FENOC
FirstEnergy Nuclear Operating Company

James H. Lash
Site Vice President

724-682-5234
Fax: 724-643-8069

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L-06-062

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

Subject: **Beaver Valley Power Station, Unit No. 1**
Docket No. 50-334, License No. DPR-66
Cycle 18 Core Operating Limits Report

Beaver Valley Power Station, Unit No. 1 completed the seventeenth cycle of operation on February 13, 2006. This letter provides a copy of the Cycle 18 Core Operating Limits Report (COLR) in accordance with Technical Specification 6.9.5.d.

This revision of the COLR includes changes due to the Cycle 18 reload design and changes due to four Unit No. 1 license amendments implemented during the Spring 2006 refueling outage. These license amendments are 271 (Containment Conversion), 272 (Best Estimate LOCA), both of which were issued on February 6, 2006, 273 (Replacement Steam Generators) which was issued on February 9, 2006, and 274 (Relaxed Axial Offset Control) which was issued on February 27, 2006.

The Cycle 18 COLR is being submitted in accordance with Technical Specification 6.9.5.d. The COLR has been updated for this cycle by incorporating the changes related to license amendments 271, 272, 273 and 274, as well as the reload-specific axial flux difference limits and F_Q Surveillance W(Z) factors associated with the Relaxed Axial Offset Control License Amendment.

No new regulatory commitments are contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Gregory A. Dunn, Manager, FENOC Fleet Licensing, at (330) 315-7243.

Sincerely,

James H. Lash

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Enclosure:

Beaver Valley Power Station Unit No. 1 Cycle 18 Core Operating Limits Report

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Senior Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
Mr. D. A. Allard, Director BRP/DEP
Mr. L. E. Ryan (BRP/DEP)

Beaver Valley Power Station

Unit No.1

Cycle 18

Core Operating Limits Report

4.1 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report provides the cycle specific parameter limits developed in accordance with the NRC approved methodologies specified in Technical Specification Administrative Control 6.9.5.

Specification 3.1.3.5 Shutdown Rod Insertion Limits

The shutdown rods shall be withdrawn to at least 225 steps.*

Specification 3.1.3.6 Control Rod Insertion Limits

Control Banks A and B shall be withdrawn to at least 225 steps.*

Control Banks C and D shall be limited in physical insertion as shown in Figure 4.1-1.*

Specification 3.2.1 Axial Flux Difference

The Axial Flux Difference (AFD) acceptable operation limits are provided in Figure 4.1-2.

Specification 3.2.2 Heat Flux Hot Channel Factor - $F_Q(Z)$ Limits

The Heat Flux Hot Channel Factor - $F_Q(Z)$ limit is defined by:

$$F_Q(Z) \leq \left[\frac{CFQ}{P}\right] * K(Z) \qquad \text{for } P > 0.5$$

$$F_Q(Z) \leq \left[\frac{CFQ}{0.5}\right] * K(Z) \qquad \text{for } P \leq 0.5$$

Where: CFQ = 2.40 $\qquad P = \dfrac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

K(Z) = the function obtained from Figure 4.1-3.

$$F_Q^C(Z) = F_Q^M(Z) * 1.0815$$

$$F_Q^W(Z) = F_Q^C(Z) * W(Z)$$

The W(Z) values are provided in Table 4.1-1.

The $F_Q(Z)$ penalty function, applied when the analytic $F_Q(Z)$ function increases from one monthly measurement to the next, is provided in Table 4.1-2.

