

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

CORE OPERATING LIMITS REPORT

Unit 1 - Cycle 19

Revision 0

Note: This report is not part of the Technical Specifications.
This report is referenced in Technical Specifications.

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This report provides the values of the limits for Unit 1 Cycle 19 as required by Technical Specification Section 6.7.A.6. These values have been established using NRC approved methodology and are established such that all applicable limits of the plant safety analysis are met.

Heat Flux Hot Channel Factor Limits

$$F_0^{RTP} = 2.40$$

K(Z) values are provided in Figure 1.

V(Z) values are provided in Figures 2a through 2f.

Reference Technical Specification Sections: 3.10.B.1 and 3.10.B.2

Nuclear Enthalpy Rise Hot Channel Factor Limits

$$F_{\Delta H}^{RTP} = 1.77$$

$$PFDH = 0.3$$

If the nuclear enthalpy rise hot channel factor exceeds its limit in Technical Specification 3.10.B.1, reduce reactor power and the high neutron flux trip setpoint by 3.33% for each percent that the measured nuclear enthalpy rise hot channel factor exceeds the 3.10.B.1 limit.

Reference Technical Specification Sections: 3.10.B.1, 3.10.B.2, and 3.10.B.3

Linear Heat Generation Rate

The 95% probability level ECCS analysis calculation utilized a peak linear heat generation rate of 14.788 kW/ft.

The Appendix K ECCS analysis calculation utilized a peak linear heat generation rate of 15.167 kW/ft for the F_Q limit of 2.40.

Reference Technical Specification Section: 3.10.B

Axial Flux Difference Limits

The Axial Flux difference limits are provided in Figure 3.

The Axial Flux Difference target band is $\pm 5\%$.

Reference Technical Specification Sections: 3.10.B.4 through 3.10.B.9

Shutdown Rod Insertion Limits

The shutdown rods shall be fully withdrawn.

Reference Technical Specification Sections: 3.10.D

Control Rod Insertion Limits

The control rod banks shall be limited in physical insertion as shown in Figures 4, 5, and 6.

Reference Technical Specification Sections: 3.10.D and 3.10.G

Reactor Coolant Flow Limit

The reactor coolant system flow shall be $\geq 178,000$ gpm.

Reference Technical Specification Sections: 3.10.J

LOCA

The Small and Large Break LOCA analyses performed for this cycle are valid for $F_Q \leq 2.80$ and $F_Q \leq 2.40$, respectively. The F_Q limit for the Large Break LOCA analysis is more limiting than the F_Q limit for the Small Break LOCA analysis. The Small Break LOCA analysis incorporates the $K(z)$ methodology. However, since the Small Break LOCA is less limiting than the Large Break LOCA analysis, no $K(z)$ penalty needs to be applied to calculations of most limiting F_Q values. Thus for the equation in Technical Specification 3.10.B, $K(z)$ is equal to 1. $K(z)$ is shown graphically in Figure 1.

Transient Power Distribution Penalty for $F_Q - V(z)$

Table 1 summarizes the bounding $V(z)$ values for the middle 80% of the core for Prairie Island Unit 1 Cycle 19. The $V(z)$ penalty takes the form of straight lines connecting data points determined as a function of core height. A particular $V(z)$ curve is valid over a given exposure range and equilibrium Axial Offset (AO) range as noted in Table 1. The $V(z)$ penalty for each exposure and AO range is shown graphically in Figures 2a - 2f.

Table 1
Bounding V(z) Values

Exposure Range	z(ft), V(z)	z(ft), V(z)
0 - 1.35 GWd/MTU	0.20, 1.000	6.30, 1.082
Eq AO range: -3% to +8%	0.39, 1.000	6.49, 1.082
Operating band: $\pm 5\% \Delta I$	0.59, 1.000	6.69, 1.082
(Startup)	0.79, 1.000	6.89, 1.082
	0.98, 1.000	7.08, 1.082
	1.18, 1.115	7.28, 1.082
	1.38, 1.112	7.48, 1.082
	1.57, 1.109	7.67, 1.082
	1.77, 1.106	7.87, 1.082
	1.97, 1.103	8.07, 1.082
	2.16, 1.100	8.26, 1.082
	2.36, 1.097	8.46, 1.082
	2.56, 1.094	8.66, 1.082
	2.75, 1.091	8.85, 1.082
	2.95, 1.088	9.05, 1.087
	3.15, 1.085	9.25, 1.092
	3.34, 1.082	9.44, 1.097
	3.54, 1.082	9.64, 1.102
	3.74, 1.082	9.84, 1.107
	3.93, 1.082	10.03, 1.112
	4.13, 1.082	10.23, 1.117
	4.33, 1.082	10.43, 1.122
	4.52, 1.082	10.62, 1.127
	4.72, 1.082	10.82, 1.132
	4.92, 1.082	11.02, 1.000
	5.11, 1.082	11.21, 1.000
	5.31, 1.082	11.41, 1.000
	5.51, 1.082	11.61, 1.000
	5.70, 1.082	11.80, 1.000
	5.90, 1.082	12.00, 1.000
	6.10, 1.082	

Table 1

Bounding V(z) Values (continued)

Exposure Range	z(ft), V(z)	z(ft), V(z)
0 - 1.35 GWd/MTU	0.20, 1.000	6.30, 1.083
Eq AO range: -3% to +5%	0.39, 1.000	6.49, 1.083
Operating band: $\pm 5\% \Delta I$	0.59, 1.000	6.69, 1.083
	0.79, 1.000	6.89, 1.083
	0.98, 1.000	7.08, 1.083
	1.18, 1.110	7.28, 1.083
	1.38, 1.107	7.48, 1.083
	1.57, 1.105	7.67, 1.083
	1.77, 1.103	7.87, 1.083
	1.97, 1.100	8.07, 1.083
	2.16, 1.098	8.26, 1.083
	2.36, 1.095	8.46, 1.083
	2.56, 1.093	8.66, 1.083
	2.75, 1.090	8.85, 1.083
	2.95, 1.088	9.05, 1.088
	3.15, 1.085	9.25, 1.092
	3.34, 1.083	9.44, 1.096
	3.54, 1.083	9.64, 1.101
	3.74, 1.083	9.84, 1.105
	3.93, 1.083	10.03, 1.110
	4.13, 1.083	10.23, 1.114
	4.33, 1.083	10.43, 1.119
	4.52, 1.083	10.62, 1.123
	4.72, 1.083	10.82, 1.127
	4.92, 1.083	11.02, 1.000
	5.11, 1.083	11.21, 1.000
	5.31, 1.083	11.41, 1.000
	5.51, 1.083	11.61, 1.000
	5.70, 1.083	11.80, 1.000
	5.90, 1.083	12.00, 1.000
	6.10, 1.083	

Table 1

Bounding V(z) Values (continued)

