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DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
CORE OPERATING LIMITS REPORT CYCLE 30 REVISION 2

Pursuant to Kewaunee Power Station (KPS) Technical Specification (TS) 6.9.a.4.D, enclosed is a copy of the KPS Technical Requirements Manual Section 2.1, Kewaunee Power Station Core Operating Limits Report Cycle 30, Revision 2.

If you have questions or require additional information, please feel free to contact Mr. Jack Gadzala at 920-388-8604.

Very truly yours,

Michael J. Wilson
Director Safety and Licensing
Kewaunee Power Station

Commitments made by this letter: NONE

Enclosure
1. KPS Technical Requirements Manual Section 2.1, Kewaunee Power Station Core Operating Limits Report Cycle 30, Revision 2.

A001
NRR

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TRM 2.1

Kewaunee Power Station

CORE OPERATING LIMITS REPORT
(COLR)

CYCLE 30

REVISION 2

Approved ________ *FSRC Chairman* 1/5/10 *Date* 10-001 *Mtg.#*

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1.0 INTRODUCTION

This Core Operating Limits Report (COLR) for Kewaunee Unit 1 Cycle 30 has been prepared in accordance with the requirements of Kewaunee Technical Specification 6.9.a.4.

A cross reference between the COLR section and the KPS Technical Specifications affected by this report is given below:

COLR Section	KPS Technical Specification	Description
2.1	2.1	Reactor Core Safety Limit
2.2	3.10.a	Shutdown Margin
2.3	3.1.f.3	Moderator Temperature Coefficient (MTC)
2.4	3.10.d.1	Shutdown Bank Insertion Limits
2.5	3.10.d.2	Control Bank Insertion Limits
2.6	3.10.b.1.A 3.10.b.5 3.10.b.6.C.i	Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$)
2.7	3.10.b.1.B	Nuclear Enthalpy Rise Hot Channel Factor Limits ($F_{\Delta H}^N$)
2.8	3.10.b.8	Axial Flux Difference (AFD) Target Band
2.9	2.3.a.3.A	Overtemperature ΔT Setpoint
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Figure 1	2.1	Reactor Core Safety Limits (1772 MWt)
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Figure 7	3.10.b.8.A	Axial Flux Difference Envelope

CORE OPERATING LIMITS REPORT CYCLE 30

2.0 OPERATING LIMITS

The cycle-specific parameter limits for the specifications listed in Section 1.0 are presented in the following subsections. These limits have been developed using the NRC-approved methodologies specified in Technical Specification 6.9.a.4.

2.1 Reactor Core Safety Limits (TS 2.1.a)

The combination of rated power level, coolant pressure, and coolant temperature shall not exceed the limits shown in COLR Figure 1 (1772 MWt). The safety limit is exceeded if the point defined by the combination of Reactor Coolant System average temperature and power level is at any time above the appropriate pressure line.

2.2 Shutdown Margin (TS 3.10.a)

When the reactor is subcritical prior to reactor startup, the SHUTDOWN margin shall be at least that shown in COLR Figure 2.

2.3 Moderator Temperature Coefficient (TS 3.1.f.3)

2.3.1 When the reactor is critical and ≤60% of RATED POWER, the moderator temperature coefficient shall be ≤5.0 pcm/°F, except during LOW POWER PHYSICS TESTING. When the reactor is > 60% RATED POWER, the moderator temperature coefficient shall be zero or negative.

2.3.2 The reactor will have a moderator temperature coefficient no less negative than -8 pcm/°F for 95% of the cycle time at full power.

2.4 Shutdown Bank Insertion Limits (TS 3.10.d.1)

The shutdown banks shall be fully withdrawn (229 steps) when the reactor is critical or approaching criticality.

2.5 Control Bank Insertion Limits (TS 3.10.d.2)

The control banks shall be limited in physical insertion as shown in COLR Figure 4.

2.6 <u>Nuclear Heat Flux Hot Channel Factor ($F_Q^N(Z)$)</u> (TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i)

2.6.1 $F_Q^N(Z)$ Limits for Fuel

$$F_Q^N(Z)*1.03*1.05 \le \frac{CFQ}{P}*K(Z)\ for\ P > 0.5$$ [422 V+]

$$F_Q^N(Z)*1.03*1.05 \le \frac{CFQ}{0.5}*K(Z)\ for\ P \le 0.5$$ [422 V+]

Where:

P	is the fraction of full power at which the core is OPERATING
K(Z)	is the function given in Figure 3
Z	is the core height location for the FQ of interest
CFQ	= 2.50

2.6.2 The measured $F_Q^N(Z)$ hot channel factors under equilibrium conditions shall satisfy the following relationship for the central axial 80% of the core for fuel:

$$F_Q^N(Z)*1.03*1.05*N(Z)*F_p \le \frac{CFQ}{P}*K(Z)$$ [422 V+]

Where:

P	is the fraction of full power at which the core is OPERATING
K(Z)	is the function given in Figure 3
Z	is the core height location for the FQ of interest
CFQ	equals 2.50
Fp	is the penalty factor described in 2.6.3
N(Z)	is a cycle-specific non-equilibrium multiplier on $F_Q^N(Z)$ to account for power distribution transients during normal operation, provided in Figure 5.
$F_Q^N(Z)$	is a measured FQ distribution obtained during the target flux determination

The N(z) decks are generated for normal operation flux maps that are typically taken at full power, ARO. Additional N(z) decks may be generated, if necessary, consistent with the methodology described in Reference 1.

