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U S Nuclear Regulatory Commission
ATTN: Document Control Desk
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PRAIRIE ISLAND NUCLEAR GENERATING PLANT
DOCKET 50-306
LICENSE No. DPR-60
CORE OPERATING LIMITS REPORT (COLR) FOR PRAIRIE ISLAND UNIT 2 CYCLE 22, REVISION 0

The attached COLR revision for Prairie Island Unit 2 Cycle 22 is provided in accordance with the requirements of Technical Specification Section 5.6.5.d.

The limits specified in the attached COLR have been established using NRC approved methodologies.

The Unit 2 COLR has been revised for Cycle 22 to incorporate the following changes:

- Tables 1 and 2 have been updated to incorporate revised bounding V(z) values.
- Table 3 has been updated to incorporate revised minimum shutdown margin limits.
- A reduced number of exposure ranges were calculated in Table 1, therefore new Figures 2a through 2e with revised bounding V(z) values replaced Figures 2a through 2f.
- New Figure 2f replaced Figure 2g for the two tier band bounding V(z) values.
- Text has been deleted or revised to eliminate duplication with the Technical Specifications and Bases.

The Nuclear Management Company has not made new or revised existing Nuclear Regulatory Commission commitments in this letter or the attachment. Please contact Dale Vincent (651-388-1121) if you have any questions related to this report.

Joseph M. Solymossy
Site Vice President, Prairie Island Nuclear Generating Plant

(Copies and attachments shown on page 2)

A001

CC Regional Administrator - Region III, NRC
Senior Resident Inspector, NRC
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Attachment: Core Operating Limits Report - Unit 2 Cycle 22, Revision 0

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

CORE OPERATING LIMITS REPORT

UNIT 2 – CYCLE 22

REVISION 0

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
CORE OPERATING LIMITS REPORT
UNIT 2 - CYCLE 22
REVISION 0

This report provides the values of the limits for Unit 2 Cycle 22 as required by Technical Specification Section 5.6.5. 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 ($F_Q(Z)$) Limits

The Heat Flux Hot Channel Factor, $F_Q(Z)$, shall be limited by the relationships in Technical Specification Bases B3.2.1.

Where:
CFQ = 2.40,
K(z) values are provided in Figure 1.

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

Where:
$F_Q^M(Z)$ is the measured value from the incore flux map

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

Where:
V(Z) values are provided in Figures 2a through 2f and Table 1 and Table 2.

For SR 3.2.1.2 the appropriate factor to meet the $F_Q(Z)$ limit, F_Q^A, is applied to the $F_Q^W(Z)$ when the measured F_Q increases, specified in Table 4.

Reference Technical Specification section: 3.2.1

Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}^N$) Limits

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

Where:
$F_{\Delta H}^{RTP} = 1.77$
PFDH = 0.3
P = Thermal Power / RTP

Reference Technical Specification section: 3.2.2

Isothermal Temperature Coefficient (ITC)

ITC Upper limit:

a. < 5 pcm/°F for power levels ≤ 70% RTP; and
b. < 0 pcm/°F for power levels > 70% RTP

ITC Lower limit:

a. -32.7 pcm/°F

Reference Technical Specification section: 3.1.3.

RCS Pressure, Temperature, and Flow – Departure from Nucleate Boiling (DNB) Limits

Pressurizer pressure limit = 2205 psig
RCS average temperature limit = 564°F
RCS total flow rate limit = 178,000 gpm

Reference Technical Specification section: 3.4.1.

Axial Flux Difference Limits

The axial flux difference limits are provided in Figure 3.

The axial flux difference target band is ±5% when using figures 2a through 2e and Table 1. The axial flux difference target band is ±5% when equal to or above 90% power and ±10% below 90% power when using figure 2f and Table 2.

Reference Technical Specification sections: 3.2.3.

Shutdown Rod Insertion Limits

The shutdown rods shall be fully withdrawn.

Reference Technical Specification section: 3.1.5.

Control Rod Insertion Limits

The control rod banks shall be limited in physical insertion as shown in Figures 4, 5, and 6.
The control rod banks withdrawal sequence shall be Bank A, Bank B, Bank C, and finally Bank D.

The control rod banks shall be withdrawn in 100 step overlap.

Reference Technical Specification sections: 3.1.6.

Shutdown Margin Requirements

Minimum Shutdown Margin requirements are shown in Table 3.

Reference Technical Specification sections: 3.1.1 and 3.1.8.

Refueling Boron Concentrations

The boron concentration of the reactor coolant system and the refueling cavity shall be sufficient to ensure that the more restrictive of the following conditions is met:

a) $K_{eff} \leq 0.95$
b) 2000 ppm
c) The Shutdown Margin specified in Table 3

Reference Technical Specification sections: 3.9.1.

Penalty on F_Q for Small Break LOCA – K(z)

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, no K(z) penalty needs to be applied to calculations of most limiting F_Q values. Thus for the equation in Technical Specification Bases B3.2.1, 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 2, cycle 22 with an operating band of $\pm$ 5% ΔI. 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 range as noted in Table 1. The V(z) penalty for each exposure and axial offset range is shown graphically in Figures 2a – 2e.

An alternate two tier V(z) curve is presented in Table 2 and figure 2f. The operating band is $\pm$5% ΔI at or above 90% power, and $\pm$ 10% ΔI below 90% power. This figure is valid over all exposure ranges.

Table 1
Bounding V(z) Values

Exposure Range	z (ft)	V(z)	z (ft)	V(z)
0.0 – 4.000 GWd/MTU	0.20	1.000	6.30	1.058
Eq AO range: -3% to +8%	0.39	1.000	6.49	1.054
Operating band: ±5% ΔI	0.59	1.000	6.69	1.050
(Startup)	0.79	1.000	6.89	1.049
	0.98	1.000	7.08	1.049
	1.18	1.111	7.28	1.049
	1.38	1.106	7.48	1.052
	1.57	1.101	7.67	1.055
	1.77	1.096	7.87	1.057
	1.97	1.090	8.07	1.058
	2.16	1.084	8.26	1.060
	2.36	1.078	8.46	1.061
	2.56	1.072	8.66	1.062
	2.75	1.066	8.85	1.063
	2.95	1.064	9.05	1.065
	3.15	1.062	9.25	1.066
	3.34	1.062	9.44	1.068
	3.54	1.062	9.64	1.071
	3.74	1.063	9.84	1.073
	3.93	1.063	10.03	1.074
	4.13	1.063	10.23	1.076
	4.33	1.064	10.43	1.079
	4.52	1.065	10.62	1.082
	4.72	1.066	10.82	1.085
	4.92	1.066	11.02	1.000
	5.11	1.065	11.21	1.000
	5.31	1.065	11.41	1.000
	5.51	1.064	11.61	1.000
	5.70	1.063	11.80	1.000
	5.90	1.061	12.00	1.000
	6.10	1.060		

