CAROLINA POWER AND LIGHT COMPANY

H. B. ROBINSON SEG PLANT

PLANT OPERATING MANUAL

VOLUME 6

PART 5

FUEL MANAGEMENT PROCEDURE

FMP-001

CORE OPERATING LIMITS REPORT (COLR)

REVISION 2

Effective Date 12/21/94

RECOMMENDED BY: _____ 12/20/94
Manager - NSSS — Date

APPROVED BY: J Morris for L JW 12/20/94
Manager - Technical Support — Date

PNSC CONCURRENCE: _____ 12/20/94
PNSC Chairman — Date

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1.0 PURPOSE

1.1 To present the cycle-specific Core Operating Limit Report (COLR) for H. B. Robinson Unit 2.

1.2 To provide a means of incorporating the Core Operating Limits Report (COLR) into the Plant Operating Manual (POM) so it resides in a location that can be controlled and referenced to insure the requirements delineated in NRC Generic Letter 88-16 and Technical Specification 6.9.3.3.d are met.

2.0 REFERENCES

2.1 NRC Generic Letter 88-16, "Removal of Cycle-Specific Parameter Limits from Technical Specifications," October 4, 1988.

2.2 Shearon Harris Nuclear Power Plant Procedure PLP-106, Technical Specification Equipment List Program

2.3 HBR 2 Technical Specifications 1.22, 3.1.3.1, 3.1.3.3, 3.10.1.2, 3.10.1.3, 3.10.1.4, 3.10.2.1, 3.10.2.2, 3.10.2.2.1, 3.10.2.2.2, 3.10.2.7, 3.10.2.9, 3.10.2.11, 6.5.1.6.6.j and 6.9.3.3

2.4 License Amendment No. 141 - Regarding Removal of Cycle-Specific Parameter Limits to Core Operating Limits Report

3.0 RESPONSIBILITIES

3.1 Reactor Engineering and/or the Nuclear Fuel Section is responsible for revising this procedure as changes to the COLR are required. At a minimum, revisions are required once per cycle, at the Beginning Of Cycle, to make the COLR cycle-specific.

3.0 RESPONSIBILITIES (continued)

3.2 Reactor Engineering and Operations are responsible for monitoring plant conditions to insure the Core Operating Limits are met.

4.0 DEFINITIONS/ABBREVIATIONS

4.1 Definitions:

4.1.1 $F_Q(Z)$ - the Heat Flux Hot Channel Factor is the maximum local heat flux on the surface of a fuel rod divided by the average fuel rod heat flux.

4.1.2 F_Q^{RTP} - the cycle-specific F_Q limit at Rated Thermal Power (RTP).

4.1.3 K(Z) - the normalized axial dependence factor for F_Q versus core elevation.

4.1.4 $F_{\Delta H}$ - the Nuclear Enthalpy Rise Hot Channel Factor is the integral of linear power along the rod with the highest integrated power divided by the average rod power.

4.1.5 $F_{\Delta H}^{RTP}$ - the cycle-specific $F_{\Delta H}$ limit at Rated Thermal Power (RTP).

4.1.6 $PF_{\Delta H}$ - the Power Factor Multiplier for $F_{\Delta H}^{RTP}$.

4.1.7 AFD - the Axial Flux Difference is the difference in signals between the top and bottom halves of a two-section excore detector which is proportional to the difference in power between the top and bottom halves of the core.

4.1.8 V(Z) - the ratio of the maximum $F_Q^T(Z)$ produced during and following transient maneuvers to the equilibrium $F_Q^T(Z)$ value at target axial offset conditions.

4.1.9 P - the fraction of rated power (2300 Mwt) at which the core is operating

4.1.10 RTP - Rated Thermal Power, 2300 Mwt

4.0 DEFINITIONS/ABBREVIATIONS (Continued)

4.2 Abbreviations:

4.2.1 POM - Plant Operating Manual

4.2.2 PNSC - Plant Nuclear Safety Committee

4.2.3 COLR - Core Operating Limits Report

4.2.4 MTC - Moderator Temperature Coefficient.

5.0 GENERAL

5.1 Background Information

H. B. Robinson Unit 2, like all other commercial nuclear power plants, is required to operate within specific core operating limits and restrictions as specified in the Technical Specifications. Examples of these limits/restrictions include power dependent rod insertion limits, and limits on $F_Q(Z)$ and $F_{\Delta H}$, among others. Technical Specification changes and NRC approval were required as specific numerical values for these limits/restrictions were revised. If these changes were frequent, e.g. on a cycle-specific basis, or if they were needed on accelerated schedules, considerable administrative burdens were placed on both the NRC and on utility personnel.

To reduce this burden, the CORE OPERATING LIMITS REPORT (COLR) concept was developed in which specific numerical values for certain core operating limits and/or restrictions would be removed from the Technical Specifications and relocated to a COLR document. Using NRC approved methodologies, numerical values for these operating limits and/or restrictions can be updated on an as-needed basis (e.g. each cycle) by simply revising the COLR with appropriate review and notification to the NRC, hence, revisions to the Technical Specifications are not required.

