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December 11, 2014
L-14-389

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
Unit Nos. 1 and 2 Core Operating Limits Report

Pursuant to the requirements of Beaver Valley Power Station, Unit Nos. 1 (BVPS-1) and 2 (BVPS-2) Technical Specification 5.6.3, "CORE OPERATING LIMITS REPORT (COLR)," FirstEnergy Nuclear Operating Company (FENOC) hereby submits the BVPS-1 COLR for Cycle 23 and the BVPS-2 COLR for Cycle 18. The COLRs have been revised to implement license amendments 291 (BVPS-1) and 178 (BVPS-2) that allow the normally required near end-of-life moderator temperature coefficient measurement to not be performed under certain conditions. Technical Specification 5.6.3.d requires, in part, that the COLR be provided to the Nuclear Regulatory Commission (NRC) upon issuance for any midcycle revisions or supplements. The COLRs were effective November 14, 2014.

There are no regulatory commitments established in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at (330) 315-6810.

Sincerely,

Eric A. Larson

Enclosures:
A. Beaver Valley Power Station, Unit No. 1, Core Operating Limits Report, Cycle 23
B. Beaver Valley Power Station, Unit No. 2, Core Operating Limits Report, Cycle 18

cc: NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Enclosure A
L-14-389

Beaver Valley Power Station, Unit No. 1
Core Operating Limits Report, Cycle 23
(14 Pages Follow)

5.0 ADMINISTRATIVE CONTROLS

5.1 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 5.6.3.

5.1.1 SL 2.1.1 Reactor Core Safety Limits

See Figure 5.1-1.

5.1.2 SHUTDOWN MARGIN (SDM)

a. In MODES 1, 2, 3, and 4, SHUTDOWN MARGIN shall be ≥ 1.77% Δk/k.(1)

b. Prior to manually blocking the Low Pressurizer Pressure Safety Injection Signal, the Reactor Coolant System shall be borated to ≥ the MODE 5 boron concentration and shall remain ≥ this boron concentration at all times when this signal is blocked.

c. In MODE 5, SHUTDOWN MARGIN shall be ≥ 1.0% Δk/k.

5.1.3 LCO 3.1.3 Moderator Temperature Coefficient (MTC)

a. Upper Limit - MTC shall be maintained within the acceptable operation limit specified in Technical Specification Figure 3.1.3-1.

b. Lower Limit - MTC shall be maintained less negative than - 4.4 x 10^{-4} Δk/k/°F at RATED THERMAL POWER.

c. 300 ppm Surveillance Limit: (- 37 pcm/°F)

d. The revised predicted near-EOL 300 ppm MTC shall be calculated using Figure 5.1-5 and the following algorithm from Reference 11 :

Revised Predicted MTC = Predicted MTC* + AFD Correction** + Predictive Correction***

where,

* Predicted MTC is calculated from Figure 5.1-5 at the burnup corresponding to the measurement of 300 ppm at RTP conditions,

** AFD Correction is the more negative value of :

{0 pcm/°F or (ΔAFD * AFD Sensitivity)}

where: ΔAFD is the measured AFD minus the predicted AFD from an incore flux map taken at or near the burnup corresponding to 300 ppm.

and

AFD Sensitivity = 0.05 pcm/°F / ΔAFD

***Predictive Correction is -3 pcm/°F.

(1) The MODE 1 and MODE 2 with k_{eff} ≥ 1.0 SDM requirements are included to address SDM requirements (e.g., MODE 1 Required Actions to verify SDM) that are not within the applicability of LCO 3.1.1, SHUTDOWN MARGIN (SDM).

5.1 Core Operating Limits Report

If the revised predicted MTC is less negative than the SR 3.1.3.2 limit (COLR 5.1.3.c) and all of the benchmark data contained in the surveillance procedure are met, then an MTC measurement, in accordance with SR 3.1.3.2, is not required.

e. 60 ppm Surveillance Limit: (- 43 pcm/°F)

5.1.4 LCO 3.1.5 Shutdown Bank Insertion Limits

The Shutdown Banks shall be withdrawn to at least 225 steps.(2)

5.1.5 LCO 3.1.6 Control Bank Insertion Limits

a. Control Banks A and B shall be withdrawn to at least 225 steps.(2)

b. Control Banks C and D shall be limited in physical insertion as shown in Figure 5.1-2.(2)

c. Sequence Limits - The sequence of withdrawal shall be A, B, C and D bank, in that order.

d. Overlap Limits(2) - Overlap shall be such that step 129 on banks A, B, and C corresponds to step 1 on the following bank. When C bank is fully withdrawn, these limits are verified by confirming D bank is withdrawn at least to a position equal to the all-rods-out position minus 128 steps.

5.1.6 LCO 3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)

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

K(Z) = the function obtained from Figure 5.1-3.

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

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

(2) As indicated by the group demand counter

5.1 Core Operating Limits Report

The W(Z) values are provided in Table 5.1-1. The W(Z) values are generated assuming that they will be used for a full power surveillance. When a part power surveillance is performed, the W(Z) values should be multiplied by the factor 1/P, when P > 0.5. When P is ≤ 0.5, the W(z) values should be multiplied by the factor 1/(0.5), or 2.0. This is consistent with the adjustment in the $F_Q(Z)$ limit at part power conditions.

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 5.1-2.

5.1.7 LCO 3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

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

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

$PF_{\Delta H}$ = 0.3

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

5.1.8 LCO 3.2.3 Axial Flux Difference (AFD)

The AFD acceptable operation limits are provided in Figure 5.1-4.

5.1.9 LCO 3.3.1 Reactor Trip System Instrumentation - Overtemperature and Overpower ΔT Parameter Values from Table Notations 1 and 2

a. Overtemperature ΔT Setpoint Parameter Values:

Parameter	Value
Overtemperature ΔT reactor trip setpoint	K1 ≤ 1.242
Overtemperature ΔT reactor trip setpoint Tavg coefficient	K2 ≥ 0.0183/°F
Overtemperature ΔT reactor trip setpoint pressure coefficient	K3 ≥ 0.001/psia
Tavg at RATED THERMAL POWER	T' ≤ 577.9°F(1)
Nominal pressurizer pressure	P' ≥ 2250 psia
Measured reactor vessel average temperature lead/lag time constants	τ_1 ≥ 30 secs τ_2 ≤ 4 secs
Measured reactor vessel ΔT lag time constant	τ_4 ≤ 6 secs

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

5.1 Core Operating Limits Report

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% and +15%, 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%, the ΔT trip setpoint shall be automatically reduced by 2.52% of its value at RATED THERMAL POWER.

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

b. 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" ≤ 577.9°F(2)
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

(2) T" represents the cycle-specific Full Power Tavg value used in core design.

5.1 Core Operating Limits Report

5.1.10 LCO 3.4.1, RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits

Parameter	Indicated Value
Reactor Coolant System Tavg	Tavg $\leq$ 581.5°F(1)
Pressurizer Pressure	Pressure $\geq$ 2218 psia(2)
Reactor Coolant System Total Flow Rate	Flow $\geq$ 267,300 gpm(3)

5.1.11 LCO 3.9.1 Boron Concentration (MODE 6)

The boron concentration of the Reactor Coolant System, the refueling canal, and the refueling cavity shall be maintained $\geq$ 2400 ppm. This value includes a 50 ppm conservative allowance for uncertainties.

(1) The Reactor Coolant System (RCS) indicated T_{avg} value is determined by adding the appropriate allowances for rod control operation and verification via control board indication (3.6°F) to the cycle specific full power T_{avg} used in the core design.

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

(3) 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.

5.1 Core Operating Limits Report

5.1.12 References

1. WCAP-9272-P-A, "WESTINGHOUSE RELOAD SAFETY EVALUATION METHODOLOGY," July 1985 (Westinghouse Proprietary).

2. WCAP-8745-P-A, "Design Bases for the Thermal Overpower ΔT and Thermal Overtemperature ΔT Trip Functions," September 1986.

3. WCAP-12945-P-A, Volume 1 (Revision 2) and Volumes 2 through 5 (Revision 1), "Code Qualification Document for Best Estimate LOCA Analysis," March 1998 (Westinghouse Proprietary).

4. WCAP-10216-P-A, Revision 1A, "Relaxation of Constant Axial Offset Control-F_Q Surveillance Technical Specification," February 1994.

5. WCAP-14565-P-A, "VIPRE-01 Modeling and Qualification for Pressurized Water Reactor Non-LOCA Thermal-Hydraulic Safety Analysis," October 1999.

6. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995 (Westinghouse Proprietary).

