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

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 0.

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 0.

A001
NRR

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TRM 2.1

Kewaunee Power Station

CORE OPERATING LIMITS REPORT
(COLR)

CYCLE 30

REVISION 0

Approved	[signature] *FSRC Chairman*	9/8/09 *Date*	09-065 *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
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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 rods 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 rod banks shall be limited in physical insertion as shown in COLR Figure 4.

2.6 Nuclear Heat Flux Hot Channel Factor ($F_Q^N(Z)$) (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

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

$$F_Q^N(Z)*1.03*1.05 \leq \frac{CFQ}{0.5}*K(Z)\ for\ P \leq 0.5$$ [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:

$$F_Q^N(Z)*1.03*1.05*N(Z)*F_p \leq \frac{CFQ}{P}*K(Z)$$ [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 3.6.3
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.

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 <u>Overpower ΔT Setpoint</u> (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 <u>RCS Pressure, Temperature and Flow Departure from Nucleate Boiling (DNB) Limits</u> (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 <u>Refueling Boron Concentration</u> (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)

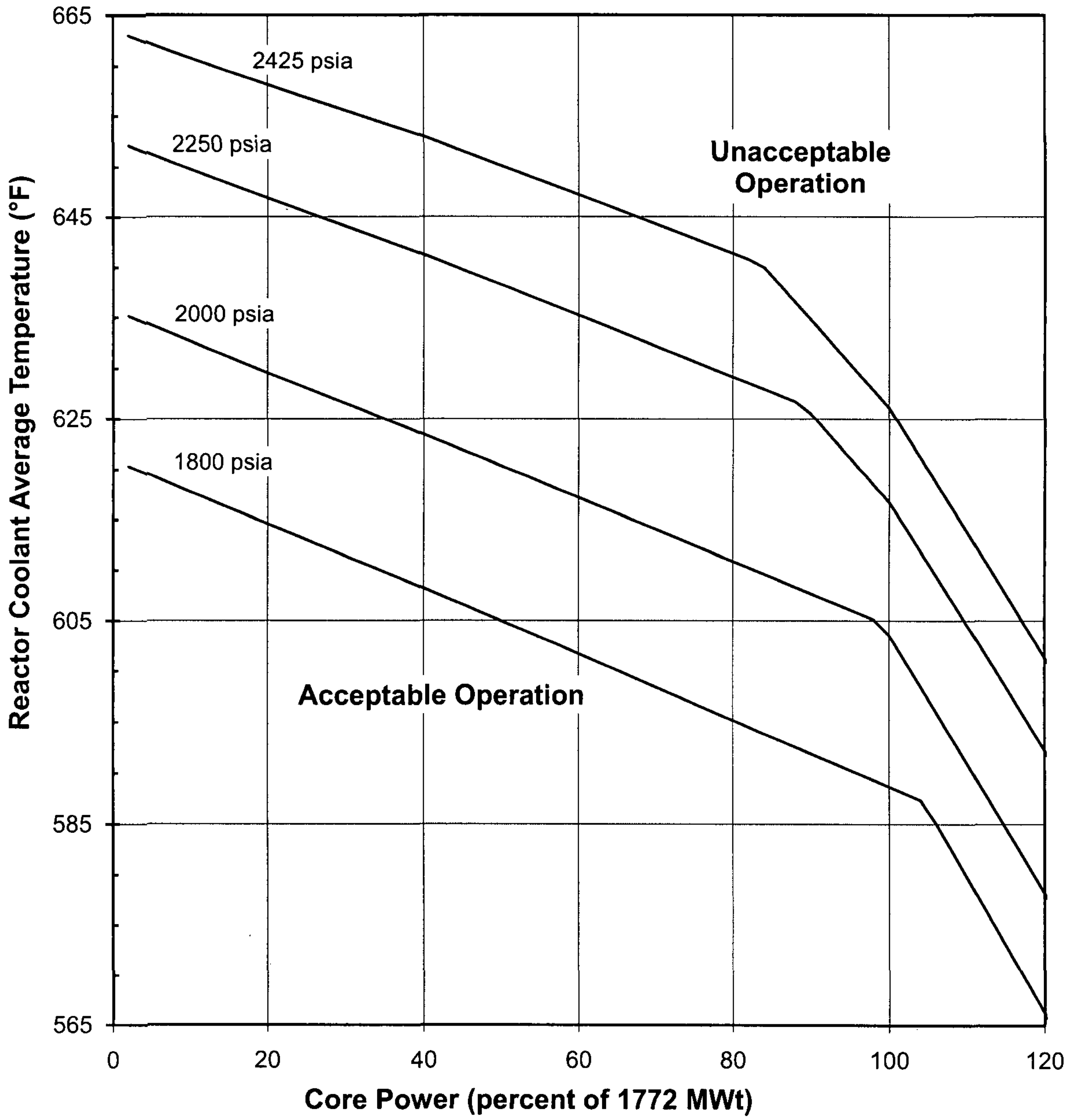

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Figure 2
Required Shutdown Reactivity vs. Boron Concentration
(TS 3.10.a)

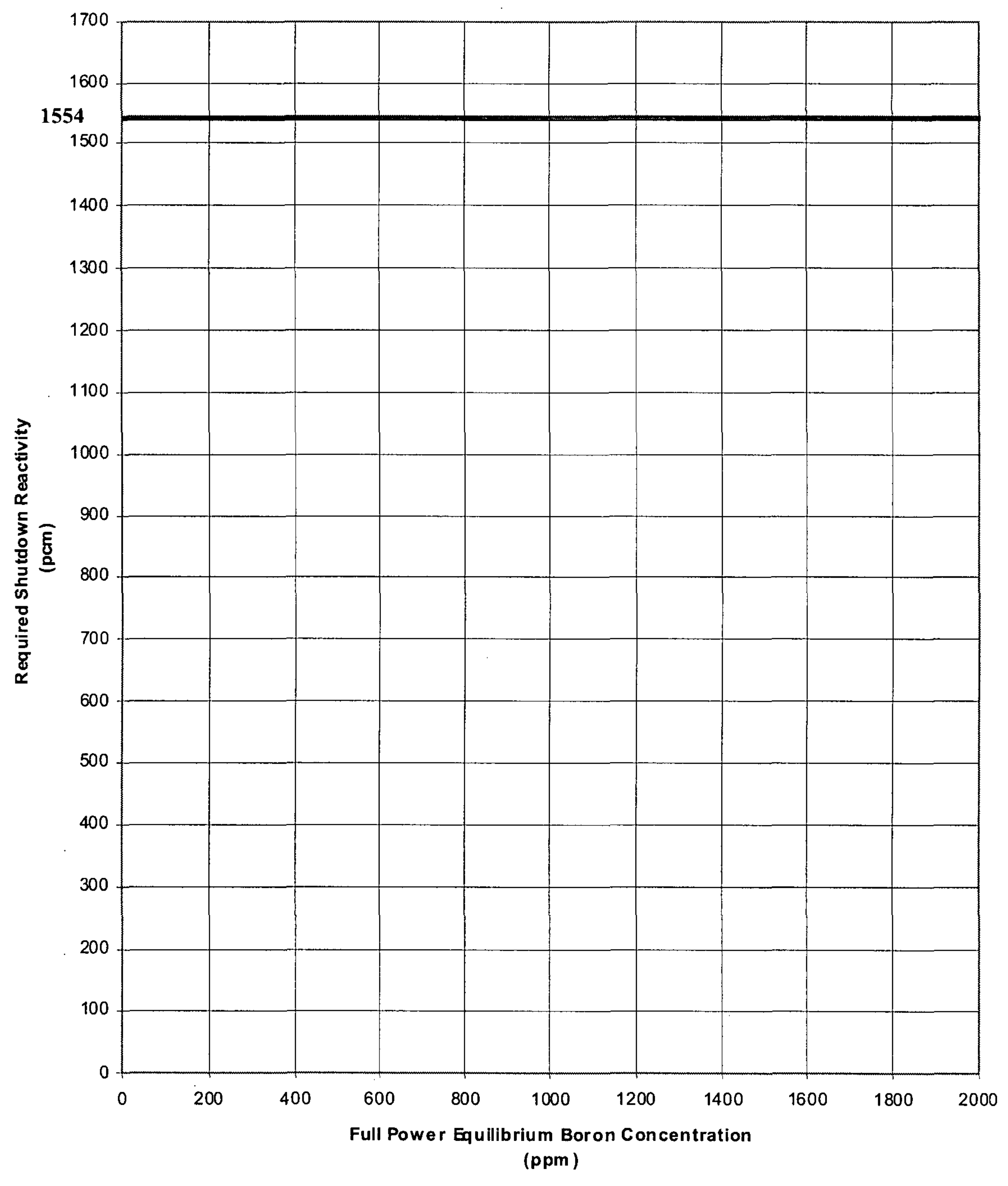


Figure 3
Hot Channel Factor Normalized Operating Envelope (K(Z))