* As indicated by the group demand counter

Specification 3.2.3 Nuclear Enthalpy Rise Hot Channel Factor $F^N_{\Delta H}$

$F^N_{\Delta H} \leq CF_{\Delta H} * (1 + PF_{\Delta H} (1-P))$

Where: $CF_{\Delta H} = 1.62$

$PF_{\Delta H} = 0.3$

$P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

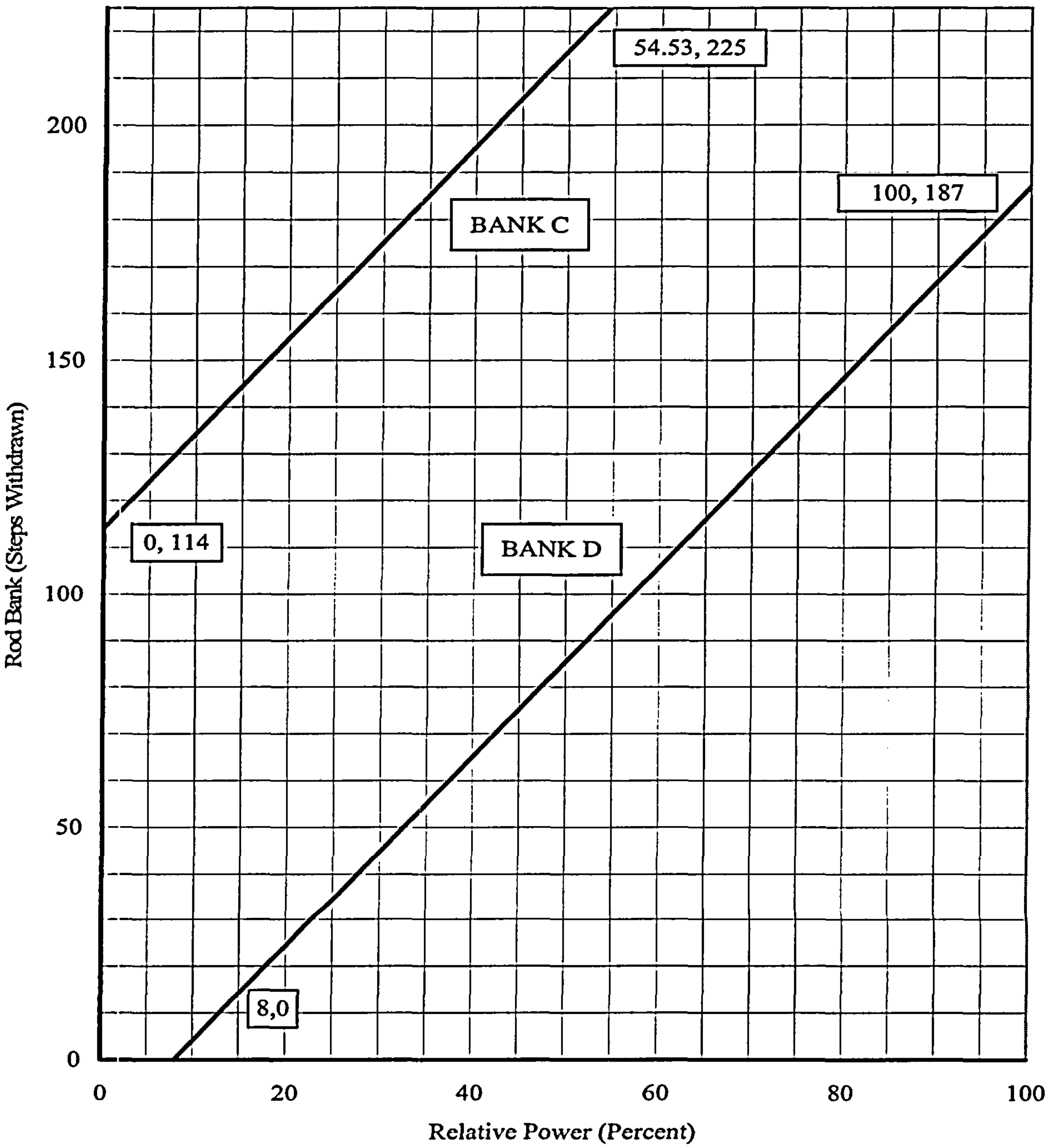

FIGURE 4.1-1
CONTROL ROD INSERTION LIMITS

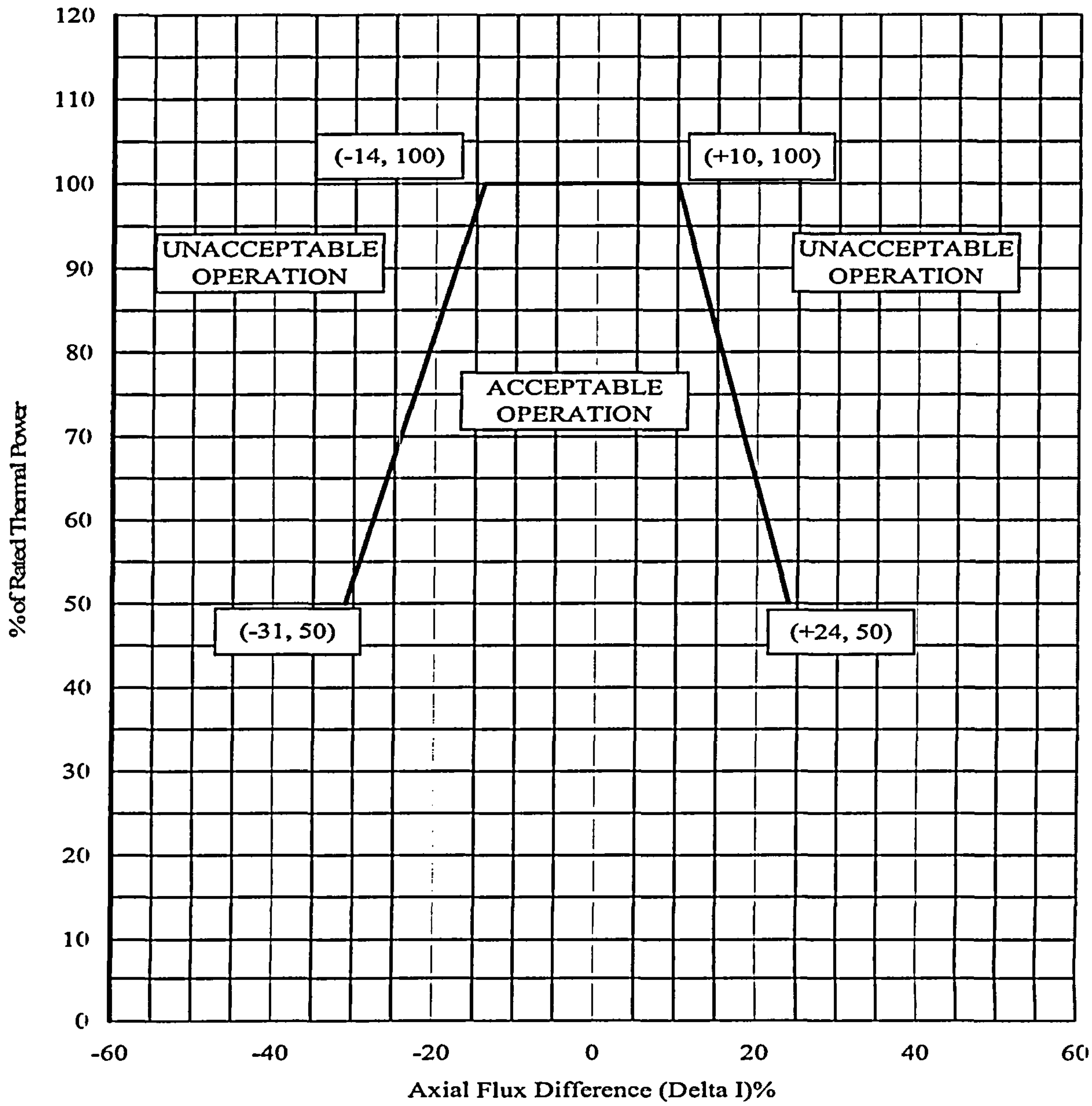

FIGURE 4.1-2
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF PERCENT OF RATED THERMAL POWER FOR RAOC

