Nuclear Operating Company

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

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South Texas Project
Unit 1
Docket Nos. STN 50-498
Unit 1 Cycle 10 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 1 Cycle 10.

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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kaw

Attachment: Unit 1 Cycle 10 Core Operating Limits Report

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Nuclear Operating Company

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION UNIT 1 CYCLE 10 CORE OPERATING LIMITS REPORT

April 2000

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report for STPEGS Unit 1 Cycle 10 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.

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, 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
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.

(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, 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
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" ≤ 592.0 °F

$f_2(\Delta I)$ = 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 2.

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 -5.36×10^{-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 592 °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 3.

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 4, 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 5.

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 9,000 MWD/MTU and less than or equal to 1.903 for cycle burnups greater than or equal to 9,000 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 1 Cycle 10, 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 3 and 4.

++ Applies to fuel Regions 10A, 10B, 11A, 11B, 12A, and 12B.

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**,

b. Pressurizer Pressure, > 2214 psig***,

c. Minimum Measured Reactor Coolant System Flow $\geq$ 403,000 gpm****,

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

** 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.

3.0 REFERENCES

3.1 Letter from R. A. Wiley (Westinghouse) to Dave Hoppes (STPNOC), "Unit 1 Cycle 10 Core Operating Limits Report," 00TG-G-0031, Revision 1 (ST-UB-NOC-2032, Revision 1), April 2000.