2.6.3 The penalty factor of 1.0 shall be used for TS 3.10.b.6.A and TS 3.10.b.6.B. The penalty factor provided in COLR Figure 6 shall be used for TS 3.10.b.6.C.i. The penalty factor for all burnups outside the range of Figure 6 shall be 1.02.

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2.7 Nuclear Enthalpy Rise Hot Channel Factor Limits ($F_{\Delta H}^{N}$) (TS 3.10.b.1.B)

$$F_{\Delta H}^{N} * 1.04 \leq CFDH * [1 + PFDH(1-P)]$$ [422 V+]

Where:

P is the fraction of full power at which the core is OPERATING
CFDH = 1.70
PFDH = 0.3

2.8 Axial Flux Difference (AFD) Target Band (TS 3.10.b.8)

The Axial Flux Difference (AFD) acceptable operation limits are provided in COLR Figure 7.

2.9 Overtemperature ΔT Setpoint (TS 2.3.a.3.A)

$$\Delta T \leq \Delta T_0 * \left[K_1 - K_2 * (T - T') * \frac{1 + \tau_1 s}{1 + \tau_2 s} + K_3 * (P - P') - f_1(\Delta I) \right]$$

ΔT_0	=	Indicated ΔT at RATED POWER, %
T	=	Average temperature, °F
T'	≤	573.0 °F
P	=	Pressurizer Pressure, psig
P'	=	2235 psig
K_1	≤	1.195
K_2	=	0.015/°F
K_3	=	0.00072/psig
τ_1	≥	30 seconds
τ_2	≤	4 seconds
$f_1(\Delta I)$	=	An even function of the indicated difference between top and bottom detectors of the power range nuclear ion chambers. Selected gains are based on measured instrument response during plant startup tests, where qt and qb are the percent power in the top and bottom halves of the core respectively and qt + qb is total core power in percent RATED POWER, such that

(a) For qt - qb within -15, +6 %, $f_1(\Delta I) = 0$

(b) For each percent that the magnitude of qt - qb exceeds +6%, the ΔT trip setpoint shall be automatically reduced by an equivalent of 1.51% of RATED POWER.

(c) For each percent that the magnitude of qt - qb exceeds -15%, the ΔT trip setpoint shall be automatically reduced by an equivalent of 3.78% of RATED POWER.

2.10 Overpower ΔT Setpoint (TS 2.3.a.3.B)

$$\Delta T \leq \Delta T_0 * \left[K_4 - K_5 * \frac{\tau_3 s}{\tau_3 s + 1} * T - K_6 * (T - T') - f_2(\Delta I) \right]$$

ΔT_0	=	Indicated ΔT at RATED POWER, %
T	=	Average temperature, °F
T'	≤	573.0 °F
K_4	≤	1.095
K_5	≥	0.0275/°F for increasing T
	≥	0 for decreasing T
K_6	≥	0.00103/°F for T > T'
	≥	0 for T < T'
τ_3	≥	10 seconds
$f_2(\Delta I)$	=	0 for all ΔI

2.11 RCS Pressure, Temperature and Flow Departure from Nucleate Boiling (DNB) Limits (TS 3.10.k, 3.10.l, and 3.10.m.1)

2.11.1 During steady state power operation, Tavg shall be < 576.7 °F for control board indication or < 576.5 °F for computer indication.

2.11.2 During steady state power operation, pressurizer pressure shall be > 2217 psig for control board indication or > 2219 psig for computer indication.

2.11.3 During steady state power operation, reactor coolant total flow rate shall be ≥ 186,000 gpm.

2.12 Refueling Boron Concentration (TS 3.8.a.5)

When there is fuel in the reactor, a minimum boron concentration of 2500 ppm and a shutdown margin of ≥ 5% Δk/k shall be maintained in the Reactor Coolant System during reactor vessel head removal or while loading and unloading fuel from the reactor.

3.0 References

1. Topical Report DOM-NAF-5-A, "Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS)," dated July, 2006.

   Methodology for:
   TS 2.1 – Reactor Core Safety Limits;
   TS 3.10.a – Shutdown Margin;
   TS 3.1.f.3 – Moderator Temperature Coefficient;
   TS 3.10.d.1 – Shutdown Bank Insertion Limits;
   TS 3.10.d.2 – Control Bank Insertion Limits;
   TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i – Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$);
   TS 3.10.b.1.B Nuclear Enthalpy Rise Hot Channel Factor Limits ($F_{\Delta H}^N$);
   TS 3.10.b.8 – Axial Flux Difference (AFD) Target Band;
   TS 3.10.k, 3.10.1 and 3.10.m.1 – RCS Pressure, Temperature and Flow Departure from Nucleate Boiling (DNB) Limits;
   TS 3.8.a.5 – Refueling Boron Concentration

2. Kewaunee Nuclear Power Plant – Review for Kewaunee Reload Safety Evaluation Methods Topical Report WPSRSEM-NP-A, Revision 3 (TAC No. MB0306) dated September 10, 2001.

