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South Texas Project
Unit 2
Docket Nos. STN 50-499
Unit 2 Cycle 8 Core Operating Limits Report, Revision 1

In accordance with Technical Specification 6.9.1.6.d, the attached Revision 1 to the Core Operating Limits Report is submitted for South Texas Project Unit 2 Cycle 8.

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

for David A. Leazar
Director,
Nuclear Fuel & Analysis

kaw

Attachment: Unit 2 Cycle 8 Core Operating Limits Report, Revision 1

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SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION
UNIT 2 CYCLE 8
CORE OPERATING LIMITS REPORT

Rev. 1

March 2000

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for STPEGS Unit 2 Cycle 8 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 for RCS flow no less than 380,500 gpm. Setpoint and constant values for $OP\Delta T$ and $OT\Delta T$ 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}, $T' \leq$ 589.0 °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}, $T'' \leq 589.0$ °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 -5.22×10^{-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 589 °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 250 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 +3, -12%.

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 cycle burnups less than 9000 MWD/MTU and less than or equal to 1.903 for cycle burnups greater than or equal to 9000 MWD/MTU 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 8, 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 regions 1 and 2.
**Applies to fuel regions 8A, 8B, 9A, 9B, 10A, and 10B.

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, $>$ 2214 psig**,

c. Minimum Measured Reactor Coolant System Flow $\geq$ 392,300 gpm***,

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

* Includes a 1.9 °F measurement uncertainty.

** 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 22.5 psi measurement uncertainty as read on the QDPS display.

*** Includes a 2.8% flow measurement uncertainty.

**** 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), "Unit 2 Cycle 8 Core Operating Limits Report," 99TG-G-0100 (ST-UB-NOC-1978), October 15, 1999.

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. 1, "Loop Uncertainty Calculation for Narrow Range Pressurizer Pressure Monitoring Instrumentation," June 10, 1999.