Exposure Range	z(ft), V(z)	z(ft), V(z)
0 - 4.55 GWd/MTU Eq AO range: -6% to +3% Operating band: $\pm 5\% \Delta I$	0.20, 1.000	6.30, 1.086
	0.39, 1.000	6.49, 1.086
	0.59, 1.000	6.69, 1.086
	0.79, 1.000	6.89, 1.086
	0.98, 1.000	7.08, 1.086
	1.18, 1.111	7.28, 1.086
	1.38, 1.108	7.48, 1.086
	1.57, 1.106	7.67, 1.086
	1.77, 1.104	7.87, 1.086
	1.97, 1.102	8.07, 1.086
	2.16, 1.100	8.26, 1.086
	2.36, 1.097	8.46, 1.090
	2.56, 1.095	8.66, 1.093
	2.75, 1.093	8.85, 1.097
	2.95, 1.090	9.05, 1.101
	3.15, 1.088	9.25, 1.104
	3.34, 1.086	9.44, 1.108
	3.54, 1.086	9.64, 1.111
	3.74, 1.086	9.84, 1.115
	3.93, 1.086	10.03, 1.119
	4.13, 1.086	10.23, 1.122
	4.33, 1.086	10.43, 1.126
	4.52, 1.086	10.62, 1.130
	4.72, 1.086	10.82, 1.133
	4.92, 1.086	11.02, 1.000
	5.11, 1.086	11.21, 1.000
	5.31, 1.086	11.41, 1.000
5.51, 1.086	11.61, 1.000	
5.70, 1.086	11.80, 1.000	
5.90, 1.086	12.00, 1.000	
6.10, 1.086		

Table 1

Bounding V(z) Values (continued)

Exposure Range	z(ft), V(z)	z(ft), V(z)
0 - 9.55 GWd/MTU	0.20, 1.000	6.30, 1.095
Eq AO range: -6% to +2%	0.39, 1.000	6.49, 1.095
Operating band: $\pm 5\% \Delta I$	0.59, 1.000	6.69, 1.095
	0.79, 1.000	6.89, 1.095
	0.98, 1.000	7.08, 1.095
	1.18, 1.113	7.28, 1.095
	1.38, 1.111	7.48, 1.095
	1.57, 1.109	7.67, 1.095
	1.77, 1.108	7.87, 1.095
	1.97, 1.106	8.07, 1.095
	2.16, 1.104	8.26, 1.095
	2.36, 1.102	8.46, 1.095
	2.56, 1.100	8.66, 1.095
	2.75, 1.099	8.85, 1.098
	2.95, 1.097	9.05, 1.102
	3.15, 1.095	9.25, 1.106
	3.34, 1.095	9.44, 1.109
	3.54, 1.095	9.64, 1.113
	3.74, 1.095	9.84, 1.117
	3.93, 1.095	10.03, 1.120
	4.13, 1.095	10.23, 1.124
	4.33, 1.095	10.43, 1.127
	4.52, 1.095	10.62, 1.131
	4.72, 1.095	10.82, 1.134
	4.92, 1.095	11.02, 1.000
	5.11, 1.095	11.21, 1.000
	5.31, 1.095	11.41, 1.000
	5.51, 1.095	11.61, 1.000
	5.70, 1.095	11.80, 1.000
	5.90, 1.095	12.00, 1.000
	6.10, 1.095	

Table 1

Bounding V(z) Values (continued)

Exposure Range	z(ft), V(z)	z(ft), V(z)
0 - 13.05 GWd/MTU Eq AO range: -6% to +4% Operating band: $\pm 5\% \Delta I$	0.20, 1.000	6.30, 1.084
	0.39, 1.000	6.49, 1.084
	0.59, 1.000	6.69, 1.085
	0.79, 1.000	6.89, 1.087
	0.98, 1.000	7.08, 1.089
	1.18, 1.109	7.28, 1.091
	1.38, 1.107	7.48, 1.092
	1.57, 1.106	7.67, 1.093
	1.77, 1.105	7.87, 1.094
	1.97, 1.102	8.07, 1.095
	2.16, 1.100	8.26, 1.096
	2.36, 1.097	8.46, 1.096
	2.56, 1.093	8.66, 1.097
	2.75, 1.090	8.85, 1.097
	2.95, 1.087	9.05, 1.099
	3.15, 1.083	9.25, 1.100
	3.34, 1.081	9.44, 1.101
	3.54, 1.079	9.64, 1.102
	3.74, 1.077	9.84, 1.103
	3.93, 1.079	10.03, 1.107
4.13, 1.081	10.23, 1.110	
4.33, 1.083	10.43, 1.115	
4.52, 1.085	10.62, 1.119	
4.72, 1.086	10.82, 1.123	
4.92, 1.087	11.02, 1.000	
5.11, 1.089	11.21, 1.000	
5.31, 1.089	11.41, 1.000	
5.51, 1.089	11.61, 1.000	
5.70, 1.089	11.80, 1.000	
5.90, 1.087	12.00, 1.000	
6.10, 1.085		

Table 1

Bounding V(z) Values (continued)

Exposure Range	z(ft), V(z)	z(ft), V(z)
0 GWd/MTU - EOC	0.20, 1.000	6.30, 1.108
Eq AO range: -6% to +4%	0.39, 1.000	6.49, 1.108
Operating band: $\pm 5\% \Delta I$	0.59, 1.000	6.69, 1.108
	0.79, 1.000	6.89, 1.108
	0.98, 1.000	7.08, 1.109
	1.18, 1.118	7.28, 1.109
	1.38, 1.116	7.48, 1.103
	1.57, 1.114	7.67, 1.106
	1.77, 1.111	7.87, 1.103
	1.97, 1.107	8.07, 1.100
	2.16, 1.104	8.26, 1.097
	2.36, 1.099	8.46, 1.097
	2.56, 1.094	8.66, 1.098
	2.75, 1.090	8.85, 1.099
	2.95, 1.085	9.05, 1.100
	3.15, 1.080	9.25, 1.102
	3.34, 1.079	9.44, 1.105
	3.54, 1.083	9.64, 1.108
	3.74, 1.086	9.84, 1.113
	3.93, 1.091	10.03, 1.119
	4.13, 1.096	10.23, 1.125
	4.33, 1.101	10.43, 1.133
	4.52, 1.104	10.62, 1.140
	4.72, 1.108	10.82, 1.147
	4.92, 1.111	11.02, 1.000
	5.11, 1.113	11.21, 1.000
	5.31, 1.114	11.41, 1.000
	5.51, 1.114	11.61, 1.000
	5.70, 1.114	11.80, 1.000
	5.90, 1.112	12.00, 1.000
	6.10, 1.110	