   Methodology for:
   TS 3.10.a – Shutdown Margin

3. S.M. Bajorek, et al., WCAP-12945-P-A (Proprietary), Westinghouse Code Qualification Document for Best-Estimate Loss-of-Coolant Accident Analysis, Volume 1, Rev. 2, and Volume II-V, Rev. 1 March 1998.

   Methodology for:
   TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i – Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$)
   TS 3.10.b.1.B Nuclear Enthalpy Rise Hot Channel Factor Limits ($F_{\Delta H}^N$);

4. N. Lee, et al., "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," WCAP-10054-P-A, dated August 1985.

   Methodology for:
   TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i – Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$)

5. C. M. Thompson, et al., "Addendum to the Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code: Safety Injection into the Broken Loop and the COSI Condensation Model," WCAP-10054-P-A, Addendum 2, Revision 1, dated July 1997.

   Methodology for:
   TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i – Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$)

6. WCAP-9272-P-A, "Westinghouse Reload Safety Evaluation Methodology," July 1985. (Westinghouse Proprietary)

   Methodology for:
   TS 2.1 – Reactor Core Safety Limits;
   TS 3.1.f.3 – Moderator Temperature Coefficient;

7. WCAP-8745-P-A, Design Bases for the Thermal Overtemperature ΔT and Thermal Overpower ΔT trip functions, September 1986.

   Methodology for:
   TS 2.3.a.3.A – Overtemperature ΔT Setpoint;
   TS 2.3.a.3.B – Overpower ΔT Setpoint

8. S. I. Dederer, et al., WCAP-14449-P-A, Application of Best Estimate Large-Break LOCA Methodology to Westinghouse POWs with Upper Plenum Injection, Rev. 1, October 1999.

   Methodology for:
   TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i – Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$)
   TS 3.10.b.1.B Nuclear Enthalpy Rise Hot Channel Factor Limits ($F_{\Delta H}^N$);

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

   Methodology for:
   TS 3.10.b.1.A, 3.10.b.5, and 3.10.b.6.C.i – Heat Flux Hot Channel Factor Limits ($F_Q^N(Z)$)

10. CENP-397-P-A, "Improved Flow Measurement Accuracy Using Cross Flow Ultrasonic Flow Measurement Technology," Rev. 1, May 2000.

    Methodology for:
    TS 2.3.a.3.A – Overtemperature ΔT Setpoint;
    TS 2.3.a.3.B – Overpower ΔT Setpoint

Figure 1

Reactor Core Safety Limits Curve (1772 Mwt)
(Cores Containing 422V+ fuel)
(TS 2.1.a)