7. WCAP-15025-P-A, "Modified WRB-2 Correlation, WRB-2M, for Predicting Critical Heat Flux in 17x17 Rod Bundles with Modified LPD Mixing Vane Grids," April 1999.

8. Caldon, Inc. Engineering Report-80P, "Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM√™ System," Revision 0, March 1997.

9. Caldon, Inc. Engineering Report-160P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate With the LEFM√™ System," Revision 0, May 2000.

10. WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)," Revision 0, January 2005.

11. WCAP-13749-P-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," March 1997 (Westinghouse Proprietary).

12. WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON," August 2004.

13. WCAP-16045-P-A, Addendum 1, "Qualification of the NEXUS Nuclear Data Methodology," November 2005.

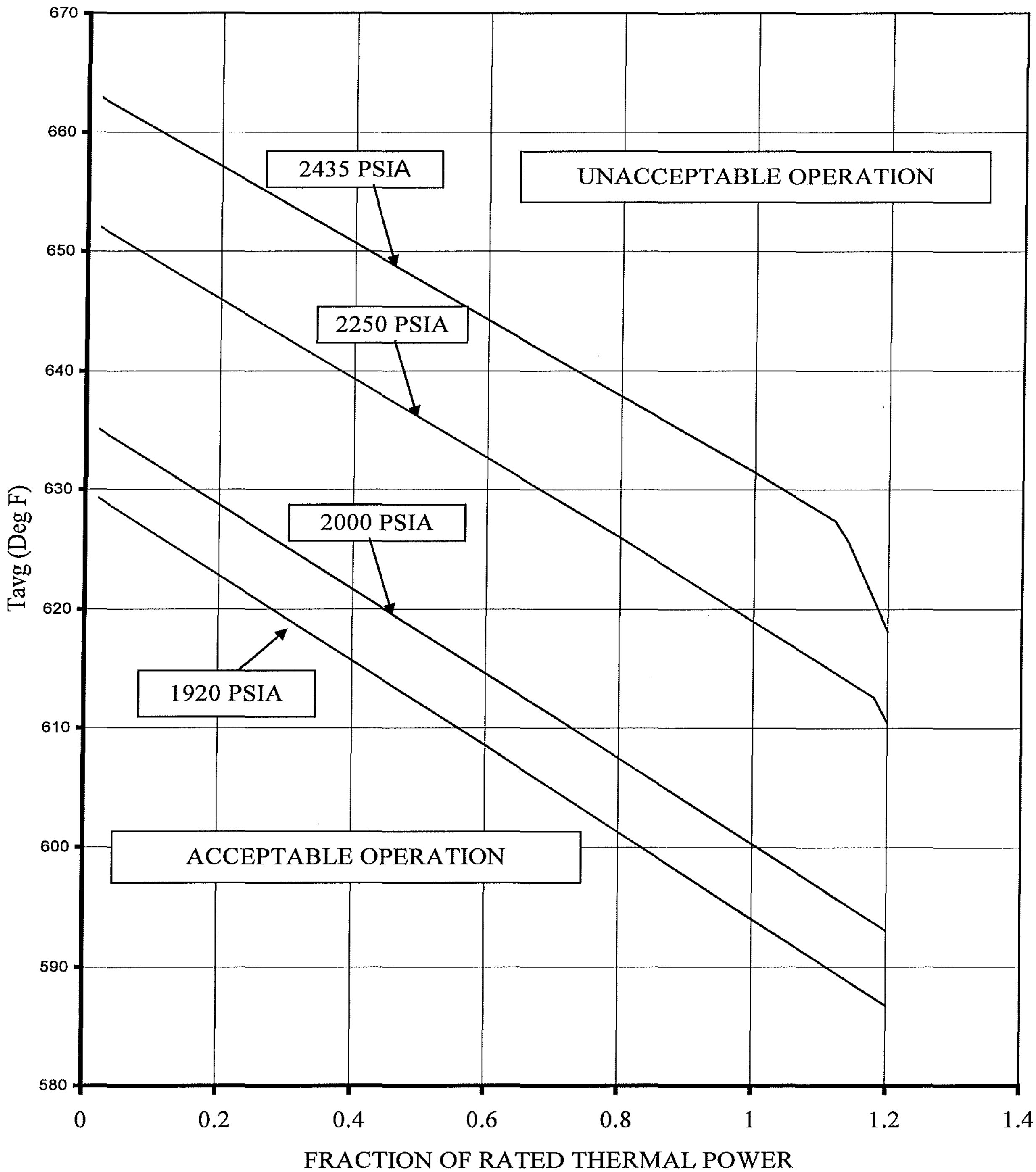

Figure 5.1-1 (Page 1 of 1)

REACTOR CORE SAFETY LIMIT
THREE LOOP OPERATION
(Technical Specification Safety Limit 2.1.1)

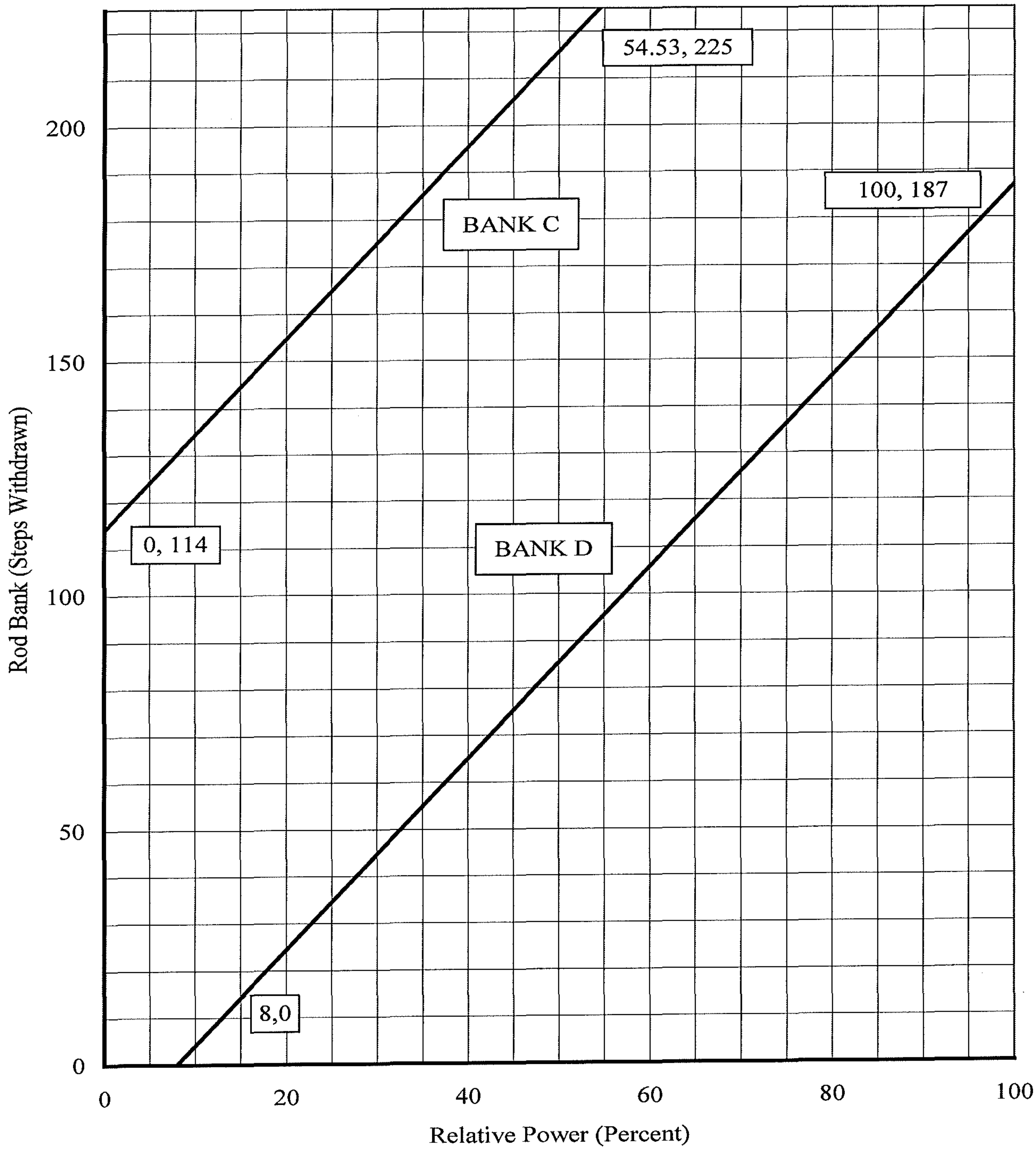

Figure 5.1-2 (Page 1 of 1)