Figure 1

Reactor Core Safety Limit - Four Loops in Operation

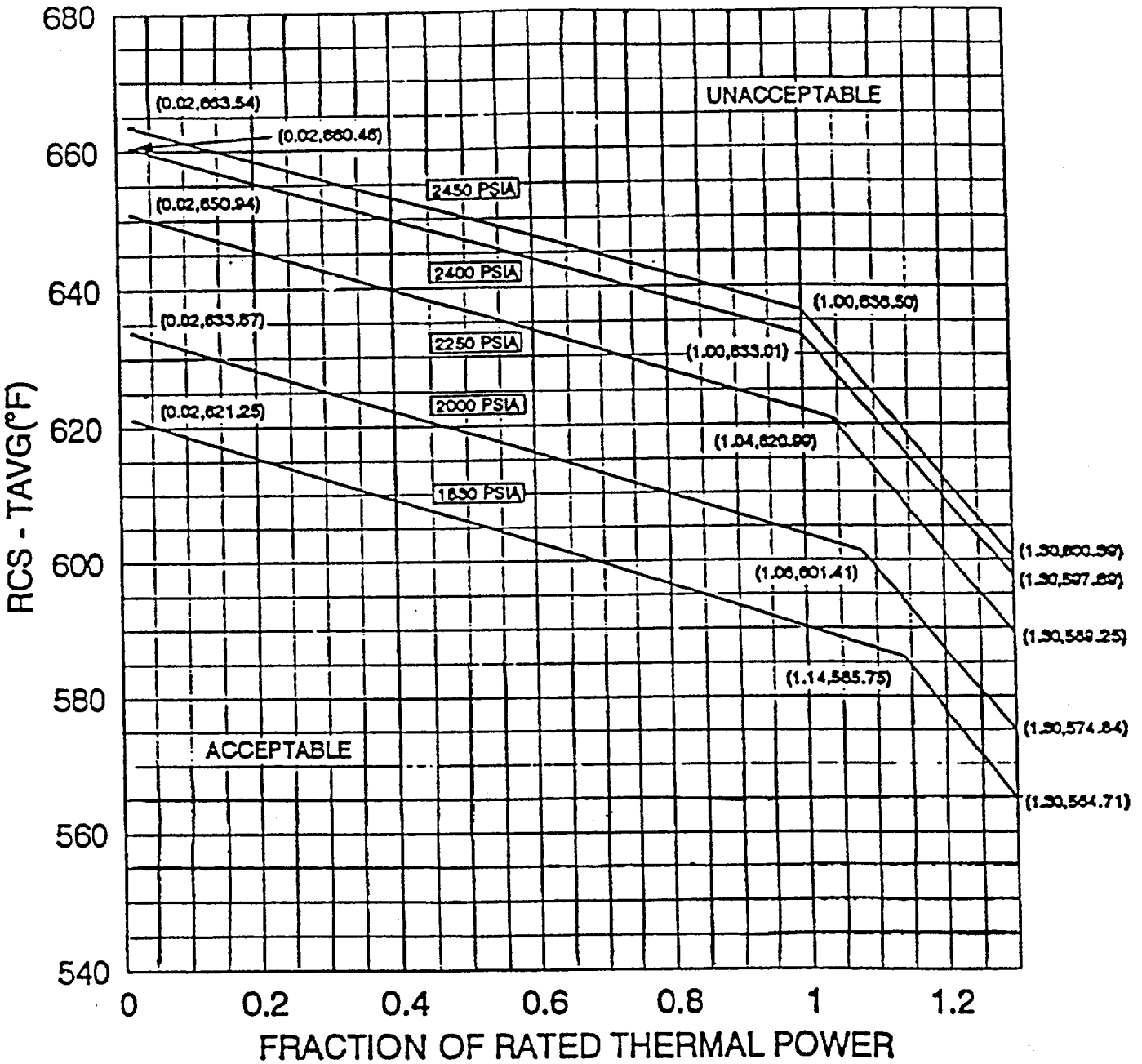


Figure 2

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