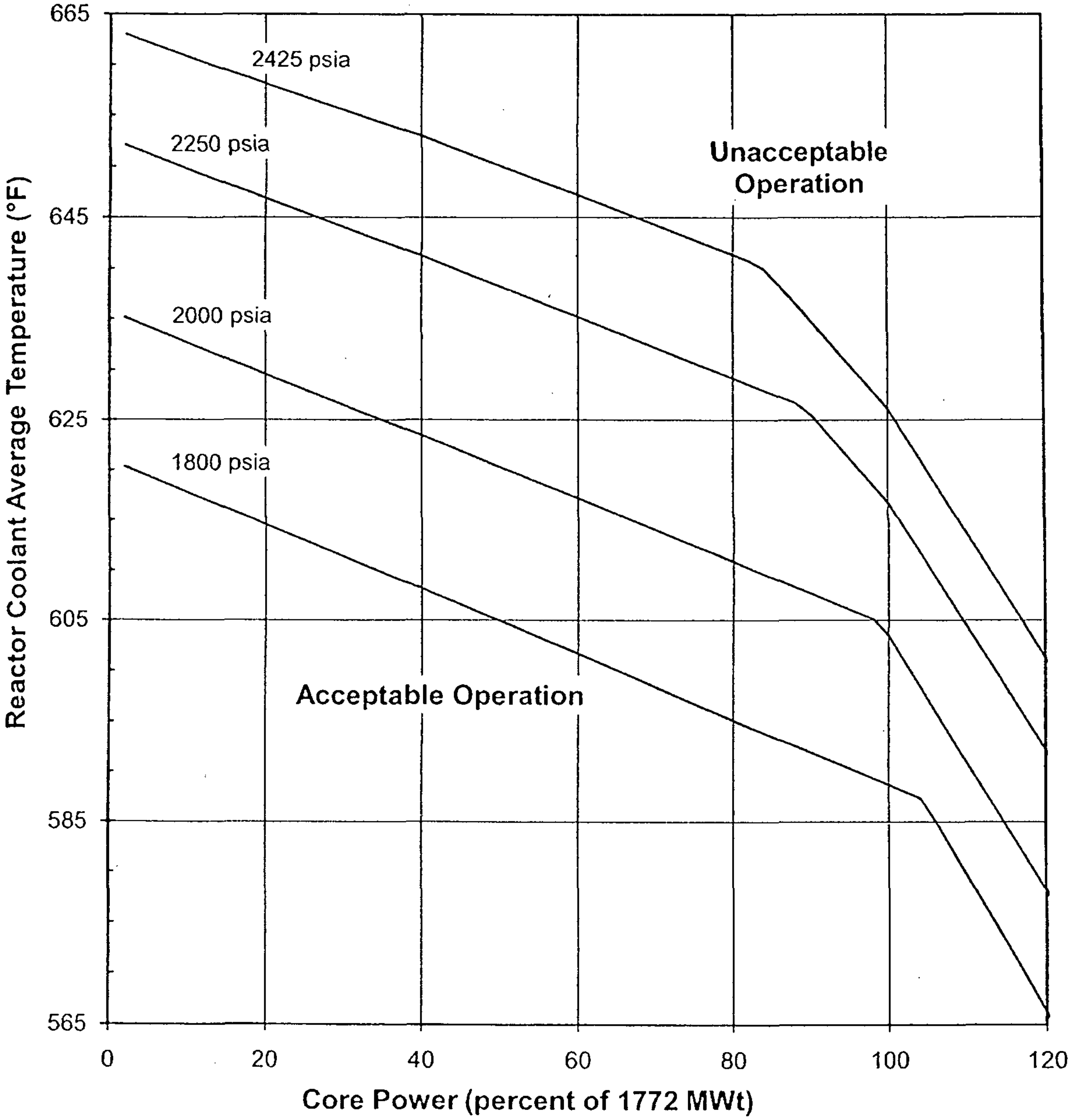

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Figure 2
Required Shutdown Margin vs. Boron Concentration
(TS 3.10.a)