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

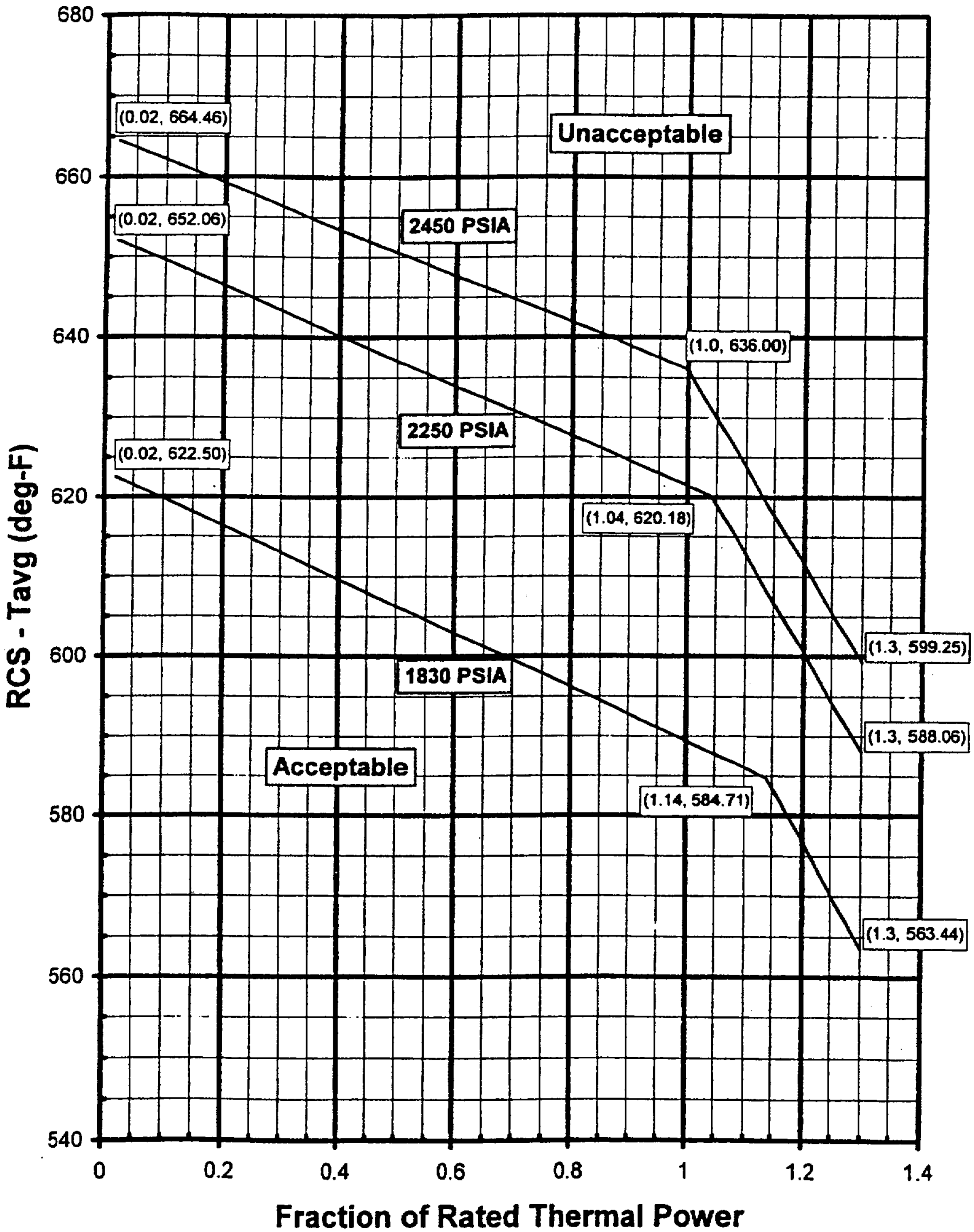


Figure 2

MTC versus Power Level