Table 1
Bounding V(z) Values

Exposure Range	z (ft)	V(z)	z (ft)	V(z)
4.000 – 7.000 GWd/MTU	0.20	1.000	6.30	1.064
Eq AO range: -4% to +6%	0.39	1.000	6.49	1.059
Operating band: ±5% ΔI	0.59	1.000	6.69	1.054
(Startup)	0.79	1.000	6.89	1.053
	0.98	1.000	7.08	1.053
	1.18	1.108	7.28	1.053
	1.38	1.103	7.48	1.056
	1.57	1.098	7.67	1.058
	1.77	1.092	7.87	1.060
	1.97	1.087	8.07	1.062
	2.16	1.082	8.26	1.064
	2.36	1.076	8.46	1.064
	2.56	1.071	8.66	1.065
	2.75	1.065	8.85	1.066
	2.95	1.064	9.05	1.068
	3.15	1.063	9.25	1.070
	3.34	1.063	9.44	1.073
	3.54	1.064	9.64	1.076
	3.74	1.065	9.84	1.079
	3.93	1.066	10.03	1.082
	4.13	1.066	10.23	1.085
	4.33	1.068	10.43	1.086
	4.52	1.069	10.62	1.086
	4.72	1.071	10.82	1.087
	4.92	1.072	11.02	1.000
	5.11	1.072	11.21	1.000
	5.31	1.072	11.41	1.000
	5.51	1.071	11.61	1.000
	5.70	1.069	11.80	1.000
	5.90	1.068	12.00	1.000
	6.10	1.066		

Table 1
Bounding V(z) Values

Exposure Range	z (ft)	V(z)	z (ft)	V(z)
7.000 – 10.000 GWd/MTU	0.20	1.000	6.30	1.063
Eq AO range: -6% to +4%	0.39	1.000	6.49	1.061
Operating band: ±5% ΔI	0.59	1.000	6.69	1.058
	0.79	1.000	6.89	1.058
	0.98	1.000	7.08	1.059
	1.18	1.102	7.28	1.060
	1.38	1.097	7.48	1.063
	1.57	1.092	7.67	1.066
	1.77	1.087	7.87	1.068
	1.97	1.081	8.07	1.069
	2.16	1.076	8.26	1.070
	2.36	1.071	8.46	1.070
	2.56	1.068	8.66	1.070
	2.75	1.066	8.85	1.070
	2.95	1.064	9.05	1.071
	3.15	1.062	9.25	1.072
	3.34	1.062	9.44	1.075
	3.54	1.063	9.64	1.077
	3.74	1.064	9.84	1.080
	3.93	1.065	10.03	1.082
	4.13	1.065	10.23	1.085
	4.33	1.066	10.43	1.086
	4.52	1.069	10.62	1.087
	4.72	1.071	10.82	1.088
	4.92	1.071	11.02	1.000
	5.11	1.071	11.21	1.000
	5.31	1.071	11.41	1.000
	5.51	1.070	11.61	1.000
	5.70	1.069	11.80	1.000
	5.90	1.067	12.00	1.000
	6.10	1.066		

Table 1
Bounding V(z) Values

Exposure Range	z (ft)	V(z)	z (ft)	V(z)
10.000 – 14.000 GWd/MTU	0.20	1.000	6.30	1.082
Eq AO range: -6% to +2%	0.39	1.000	6.49	1.086
Operating band: ±5% ΔI	0.59	1.000	6.69	1.090
	0.79	1.000	6.89	1.091
	0.98	1.000	7.08	1.092
	1.18	1.097	7.28	1.092
	1.38	1.094	7.48	1.090
	1.57	1.091	7.67	1.089
	1.77	1.089	7.87	1.087
	1.97	1.087	8.07	1.084
	2.16	1.086	8.26	1.081
	2.36	1.083	8.46	1.079
	2.56	1.079	8.66	1.077
	2.75	1.075	8.85	1.077
	2.95	1.071	9.05	1.079
	3.15	1.066	9.25	1.081
	3.34	1.063	9.44	1.081
	3.54	1.059	9.64	1.081
	3.74	1.056	9.84	1.084
	3.93	1.057	10.03	1.088
	4.13	1.059	10.23	1.093
	4.33	1.061	10.43	1.097
	4.52	1.065	10.62	1.100
	4.72	1.069	10.82	1.104
	4.92	1.072	11.02	1.000
	5.11	1.073	11.21	1.000
	5.31	1.074	11.41	1.000
	5.51	1.075	11.61	1.000
	5.70	1.075	11.80	1.000
	5.90	1.077	12.00	1.000
	6.10	1.079		

Table 1
Bounding V(z) Values

Exposure Range	z (ft)	V(z)	z (ft)	V(z)
14.000 GWd/MTU – EOC	0.20	1.000	6.30	1.115
Eq AO range: -6% to +4%	0.39	1.000	6.49	1.115
Operating band: ±5% ΔI	0.59	1.000	6.69	1.115
	0.79	1.000	6.89	1.114
	0.98	1.000	7.08	1.112
	1.18	1.139	7.28	1.111
	1.38	1.137	7.48	1.107
	1.57	1.134	7.67	1.104
	1.77	1.131	7.87	1.100
	1.97	1.125	8.07	1.096
	2.16	1.120	8.26	1.092
	2.36	1.112	8.46	1.087
	2.56	1.104	8.66	1.081
	2.75	1.096	8.85	1.080
	2.95	1.092	9.05	1.082
	3.15	1.088	9.25	1.084
	3.34	1.083	9.44	1.090
	3.54	1.078	9.64	1.096
	3.74	1.072	9.84	1.102
	3.93	1.073	10.03	1.107
	4.13	1.074	10.23	1.112
	4.33	1.075	10.43	1.112
	4.52	1.078	10.62	1.111
	4.72	1.080	10.82	1.113
	4.92	1.080	11.02	1.000
	5.11	1.080	11.21	1.000
	5.31	1.083	11.41	1.000
	5.51	1.090	11.61	1.000
	5.70	1.098	11.80	1.000
	5.90	1.104	12.00	1.000
	6.10	1.111		

Table 2
Bounding V(z) Values

Exposure Range	z (ft)	V(z)	z (ft)	V(z)
BOC – EOC	0.20	1.000	6.30	1.225
Eq AO range: -6% to +4%	0.39	1.000	6.49	1.225
Operating band:	0.59	1.000	6.69	1.225
±5% ΔI at and above 90% power	0.79	1.000	6.89	1.224
±10% ΔI below 90% power	0.98	1.000	7.08	1.221
	1.18	1.269	7.28	1.218
	1.38	1.264	7.48	1.206
	1.57	1.259	7.67	1.196
	1.77	1.252	7.87	1.182
	1.97	1.241	8.07	1.166
	2.16	1.231	8.26	1.151
	2.36	1.222	8.46	1.132
	2.56	1.214	8.66	1.114
	2.75	1.206	8.85	1.102
	2.95	1.197	9.05	1.094
	3.15	1.188	9.25	1.086
	3.34	1.179	9.44	1.086
	3.54	1.167	9.64	1.087
	3.74	1.156	9.84	1.089
	3.93	1.144	10.03	1.093
	4.13	1.132	10.23	1.097
	4.33	1.126	10.43	1.097
	4.52	1.131	10.62	1.098
	4.72	1.137	10.82	1.100
	4.92	1.148	11.02	1.000
	5.11	1.159	11.21	1.000
	5.31	1.172	11.41	1.000
	5.51	1.185	11.61	1.000
	5.70	1.198	11.80	1.000
	5.90	1.208	12.00	1.000
	6.10	1.217		

Table 3

Minimum Required Shutdown Margin

Plant Conditions	Number of Charging Pumps Running**		
	0-1 Pump	2 Pumps	3 Pumps
Mode 1*	2.0%	2.0%	2.0%
Mode 2*	2.0%	2.0%	2.0%
Mode 3, $T_{ave} \geq 520°F$	2.0%	2.0%	2.0%
Mode 3, $350°F \leq T_{ave} < 520°F$	2.0%	2.0%	2.5%
Mode 4	2.0%	4.5%	7.0%
Mode 5***, $T_{ave} \leq 200°F$	2.0%	4.5%	7.0%
Mode 6, ARI***, $T_{ave} \geq 68°F$	5.26%	5.26%	7.0%
Mode 6, ARO***, $T_{ave} \geq 68°F$	5.26%	5.5%	9.0%
Physics Testing in Mode 2	0.5%	0.5%	0.5%

Operational Mode Definitions, as per TS Table 1.1-1.