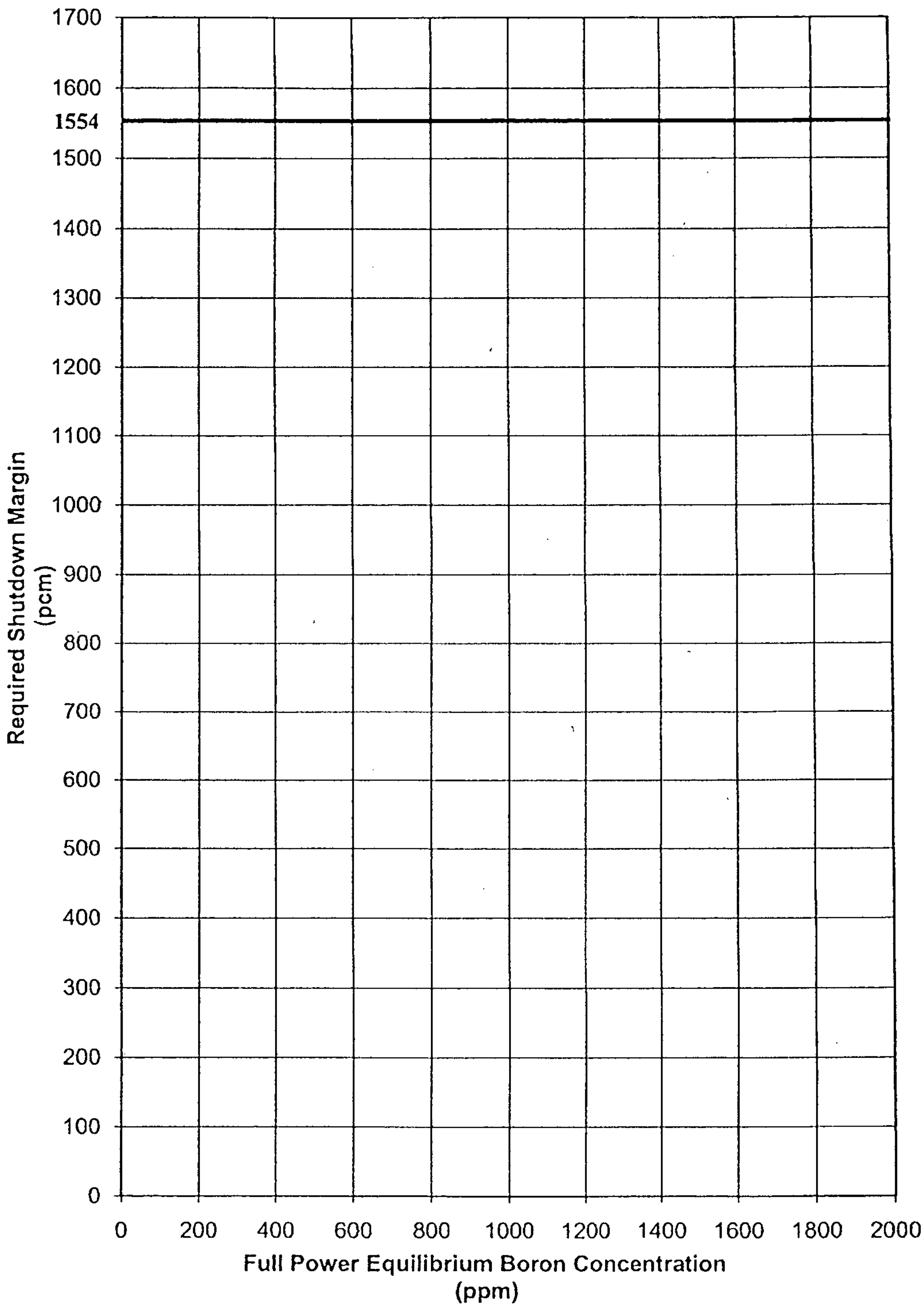


Figure 3
Hot Channel Factor Normalized Operating Envelope (K(Z))

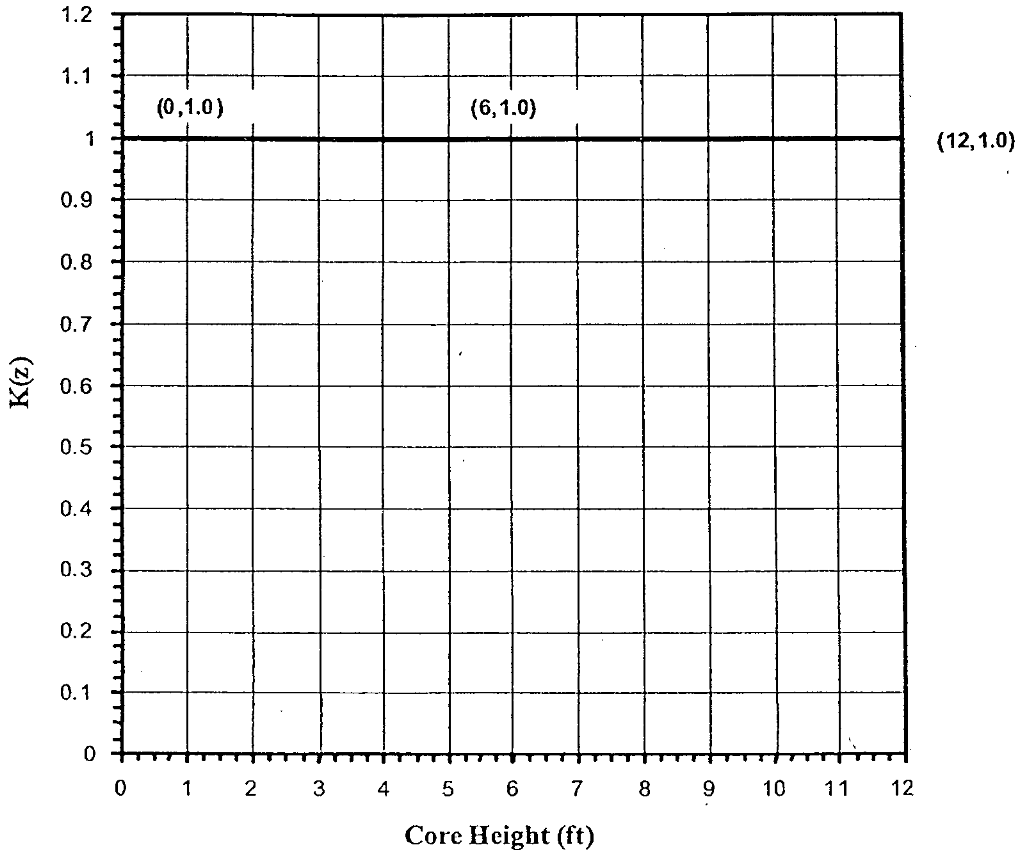
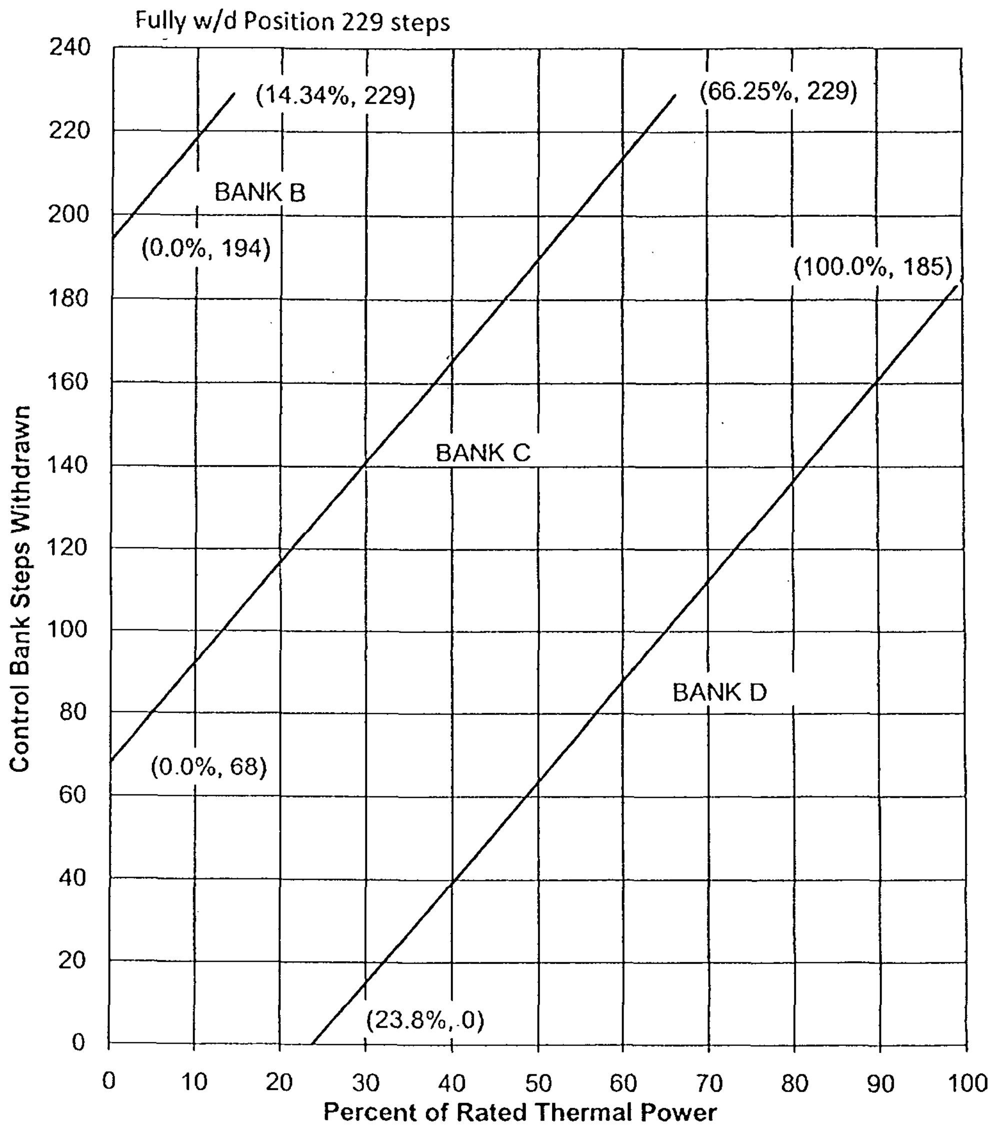