CONTROL ROD INSERTION LIMITS

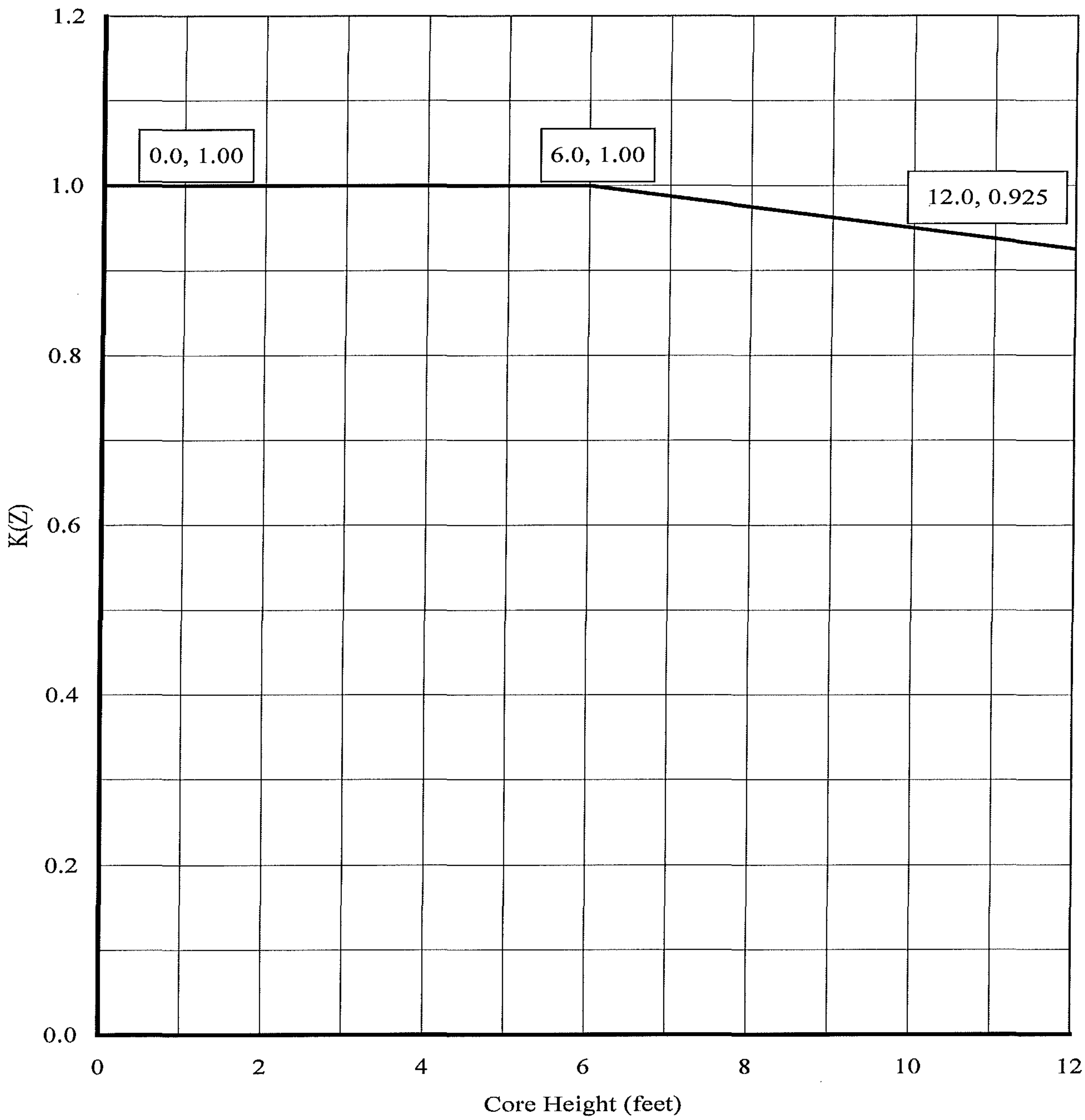

Figure 5.1-3 (Page 1 of 1)

F_QT NORMALIZED OPERATING ENVELOPE, K(Z)

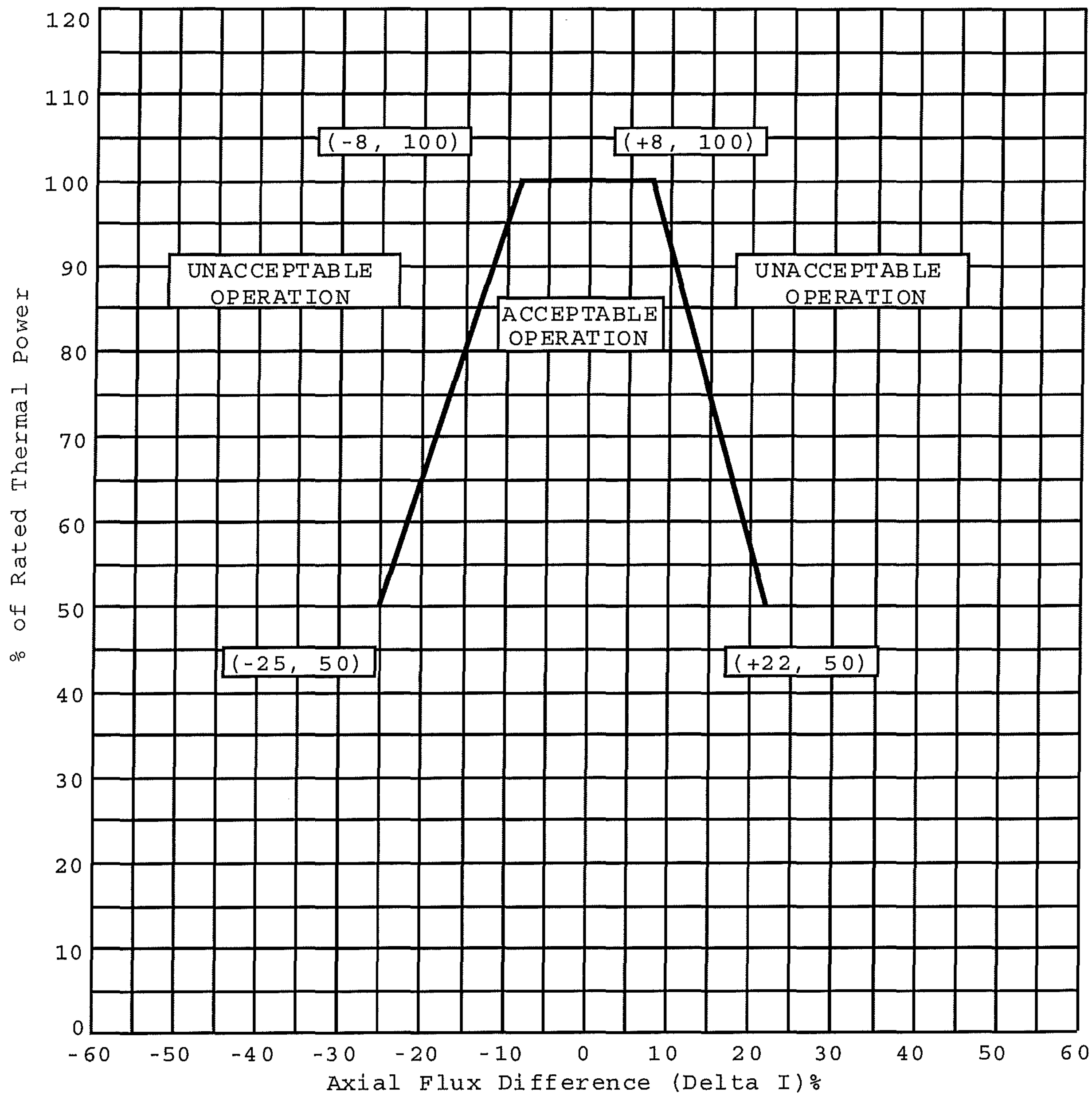

Figure 5.1-4 (Page 1 of 1)