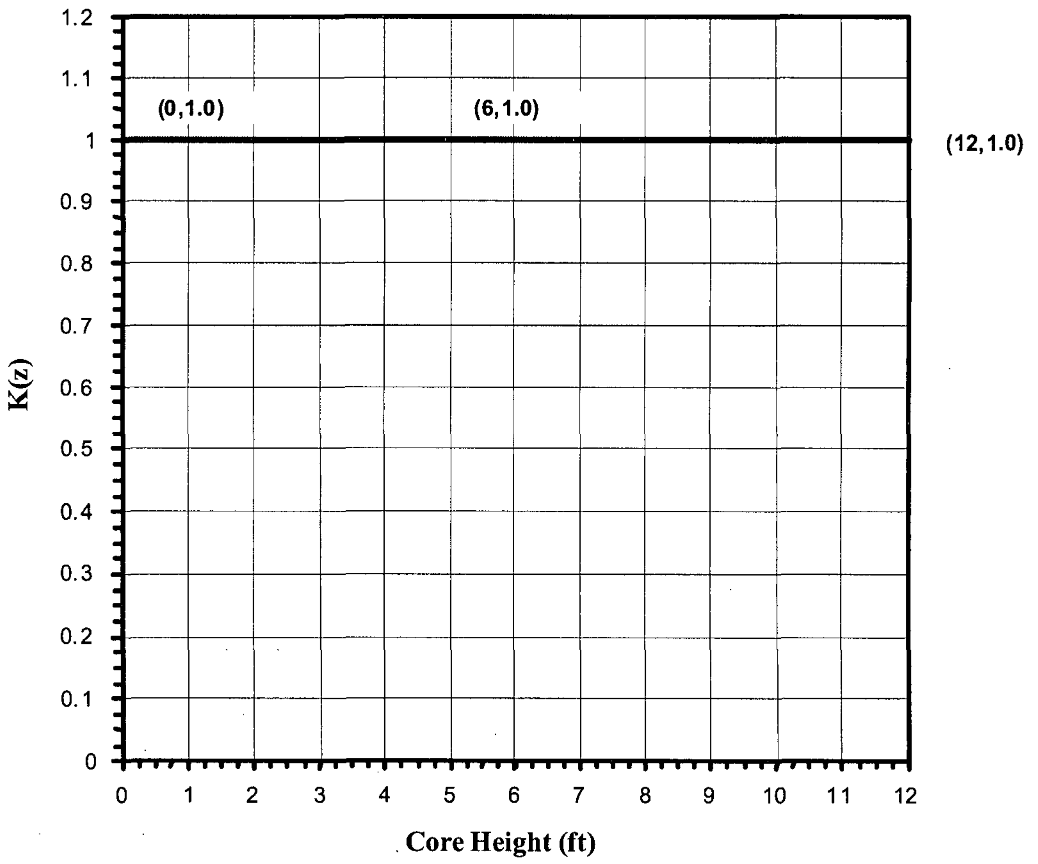
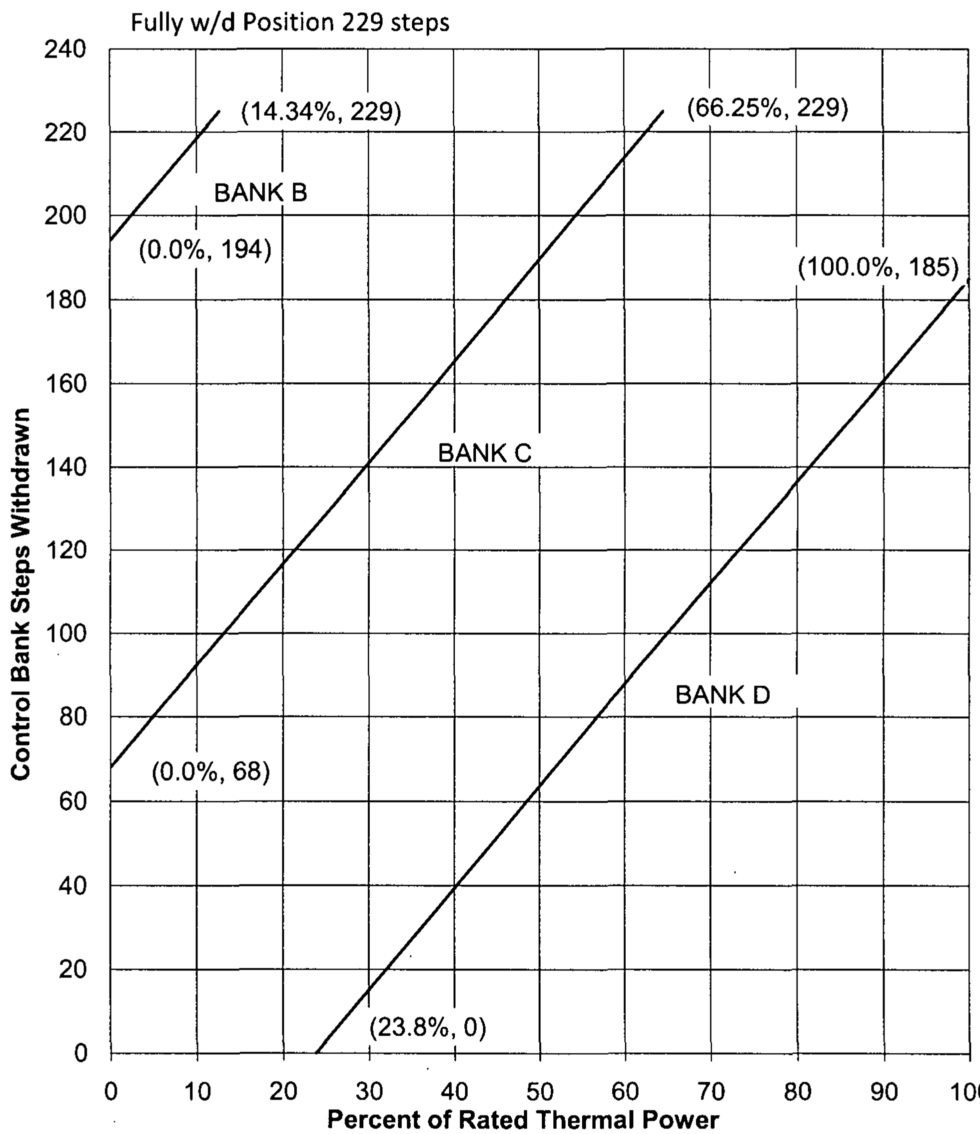