Figure 4
Control Bank Insertion Limits
(TS 3.10.d.2)



Note: The Rod Bank Insertion Limits are based on a control bank tip-to-tip distance of 126 steps.

Figure 5

N(Z) Values [1]

Node	Height (FEET)	Burnup (MWD/MTU) 0 to 1000 AO = 0.50%	1000 to 3000 AO = -1.2%	3000 to 5000 AO = -2.4%	5000 to 7000 AO = -2.8%	7000 to 9000 AO = -2.6%	9000 to 11000 AO = -2.4%
Top							
7	10.8	1.092	1.127	1.147	1.147	1.146	1.123
8	10.6	1.090	1.126	1.143	1.143	1.141	1.127
9	10.4	1.090	1.124	1.139	1.139	1.138	1.133
10	10.2	1.090	1.122	1.136	1.135	1.138	1.138
11	10.0	1.091	1.121	1.132	1.133	1.141	1.142
12	9.8	1.094	1.119	1.127	1.130	1.144	1.145
13	9.6	1.098	1.117	1.123	1.129	1.147	1.147
14	9.4	1.100	1.113	1.116	1.127	1.147	1.147
15	9.2	1.102	1.113	1.115	1.128	1.148	1.148
16	9.0	1.106	1.121	1.121	1.133	1.145	1.145
17	8.8	1.112	1.132	1.132	1.142	1.147	1.147
18	8.6	1.120	1.140	1.140	1.151	1.156	1.159
19	8.4	1.127	1.146	1.146	1.160	1.169	1.174
20	8.2	1.132	1.150	1.150	1.168	1.179	1.184
21	8.0	1.135	1.152	1.152	1.173	1.188	1.193
22	7.8	1.136	1.153	1.153	1.178	1.195	1.203
23	7.6	1.135	1.152	1.152	1.180	1.201	1.210
24	7.4	1.132	1.149	1.149	1.180	1.204	1.217
25	7.2	1.130	1.148	1.147	1.181	1.206	1.221
26	7.0	1.127	1.145	1.144	1.181	1.207	1.223
27	6.8	1.121	1.137	1.141	1.174	1.204	1.226
28	6.6	1.113	1.125	1.136	1.164	1.198	1.227
29	6.4	1.108	1.118	1.132	1.159	1.195	1.227
30	6.2	1.104	1.112	1.127	1.156	1.192	1.223
31	6.0	1.099	1.104	1.123	1.153	1.189	1.220
32	5.8	1.093	1.096	1.118	1.149	1.183	1.212
33	5.6	1.082	1.085	1.110	1.144	1.175	1.203
34	5.4	1.075	1.079	1.104	1.135	1.166	1.192
35	5.2	1.073	1.077	1.101	1.124	1.160	1.183
36	5.0	1.076	1.079	1.102	1.114	1.156	1.174
37	4.8	1.079	1.080	1.103	1.107	1.153	1.166
38	4.6	1.090	1.090	1.103	1.104	1.152	1.158
39	4.4	1.104	1.104	1.103	1.102	1.149	1.150
40	4.2	1.111	1.111	1.102	1.102	1.144	1.143
41	4.0	1.111	1.111	1.101	1.101	1.138	1.137
42	3.8	1.115	1.115	1.101	1.098	1.131	1.131
43	3.6	1.124	1.124	1.104	1.096	1.124	1.123
44	3.4	1.134	1.134	1.108	1.093	1.115	1.115
45	3.2	1.145	1.145	1.116	1.096	1.105	1.105
46	3.0	1.156	1.156	1.125	1.101	1.094	1.093
47	2.8	1.166	1.166	1.136	1.110	1.085	1.085
48	2.6	1.175	1.176	1.145	1.116	1.076	1.080
49	2.4	1.186	1.186	1.156	1.126	1.075	1.081
50	2.2	1.200	1.199	1.169	1.138	1.078	1.084