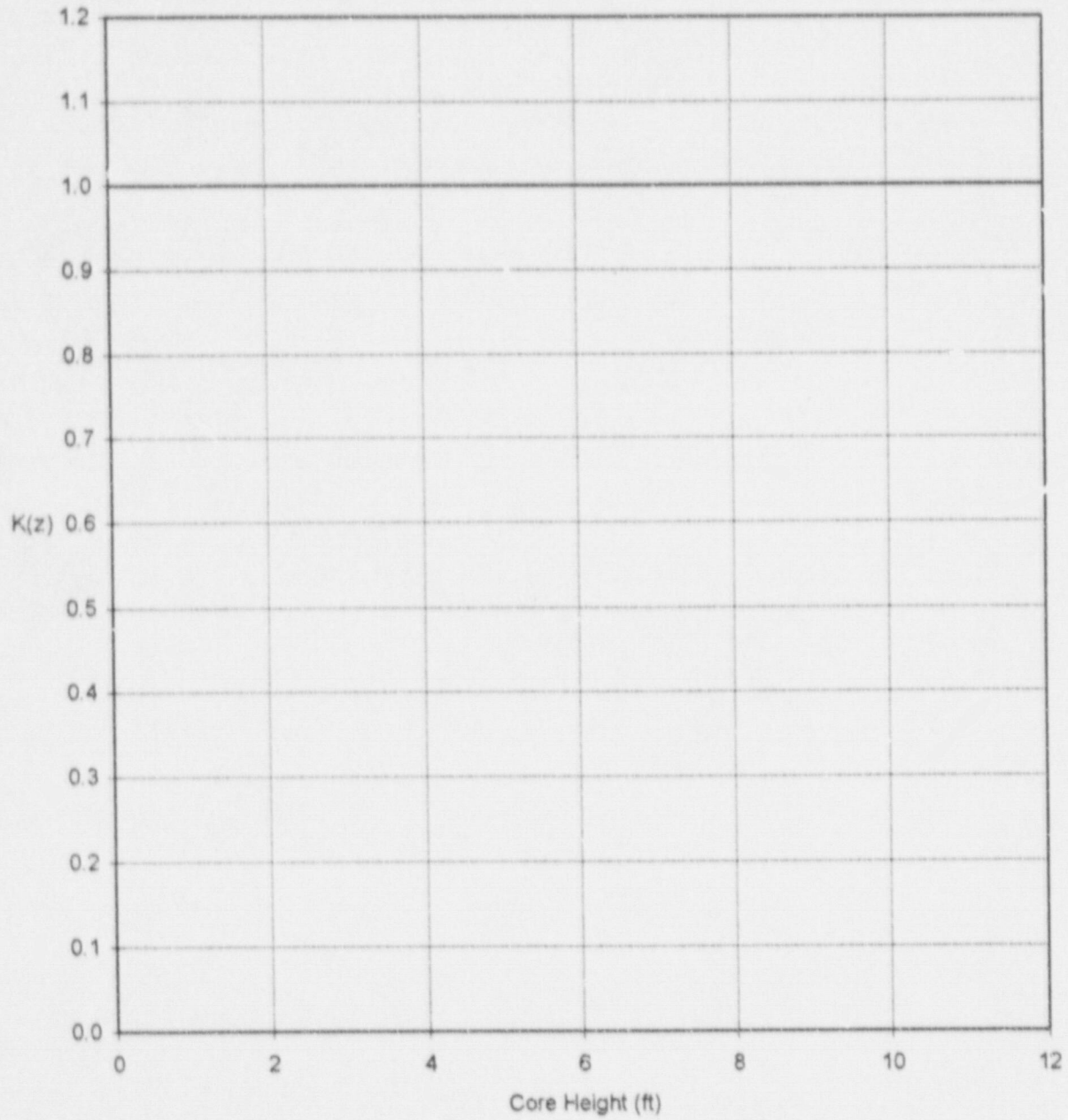


Figure 1: Hot Channel Factor
Normalized Operating Envelope

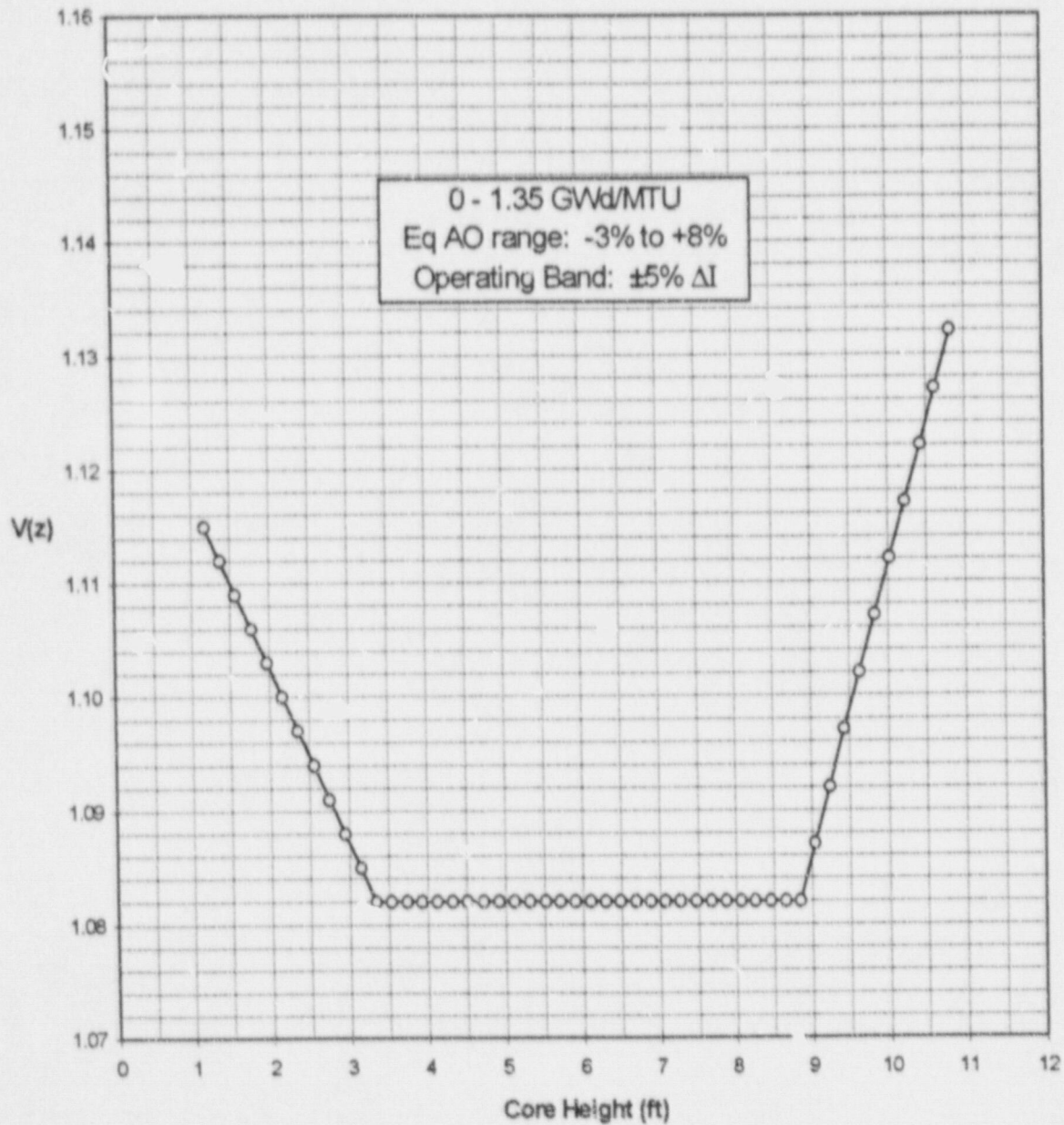


Figure 2a. Bounding V(z) Values
From 0 - 1.35 GWd/MTU
(Startup)