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF

PERCENT OF RATED THERMAL POWER FOR RAOC

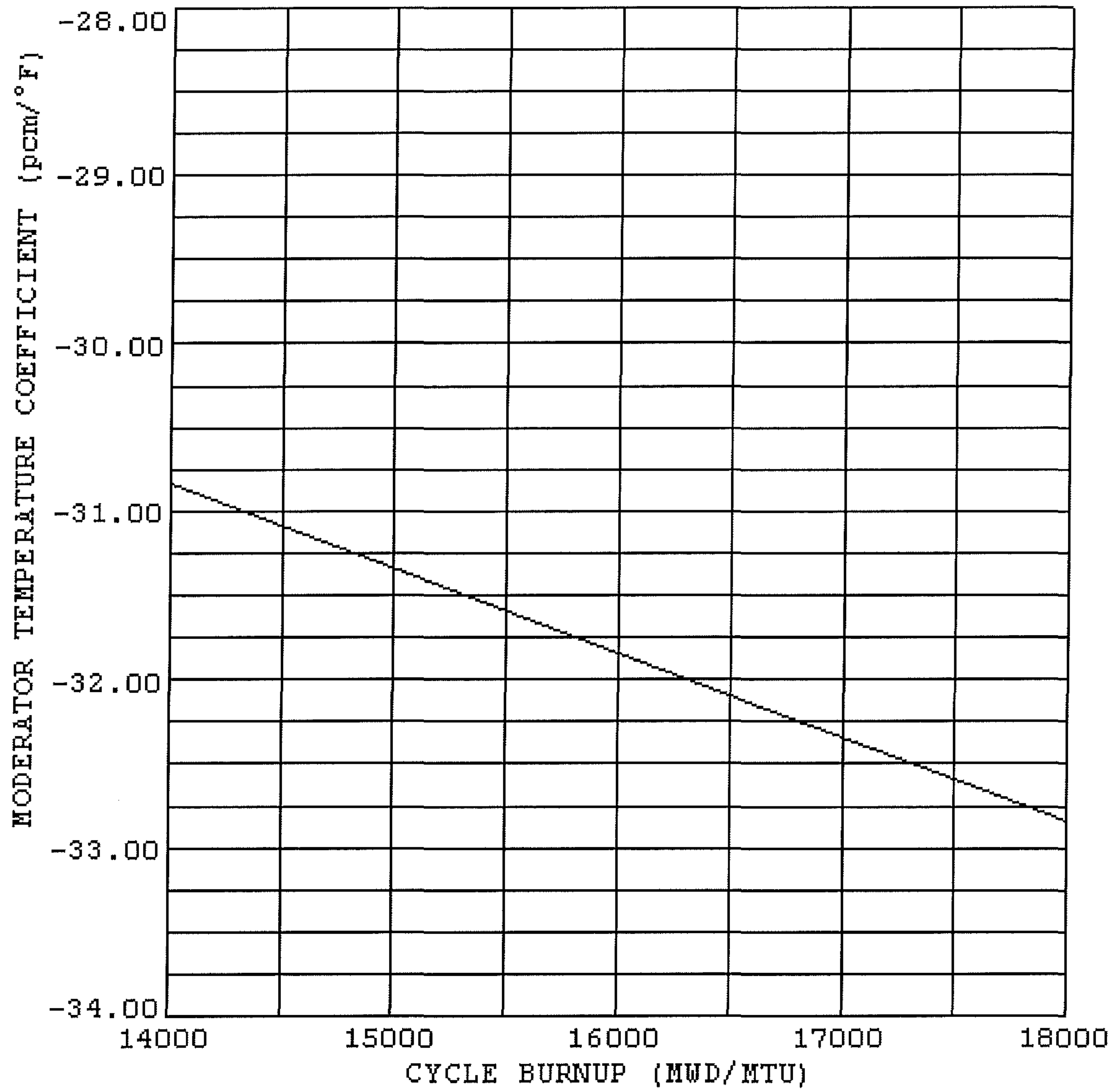

Figure 5.1-5 (Page 1 of 1)

HOT FULL POWER PREDICTED

MODERATOR TEMPERATURE COEFFICIENT

AS A FUNCTION OF CYCLE BURNUP

WHEN 300 PPM IS ACHIEVED

Table 5.1-1 (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	18000 MWD/MTU
*	1	12.08	1.0000	1.0000	1.0000	1.0000
*	2	11.88	1.0000	1.0000	1.0000	1.0000
*	3	11.68	1.0000	1.0000	1.0000	1.0000
*	4	11.47	1.0000	1.0000	1.0000	1.0000
*	5	11.27	1.0000	1.0000	1.0000	1.0000
*	6	11.07	1.0000	1.0000	1.0000	1.0000
*	7	10.87	1.0000	1.0000	1.0000	1.0000
	8	10.67	1.1709	1.1930	1.2357	1.2060
	9	10.47	1.1645	1.1882	1.2302	1.2013
	10	10.27	1.1572	1.1825	1.2248	1.1960
	11	10.06	1.1490	1.1756	1.2179	1.1903
	12	9.86	1.1428	1.1687	1.2096	1.1841
	13	9.66	1.1388	1.1670	1.2005	1.1768
	14	9.46	1.1353	1.1675	1.1903	1.1708
	15	9.26	1.1304	1.1633	1.1797	1.1696
	16	9.06	1.1234	1.1614	1.1771	1.1743
	17	8.86	1.1240	1.1660	1.1816	1.1772
	18	8.66	1.1298	1.1763	1.1919	1.1822
	19	8.45	1.1348	1.1828	1.1986	1.1942
	20	8.25	1.1420	1.1875	1.2035	1.2038
	21	8.05	1.1476	1.1901	1.2063	1.2109
	22	7.85	1.1511	1.1906	1.2069	1.2158
	23	7.65	1.1531	1.1890	1.2053	1.2182
	24	7.45	1.1534	1.1855	1.2018	1.2182
	25	7.25	1.1525	1.1803	1.1964	1.2162
	26	7.05	1.1512	1.1737	1.1902	1.2122
	27	6.84	1.1492	1.1658	1.1833	1.2072
	28	6.64	1.1460	1.1568	1.1754	1.2016
	29	6.44	1.1417	1.1467	1.1662	1.1946
	30	6.24	1.1364	1.1356	1.1557	1.1859
	31	6.04	1.1303	1.1232	1.1443	1.1758
	32	5.84	1.1229	1.1110	1.1315	1.1640

Note: Top and Bottom 10% Excluded

Table 5.1-1 (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	18000 MWD/MTU
	33	5.64	1.1153	1.1026	1.1190	1.1515
	34	5.44	1.1107	1.1012	1.1106	1.1418
	35	5.23	1.1085	1.1008	1.1027	1.1367
	36	5.03	1.1095	1.1006	1.0980	1.1330
	37	4.83	1.1122	1.1007	1.0961	1.1283
	38	4.63	1.1145	1.1012	1.0935	1.1227
	39	4.43	1.1187	1.1024	1.0906	1.1165
	40	4.23	1.1229	1.1034	1.0873	1.1094
	41	4.03	1.1265	1.1039	1.0839	1.1022
	42	3.83	1.1298	1.1047	1.0819	1.0956
	43	3.62	1.1327	1.1066	1.0816	1.0901
	44	3.42	1.1354	1.1091	1.0813	1.0853
	45	3.22	1.1372	1.1127	1.0812	1.0799
	46	3.02	1.1410	1.1210	1.0826	1.0812
	47	2.82	1.1529	1.1354	1.0906	1.0920
	48	2.62	1.1753	1.1527	1.1050	1.1045
	49	2.42	1.1985	1.1747	1.1200	1.1191
	50	2.21	1.2213	1.1982	1.1350	1.1344
	51	2.01	1.2441	1.2211	1.1500	1.1491
	52	1.81	1.2662	1.2436	1.1646	1.1636
	53	1.61	1.2872	1.2652	1.1788	1.1776
	54	1.41	1.3065	1.2850	1.1918	1.1909
*	55	1.21	1.0000	1.0000	1.0000	1.0000
*	56	1.01	1.0000	1.0000	1.0000	1.0000
*	57	0.81	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 10% Excluded

Table 5.1-2 (Page 1 of 1)
$F_Q(Z)$ Penalty Factor versus Burnup

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
0 to 1600	1.0425
> 1600	1.0200

Note: The Penalty Factor, to be applied to $F_Q(Z)$ in accordance with Technical Specification Surveillance Requirement (SR) 3.2.1.2, 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 SR 3.0.2) starting from the burnup at which the $F_Q(Z)$ was determined.

Enclosure B
L-14-389

Beaver Valley Power Station, Unit No. 2
Core Operating Limits Report, Cycle 18
(14 Pages Follow)

5.0 ADMINISTRATIVE CONTROLS

5.1 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 5.6.3.

5.1.1 SL 2.1.1 Reactor Core Safety Limits

See Figure 5.1-1.

5.1.2 SHUTDOWN MARGIN (SDM)

a. In MODES 1, 2, 3, and 4, SHUTDOWN MARGIN shall be ≥ 1.77% Δk/k.[(1)]

b. Prior to manually blocking the Low Pressurizer Pressure Safety Injection Signal, the Reactor Coolant System shall be borated to ≥ the MODE 5 boron concentration and shall remain ≥ this boron concentration at all times when this signal is blocked.

c. In MODE 5, SHUTDOWN MARGIN shall be ≥ 1.0% Δk/k.

