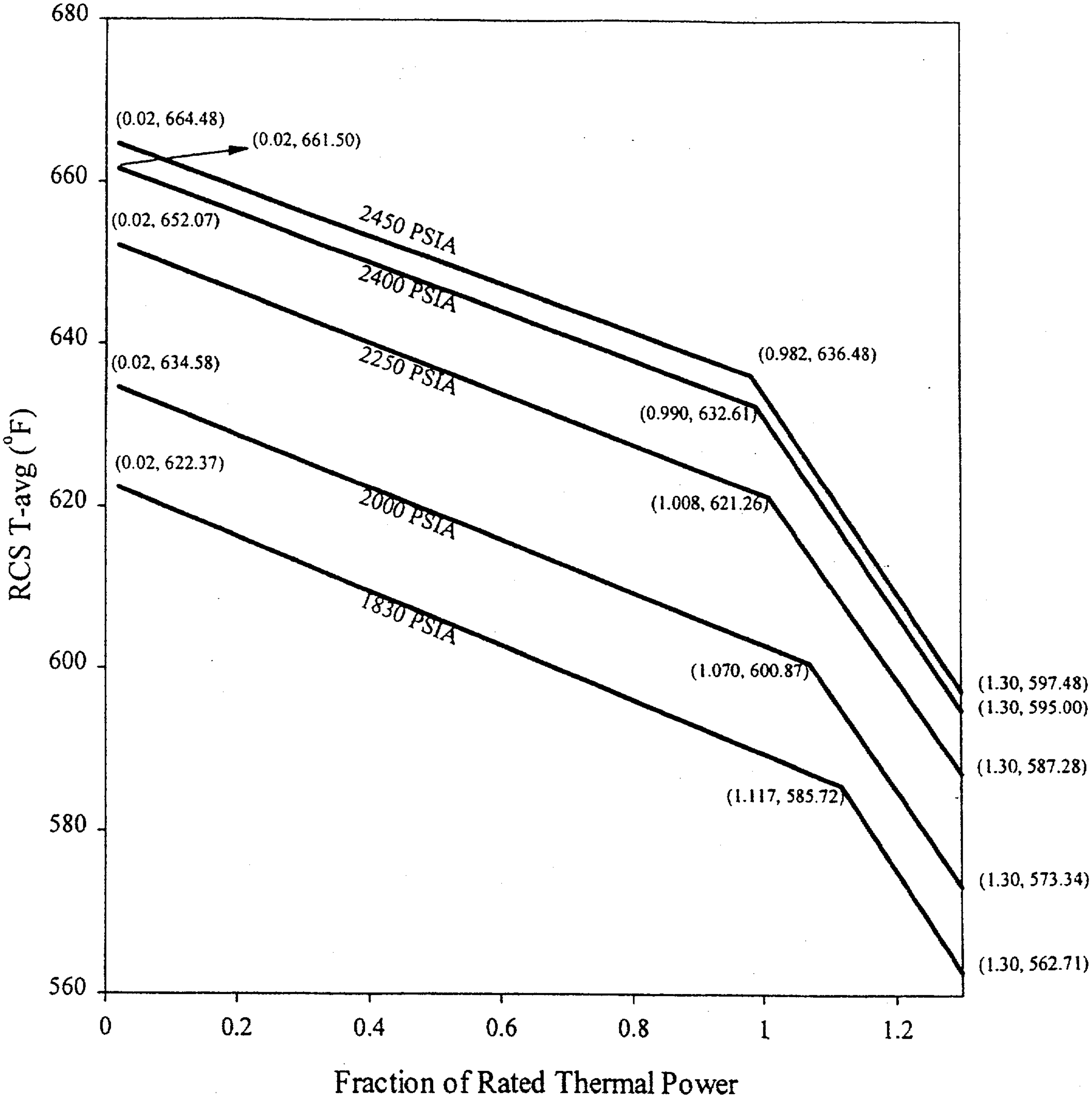


Figure 3