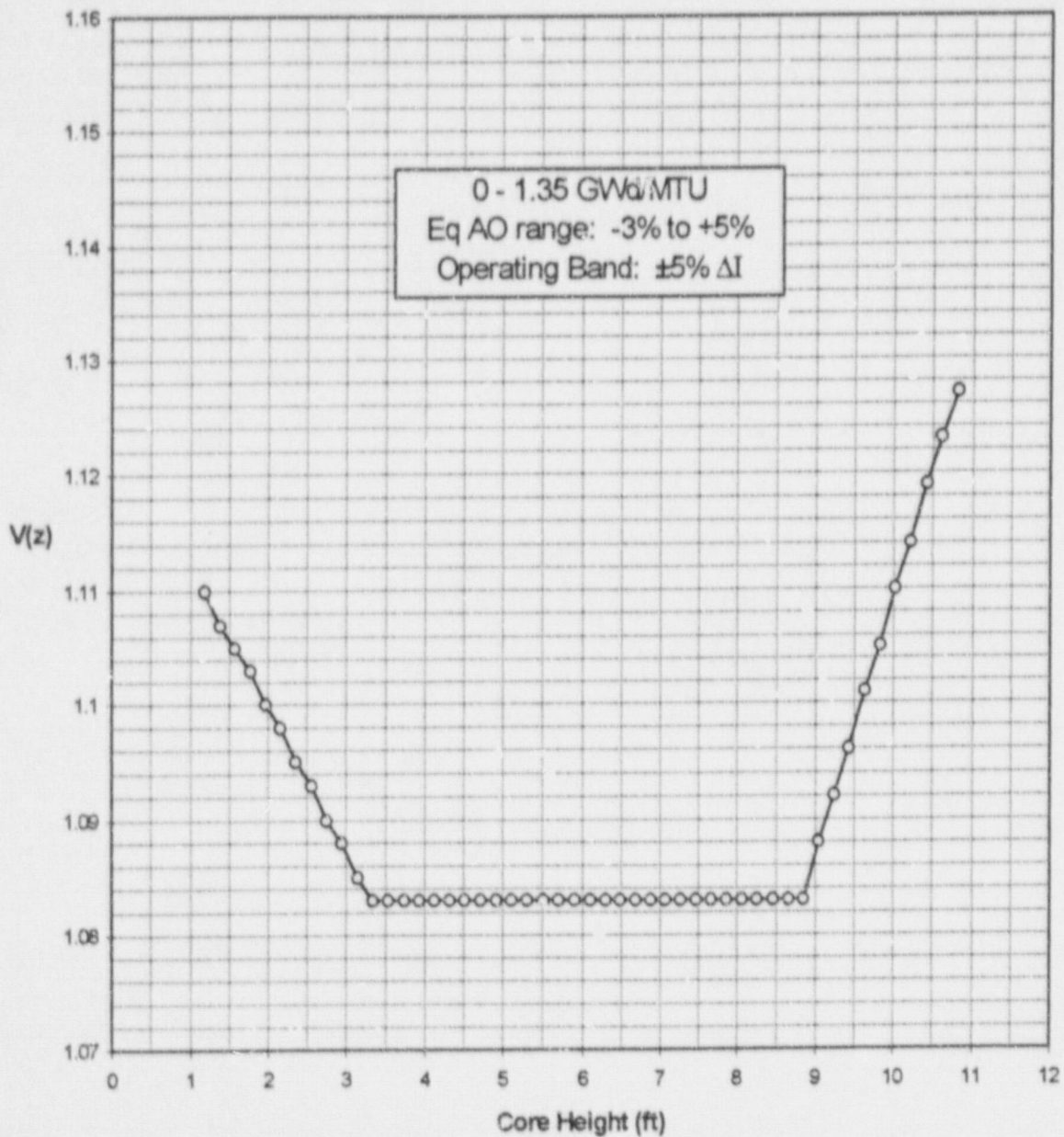


Figure 2b: Bounding V(z) Values
From 0 - 1.35 GWd/MTU

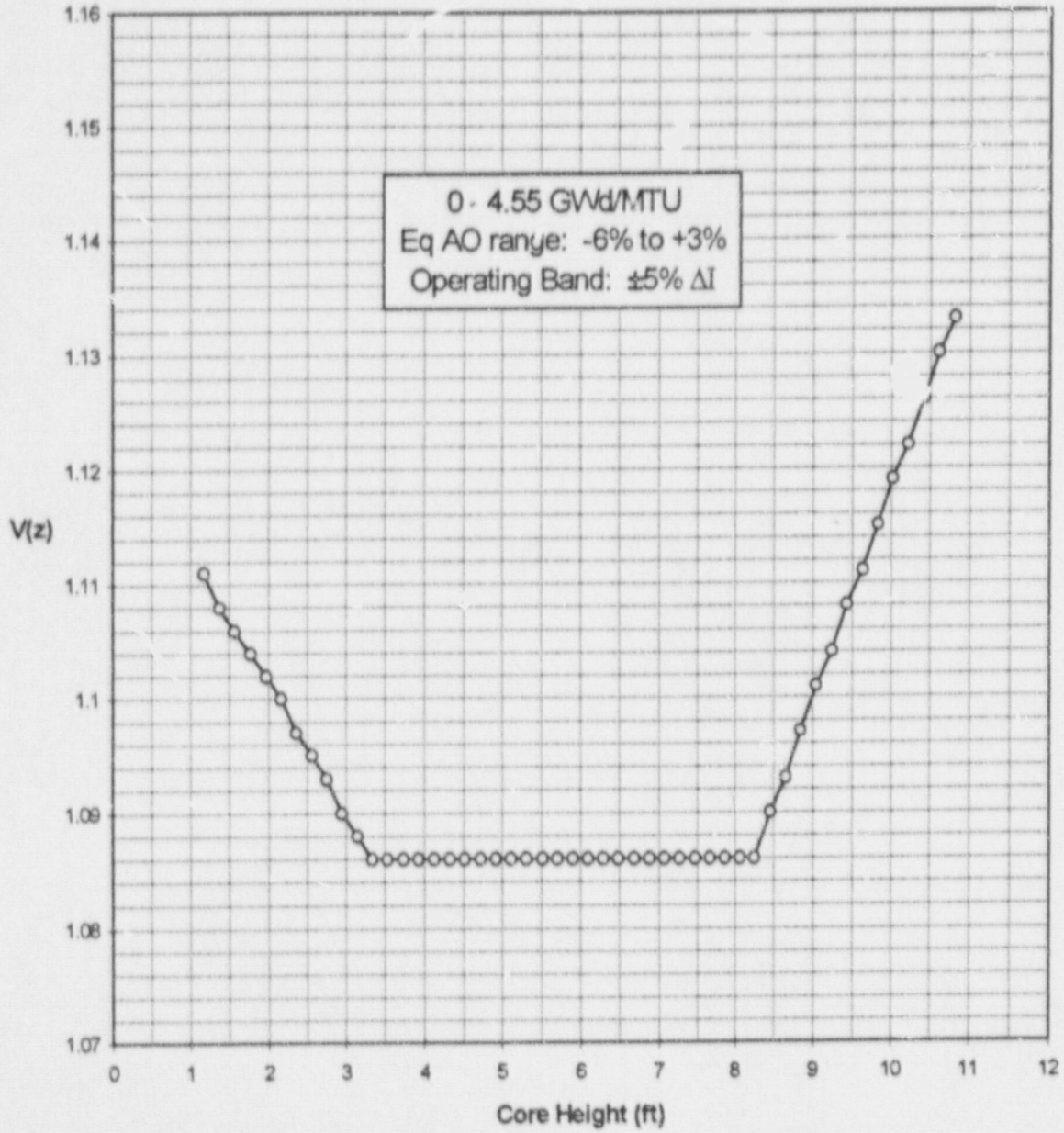


Figure 2c: Bounding V(z) Values
From 0 - 4.55 GWd/MTU

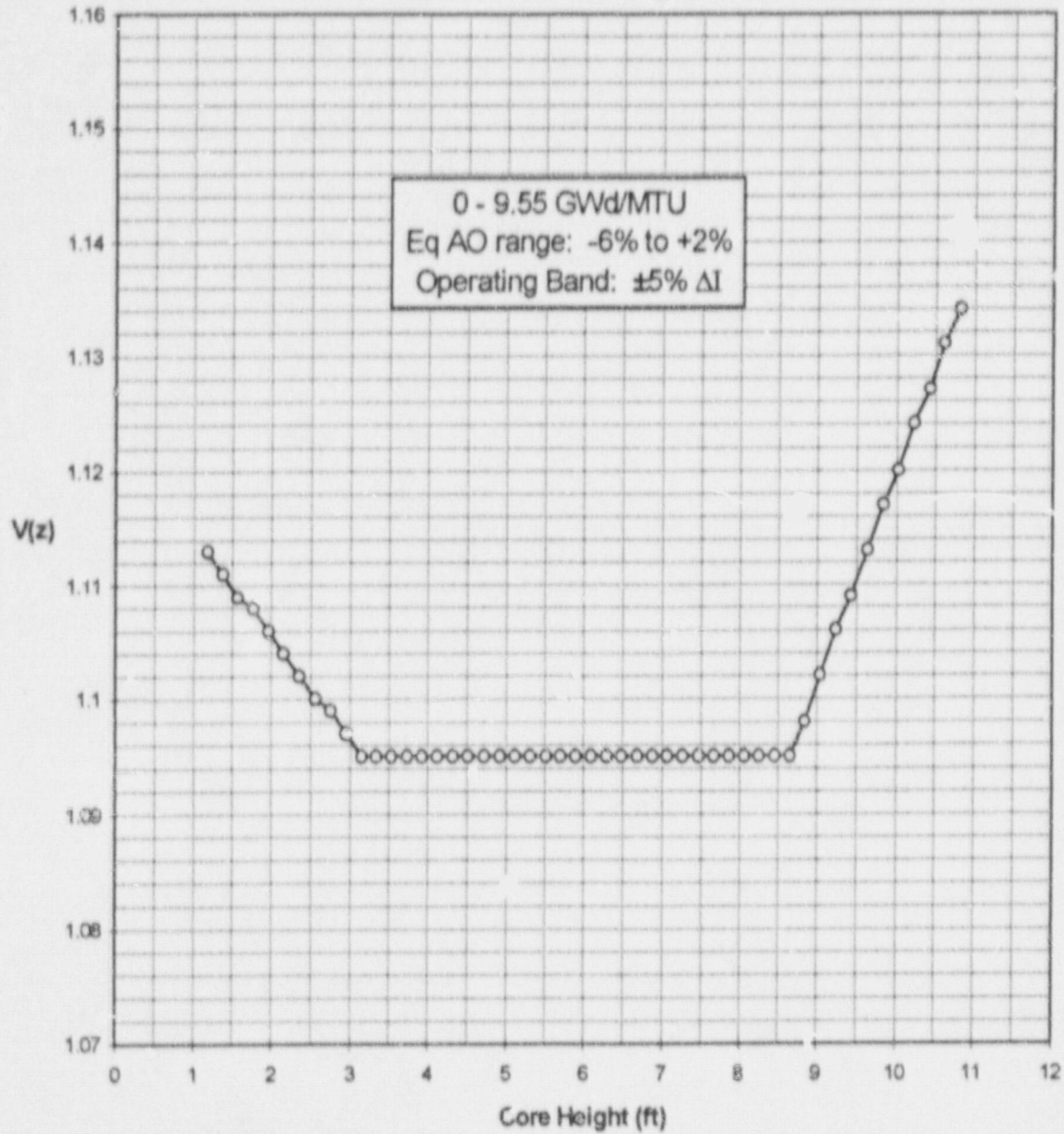