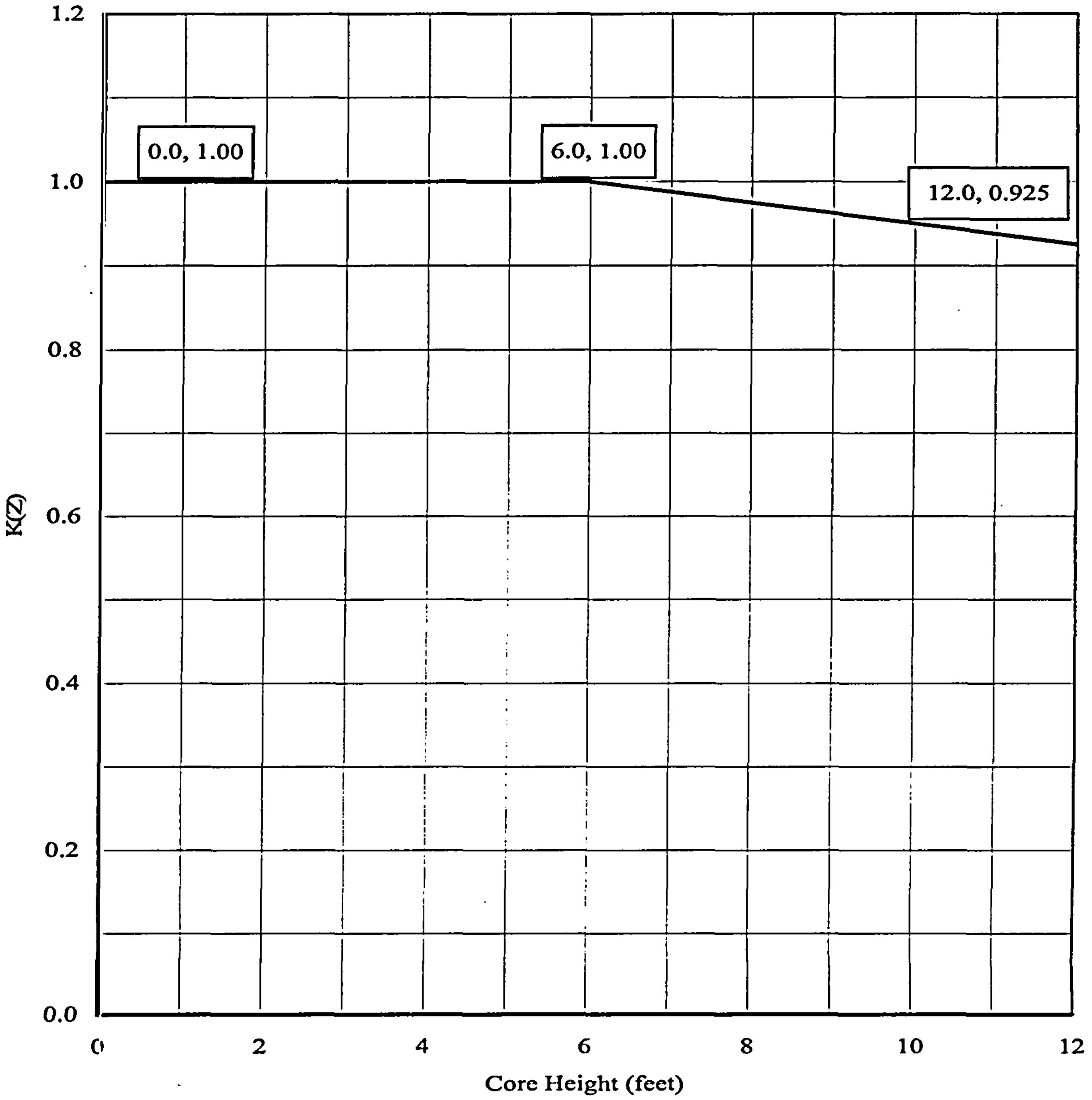

FIGURE 4.1-3
F_QT NORMALIZED OPERATING ENVELOPE, K(Z)

Specification 3.3.1.1 Reactor Trip System Instrumentation Setpoints, Table 3.3-1 Table Notations A and B

Overtemperature ΔT Setpoint Parameter Values:

Parameter	Value
Overtemperature ΔT reactor trip setpoint	$K1 \leq 1.242$
Overtemperature ΔT reactor trip setpoint Tavg coefficient	$K2 \geq 0.0183/°F$
Overtemperature ΔT reactor trip setpoint pressure coefficient	$K3 \geq 0.001/psia$
Tavg at RATED THERMAL POWER	$T' \leq 580.0°F$[1]
Nominal Pressurizer Pressure	$P' \geq 2250$ psia
Measured reactor vessel average temperature lead/lag time constants	$\tau_1 \geq 30$ secs $\tau_2 \leq 4$ secs
Measured reactor vessel ΔT lag time constant	$\tau_4 \leq 6$ secs
Measured reactor vessel average temperature lag time constant	$\tau_5 \leq 2$ secs

f (ΔI) is a function of the indicated difference between top and bottom detectors of the power-range nuclear ion chambers; with gains to be selected based on measured instrument response during plant startup tests such that:

(i) for $q_t - q_b$ between -37 percent and +15 percent, f (ΔI) = 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).

(ii) for each percent that the magnitude of $(q_t - q_b)$ exceeds -37 percent, the ΔT trip setpoint shall be automatically reduced by 2.52 percent of its value at RATED THERMAL POWER.

(iii) for each percent that the magnitude of $(q_t - q_b)$ exceeds +15 percent, the ΔT trip setpoint shall be automatically reduced by 1.47 percent of its value at RATED THERMAL POWER.

(1) T' represents the cycle-specific Full Power Tavg value used in core design (576.2 °F).

Overpower ΔT Setpoint Parameter Values:

Parameter	Value
Overpower ΔT reactor trip setpoint	K4 ≤ 1.085
Overpower ΔT reactor trip setpoint Tavg rate/lag coefficient	K5 ≥ 0.02/°F for increasing average temperature K5=0/°F for decreasing average temperature
Overpower ΔT reactor trip setpoint Tavg heatup coefficient	K6 ≥ 0.0021/°F for T > T" K6 = 0/°F for T ≤ T"
Tavg at RATED THERMAL POWER	T" ≤ 580.0°F(1)
Measured reactor vessel average temperature rate/lag time constant	$\tau_3 \geq 10$ secs
Measured reactor vessel ΔT lag time constant	$\tau_4 \leq 6$ secs
Measured reactor vessel average temperature lag time constant	$\tau_5 \leq 2$ secs

Specification 3.2.5 DNB Parameters

Parameter	Indicated Value
Reactor Coolant System Tavg	Tavg ≤ 583.6°F(2)
Pressurizer Pressure	Pressure ≥ 2218 psia(3)
Reactor Coolant System Total Flow Rate	Flow ≥ 267,300 gpm(4)

(1) T" represents the cycle-specific Full Power Tavg value used in core design (576.2 °F).

(2) The Reactor Coolant System (RCS) T_{avg} value includes allowances for rod control operation and verification via control board indication.

(3) The pressurizer pressure value includes allowances for pressurizer pressure control operation and verification via control board indication.

(4) The RCS total flow rate includes allowances for normalization of the cold leg elbow taps with a beginning of cycle precision RCS flow calorimetric measurement and verification on a periodic basis via control board indication.