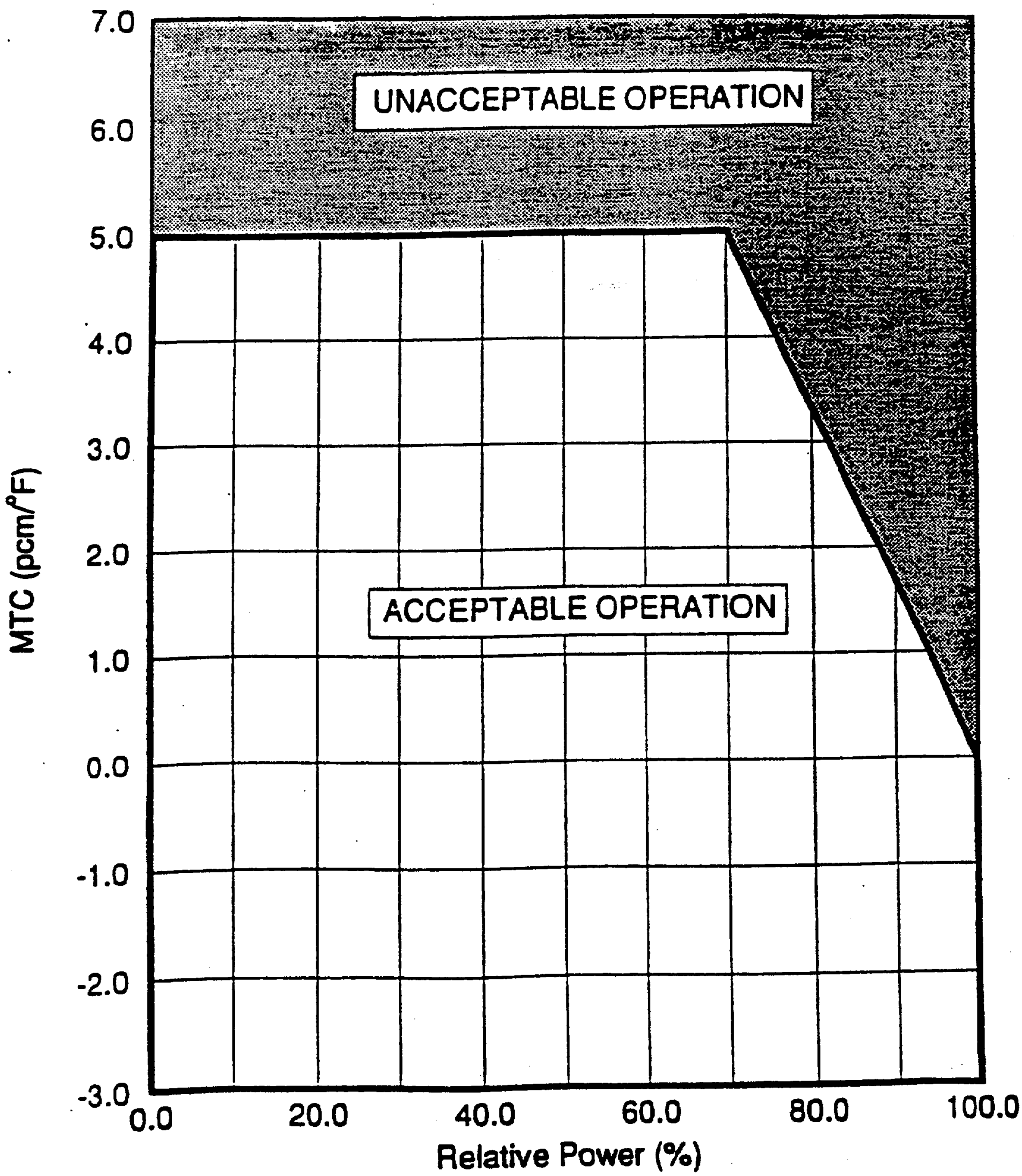
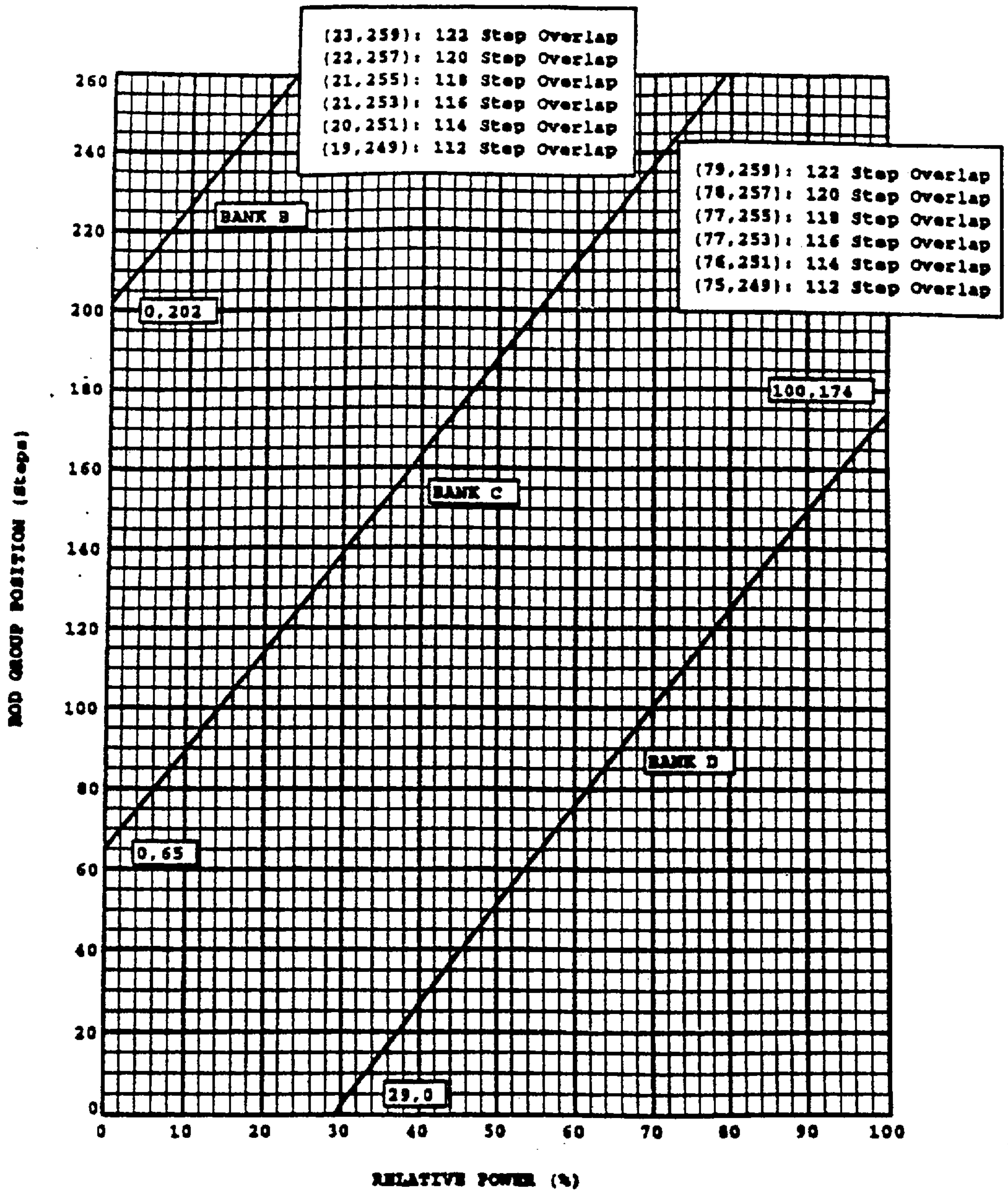