* For Modes 1 and 2, minimum shutdown margin requirements are provided by the Rod Insertion Limits.

** Charging pump(s) in service only pertains to steady state operations. It does not include transitory operations. For example, operations such as starting a second charging pump in order to secure the operating pump would fall under the one pump in service column.

*** These values are also applicable for the Unit 2 Cycle 21 end of cycle.

Table 4
F_Q^A Factor

Exposure Range	F_Q^A Factor
BOC – EOC	1.029

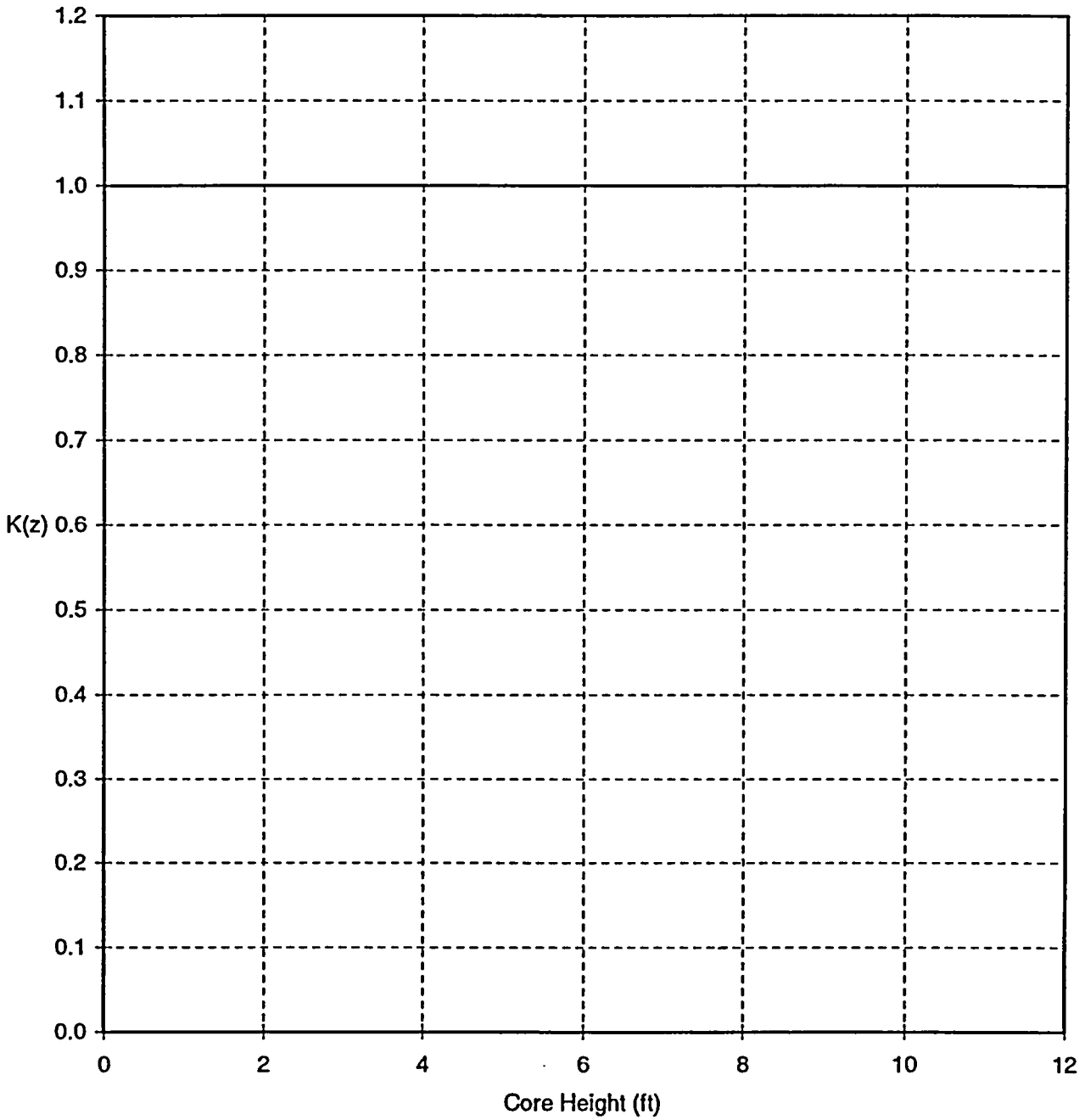

Figure 1: Hot Channel Factor Normalized Operating Envelope

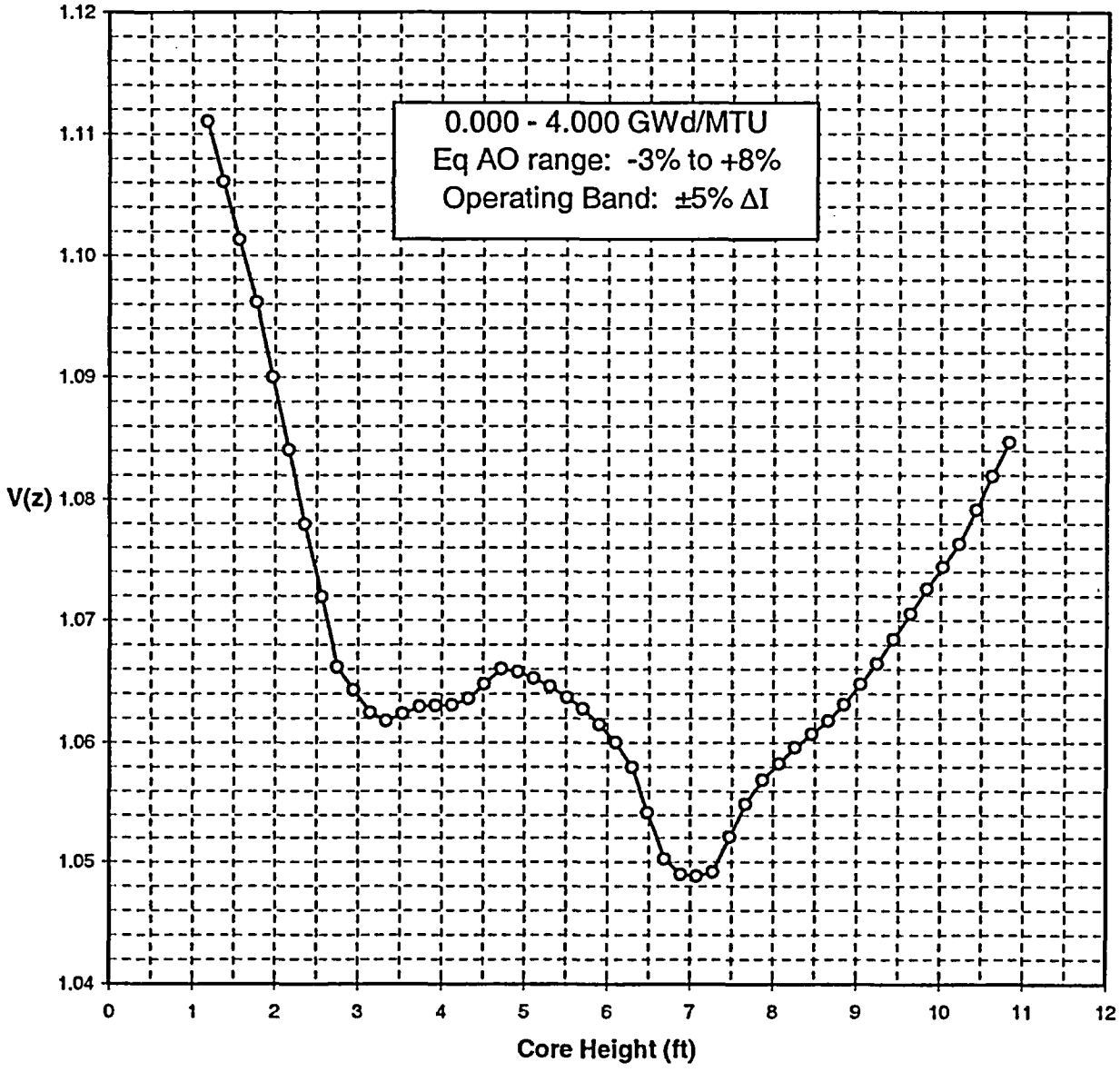

Figure 2a: Bounding V(z) Values From 0 - 4.000 GWd/MTU (Startup)