5.1.3 LCO 3.1.3 Moderator Temperature Coefficient (MTC)

a. Upper Limit - MTC shall be maintained within the acceptable operation limit specified in Technical Specification Figure 3.1.3-1.

b. Lower Limit - MTC shall be maintained less negative than -4.29×10^{-4} Δk/k/°F at RATED THERMAL POWER.

c. 300 ppm Surveillance Limit: (- 35 pcm/°F)

d. The revised predicted near-EOL 300 ppm MTC shall be calculated using Figure 5.1-5 and the following algorithm from Reference 10 :

Revised Predicted MTC = Predicted MTC* + AFD Correction** + Predictive Correction***

where,

* Predicted MTC is calculated from Figure 5.1-5 at the burnup corresponding to the measurement of 300 ppm at RTP conditions,

** AFD Correction is the more negative value of :

{0 pcm/°F or (ΔAFD * AFD Sensitivity)}

where: ΔAFD is the measured AFD minus the predicted AFD from an incore flux map taken at or near the burnup corresponding to 300 ppm.

and

AFD Sensitivity = 0.05 pcm/°F / ΔAFD

***Predictive Correction is -3 pcm/°F.

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(1) The MODE 1 and MODE 2 with $k_{eff} \geq 1.0$ SDM requirements are included to address SDM requirements (e.g., MODE 1 Required Actions to verify SDM) that are not within the applicability of LCO 3.1.1, SHUTDOWN MARGIN (SDM).

5.1 Core Operating Limits Report

If the revised predicted MTC is less negative than the SR 3.1.3.2 limit (COLR 5.1.3.c) and all of the benchmark data contained in the surveillance procedure are met, then an MTC measurement in accordance with SR 3.1.3.2 is not required.

e. 60 ppm Surveillance Limit: (- 41 pcm/°F)

5.1.4 LCO 3.1.5 Shutdown Bank Insertion Limits

The Shutdown Banks shall be withdrawn to at least 225 steps.(2)

5.1.5 LCO 3.1.6 Control Bank Insertion Limits

a. Control Banks A and B shall be withdrawn to at least 225 steps.(2)

b. Control Banks C and D shall be limited in physical insertion as shown in Figure 5.1-2.(2)

c. Sequence Limits - The sequence of withdrawal shall be A, B, C and D bank, in that order.

d. Overlap Limits(2) - Overlap shall be such that step 129 on banks A, B, and C corresponds to step 1 on the following bank. When C bank is fully withdrawn, these limits are verified by confirming D bank is withdrawn at least to a position equal to the all-rods-out position minus 128 steps.

5.1.6 LCO 3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)

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

K(Z) = the function obtained from Figure 5.1-3.

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

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

(2) As indicated by the group demand counter

5.1 Core Operating Limits Report

W(Z) values are provided in Table 5.1-1. The W(Z) values are generated assuming that they will be used for a full power surveillance. When a part power surveillance is performed, the W(Z) values should be multiplied by the factor 1/P, when P > 0.5. When P is ≤ 0.5, the W(Z) values should be multiplied by the factor 1/(0.5), or 2.0. This is consistent with the adjustment in the $F_Q(Z)$ limit at part power conditions.

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 5.1-2.

5.1.7 LCO 3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

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

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

$PF_{\Delta H} = 0.3$

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

5.1.8 LCO 3.2.3 Axial Flux Difference (AFD)

The AFD acceptable operation limits are provided in Figure 5.1-4.

5.1.9 LCO 3.3.1 Reactor Trip System Instrumentation - Overtemperature and Overpower ΔT Parameter Values from Table Notations 3 and 4

a. Overtemperature ΔT Setpoint Parameter Values:

Parameter	Value
Overtemperature ΔT reactor trip setpoint	K1 ≤ 1.239
Overtemperature ΔT reactor trip setpoint Tavg coefficient	K2 ≥ 0.0183/°F
Overtemperature ΔT reactor trip setpoint pressure coefficient	K3 ≥ 0.001/psia
Tavg at RATED THERMAL POWER	T' ≤ 574.2°F(1)
Nominal pressurizer pressure	P' ≥ 2250 psia
Measured reactor vessel ΔT lead/lag time constants (* The response time is toggled off to meet the analysis value of zero.)	τ_1 = 0 sec* τ_2 = 0 sec*
Measured reactor vessel ΔT lag time constant	τ_3 ≤ 6 secs

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

5.1 Core Operating Limits Report

Measured reactor vessel average temperature lead/lag time constants	$\tau_4 \geq 30$ secs $\tau_5 \leq 4$ secs
Measured reactor vessel average temperature lag time constant	$\tau_6 \leq 2$ 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% and +15%, $f_1(\Delta I)$ = 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.

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

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

b. Overpower ΔT Setpoint Parameter Values:

Parameter	Value
Overpower ΔT reactor trip setpoint	K4 $\leq$ 1.094
Overpower ΔT reactor trip setpoint Tavg rate/lag coefficient	K5 $\geq$ 0.02/°F for increasing average temperature K5 = 0/°F for decreasing average temperature
Overpower ΔT reactor trip setpoint Tavg heatup coefficient	K6 $\geq$ 0.0021/°F for T > T" K6 = 0/°F for T $\leq$ T"
Tavg at RATED THERMAL POWER	T" $\leq$ 574.2°F(1)
Measured reactor vessel ΔT lead/lag time constants	τ_1 = 0 sec* τ_2 = 0 sec*

(* The response time is toggled off to meet the analysis value of zero.)

Measured reactor vessel ΔT lag time constant	$\tau_3 \leq 6$ secs
Measured reactor vessel average temperature lag time constant	$\tau_6 \leq 2$ secs
Measured reactor vessel average temperature rate/lag time constant	$\tau_7 \geq 10$ secs

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

5.1 Core Operating Limits Report

5.1.10 LCO 3.4.1, RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits

Parameter	Indicated Value
Reactor Coolant System Tavg	Tavg ≤ 577.8°F[(1)]
Pressurizer Pressure	Pressure ≥ 2214 psia[(2)]
Reactor Coolant System Total Flow Rate	Flow ≥ 267,300 gpm[(3)]

5.1.11 LCO 3.9.1 Boron Concentration (MODE 6)

The boron concentration of the Reactor Coolant System, the refueling canal, and the refueling cavity shall be maintained ≥ 2400 ppm. This value includes a 50 ppm conservative allowance for uncertainties.

(1) The Reactor Coolant System (RCS) indicated Tavg value is determined by adding the appropriate allowances for rod control operation and verification via control board indication (3.6°F) to the cycle specific full power Tavg used in the core design.

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

(3) 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.

5.1 Core Operating Limits Report

5.1.12 <u>References</u>

1. WCAP-9272-P-A, "WESTINGHOUSE RELOAD SAFETY EVALUATION METHODOLOGY," July 1985 (Westinghouse Proprietary).

2. WCAP-8745-P-A, "Design Bases for the Thermal Overpower ΔT and Thermal Overtemperature ΔT Trip Functions," September 1986.

3. WCAP-12945-P-A, Volume 1 (Revision 2) and Volumes 2 through 5 (Revision 1), "Code Qualification Document for Best Estimate LOCA Analysis," March 1998 (Westinghouse Proprietary).

4. WCAP-10216-P-A, Revision 1A, "Relaxation of Constant Axial Offset Control-F_Q Surveillance Technical Specification," February 1994.

5. WCAP-14565-P-A, "VIPRE-01 Modeling and Qualification for Pressurized Water Reactor Non-LOCA Thermal-Hydraulic Safety Analysis," October 1999.

6. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995 (Westinghouse Proprietary).

7. WCAP-15025-P-A, "Modified WRB-2 Correlation, WRB-2M, for Predicting Critical Heat Flux in 17x17 Rod Bundles with Modified LPD Mixing Vane Grids," April 1999.

8. Caldon, Inc. Engineering Report-80P, "Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM√™ System," Revision 0, March 1997.

9. Caldon, Inc. Engineering Report-160P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate With the LEFM√™ System," Revision 0, May 2000.