Figure 4
Control Bank Insertion Limits
(TS 3.10.d.2)



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

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Figure 5

N(Z) Values [1]

NODE	HEIGHT (FEET)	0 to 1000 MWD/MTU	1000 to 3000 MWD/MTU	3000 to 5000 MWD/MTU	5000 to 7000 MWD/MTU	7000 to 9000 MWD/MTU	9000 to XXXXX MWD/MTU	XXXXX to EOC MWD/MTU
Top								
6	11.0							
7	10.8							
8	10.6							
9	10.4							
10	10.2							
11	10.0							
12	9.8							
13	9.6							
14	9.4							
15	9.2							
16	9.0							
17	8.8							
18	8.6							
19	8.4							
20	8.2							
21	8.0							
22	7.8							
23	7.6			Cycle	Specific	N(Z) Data		
24	7.4							
25	7.2							
26	7.0							
27	6.8							
28	6.6							
29	6.4							
30	6.2							
31	6.0							
32	5.8							
33	5.6							
34	5.4							
35	5.2							
36	5.0							
37	4.8							
38	4.6							
39	4.4							
40	4.2							
41	4.0							
42	3.8							
43	3.6							
44	3.4							
45	3.2							
46	3.0							
47	2.8							
48	2.6							
49	2.4							
50	2.2							

The N(z) data will be provided following shutdown of Cycle 29.