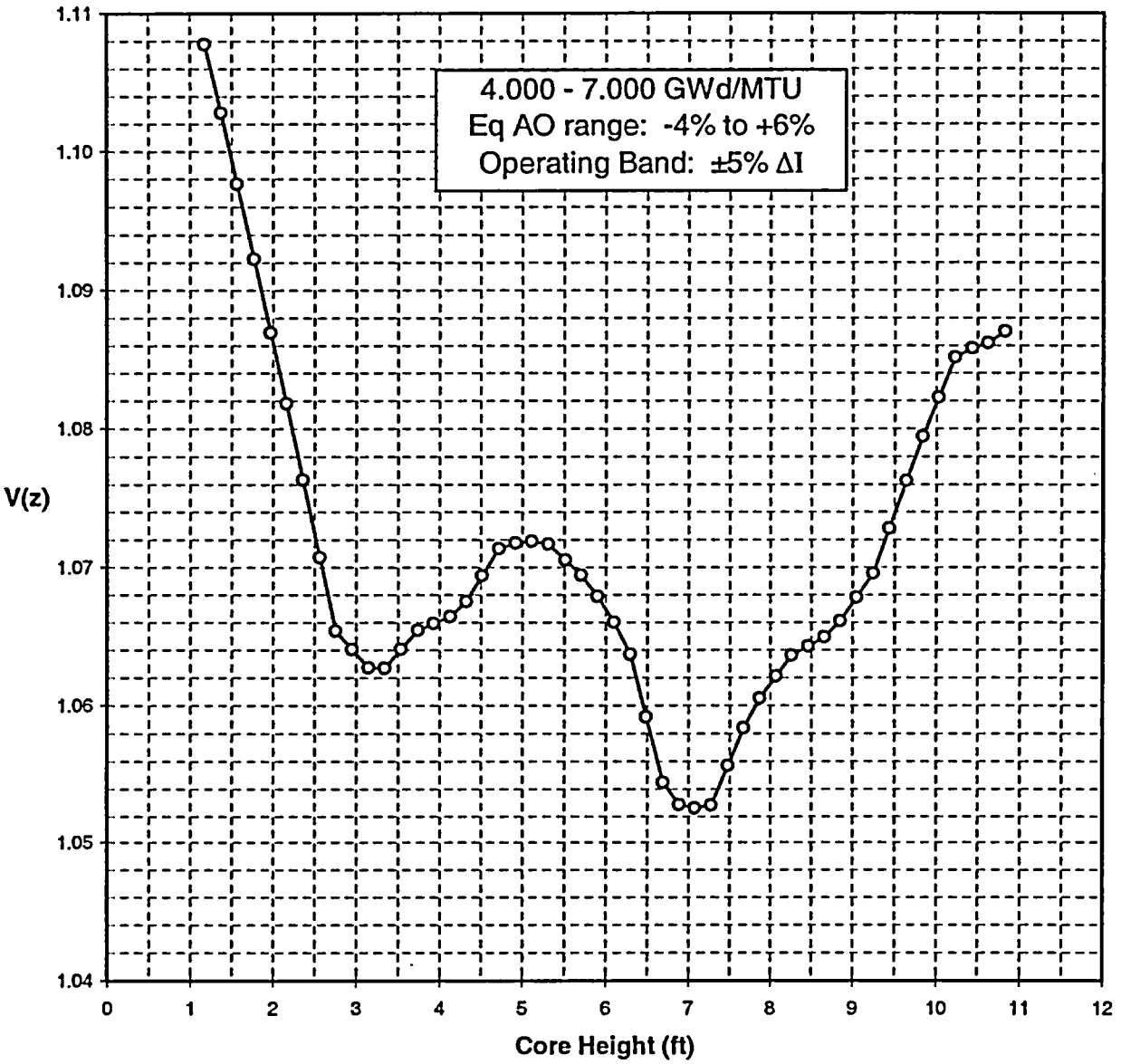

Figure 2b: Bounding V(z) Values From 4.0000 - 7.000 GWd/MTU

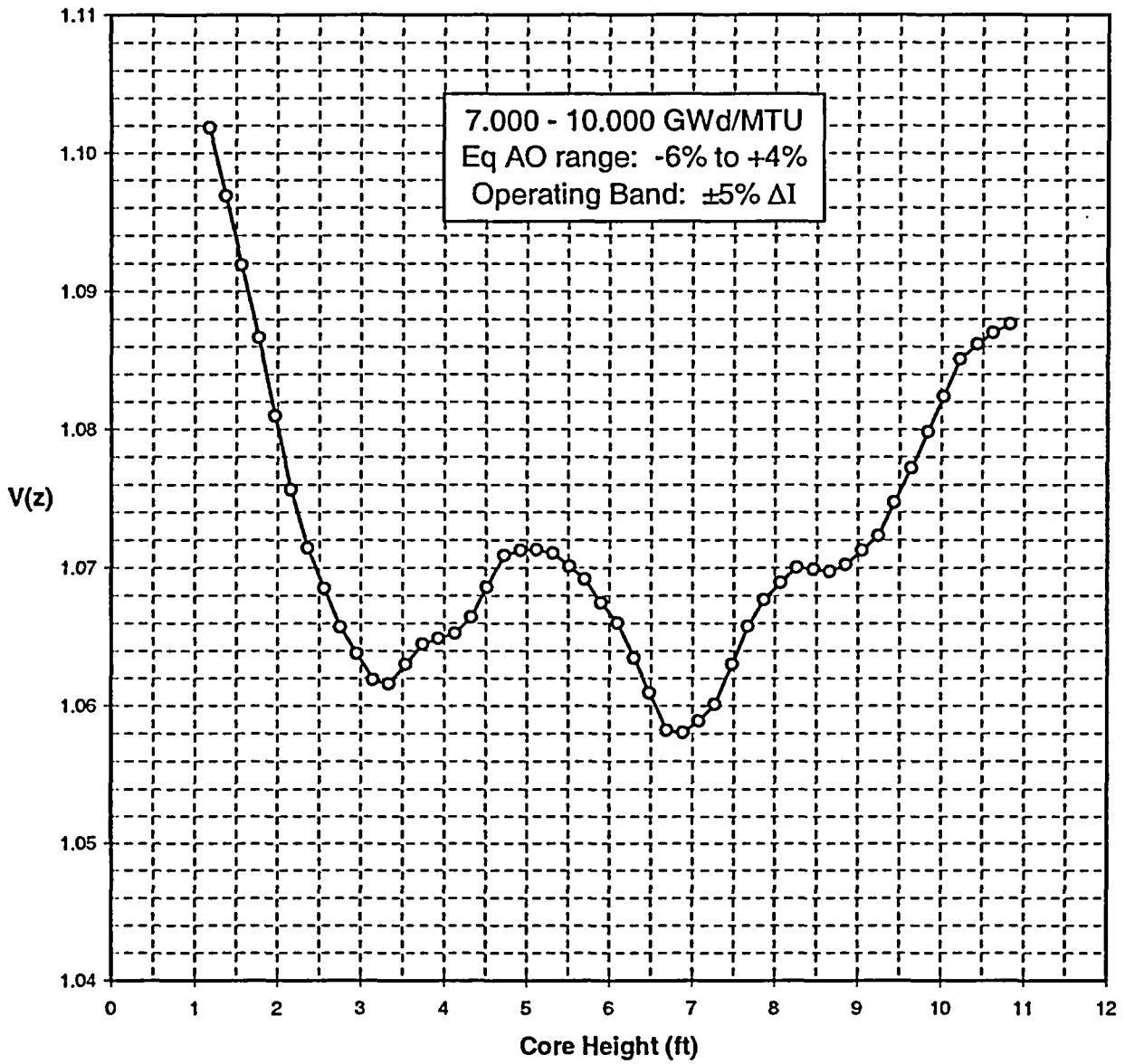

Figure 2c: Bounding V(z) Values From 7.000 - 10.000 GWd/MTU