10. WCAP-13749-P-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," March 1997 (Westinghouse Proprietary).

11. WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON," August 2004.

12. WCAP-16045-P-A, Addendum 1, "Qualification of the NEXUS Nuclear Data Methodology," November 2005.

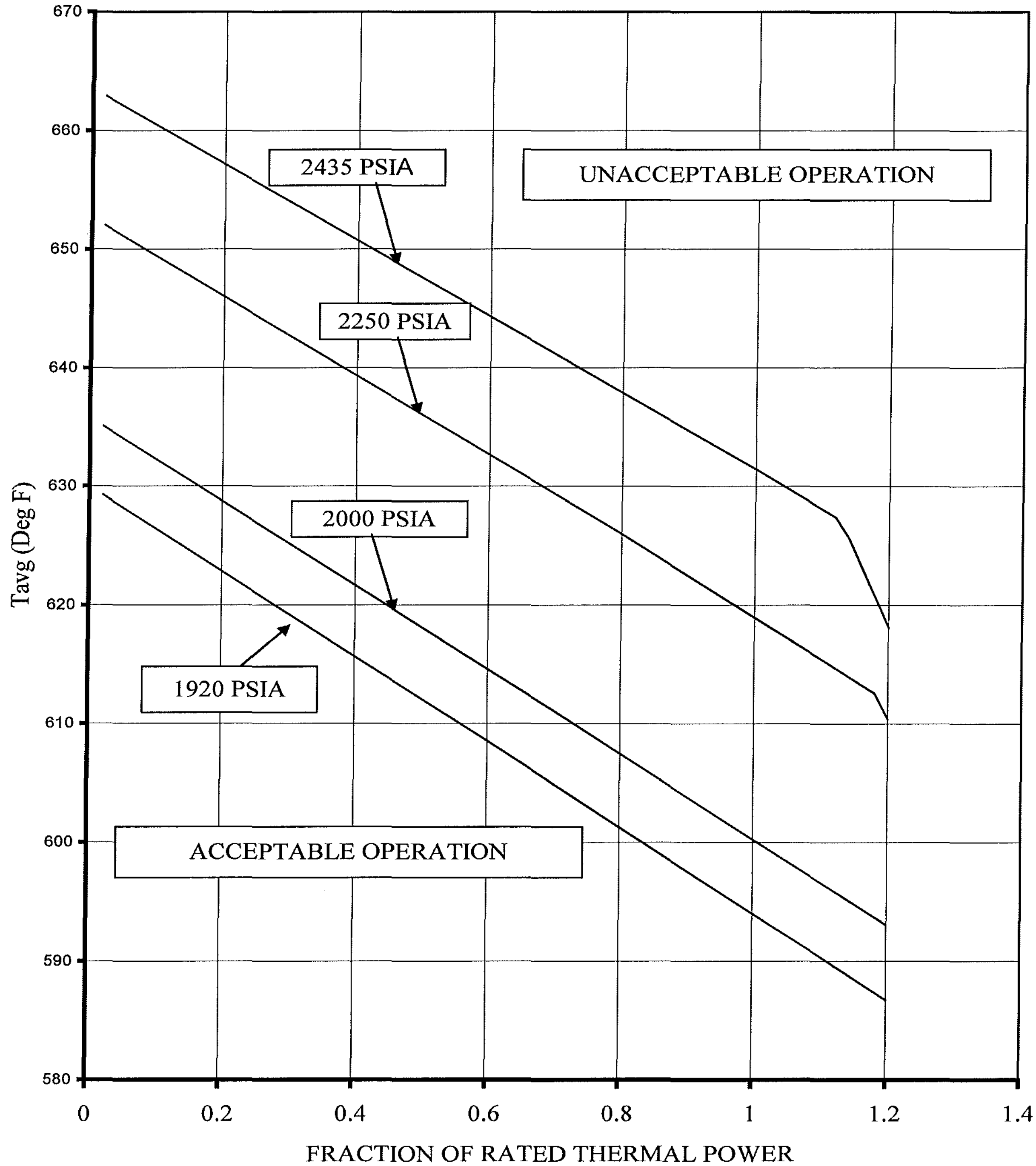

Figure 5.1-1 (Page 1 of 1)

REACTOR CORE SAFETY LIMIT
THREE LOOP OPERATION

(Technical Specification Safety Limit 2.1.1)

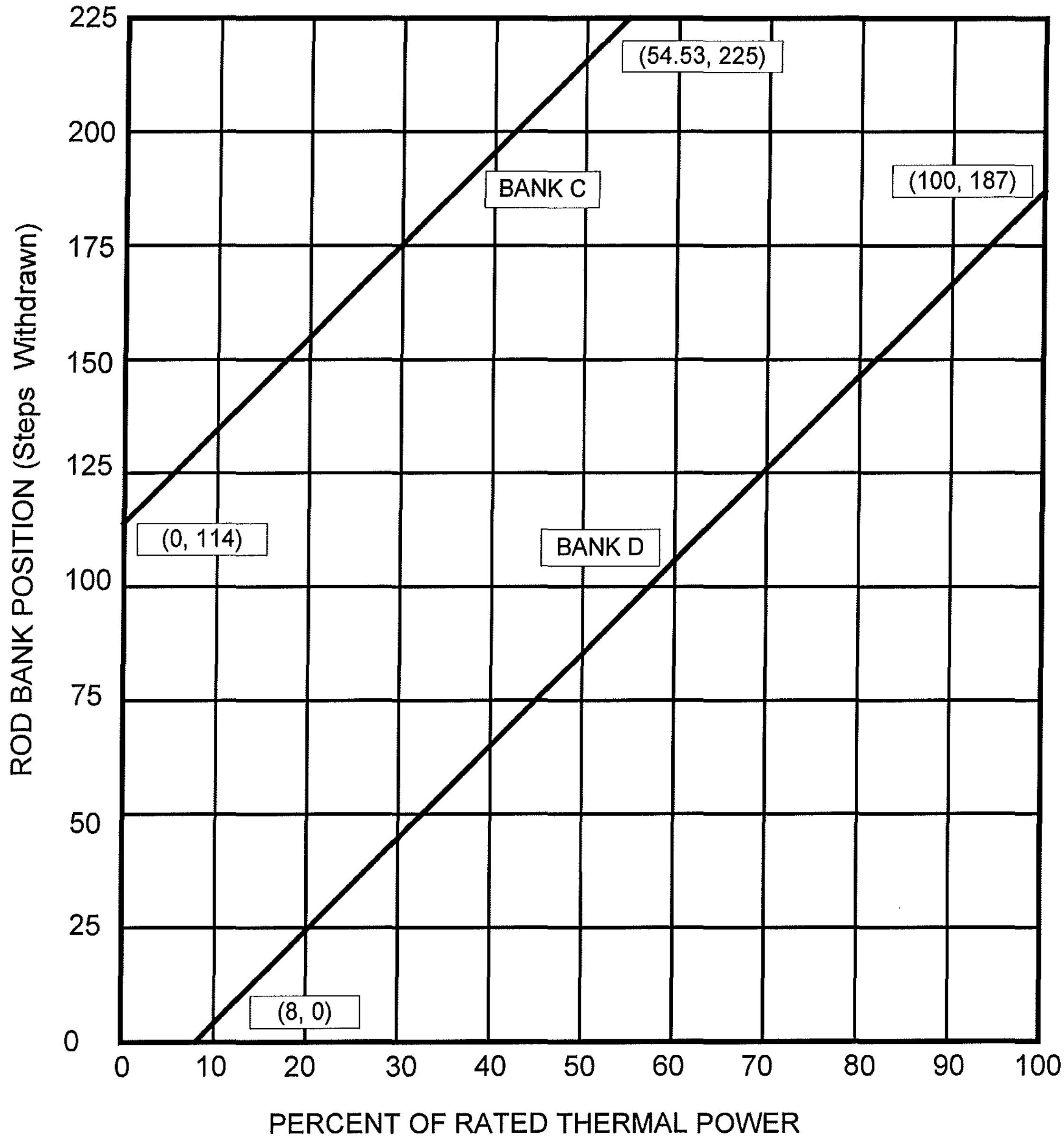

Figure 5.1-2 (Page 1 of 1)