Figure 2d: Bounding V(z) Values
From 0 - 9.55 GWd/MTU

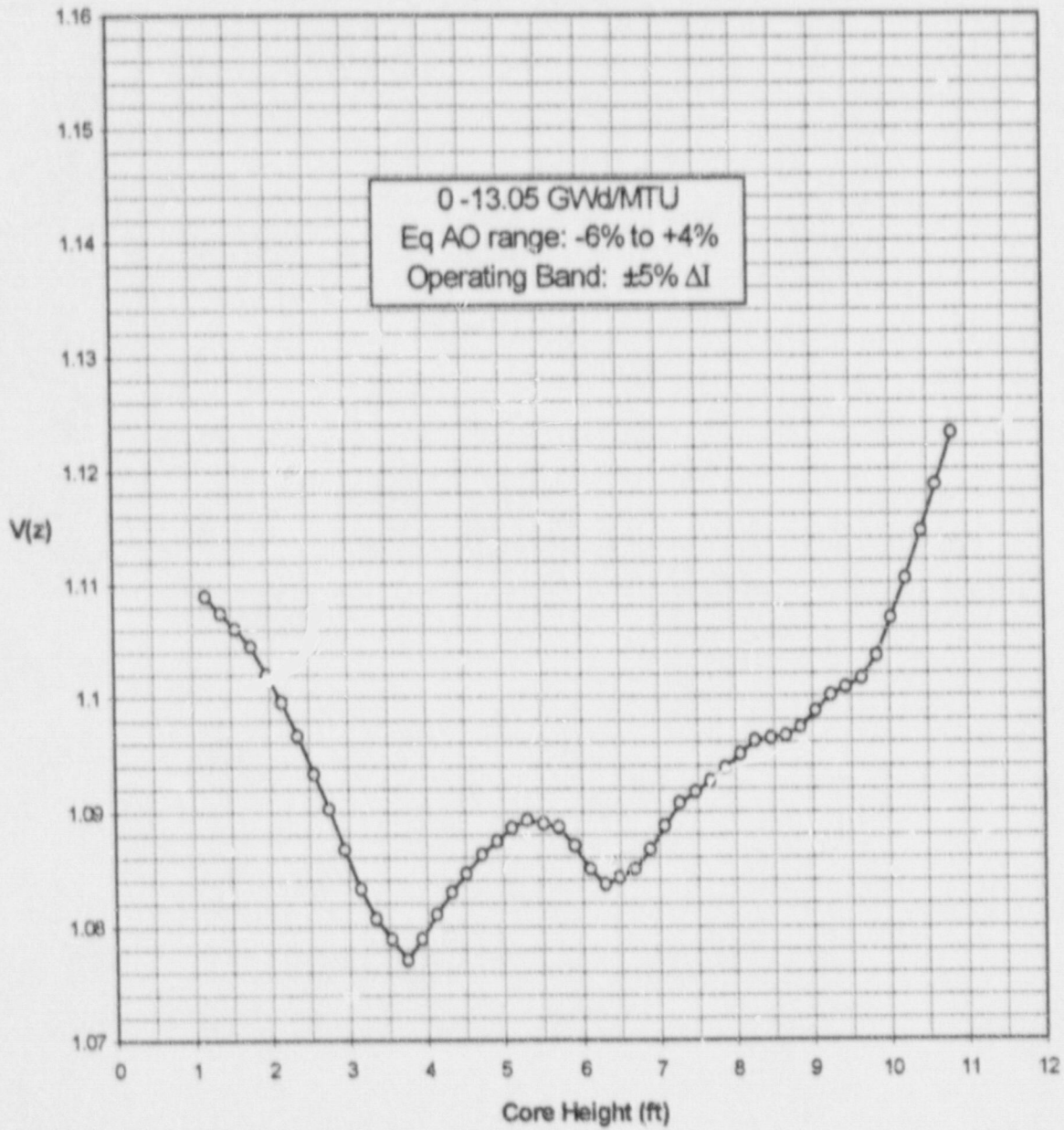


Figure 2e: Bounding V(z) Values
From 0 - 13.05 GWd/MTU

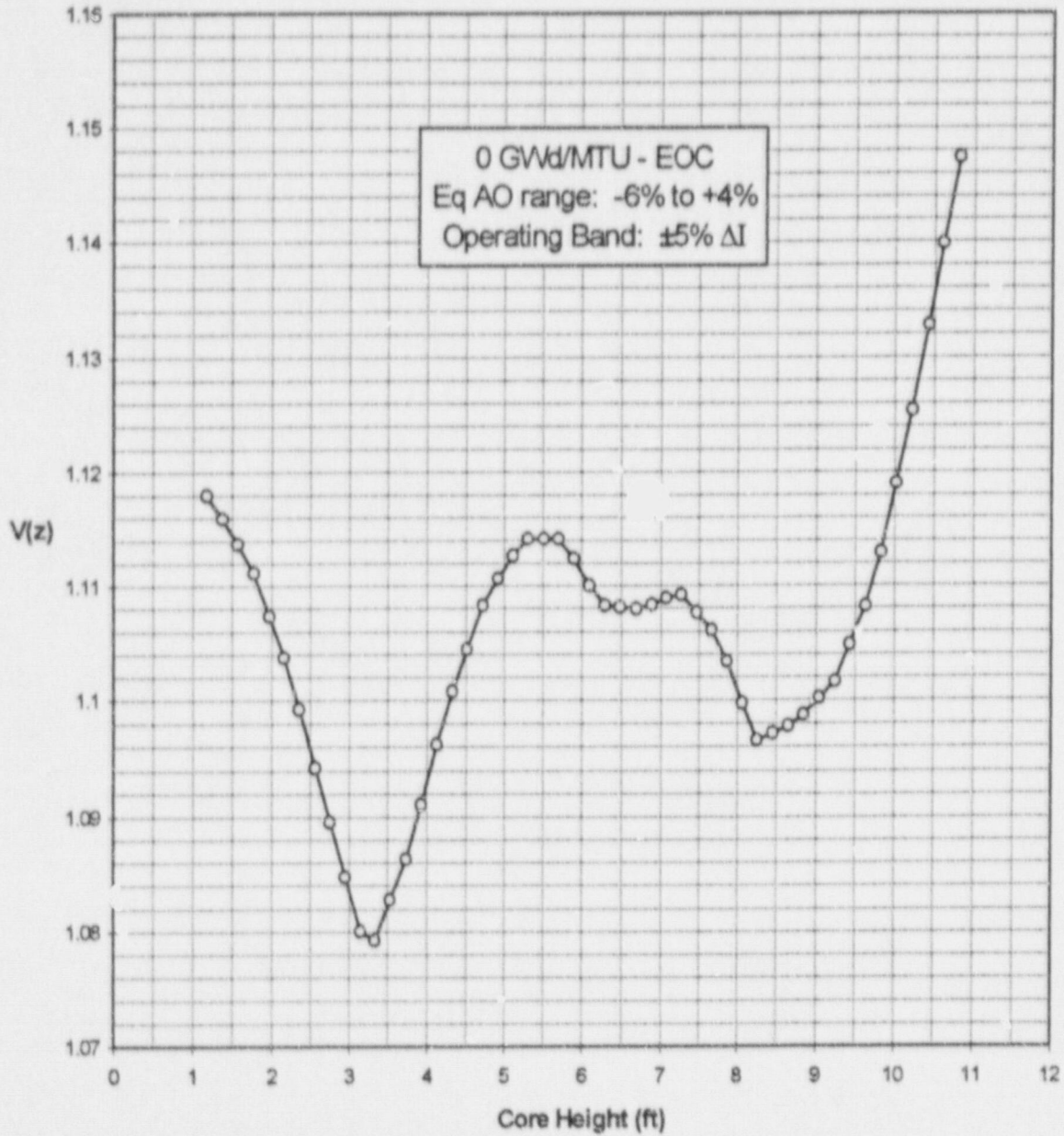


Figure 2f: Bounding V(z) Values