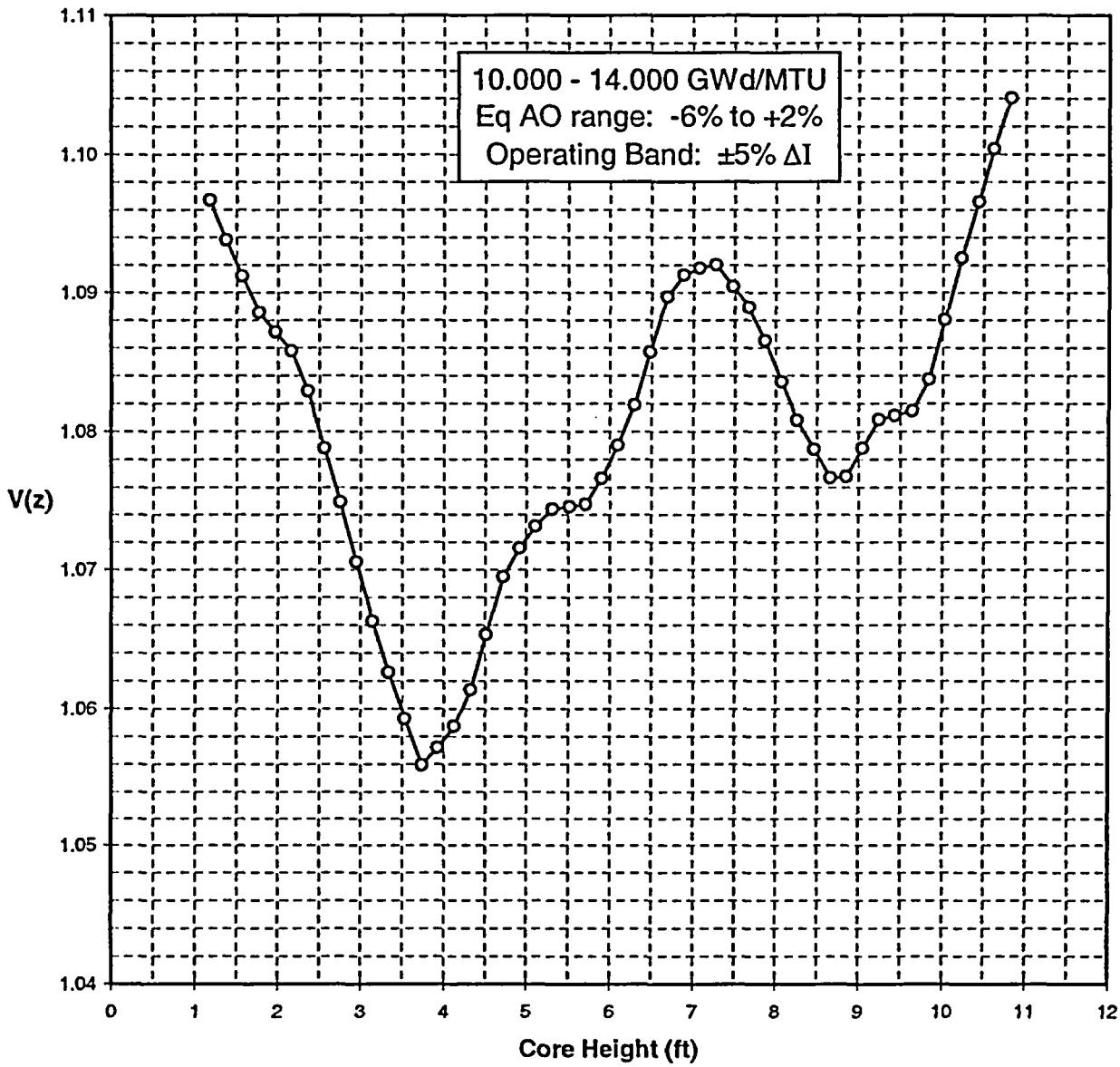

Figure 2d: Bounding V(z) Values From 10.000 - 14.000 GWd/MTU

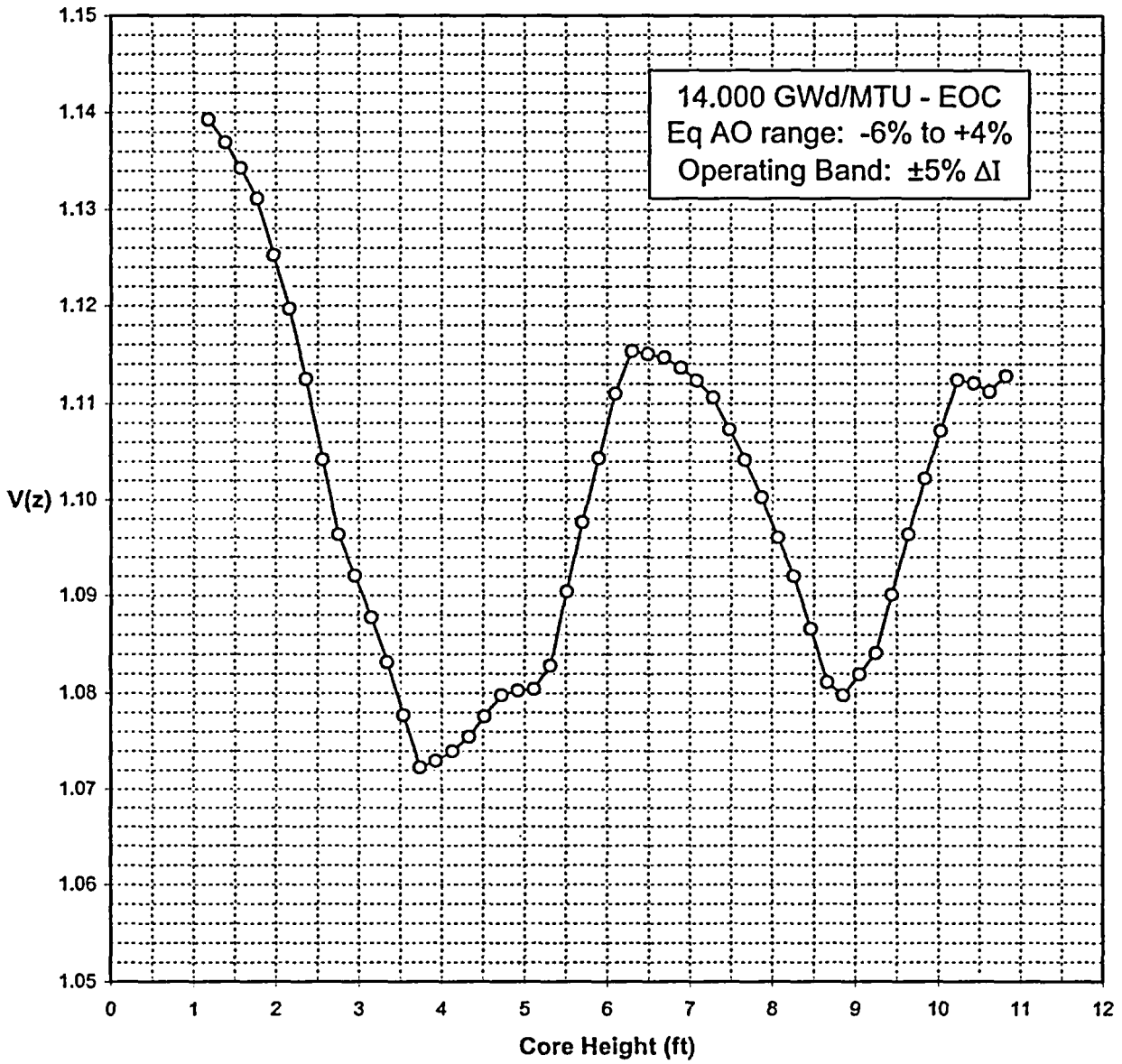

Figure 2e: Bounding V(z) Values From 14.000 GWd/MTU - EOC