CONTROL ROD INSERTION LIMITS AS A

FUNCTION OF RATED POWER LEVEL

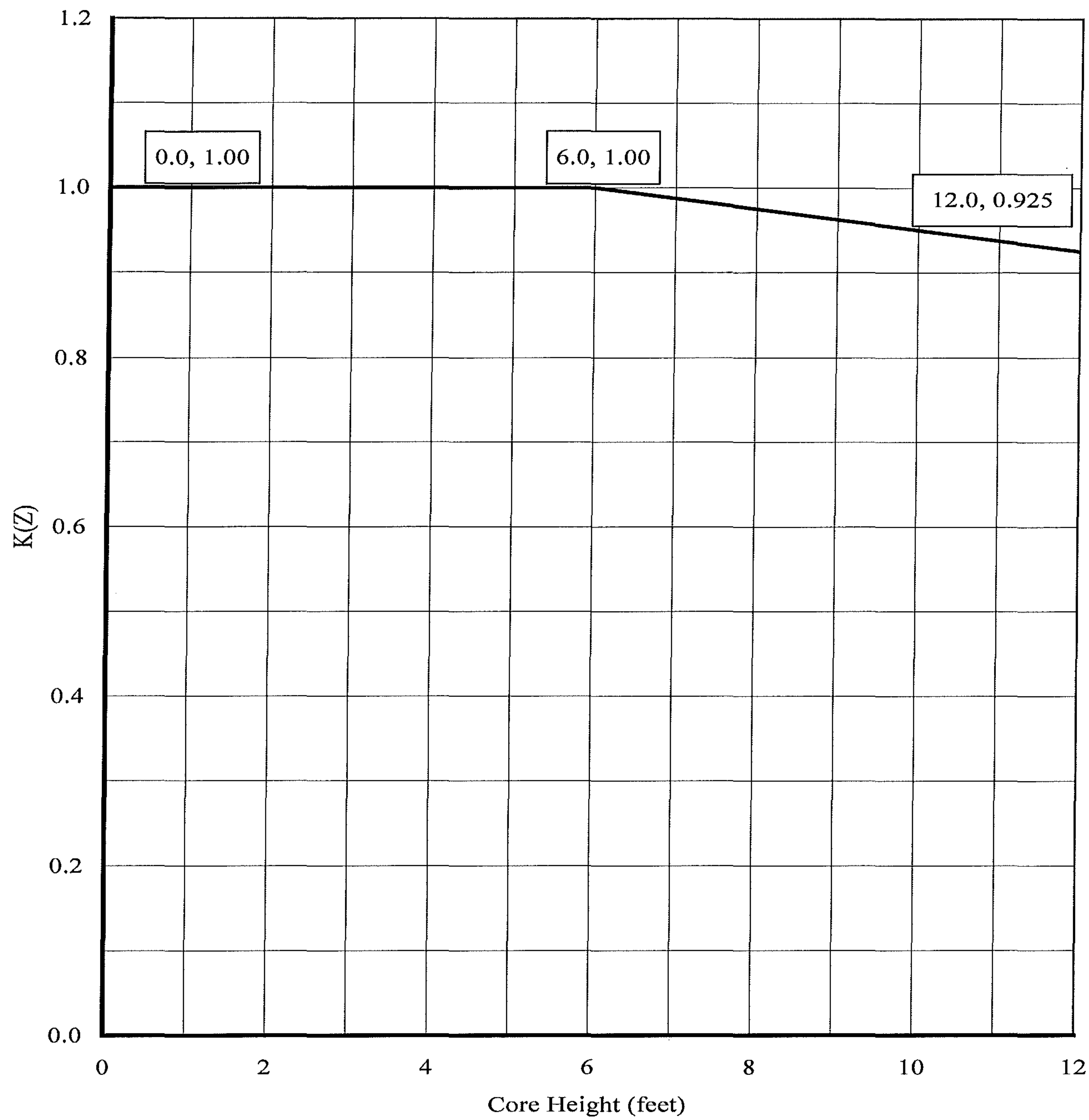

Figure 5.1-3 (Page 1 of 1)

F_QT NORMALIZED OPERATING ENVELOPE, K(Z)

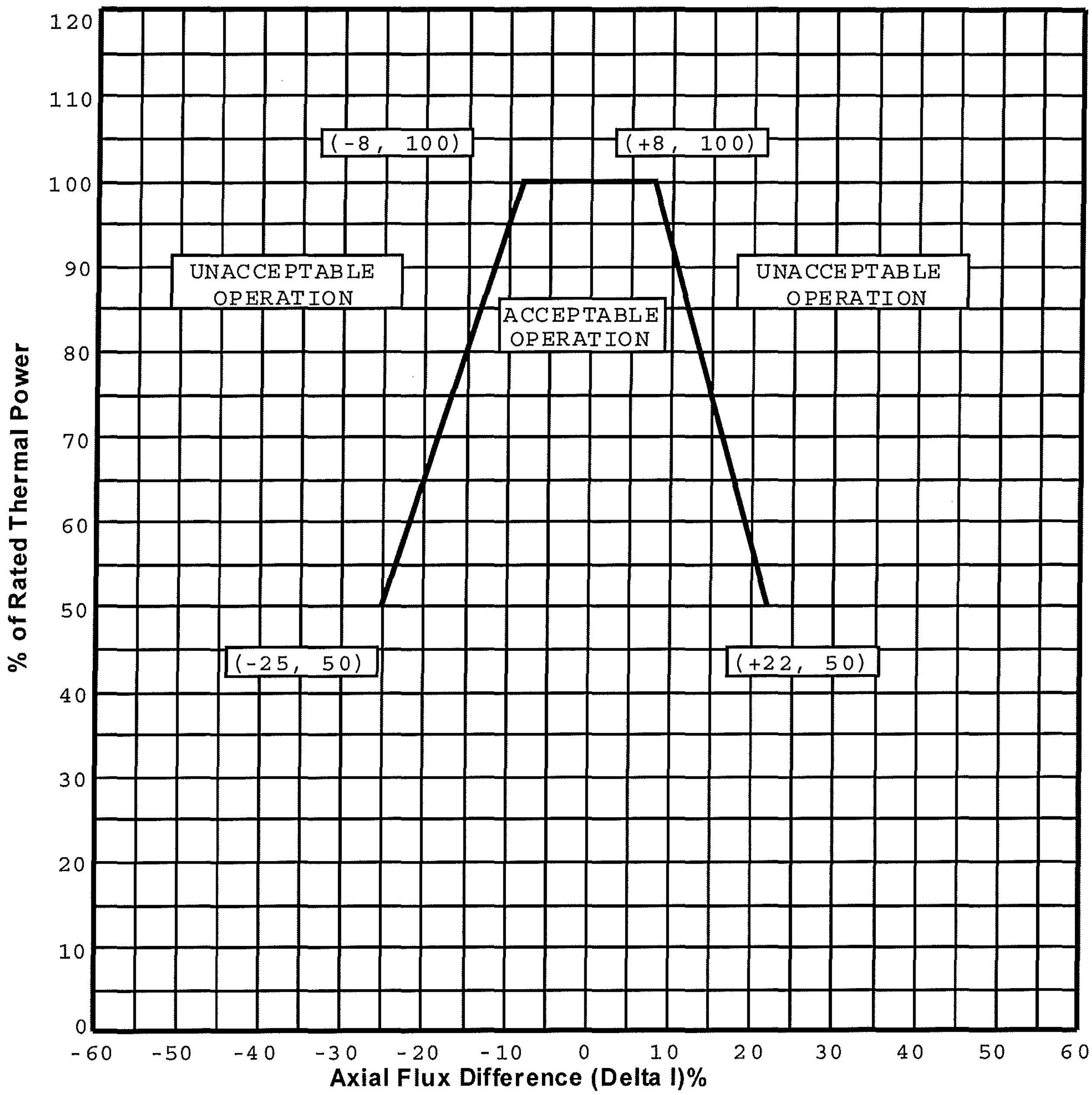

Figure 5.1-4 (Page 1 of 1)