MTC versus Power Level

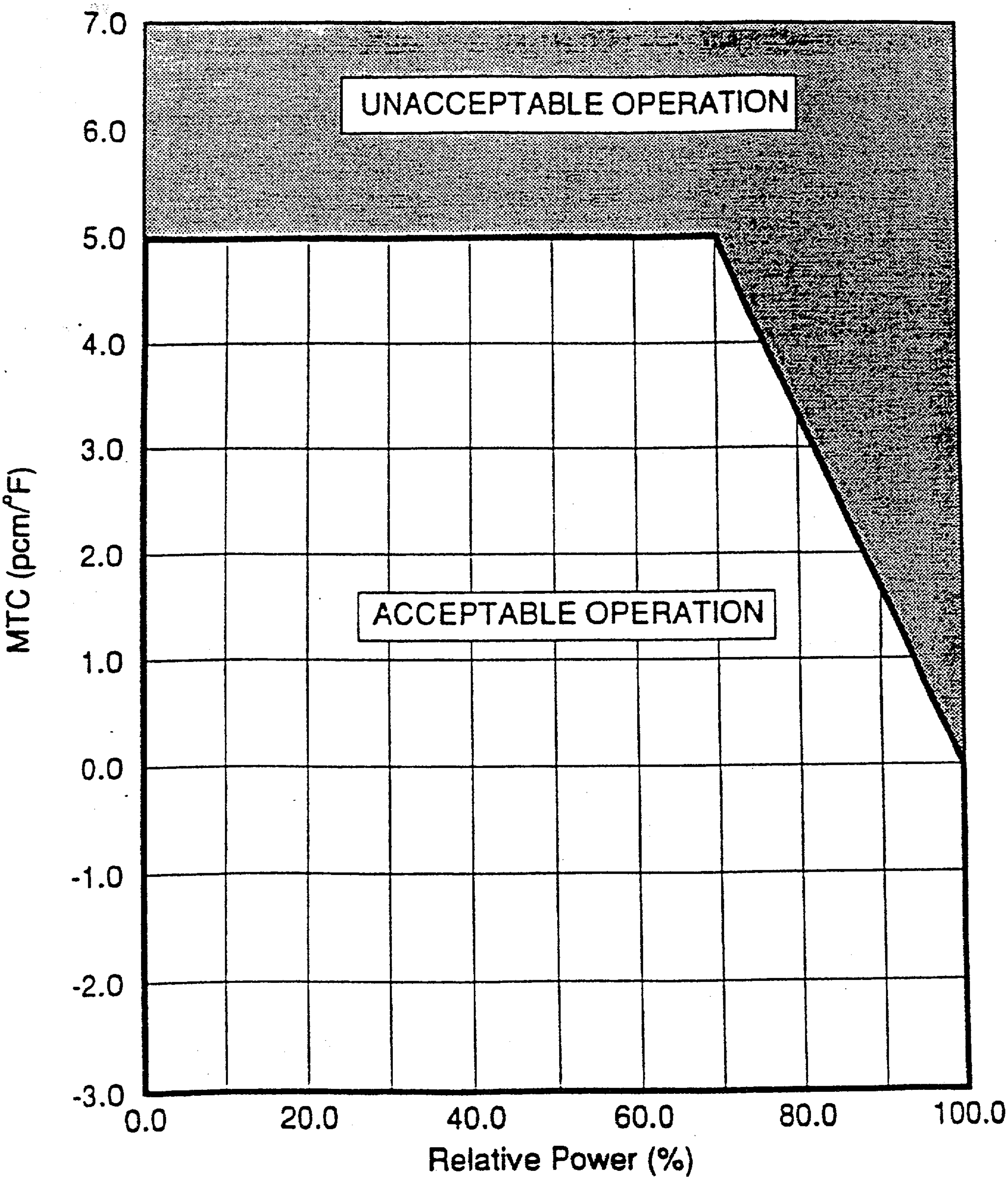