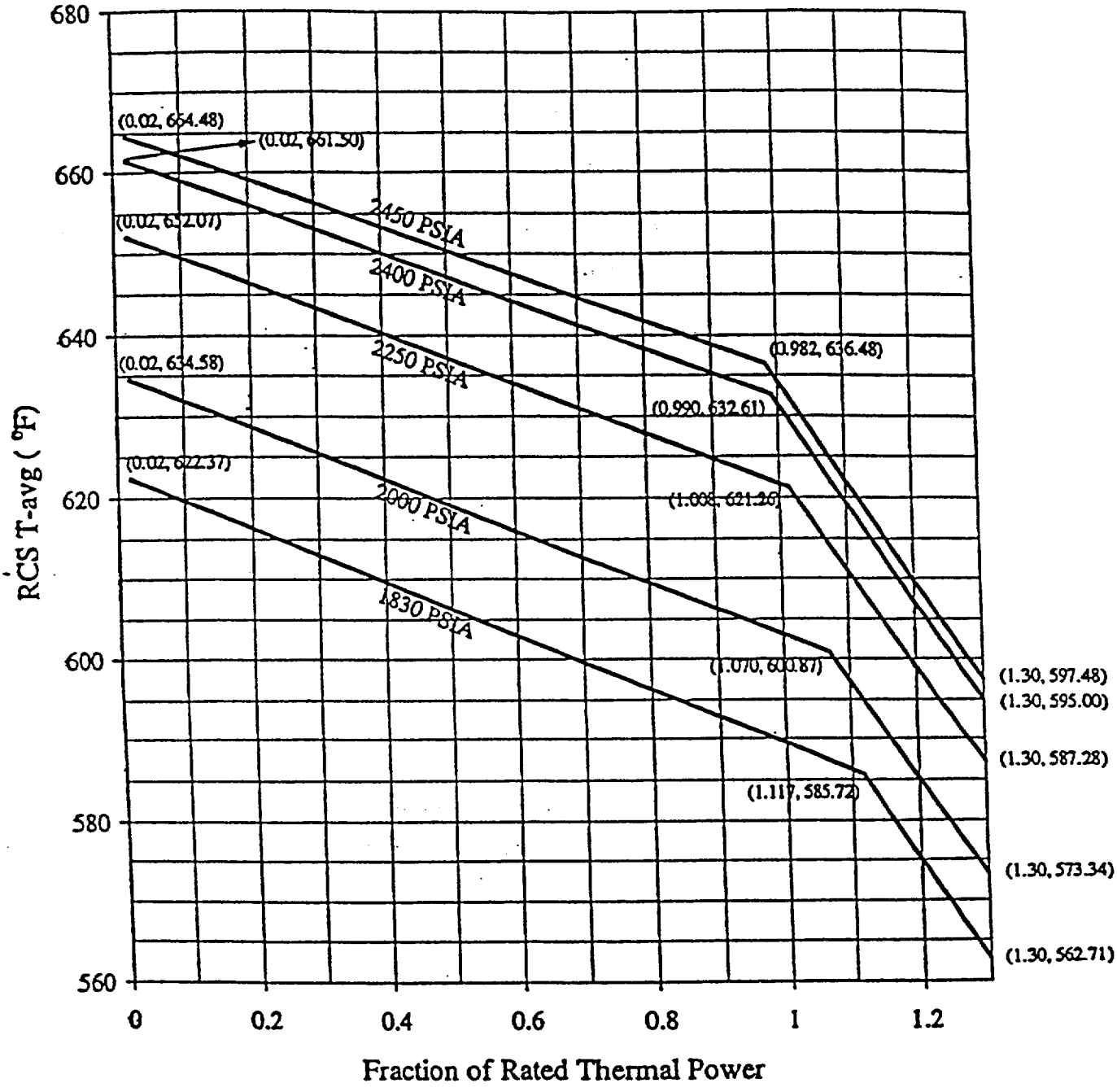


Figure 3

MTC versus Power Level