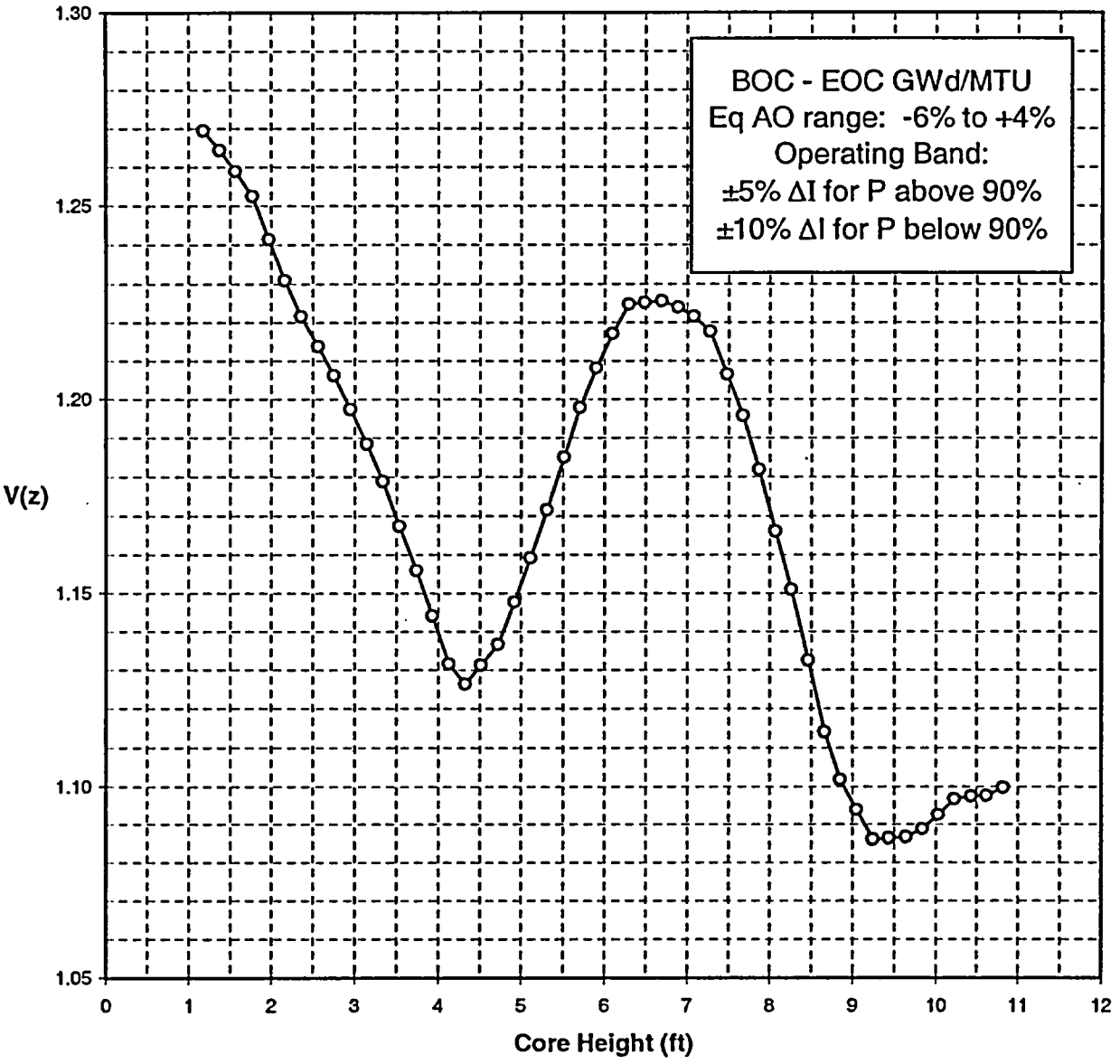

Figure 2f: Bounding V(z) Values From BOC - EOC GWd/MTU

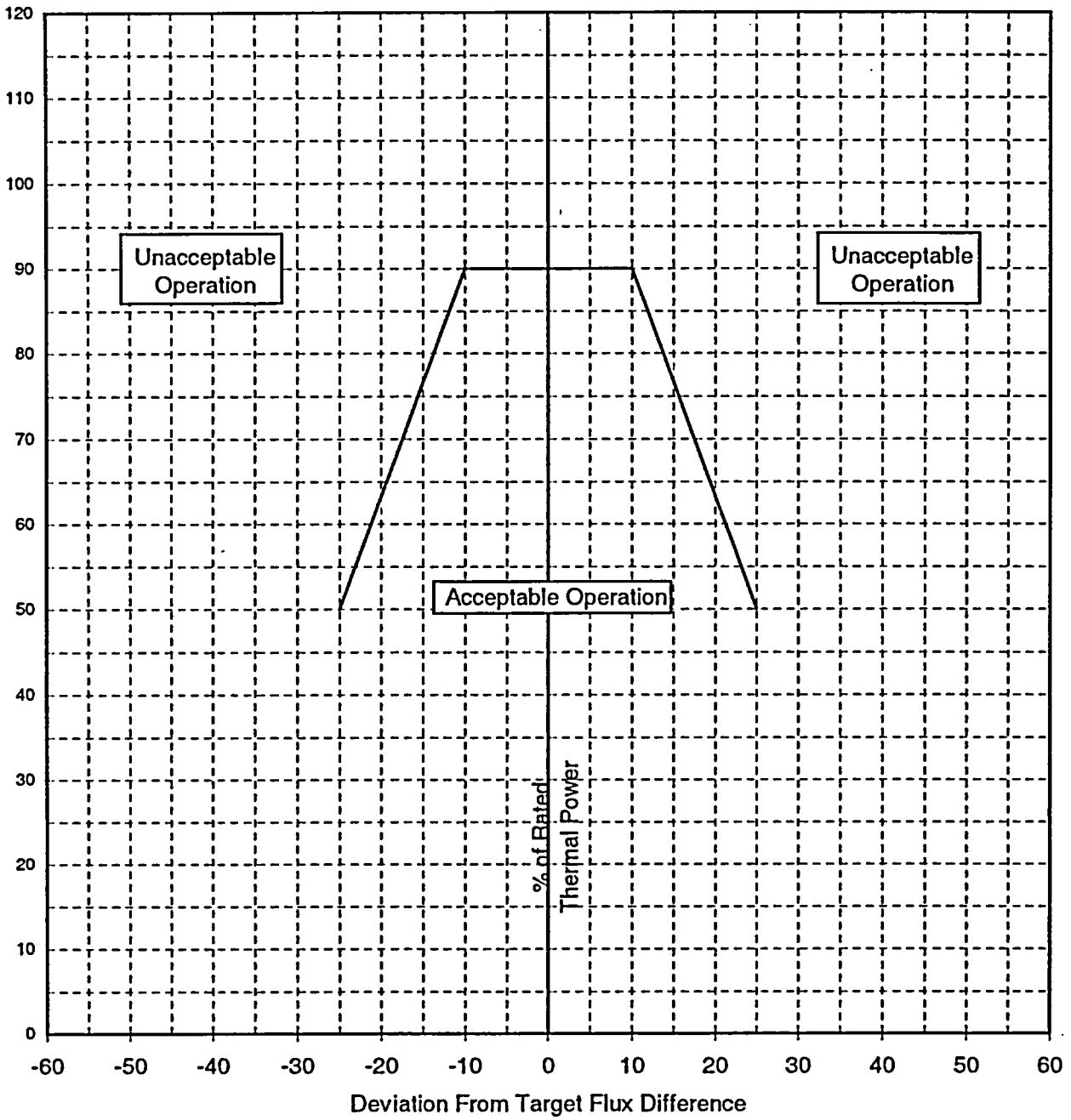

Figure 3: Deviation From Target Flux Difference as a Function of Thermal Power