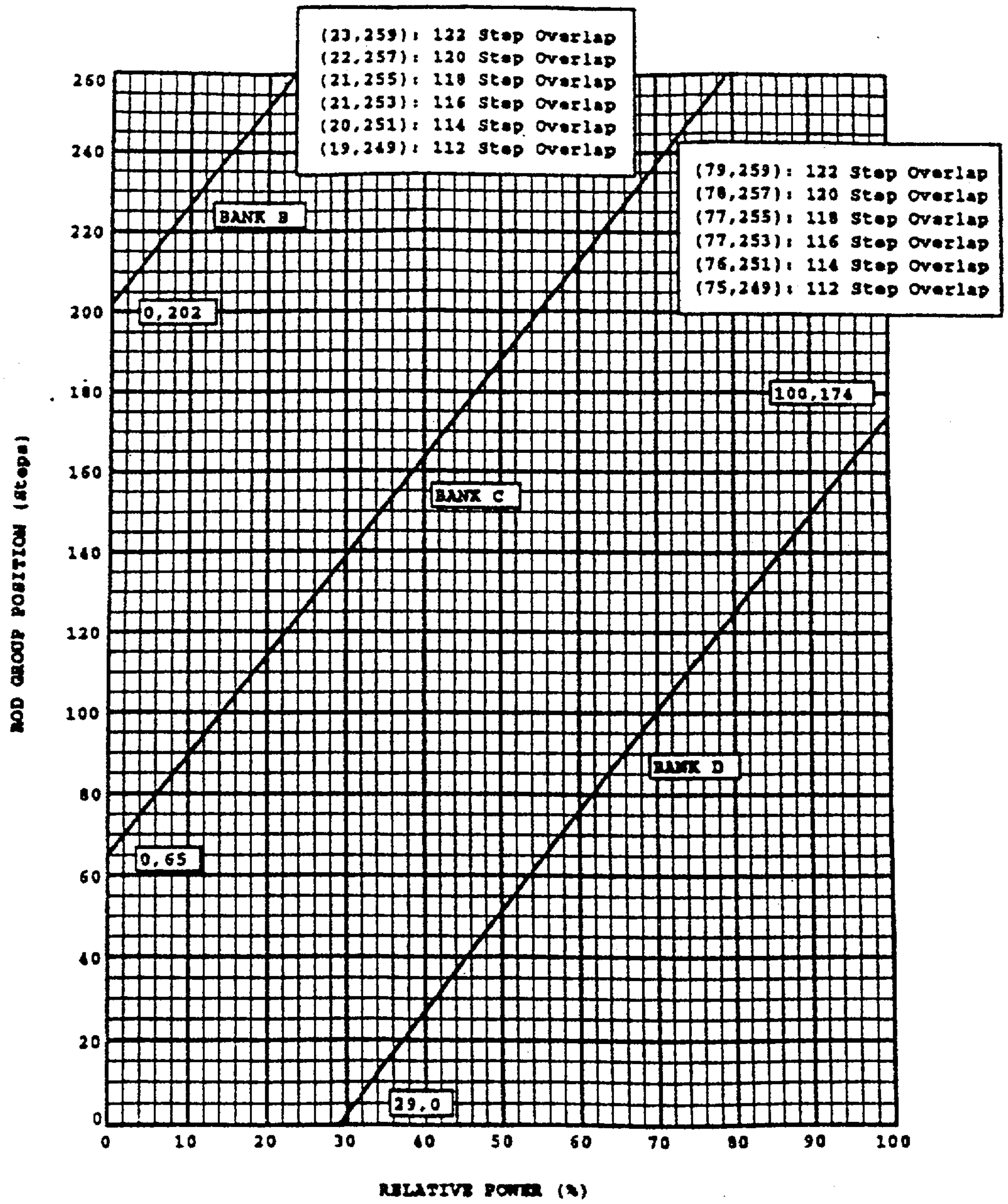