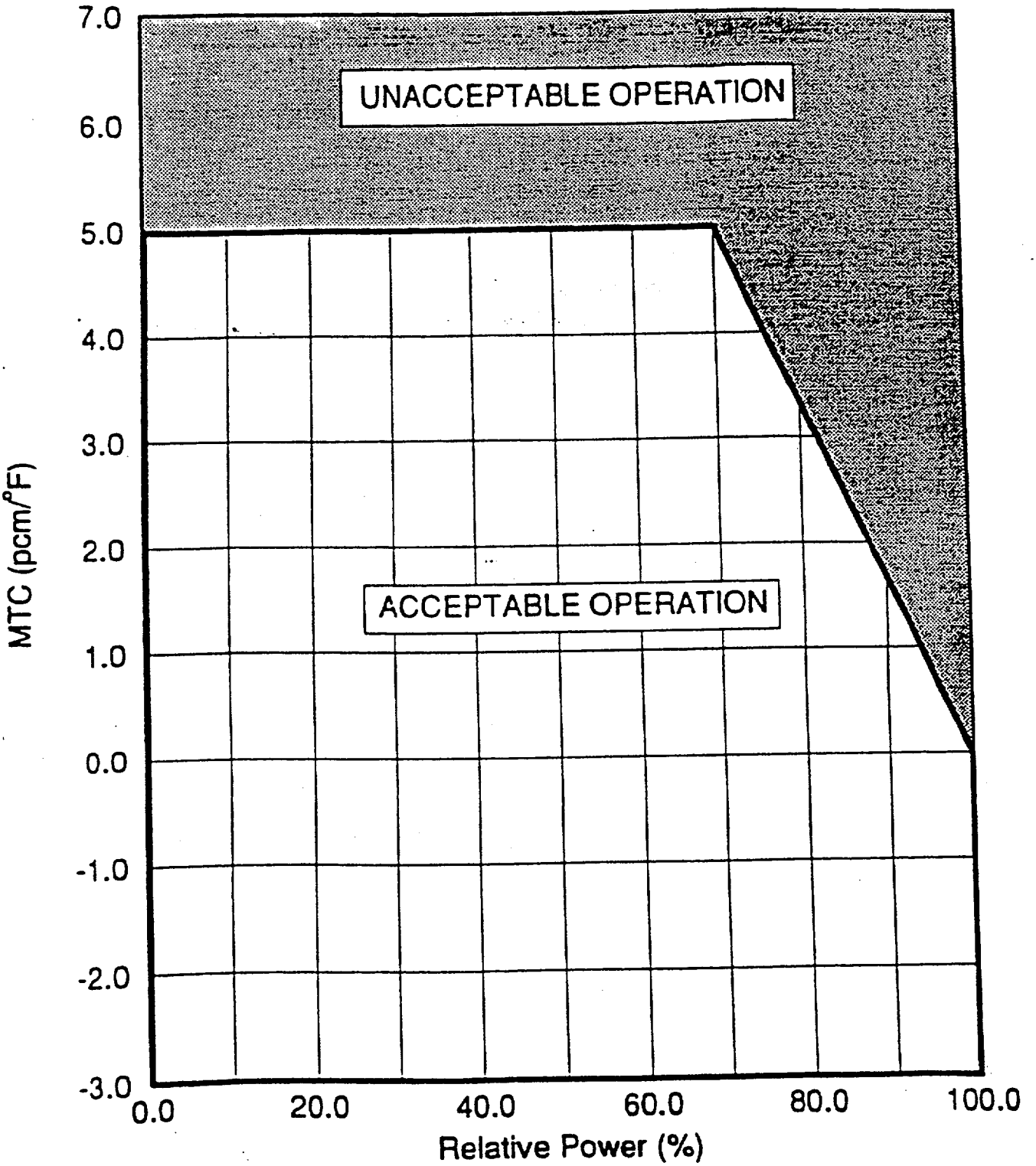
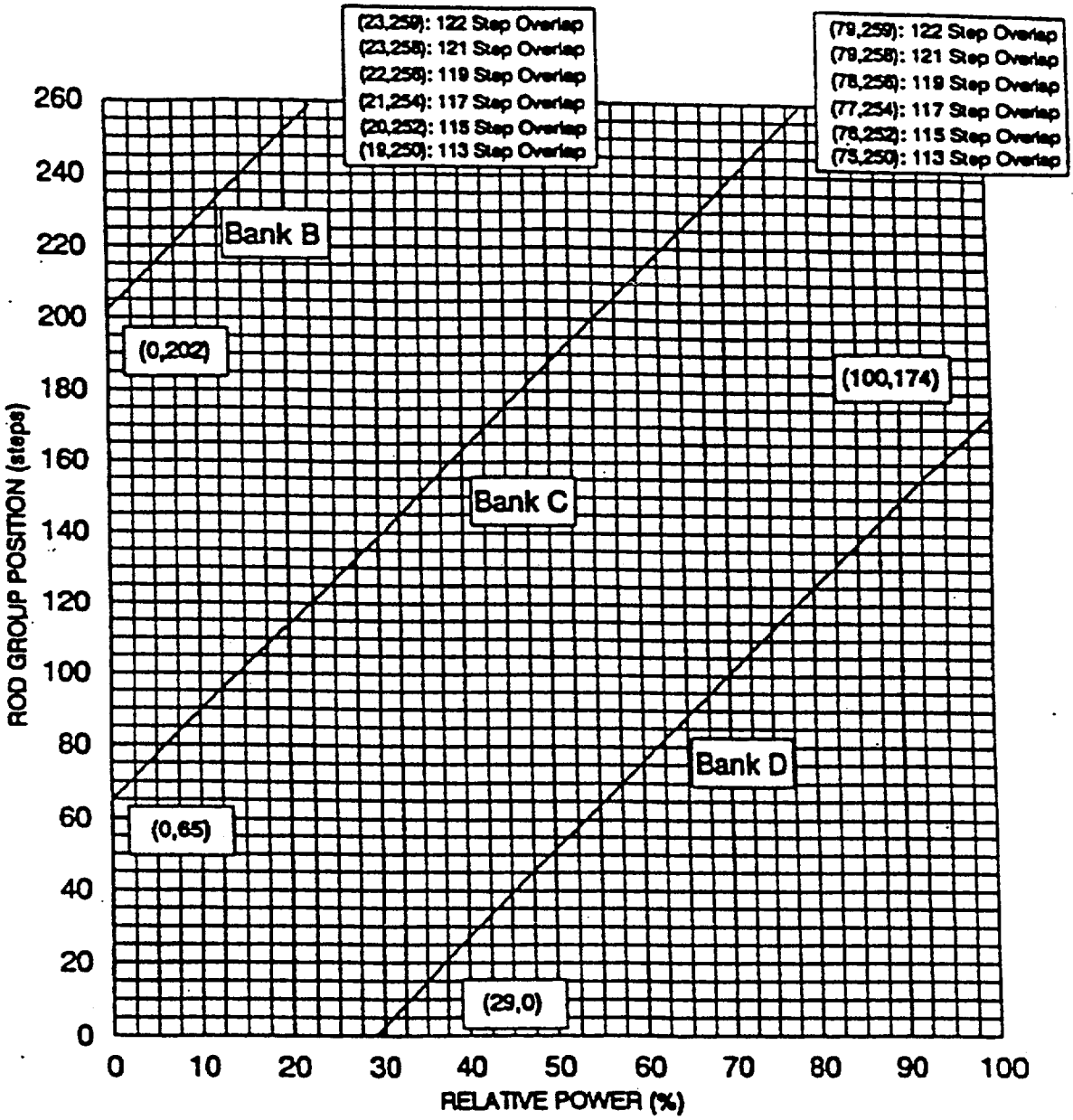