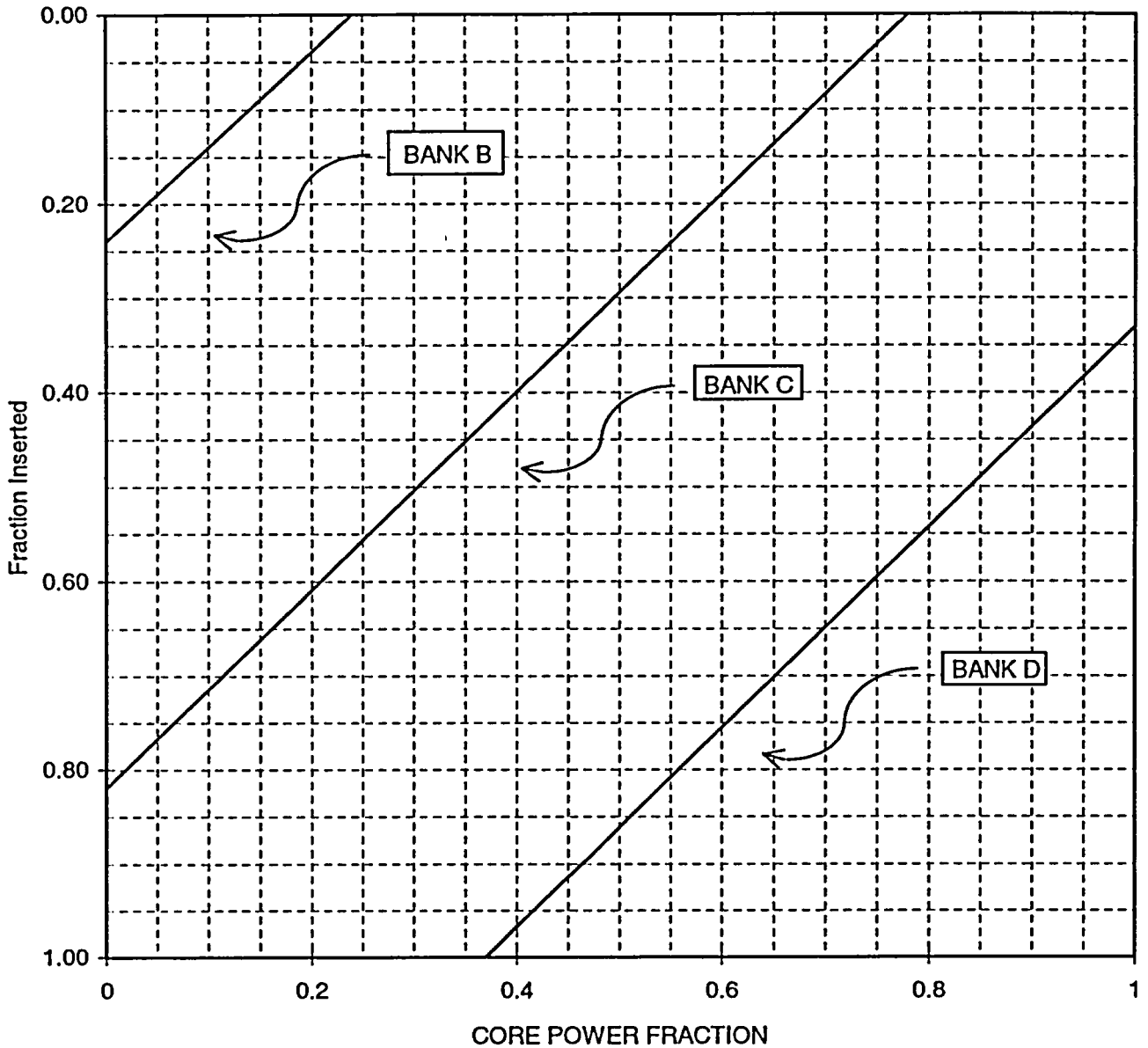

Figure 4: Control Bank Insertion Limits

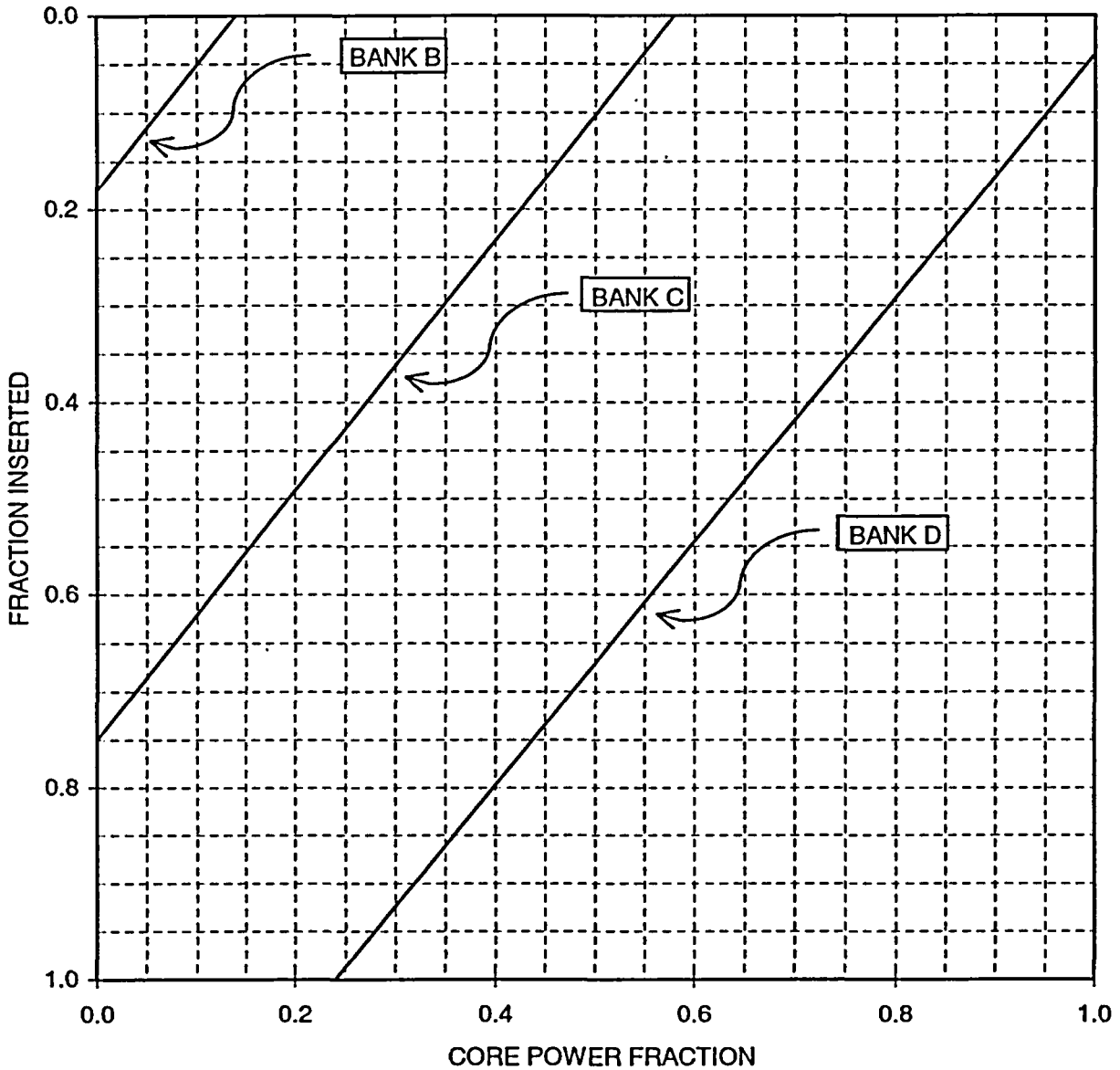

Figure 5: Insertion Limits
100 Step Overlap With One Bottomed Rod
(Technical Specification 3.1.4)