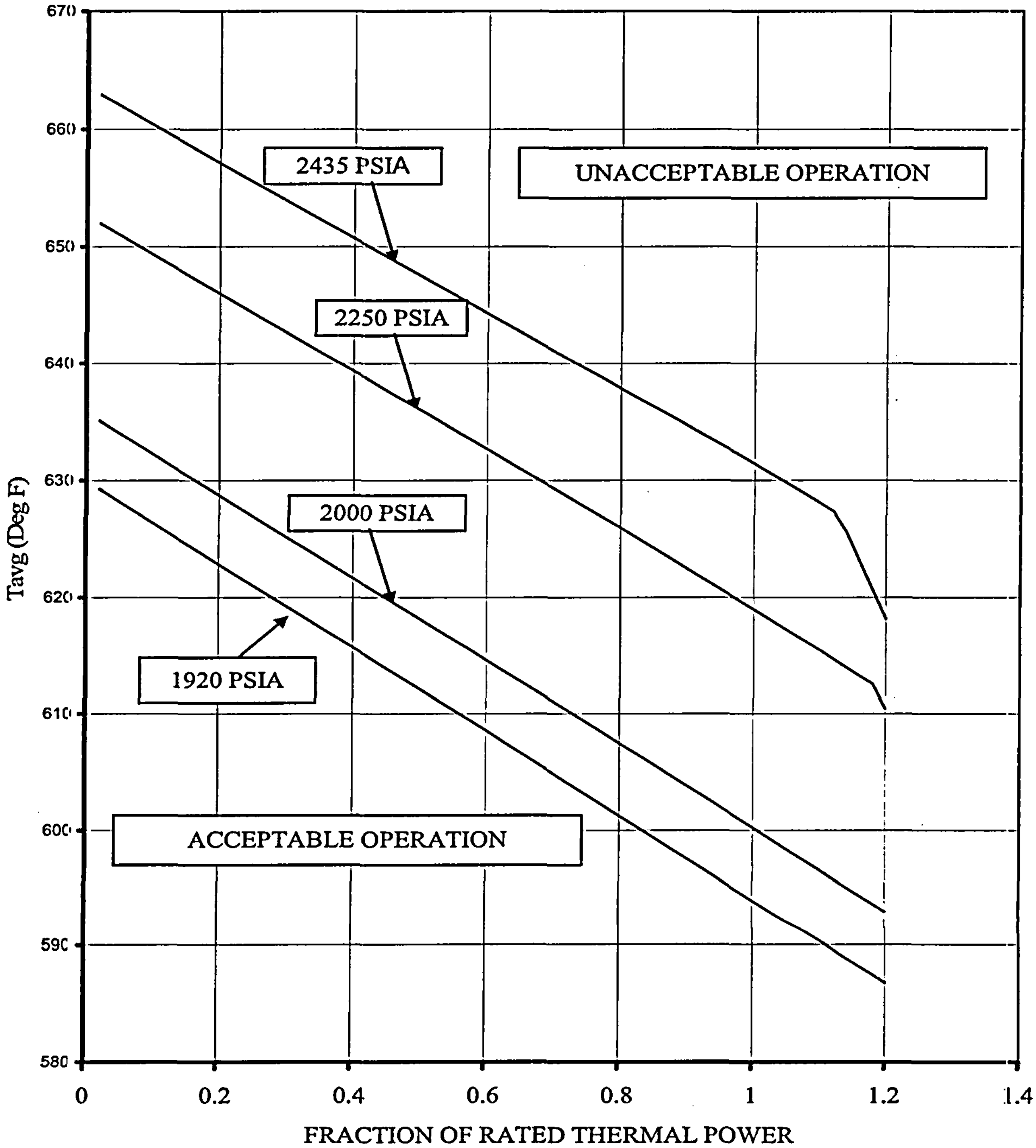

Figure 4.1-5
REACTOR CORE SAFETY LIMIT
THREE LOOP OPERATION
(Technical Specification Safety Limit 2.1.1)

Table 4.1-1 (Page 1 of 2)
F_Q Surveillance W(Z) Function versus Burnup

Exclusion Zone	Axial Point	Elevation (feet)	150 MWD/MTU	3000 MWD/MTU	10000 MWD/MTU	16000 MWD/MTU
*	1	12.00	1.0000	1.0000	1.0000	1.0000
*	2	11.80	1.0000	1.0000	1.0000	1.0000
*	3	11.60	1.0000	1.0000	1.0000	1.0000
*	4	11.40	1.0000	1.0000	1.0000	1.0000
*	5	11.20	1.0000	1.0000	1.0000	1.0000
*	6	11.00	1.0000	1.0000	1.0000	1.0000
*	7	10.80	1.0000	1.0000	1.0000	1.0000
*	8	10.60	1.0000	1.0000	1.0000	1.0000
*	9	10.40	1.0000	1.0000	1.0000	1.0000
	10	10.20	1.2273	1.2990	1.2429	1.2529
	11	10.00	1.2153	1.2811	1.2330	1.2252
	12	9.80	1.2026	1.2736	1.2223	1.2088
	13	9.60	1.1891	1.2688	1.2104	1.2014
	14	9.40	1.1772	1.2630	1.2001	1.1940
	15	9.20	1.1738	1.2536	1.1937	1.1945
	16	9.00	1.1824	1.2416	1.1912	1.2163
	17	8.80	1.1923	1.2424	1.1984	1.2353
	18	8.60	1.2001	1.2507	1.2127	1.2504
	19	8.40	1.2056	1.2584	1.2269	1.2637
	20	8.20	1.2091	1.2624	1.2375	1.2742
	21	8.00	1.2104	1.2637	1.2454	1.2819
	22	7.80	1.2097	1.2622	1.2505	1.2868
	23	7.60	1.2069	1.2580	1.2528	1.2889
	24	7.40	1.2026	1.2514	1.2525	1.2883
	25	7.20	1.1977	1.2426	1.2497	1.2849
	26	7.00	1.1930	1.2316	1.2444	1.2789
	27	6.80	1.1869	1.2187	1.2369	1.2735
	28	6.60	1.1791	1.2040	1.2272	1.2673
	29	6.40	1.1700	1.1879	1.2156	1.2581
	30	6.20	1.1597	1.1706	1.2022	1.2467