Figure 4

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 250 and ≤ 259 steps withdrawn, inclusive.

Figure 5

AFD Limits versus Rated Thermal Power

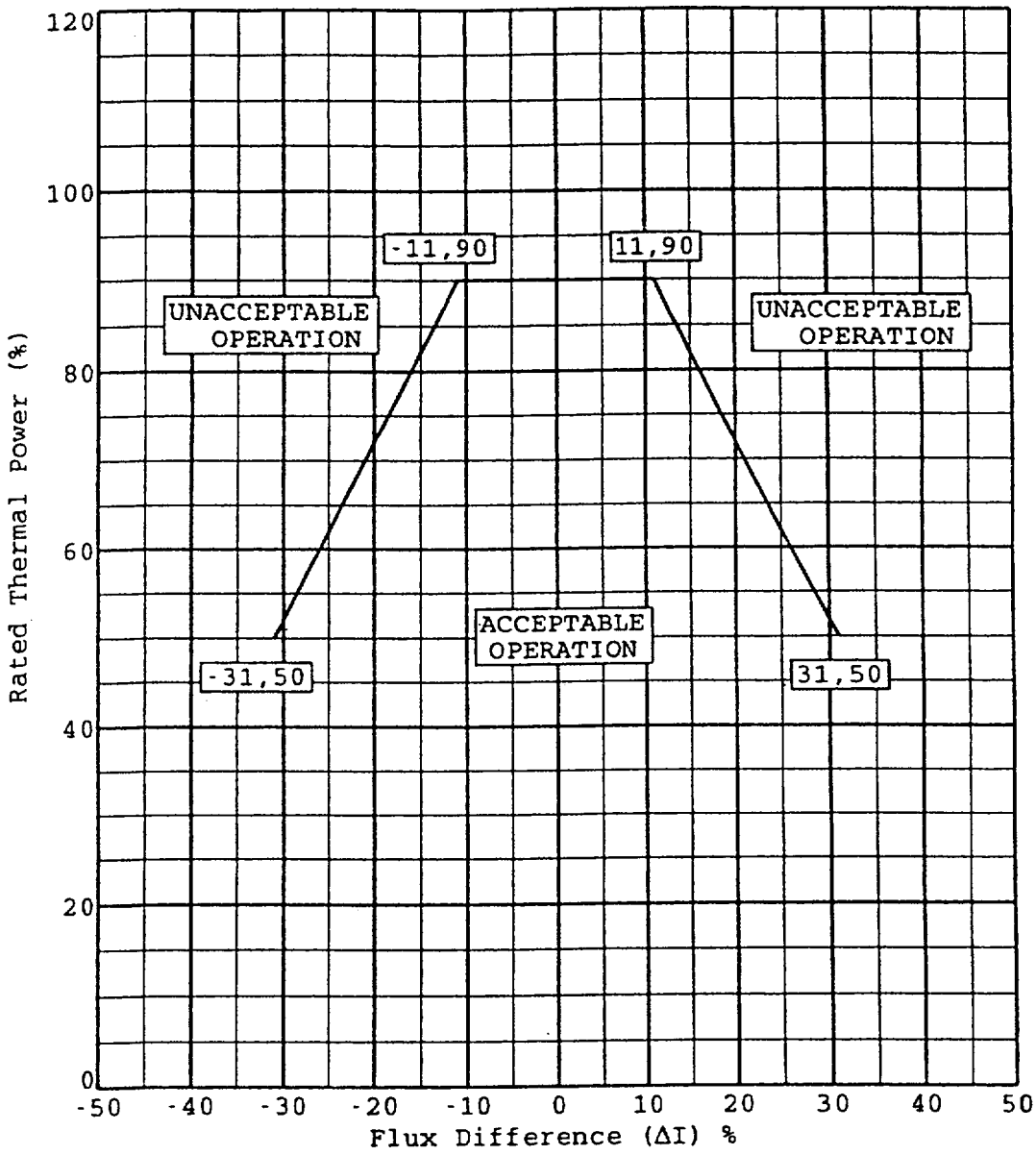


Figure 6

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

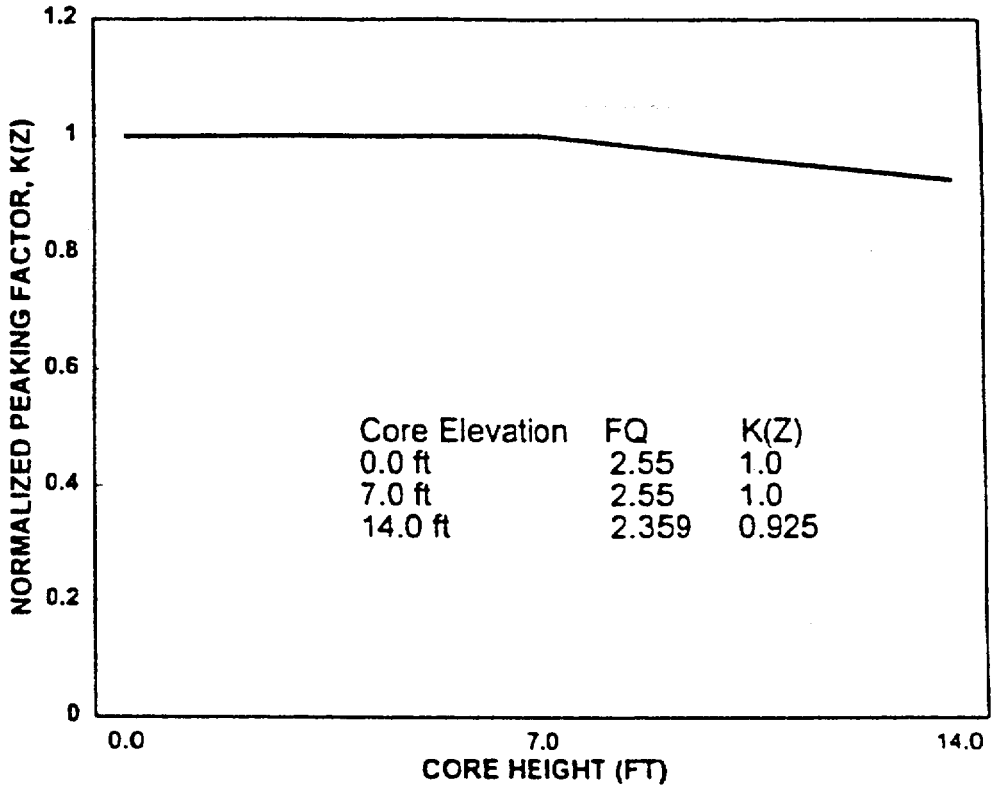


Table 1 (Part 1 of 2)