Figure 4

Control Rod Insertion Limits* versus Power Level



* Control Bank A is already withdrawn to Full Out Position. Fully withdrawn region shall be the condition where shutdown and control banks are at a position within the interval of 249 and ≤ 259 steps withdrawn, inclusive.

Figure 5

AFD Limits versus Rated Thermal Power

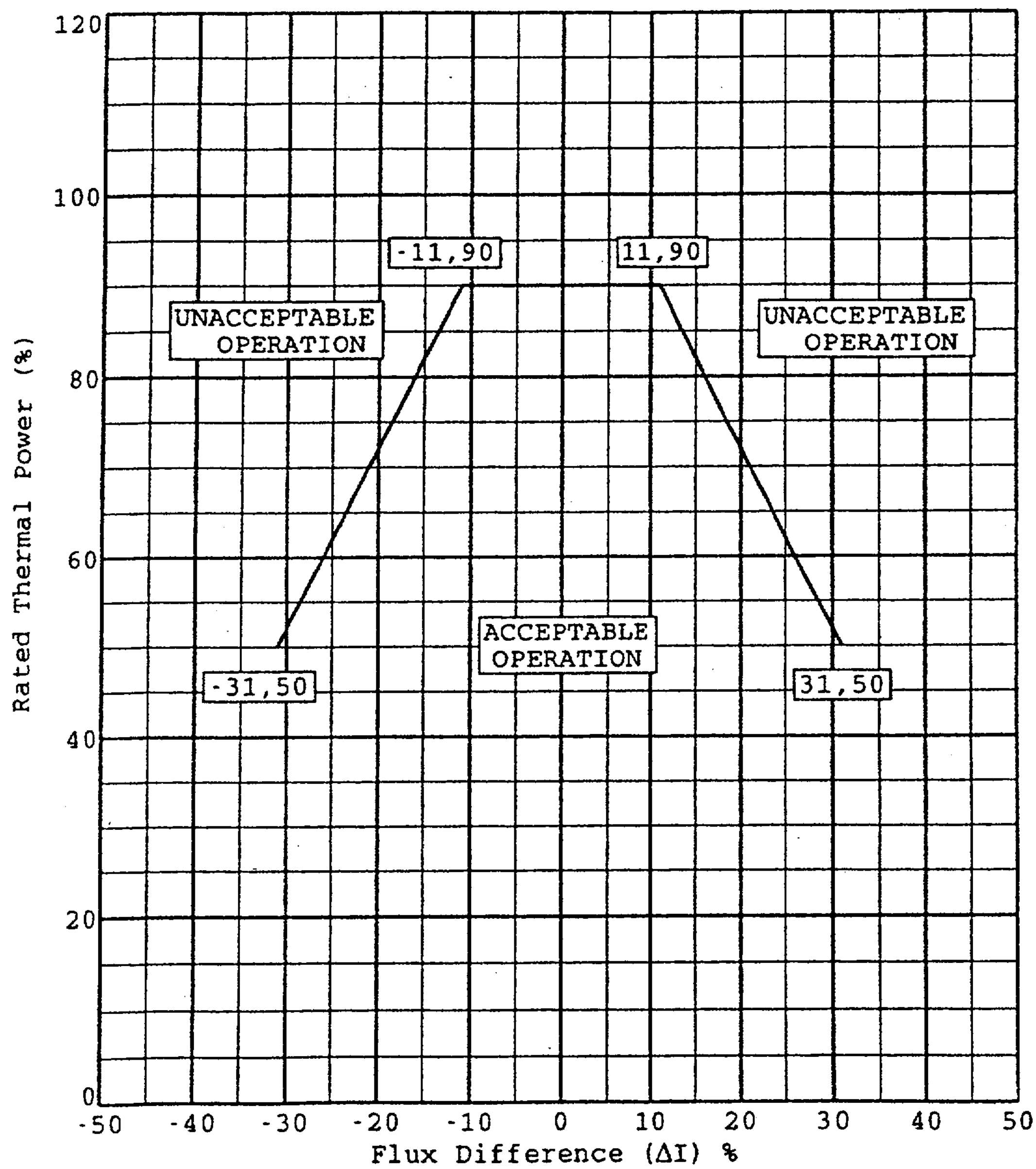


Figure 6

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

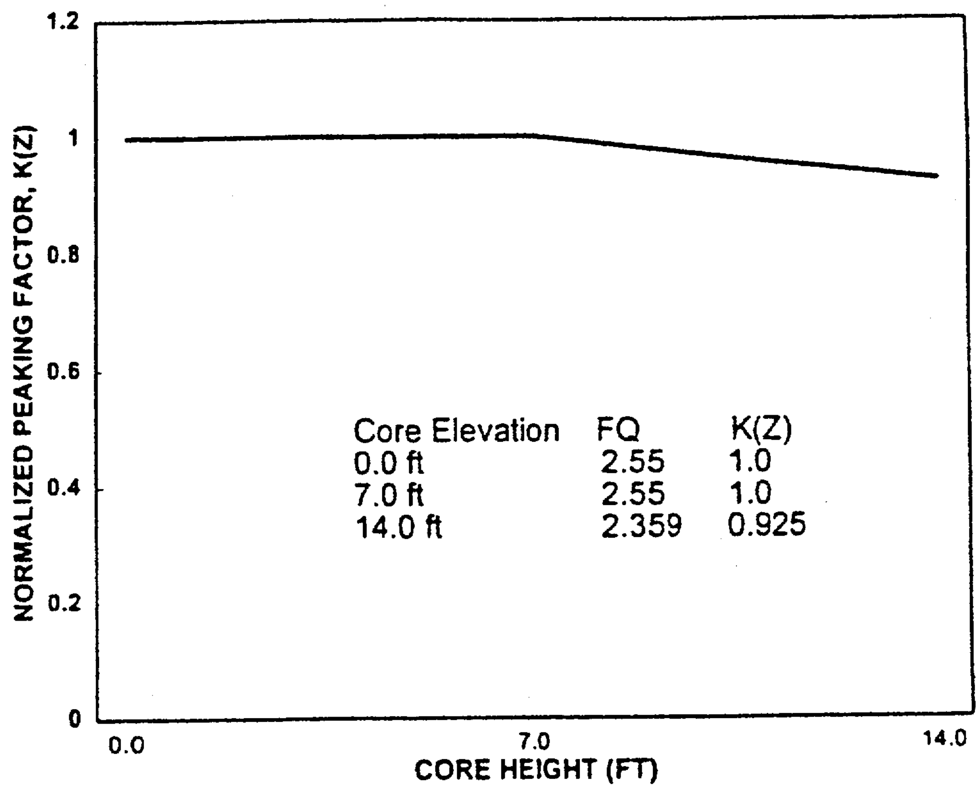


Table 1 (Part 1 of 2)