Note: Top and Bottom 15% Excluded

Table 4.1-1 (Page 2 of 2)
F_Q Surveillance W(Z) Function versus Burnup

Exclusion Zone	Axial Point	Elevation (feet)	150 MWD/MTU	3000 MWD/MTU	10000 MWD/MTU	16000 MWD/MTU
	31	6.00	1.1480	1.1509	1.1871	1.2333
	32	5.80	1.1371	1.1359	1.1713	1.2174
	33	5.60	1.1310	1.1246	1.1565	1.2015
	34	5.40	1.1295	1.1142	1.1458	1.1880
	35	5.20	1.1363	1.1140	1.1434	1.1752
	36	5.00	1.1436	1.1174	1.1421	1.1728
	37	4.80	1.1495	1.1224	1.1389	1.1726
	38	4.60	1.1551	1.1265	1.1364	1.1704
	39	4.40	1.1601	1.1302	1.1363	1.1677
	40	4.20	1.1645	1.1334	1.1364	1.1642
	41	4.00	1.1683	1.1361	1.1361	1.1594
	42	3.80	1.1716	1.1385	1.1355	1.1555
	43	3.60	1.1743	1.1404	1.1347	1.1547
	44	3.40	1.1769	1.1417	1.1344	1.1559
	45	3.20	1.1806	1.1465	1.1377	1.1571
	46	3.00	1.1929	1.1589	1.1494	1.1592
	47	2.80	1.2141	1.1779	1.1676	1.1671
	48	2.60	1.2367	1.1989	1.1881	1.1833
	49	2.40	1.2596	1.2228	1.2084	1.2002
	50	2.20	1.2823	1.2471	1.2282	1.2168
	51	2.00	1.3047	1.2706	1.2475	1.2332
	52	1.80	1.3265	1.2935	1.2660	1.2491
*	53	1.60	1.0000	1.0000	1.0000	1.0000
*	54	1.40	1.0000	1.0000	1.0000	1.0000
*	55	1.20	1.0000	1.0000	1.0000	1.0000
*	56	1.00	1.0000	1.0000	1.0000	1.0000
*	57	0.80	1.0000	1.0000	1.0000	1.0000
*	58	0.60	1.0000	1.0000	1.0000	1.0000
*	59	0.40	1.0000	1.0000	1.0000	1.0000
*	60	0.20	1.0000	1.0000	1.0000	1.0000
*	61	0.00	1.0000	1.0000	1.0000	1.0000

Note: Top and Bottom 15% Excluded

Table 4.1-2
$F_Q(Z)$ Penalty Factor versus Burnup

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
All Burnups	1.02

Note: The Penalty Factor, to be applied to $F_Q(Z)$ in accordance with Technical Specification Surveillance Requirement 4.2.2.3, is the maximum factor by which $F_Q(Z)$ is expected to increase over a 39 Effective Full Power Day (EFPD) interval (surveillance interval of 31 EFPD plus the maximum allowable extension not to exceed 25% of the surveillance interval per Technical Specification Surveillance Requirement 4.0.2) starting from the burnup at which the $F_Q(Z)$ was determined.