Unrodded F_{xy} for Each Core Height*

for Cycle Burnups Less Than 9000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded F_{xy}	Core Height (Ft.)	Axial Point	Unrodded F_{xy}
14.0	1	4.899	6.8	37	1.916
13.8	2	4.198	6.6	38	1.900
13.6	3	3.497	6.4	39	1.888
13.4	4	2.796	6.2	40	1.878
13.2	5	2.315	6.0	41	1.867
13.0	6	2.096	5.8	42	1.856
12.8	7	2.045	5.6	43	1.850
12.6	8	2.012	5.4	44	1.844
12.4	9	1.995	5.2	45	1.840
12.2	10	1.984	5.0	46	1.835
12.0	11	1.976	4.8	47	1.832
11.8	12	1.970	4.6	48	1.831
11.6	13	1.973	4.4	49	1.831
11.4	14	1.977	4.2	50	1.828
11.2	15	1.981	4.0	51	1.825
11.0	16	1.985	3.8	52	1.830
10.8	17	1.987	3.6	53	1.833
10.6	18	1.987	3.4	54	1.832
10.4	19	1.987	3.2	55	1.835
10.2	20	1.986	3.0	56	1.834
10.0	21	1.984	2.8	57	1.836
9.8	22	1.983	2.6	58	1.835
9.6	23	1.981	2.4	59	1.836
9.4	24	1.979	2.2	60	1.834
9.2	25	1.976	2.0	61	1.831
9.0	26	1.971	1.8	62	1.830
8.8	27	1.967	1.6	63	1.831
8.6	28	1.962	1.4	64	1.851
8.4	29	1.963	1.2	65	1.850
8.2	30	1.963	1.0	66	1.860
8.0	31	1.961	0.8	67	2.077
7.8	32	1.960	0.6	68	2.491
7.6	33	1.959	0.4	69	3.012
7.4	34	1.955	0.2	70	3.532
7.2	35	1.946	0.0	71	4.053
7.0	36	1.931			

For Unit 2 Cycle 8, 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 9000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded F_{xy}	Core Height (Ft.)	Axial Point	Unrodded F_{xy}
14.0	1	5.204	6.8	37	2.045
13.8	2	4.509	6.6	38	2.052
13.6	3	3.768	6.4	39	2.056
13.4	4	2.993	6.2	40	2.057
13.2	5	2.450	6.0	41	2.054
13.0	6	2.200	5.8	42	2.050
12.8	7	2.137	5.6	43	2.046
12.6	8	2.097	5.4	44	2.043
12.4	9	2.074	5.2	45	2.038
12.2	10	2.056	5.0	46	2.031
12.0	11	2.037	4.8	47	2.019
11.8	12	2.017	4.6	48	2.004
11.6	13	2.022	4.4	49	1.990
11.4	14	2.020	4.2	50	1.978
11.2	15	2.020	4.0	51	1.969
11.0	16	2.021	3.8	52	1.956
10.8	17	2.024	3.6	53	1.939
10.6	18	2.027	3.4	54	1.919
10.4	19	2.030	3.2	55	1.903
10.2	20	2.028	3.0	56	1.891
10.0	21	2.024	2.8	57	1.882
9.8	22	2.018	2.6	58	1.869
9.6	23	2.021	2.4	59	1.855
9.4	24	2.028	2.2	60	1.839
9.2	25	2.039	2.0	61	1.833
9.0	26	2.039	1.8	62	1.825
8.8	27	2.033	1.6	63	1.820
8.6	28	2.023	1.4	64	1.839
8.4	29	2.020	1.2	65	1.843
8.2	30	2.020	1.0	66	1.858
8.0	31	2.021	0.8	67	2.075
7.8	32	2.022	0.6	68	2.473
7.6	33	2.022	0.4	69	2.958
7.4	34	2.024	0.2	70	3.417
7.2	35	2.027	0.0	71	3.828
7.0	36	2.035			

For Unit 2 Cycle 8, the L(Z) penalty is not applied (i.e., L(Z) = 1.0 for all core elevations).