From 0 GWd/MTU - EOC

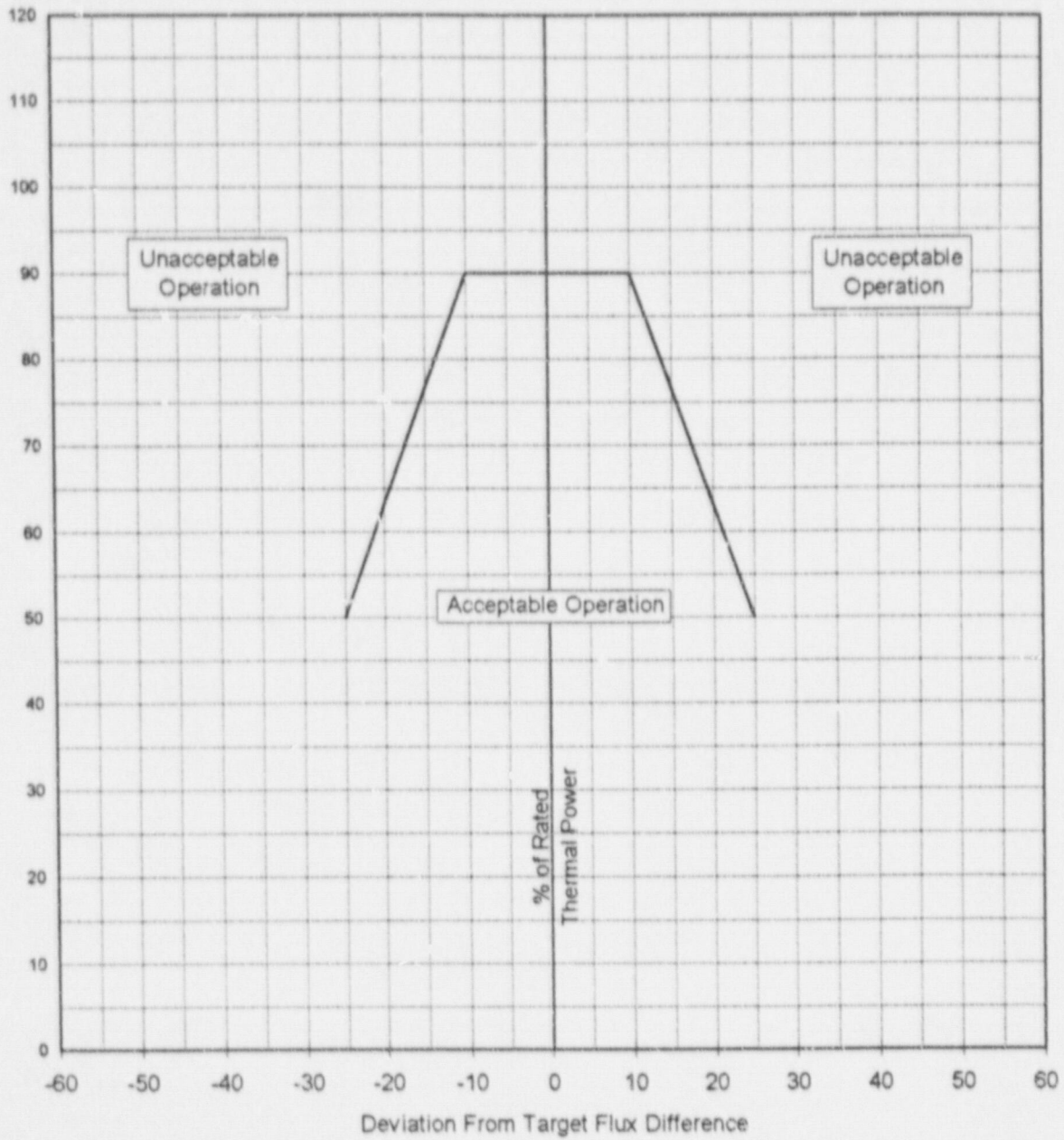


Figure 3: Deviation From Target Flux Difference as a Function of Thermal Power

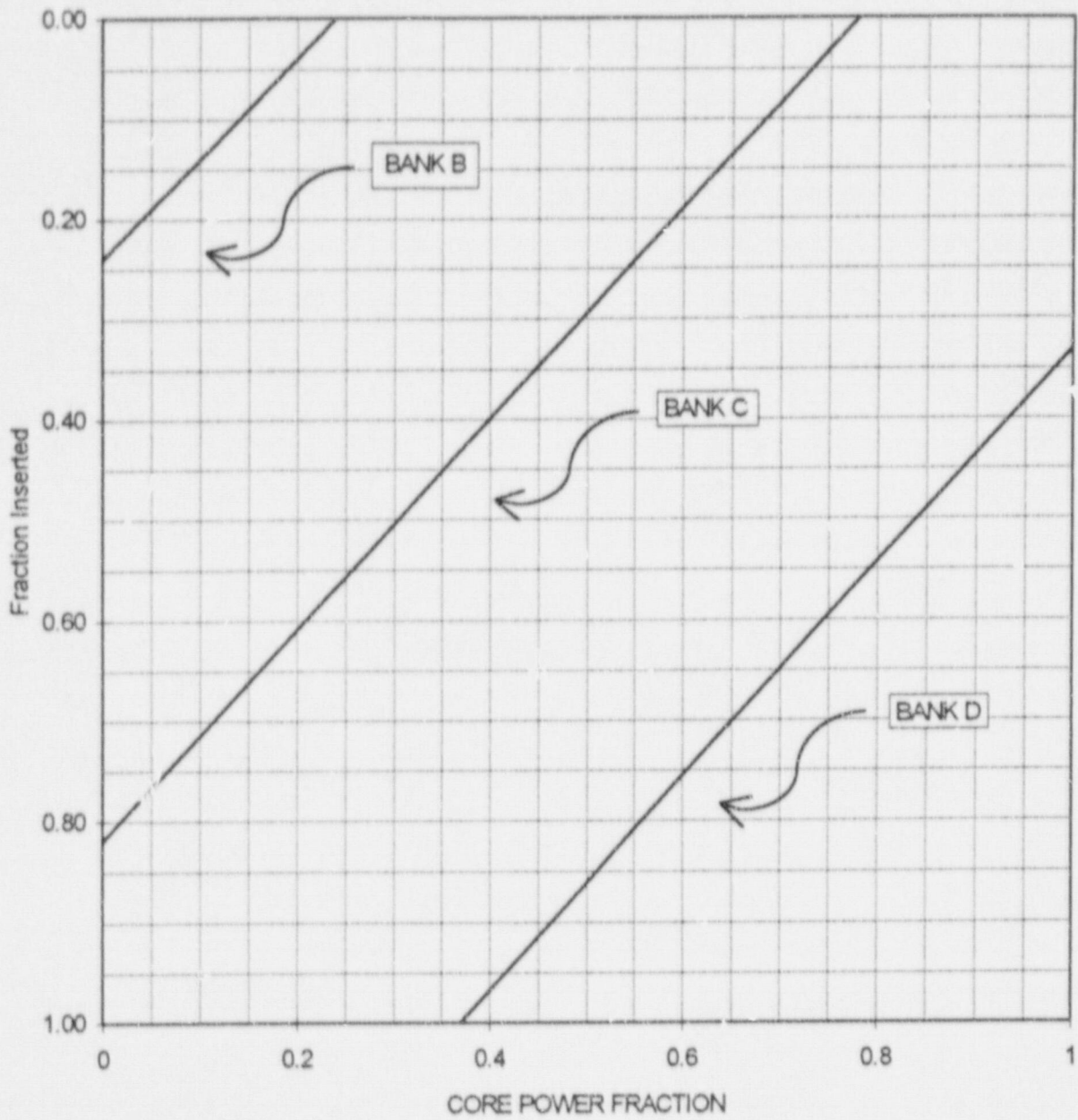


Figure 4: Control Bank Insertion Limit