Figure 3

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 4

AFD Limits versus Rated Thermal Power

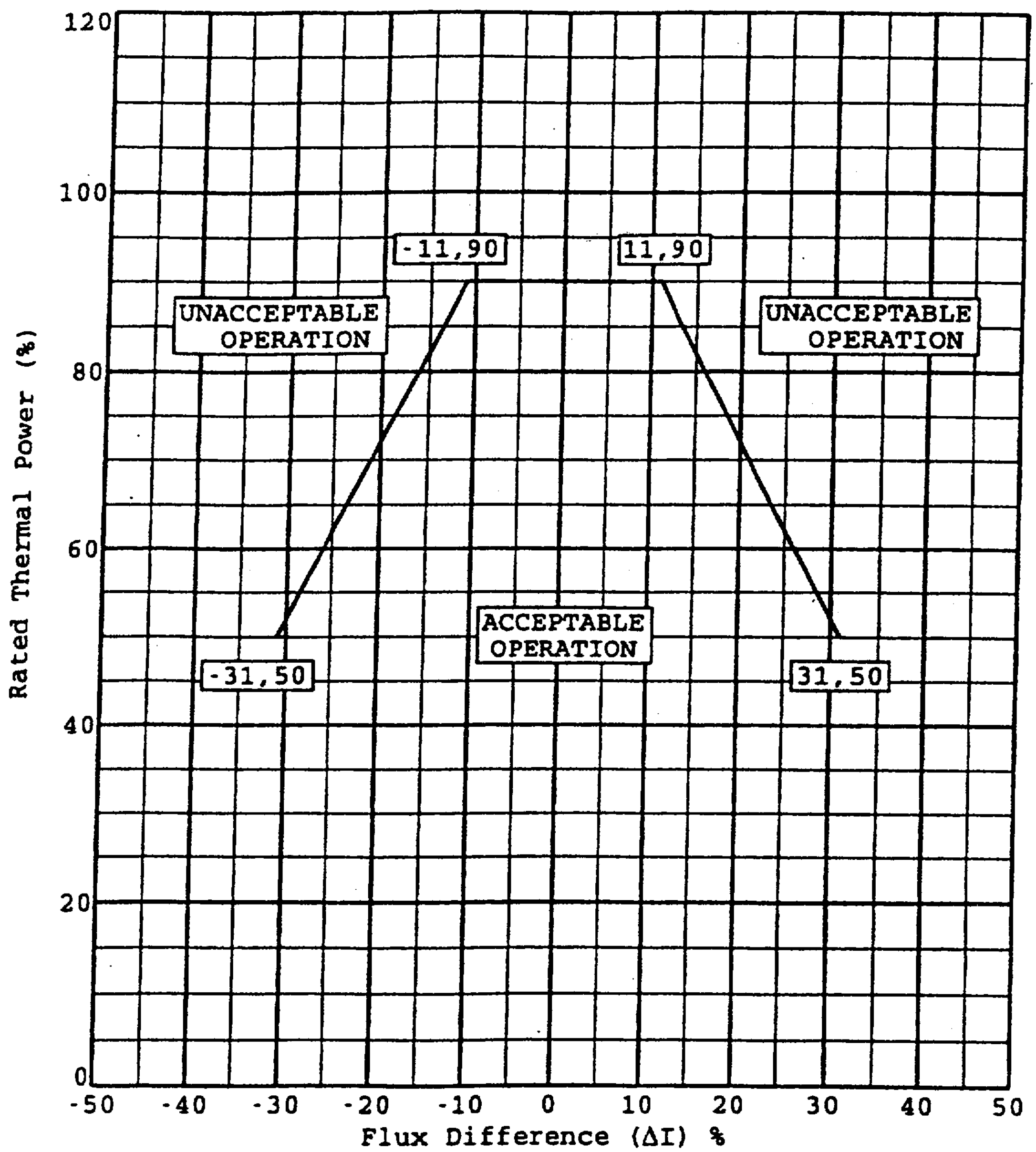


Figure 5

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

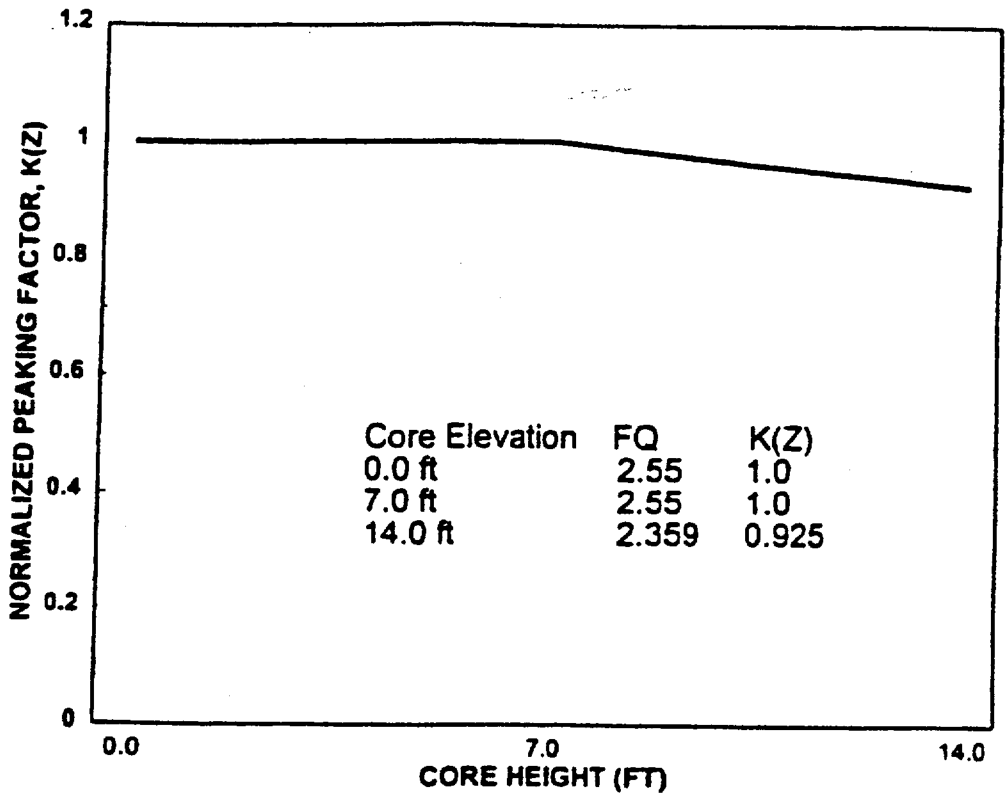


Table 1 (Part 1 of 2)