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF

PERCENT OF RATED THERMAL POWER FOR RAOC

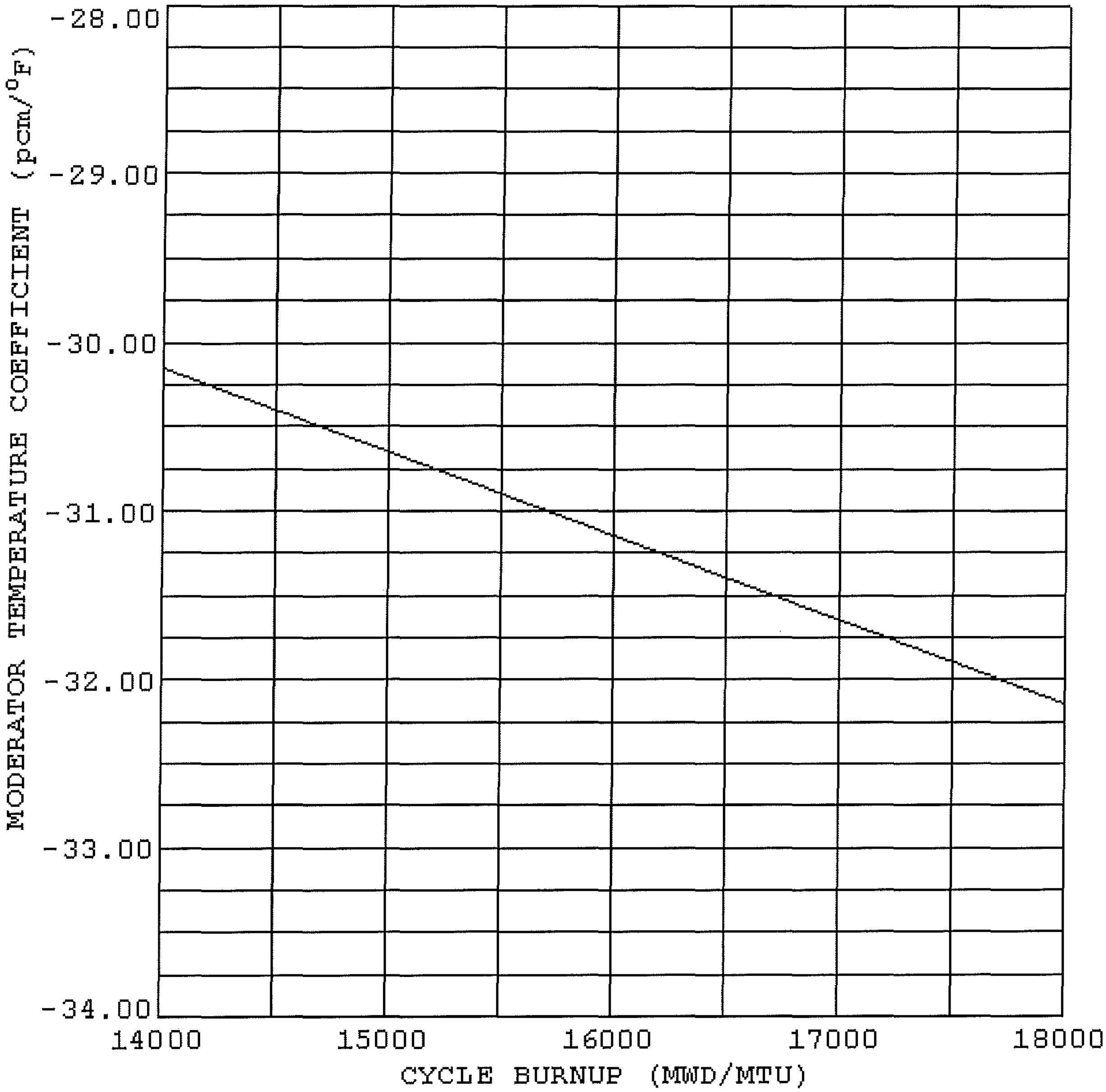

Figure 5.1-5 (Page 1 of 1)

HOT FULL POWER PREDICTED

MODERATOR TEMPERATURE COEFFICIENT

AS A FUNCTION OF CYCLE BURNUP

WHEN 300 PPM IS ACHIEVED

Table 5.1-1 (Page 1 of 2)
F_Q Surveillance W(Z) Function versus Burnup

Exclusion Zone	Axial Point	Elevation (feet)	150 (MWD/MTU)	3000 (MWD/MTU)	8000 (MWD/MTU)	12000 (MWD/MTU)	16000 (MWD/MTU)
*	1	12.1	1.0000	1.0000	1.0000	1.0000	1.0000
*	2	11.9	1.0000	1.0000	1.0000	1.0000	1.0000
*	3	11.7	1.0000	1.0000	1.0000	1.0000	1.0000
*	4	11.5	1.0000	1.0000	1.0000	1.0000	1.0000
*	5	11.3	1.0000	1.0000	1.0000	1.0000	1.0000
*	6	11.1	1.0000	1.0000	1.0000	1.0000	1.0000
*	7	10.9	1.0000	1.0000	1.0000	1.0000	1.0000
	8	10.7	1.1506	1.1928	1.2322	1.2296	1.2203
	9	10.5	1.1446	1.1860	1.2247	1.2235	1.2105
	10	10.3	1.1390	1.1783	1.2162	1.2162	1.2053
	11	10.1	1.1347	1.1700	1.2084	1.2084	1.1995
	12	9.9	1.1345	1.1618	1.2027	1.2000	1.1931
	13	9.7	1.1378	1.1570	1.1971	1.1909	1.1852
	14	9.5	1.1418	1.1561	1.1907	1.1815	1.1798
	15	9.3	1.1440	1.1542	1.1857	1.1719	1.1813
	16	9.1	1.1472	1.1518	1.1850	1.1607	1.1864
	17	8.9	1.1593	1.1556	1.1905	1.1597	1.1883
	18	8.7	1.1758	1.1664	1.2013	1.1647	1.1929
	19	8.5	1.1884	1.1745	1.2082	1.1750	1.2045
	20	8.3	1.1987	1.1807	1.2130	1.1825	1.2133
	21	8.1	1.2066	1.1849	1.2157	1.1880	1.2196
	22	7.9	1.2121	1.1872	1.2162	1.1917	1.2239
	23	7.6	1.2155	1.1878	1.2148	1.1936	1.2260
	24	7.4	1.2168	1.1868	1.2115	1.1937	1.2260
	25	7.2	1.2161	1.1843	1.2063	1.1922	1.2239
	26	7.0	1.2133	1.1813	1.2002	1.1889	1.2197
	27	6.8	1.2086	1.1771	1.1931	1.1849	1.2142
	28	6.6	1.2021	1.1712	1.1845	1.1803	1.2080
	29	6.4	1.1940	1.1639	1.1745	1.1740	1.2000
	30	6.2	1.1842	1.1553	1.1630	1.1662	1.1901
	31	6.0	1.1732	1.1456	1.1504	1.1571	1.1790
	32	5.8	1.1605	1.1345	1.1365	1.1468	1.1657

Note: Top and Bottom 10% Excluded

TABLE 5.1-1 (Page 2 of 2)
F_Q Surveillance W(Z) Function versus Burnup

Exclusion Zone	Axial Point	Elevation (feet)	150 (MWD/MTU)	3000 (MWD/MTU)	8000 (MWD/MTU)	12000 (MWD/MTU)	16000 (MWD/MTU)
	33	5.6	1.1477	1.1229	1.1233	1.1354	1.1523
	34	5.4	1.1386	1.1141	1.1138	1.1243	1.1447
	35	5.2	1.1308	1.1104	1.1036	1.1163	1.1414
	36	5.0	1.1258	1.1092	1.0963	1.1112	1.1382
	37	4.8	1.1233	1.1089	1.0924	1.1078	1.1336
	38	4.6	1.1206	1.1098	1.0885	1.1047	1.1283
	39	4.4	1.1172	1.1106	1.0849	1.1011	1.1222
	40	4.2	1.1167	1.1112	1.0810	1.0970	1.1155
	41	4.0	1.1194	1.1114	1.0773	1.0927	1.1084
	42	3.8	1.1234	1.1119	1.0749	1.0881	1.1009
	43	3.6	1.1266	1.1141	1.0746	1.0834	1.0933
	44	3.4	1.1294	1.1168	1.0743	1.0799	1.0860
	45	3.2	1.1329	1.1196	1.0747	1.0775	1.0773
	46	3.0	1.1377	1.1266	1.0776	1.0790	1.0747
	47	2.8	1.1466	1.1426	1.0893	1.0912	1.0839
	48	2.6	1.1642	1.1673	1.1068	1.1050	1.0990
	49	2.4	1.1855	1.1927	1.1251	1.1192	1.1143
	50	2.2	1.2075	1.2180	1.1434	1.1337	1.1296
	51	2.0	1.2290	1.2433	1.1619	1.1481	1.1447
	52	1.8	1.2500	1.2680	1.1800	1.1622	1.1595
	53	1.6	1.2701	1.2917	1.1976	1.1760	1.1739
	54	1.4	1.2887	1.3135	1.2139	1.1888	1.1876
*	55	1.2	1.0000	1.0000	1.0000	1.0000	1.0000
*	56	1.0	1.0000	1.0000	1.0000	1.0000	1.0000
*	57	0.8	1.0000	1.0000	1.0000	1.0000	1.0000
*	58	0.6	1.0000	1.0000	1.0000	1.0000	1.0000
*	59	0.4	1.0000	1.0000	1.0000	1.0000	1.0000
*	60	0.2	1.0000	1.0000	1.0000	1.0000	1.0000
*	61	0.0	1.0000	1.0000	1.0000	1.0000	1.0000

Note: Top and Bottom 10% Excluded

Table 5.1-2 (Page 1 of 1)
$F_Q(Z)$ Penalty Factor versus Burnup

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
> 0	1.0200

Note: The Penalty Factor, to be applied to $F_Q(Z)$ in accordance with Technical Specification Surveillance Requirement (SR) 3.2.1.2, 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 SR 3.0.2) starting from the burnup at which the $F_Q(Z)$ was determined.