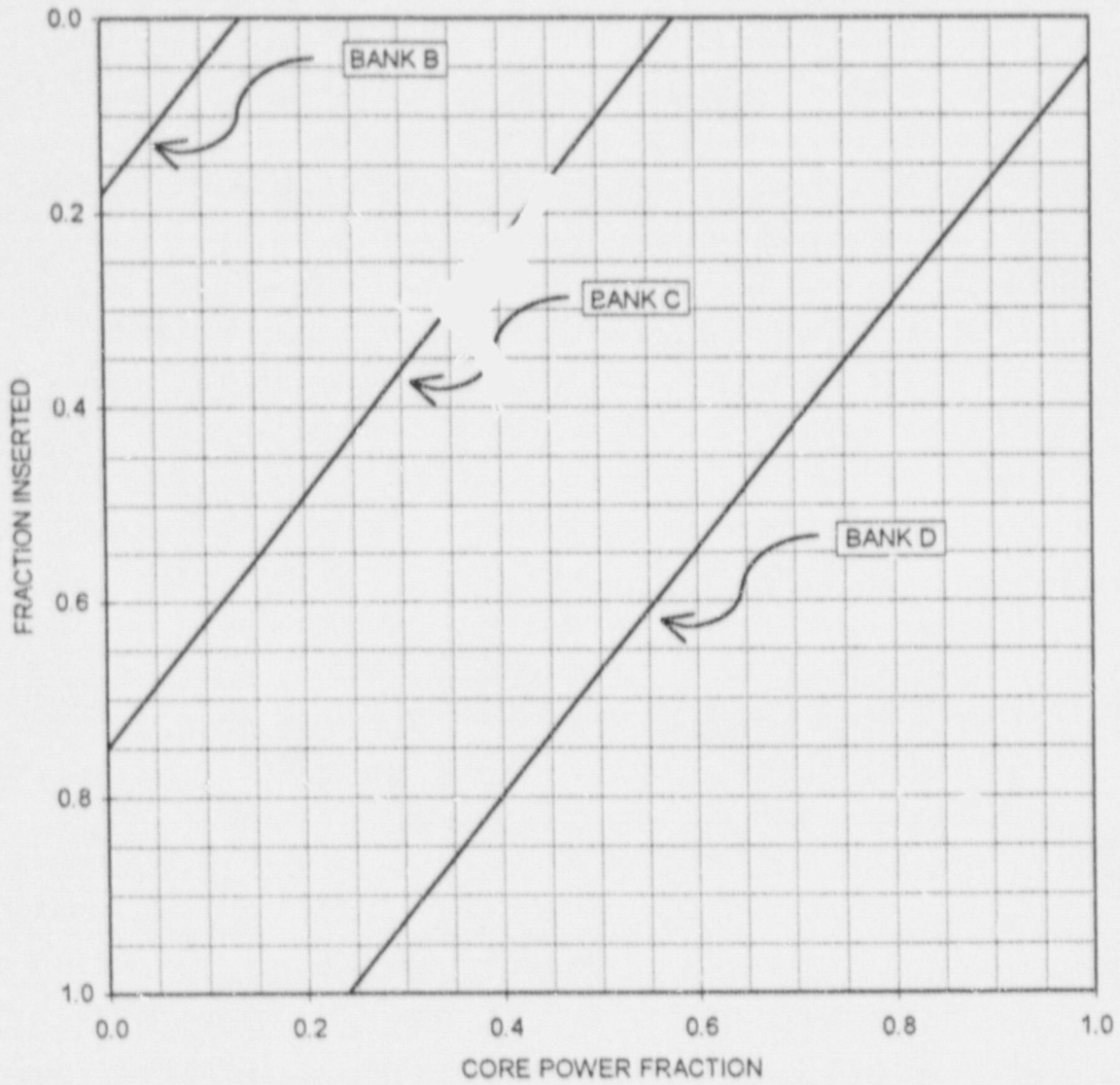


Figure 5: Insertion Limits
100 Step Overlap With One Bottomed Rod
(Technical Specification 3.10.G.3)

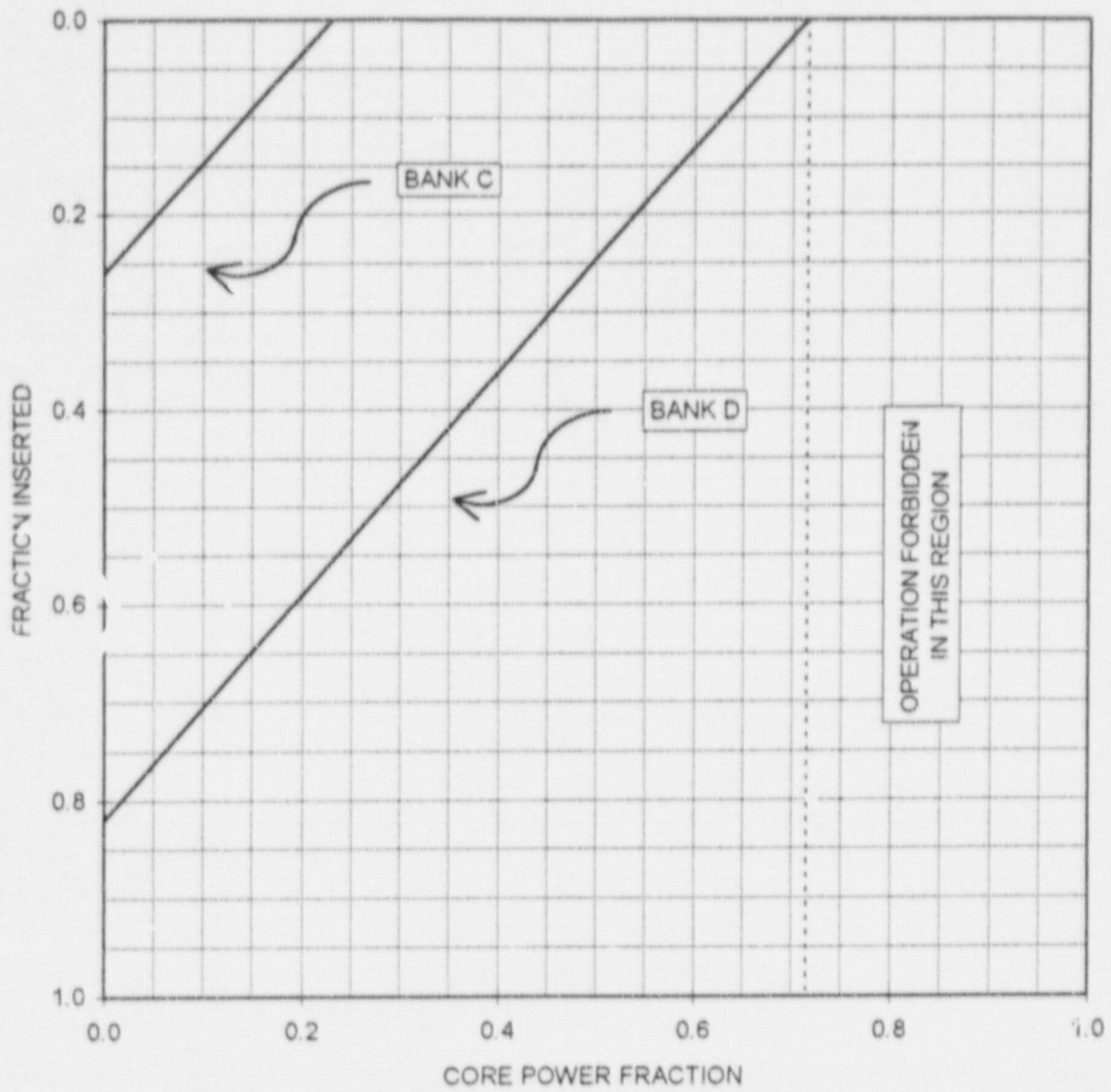

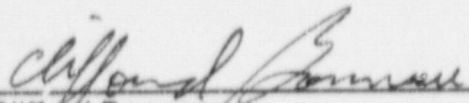

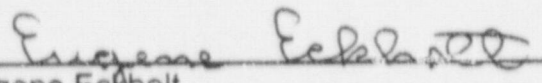


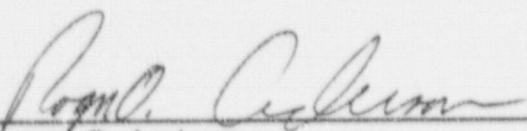
Figure 6: Insertion Limits
100 Step Overlap With One Inoperable Rod
(Technical Specification 3.10.G.4)

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