Unrodded F_{xy} for Each Core Height*

for Cycle Burnups Less Than 10,500 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded F_{xy} SGTP ≤ 10%	Core Height (Ft.)	Axial Point	Unrodded F_{xy} SGTP ≤ 10%
14.00	1	4.516	6.80	37	1.912
13.80	2	3.851	6.60	38	1.906
13.60	3	3.186	6.40	39	1.904
13.40	4	2.521	6.20	40	1.903
13.20	5	2.216	6.00	41	1.902
13.00	6	2.025	5.80	42	1.902
12.80	7	2.047	5.60	43	1.902
12.60	8	2.041	5.40	44	1.905
12.40	9	2.035	5.20	45	1.909
12.20	10	2.020	5.00	46	1.915
12.00	11	1.998	4.80	47	1.923
11.80	12	1.982	4.60	48	1.931
11.60	13	1.975	4.40	49	1.933
11.40	14	1.973	4.20	50	1.931
11.20	15	1.969	4.00	51	1.925
11.00	16	1.965	3.80	52	1.920
10.80	17	1.958	3.60	53	1.917
10.60	18	1.952	3.40	54	1.913
10.40	19	1.946	3.20	55	1.908
10.20	20	1.943	3.00	56	1.896
10.00	21	1.937	2.80	57	1.878
9.80	22	1.934	2.60	58	1.847
9.60	23	1.935	2.40	59	1.809
9.40	24	1.934	2.20	60	1.770
9.20	25	1.932	2.00	61	1.755
9.00	26	1.931	1.80	62	1.748
8.80	27	1.932	1.60	63	1.747
8.60	28	1.931	1.40	64	1.742
8.40	29	1.934	1.20	65	1.749
8.20	30	1.937	1.00	66	1.782
8.00	31	1.943	0.80	67	1.930
7.80	32	1.945	0.60	68	2.339
7.60	33	1.945	0.40	69	2.877
7.40	34	1.940	0.20	70	3.416
7.20	35	1.932	0.00	71	3.954
7.00	36	1.921			

* **For Unit 2 Cycle 9, the L(Z) penalty is not applied (i.e., L(Z) = 1.0 for all core elevations).**

Table 1 (Part 2 of 2)
Unrodded Fxy for Each Core Height*
for Cycle Burnups Greater Than or Equal to 10,500 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded F_{xy} SGTP ≤ 10%	Core Height (Ft.)	Axial Point	Unrodded F_{xy} SGTP ≤ 10%
14.00	1	5.116	6.80	37	2.138
13.80	2	4.370	6.60	38	2.129
13.60	3	3.624	6.40	39	2.117
13.40	4	2.877	6.20	40	2.104
13.20	5	2.500	6.00	41	2.091
13.00	6	2.239	5.80	42	2.078
12.80	7	2.196	5.60	43	2.064
12.60	8	2.138	5.40	44	2.051
12.40	9	2.093	5.20	45	2.038
12.20	10	2.068	5.00	46	2.028
12.00	11	2.060	4.80	47	2.019
11.80	12	2.049	4.60	48	2.013
11.60	13	2.036	4.40	49	2.002
11.40	14	2.032	4.20	50	1.989
11.20	15	2.032	4.00	51	1.973
11.00	16	2.035	3.80	52	1.960
10.80	17	2.040	3.60	53	1.949
10.60	18	2.044	3.40	54	1.940
10.40	19	2.047	3.20	55	1.929
10.20	20	2.049	3.00	56	1.914
10.00	21	2.050	2.80	57	1.895
9.80	22	2.050	2.60	58	1.872
9.60	23	2.058	2.40	59	1.851
9.40	24	2.068	2.20	60	1.827
9.20	25	2.077	2.00	61	1.829
9.00	26	2.081	1.80	62	1.829
8.80	27	2.081	1.60	63	1.832
8.60	28	2.082	1.40	64	1.855
8.40	29	2.088	1.20	65	1.891
8.20	30	2.101	1.00	66	1.954
8.00	31	2.115	0.80	67	2.146
7.80	32	2.130	0.60	68	2.625
7.60	33	2.139	0.40	69	3.248
7.40	34	2.145	0.20	70	3.870
7.20	35	2.147	0.00	71	4.493
7.00	36	2.144			

* For Unit 2 Cycle 9, the L(Z) penalty is not applied (i.e., L(Z) = 1.0 for all core elevations).