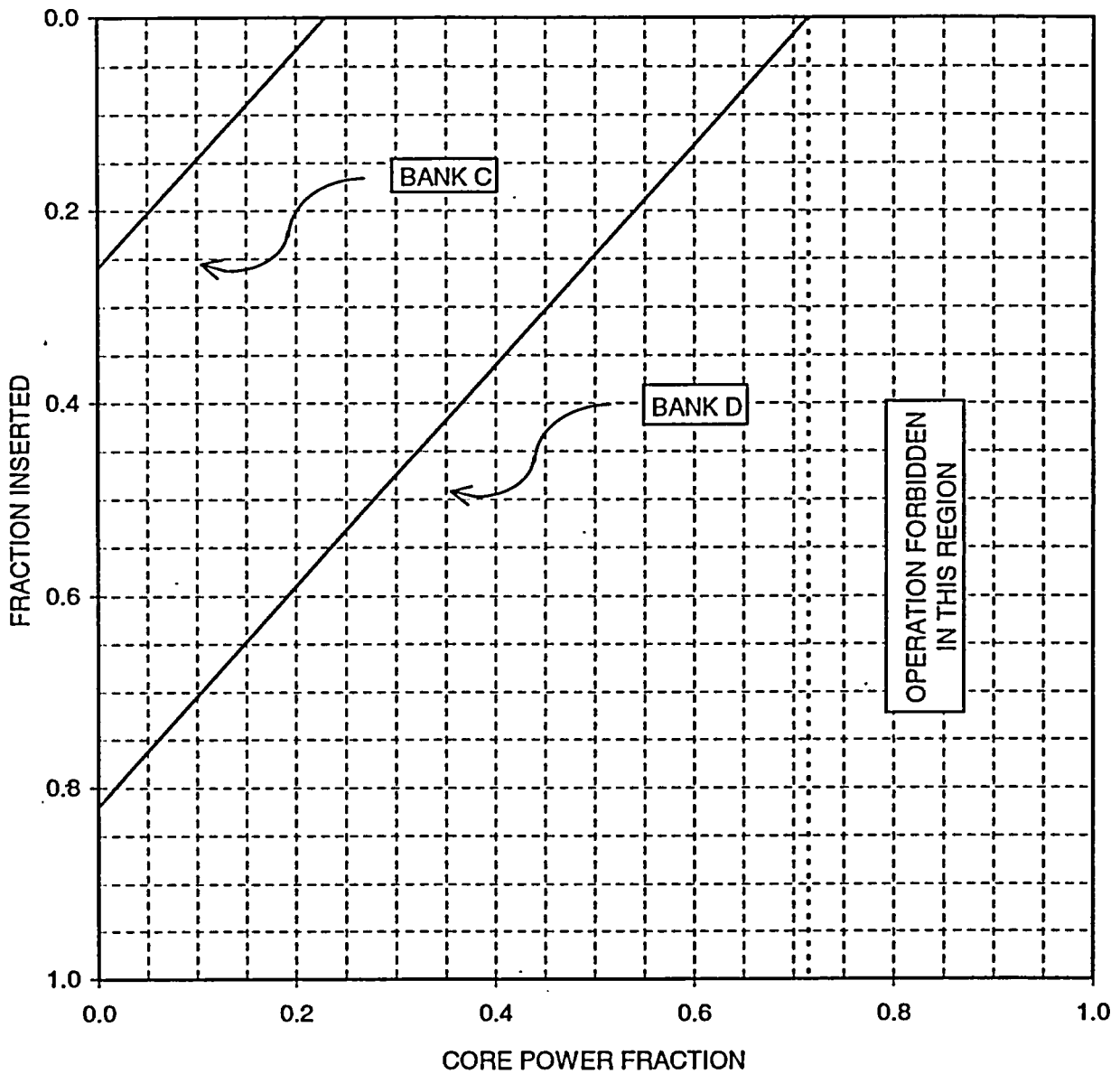

Figure 6: Insertion Limits
100 Step Overlap With One Inoperable Rod
(Technical Specification 3.1.4)

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