Figure 5 (continued)

N(Z) Values [1]

NODE	HEIGHT (FEET)	0 to 1000 MWD/MTU	1000 to 3000 MWD/MTU	3000 to 5000 MWD/MTU	5000 to 7000 MWD/MTU	7000 to 9000 MWD/MTU	9000 to XXXXX MWD/MTU	XXXXX to EOC MWD/MTU
51	2.0							
52	1.8							
53	1.6							
54	1.4							
55	1.2							
56	1.0							
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.

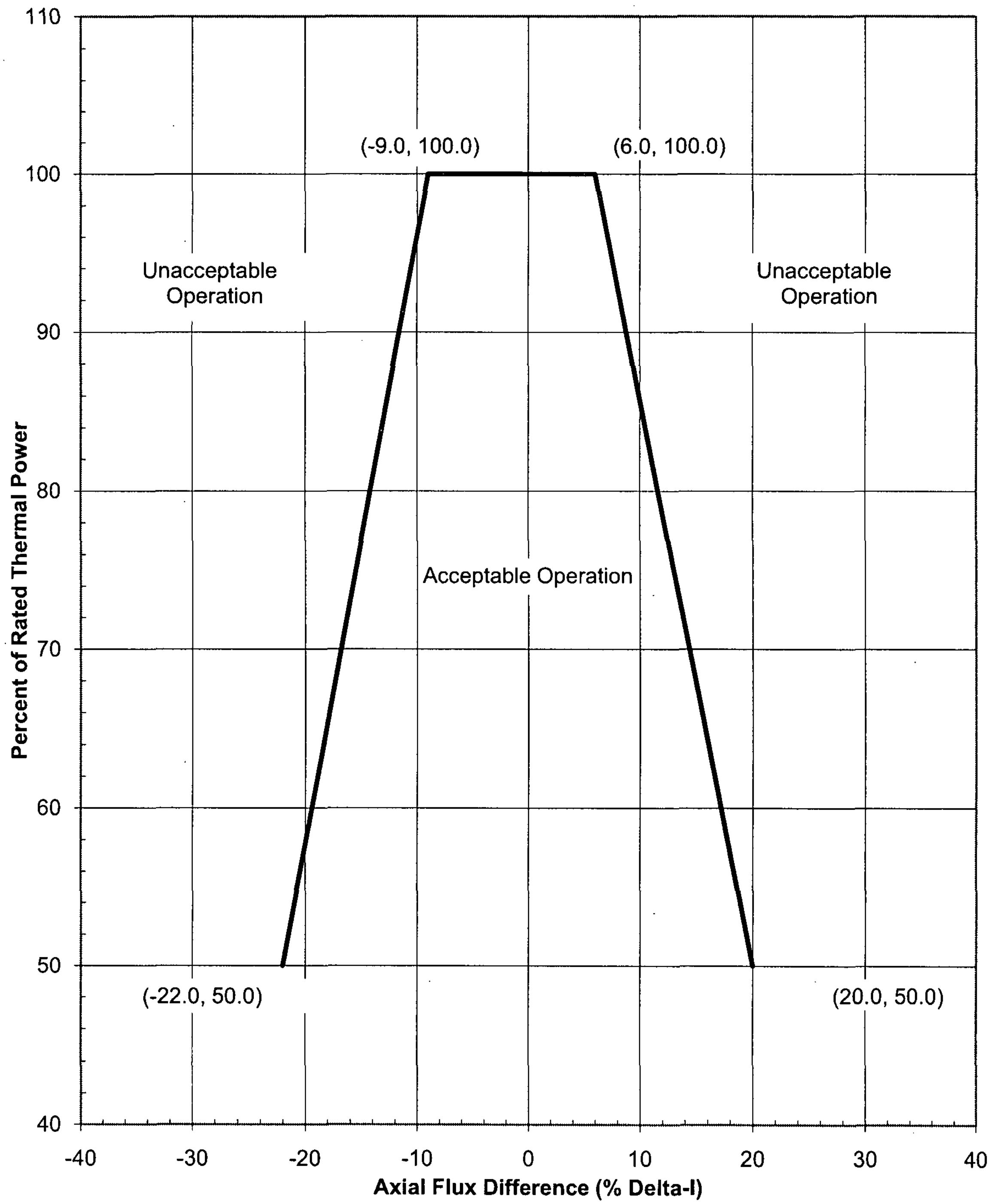
Figure 6
Penalty Factor, Fp, for FQN(Z)

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.