Unrodded F_{XY} for Each Core Height*

For Cycle Burnups Less Than 9,000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded F_{xy}	Core Height (Ft.)	Axial Point	Unrodded F_{xy}
14.0	1	4.167	6.8	37	1.903
13.8	2	3.688	6.6	38	1.886
13.6	3	3.210	6.4	39	1.869
13.4	4	2.731	6.2	40	1.856
13.2	5	2.355	6.0	41	1.850
13.0	6	2.103	5.8	42	1.848
12.8	7	2.015	5.6	43	1.848
12.6	8	1.966	5.4	44	1.847
12.4	9	1.952	5.2	45	1.849
12.2	10	1.952	5.0	46	1.850
12.0	11	1.953	4.8	47	1.853
11.8	12	1.949	4.6	48	1.854
11.6	13	1.944	4.4	49	1.857
11.4	14	1.947	4.2	50	1.860
11.2	15	1.953	4.0	51	1.862
11.0	16	1.961	3.8	52	1.861
10.8	17	1.971	3.6	53	1.860
10.6	18	1.979	3.4	54	1.856
10.4	19	1.983	3.2	55	1.860
10.2	20	1.987	3.0	56	1.866
10.0	21	1.989	2.8	57	1.874
9.8	22	1.986	2.6	58	1.882
9.6	23	1.982	2.4	59	1.884
9.4	24	1.978	2.2	60	1.883
9.2	25	1.971	2.0	61	1.875
9.0	26	1.964	1.8	62	1.859
8.8	27	1.956	1.6	63	1.834
8.6	28	1.951	1.4	64	1.810
8.4	29	1.950	1.2	65	1.798
8.2	30	1.953	1.0	66	1.804
8.0	31	1.957	0.8	67	1.900
7.8	32	1.955	0.6	68	2.184
7.6	33	1.946	0.4	69	2.569
7.4	34	1.936	0.2	70	2.954
7.2	35	1.927	0.0	71	3.339
7.0	36	1.916			

* For Unit 1 Cycle 10, the L(Z) penalty is not applied (i.e., L(Z) = 1.0 for all core elevations).

Table 1 (Part 2 of 2)

Unrodded F_{XY} for Each Core Height*

For Cycle Burnups Greater Than or Equal to 9,000 MWD/MTU

Core Height (Ft.)	Axial Point	Unrodded F_{xy}	Core Height (Ft.)	Axial Point	Unrodded F_{xy}
14.0	1	4.122	6.8	37	2.036
13.8	2	3.700	6.6	38	2.036
13.6	3	3.278	6.4	39	2.039
13.4	4	2.855	6.2	40	2.042
13.2	5	2.518	6.0	41	2.043
13.0	6	2.281	5.8	42	2.039
12.8	7	2.171	5.6	43	2.033
12.6	8	2.094	5.4	44	2.024
12.4	9	2.050	5.2	45	2.012
12.2	10	2.025	5.0	46	2.000
12.0	11	2.021	4.8	47	1.987
11.8	12	2.019	4.6	48	1.974
11.6	13	2.010	4.4	49	1.961
11.4	14	2.007	4.2	50	1.948
11.2	15	2.009	4.0	51	1.935
11.0	16	2.016	3.8	52	1.925
10.8	17	2.020	3.6	53	1.917
10.6	18	2.020	3.4	54	1.911
10.4	19	2.017	3.2	55	1.900
10.2	20	2.014	3.0	56	1.885
10.0	21	2.013	2.8	57	1.866
9.8	22	2.012	2.6	58	1.846
9.6	23	2.014	2.4	59	1.827
9.4	24	2.018	2.2	60	1.811
9.2	25	2.024	2.0	61	1.805
9.0	26	2.031	1.8	62	1.802
8.8	27	2.038	1.6	63	1.803
8.6	28	2.044	1.4	64	1.815
8.4	29	2.050	1.2	65	1.854
8.2	30	2.055	1.0	66	1.926
8.0	31	2.058	0.8	67	2.085
7.8	32	2.056	0.6	68	2.336
7.6	33	2.051	0.4	69	2.636
7.4	34	2.045	0.2	70	2.937
7.2	35	2.040	0.0	71	3.237
7.0	36	2.037			

* For Unit 1 Cycle 10, the L(Z) penalty is not applied (i.e., L(Z) = 1.0 for all core elevations).