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Figure 5 (continued)

N(Z) Values [1]

	Height	Burnup (MWD/MTU)					
Node	(FEET)	0 to 1000	1000 to 3000	3000 to 5000	5000 to 7000	7000 to 9000	9000 to 11000
		AO = 0.50%	AO = -1.2%	AO = -2.4%	AO = -2.8%	AO = -2.6%	AO = -2.4%
51	2.0	1.210	1.207	1.178	1.146	1.082	1.088
52	1.8	1.214	1.211	1.181	1.149	1.082	1.088
53	1.6	1.218	1.214	1.185	1.151	1.084	1.089
54	1.4	1.225	1.221	1.191	1.157	1.086	1.091
55	1.2	1.232	1.226	1.197	1.162	1.088	1.094
Bottom							

1) Excludes top and bottom 9%

These decks were generated for normal operation flux maps that are typically taken at full power ARO. Additional N(z) decks may be generated, if necessary, consistent with the methodology described in Reference 1.

Figure 5 (continued)

N(Z) Values [1]

	Height	Burnup (MWD/MTU)			
Node	(FEET)	11000 to 13000	13000 to 15000	15000 to 17000	17000 to EOR
		AO = -2.2%	AO = -2.1%	AO = -2.2%	AO = -2.2%
Top					
7	10.8	1.103	1.102	1.096	1.099
8	10.6	1.101	1.102	1.099	1.098
9	10.4	1.100	1.106	1.105	1.097
10	10.2	1.098	1.111	1.112	1.096
11	10.0	1.097	1.117	1.117	1.096
12	9.8	1.101	1.120	1.120	1.098
13	9.6	1.109	1.121	1.121	1.105
14	9.4	1.113	1.123	1.123	1.110
15	9.2	1.119	1.127	1.127	1.119
16	9.0	1.130	1.130	1.128	1.126
17	8.8	1.146	1.138	1.134	1.139
18	8.6	1.161	1.148	1.146	1.157
19	8.4	1.174	1.159	1.159	1.176
20	8.2	1.185	1.167	1.166	1.189
21	8.0	1.194	1.175	1.175	1.200
22	7.8	1.203	1.182	1.187	1.212
23	7.6	1.210	1.187	1.199	1.221
24	7.4	1.217	1.190	1.208	1.228
25	7.2	1.221	1.192	1.215	1.232
26	7.0	1.223	1.194	1.218	1.234
27	6.8	1.226	1.197	1.225	1.237
28	6.6	1.227	1.203	1.232	1.241
29	6.4	1.227	1.208	1.235	1.243
30	6.2	1.223	1.211	1.233	1.241
31	6.0	1.219	1.213	1.233	1.241
32	5.8	1.213	1.210	1.229	1.237
33	5.6	1.209	1.210	1.225	1.233
34	5.4	1.204	1.205	1.217	1.224
35	5.2	1.198	1.199	1.206	1.212
36	5.0	1.190	1.191	1.199	1.205
37	4.8	1.182	1.182	1.198	1.203
38	4.6	1.170	1.170	1.191	1.194
39	4.4	1.156	1.156	1.177	1.178
40	4.2	1.144	1.144	1.167	1.167
41	4.0	1.136	1.136	1.162	1.161
42	3.8	1.129	1.129	1.155	1.155
43	3.6	1.122	1.122	1.146	1.146
44	3.4	1.113	1.113	1.134	1.134
45	3.2	1.103	1.105	1.121	1.121
46	3.0	1.090	1.095	1.105	1.105
47	2.8	1.083	1.090	1.096	1.096
48	2.6	1.081	1.086	1.092	1.092
49	2.4	1.085	1.088	1.095	1.095
50	2.2	1.088	1.092	1.097	1.097

Figure 5 (continued)

N(Z) Values [1]

	Height	Burnup (MWD/MTU)			
Node	(FEET)	11000 to 13000	13000 to 15000	15000 to 17000	17000 to EOR
		AO = -2.2%	AO = -2.1%	AO = -2.2%	AO = -2.2%
51	2.0	1.092	1.098	1.101	1.102
52	1.8	1.092	1.102	1.103	1.104
53	1.6	1.093	1.106	1.106	1.106
54	1.4	1.095	1.110	1.110	1.106
55	1.2	1.097	1.115	1.115	1.107
Bottom					

1) Excludes top and bottom 9%

These decks were generated for normal operation flux maps that are typically taken at full power ARO. Additional N(z) decks may be generated, if necessary, consistent with the methodology described in Reference 1.

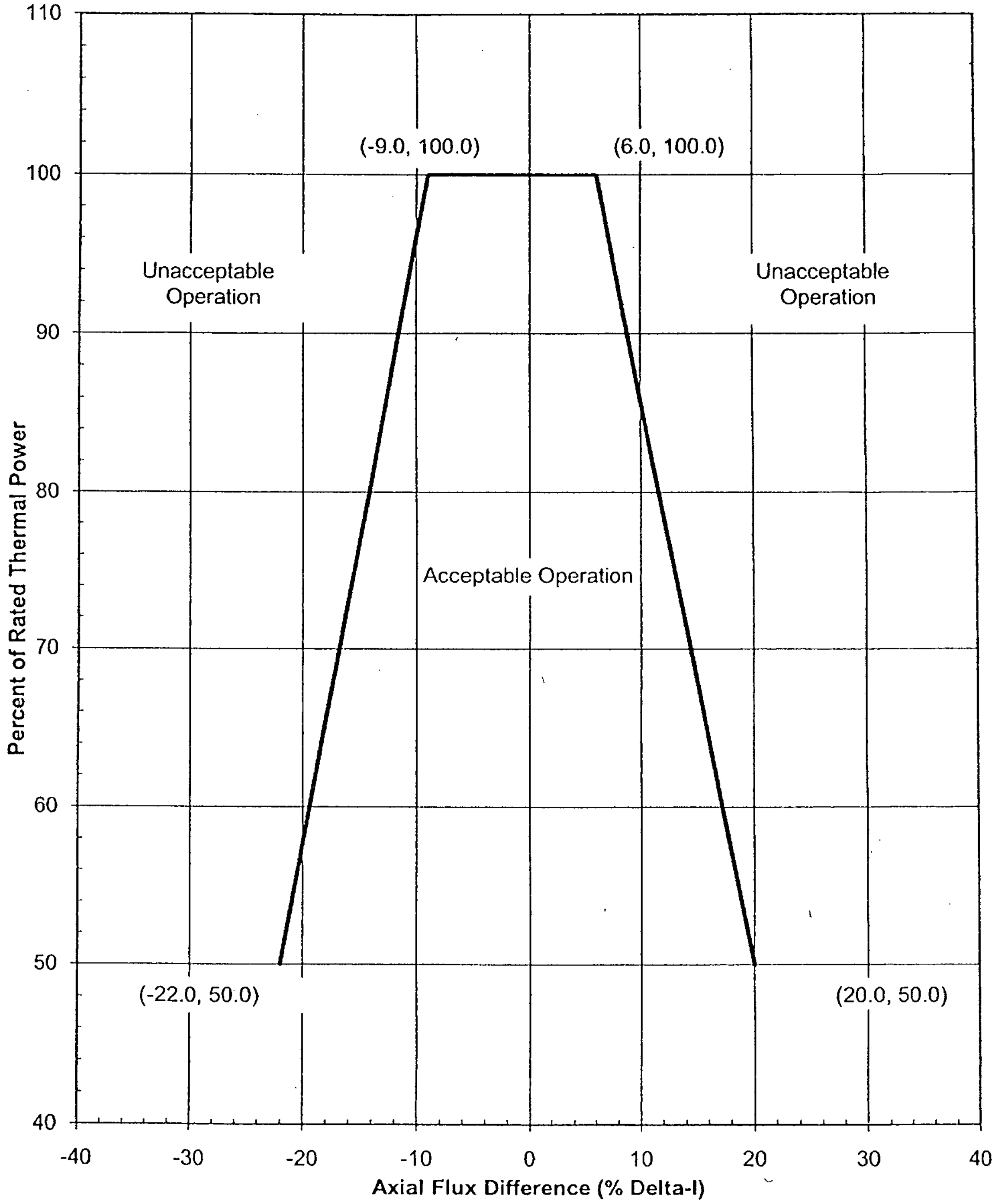
Figure 6
Penalty Factor, Fp, for FQN(Z)

Cycle Burnup (MWD/MTU)	Penalty Factor Fp
150	1.02
18,700	1.02

Note: Linear interpolation is adequate for intermediate cycle burnups.

All cycle burnups outside the range of the table shall use a penalty factor, Fp, of 1.02. Refer to TS 3.10.b.6.C.i.

Figure 7
Axial Flux Difference Target Band
(3.10.b.8.A)



Note: This figure represents the Relaxed Power Distribution Control (RPDC) band used in safety analyses; it may be administratively tightened depending on in-core flux map results. Refer to Figure RD 11.4.1 of the Reactor Data Manual.