5.0 GENERAL (Continued)

The NRC endorsed the COLR concept by encouraging licensees to develop such a document in Generic Letter 88-16 which provided guidance for relocation of specific numerical values for various core operating limits and/or restrictions to a COLR and indicated that these values could be changed without prior NRC approval so long as an NRC-approved methodology is followed. Future changes and updates would be allowable provided a safety review is performed in accordance with the provisions of 10 CFR 50.59, the COLR is suitably revised, and the NRC is promptly informed of the revision.

The use of a COLR at H. B. Robinson was accepted by the NRC per License Amendment 141. The amendment established requirements for a cycle-specific COLR and for notification of the NRC (Technical Specification 6.9.3.3.d) when revisions are made. Since the COLR is cycle-specific, the COLR will be revised at least once per cycle, that is, at the beginning of the cycle.

5.2 Revision of the COLR

This procedure will be controlled and revised in accordance with TMM-100. Changes to this procedure will require PNSC concurrence and notification to the NRC as part of the revision process.

5.3 Core Operating Limits Report (COLR)

The Core Operating Limits Report is provided in ATTACHMENT 7.1.

6.0 PROCEDURE

None

7.0 ATTACHMENTS

7.1 H. B. Robinson Unit 2, Cycle 16 Core Operating Limits Report, Revision 1

H. B. Robinson Unit 2, Cycle 16

CORE OPERATING LIMITS REPORT

Revision 1

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for H. B. Robinson Unit 2, Cycle 16 has been prepared in accordance with the requirements of Technical Specification 6.9.3.3.

The Technical Specifications affected by this report are listed below:

3.1.3.1	Moderator Temperature Coefficient
3.1.3.3	
3.10.1.2	Shutdown Rod Insertion Limits
3.10.1.3	Control Rod Insertion Limits
3.10.1.4	
3.10.2.1	Heat Flux Hot Channel Factor
3.10.2.2	
3.10.2.2.1	
3.10.2.2.2	
3.10.2.1	Nuclear Enthalpy Rise Hot Channel Factor
3.10.2.2	Axial Flux Difference
3.10.2.2.1	
3.10.2.2.2	
3.10.2.7	
3.10.2.9	
3.10.2.11	
6.9.3.3	Core Operating Limits Reports
6.9.3.3.b	

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report

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 6.9.3.3 and the COLR Section 3.0.

2.1 Moderator Temperature Coefficient (Technical Specifications 3.1.3.1 and 3.1.3.3)

2.1.1 The Moderator Temperature Coefficient (MTC) limits are:

a) The MTC shall be less than or equal to +5.0 pcm/°F at less than 50% of rated power, or

b) The MTC shall be less than or equal to 0.0 pcm/°F at 50% of rated power and above.

2.2 Shutdown Rod Insertion Limits (Technical Specification 3.10.1.2)

2.2.1 The shutdown rods shall be withdrawn to at least 225 steps.

2.3 Control Rod Insertion Limits (Technical Specifications 3.10.1.3 and 3.10.1.4).

2.3.1 The control rods shall be limited in physical insertion as shown in Figure 1.0.

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report

2.4 Heat Flux Hot Channel Factor - $F_Q(Z)$ (Technical Specifications 3.10.2.1, 3.10.2.2, 3.10.2.2.1, and 3.10.2.2.2)

$F_Q(Z) \leq (F_Q^{RTP} / P) \times K(Z)$ for $P > 0.5$

$F_Q(Z) < (F_Q^{RTP} / 0.5) \times K(Z)$ for $P \leq 0.5$

where: P = (Thermal Power / Rated Thermal Power)

2.4.1 $F_Q^{RTP} = 2.40$

2.4.2 K(Z) is specified in Figure 2.0

2.5 Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}$ (Technical Specification 3.10.2.1)

$F_{\Delta H} < F_{\Delta H}^{RTP} (1 + PF_{\Delta H}(1-P))$

where: P = (Thermal Power / Rated Thermal Power)

2.5.1 $F_{\Delta H}^{RTP} = 1.70$

2.5.2 $PF_{\Delta H} = 0.2$

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report

2.6 Axial Flux Difference (Technical Specifications 3.10.2.2, 3.10.2.2.1, 3.10.2.2.2, 3.10.2.7, 3.10.2.9, 3.10.2.11)

2.6.1 The axial flux difference target bands are ± 3% and ± 5% about the target AFD.

2.6.2 V(Z) values for the ± 3% and ± 5% target bands are specified in Figure 3.0.

2.6.3 The AFD Acceptable Operation Limits are specified in Figure 4.0.

COLR for H. B. Robinson Unit 2 Cycle 16

3.0 METHODOLOGY REFERENCES

a) XN-75-27(A), and Supplements 1, 2, 3, 4, and 5, "Exxon Nuclear Neutronics Design Methods for Pressurized Water Reactors," Exxon Nuclear Company.

b) XN-NF-84-73(P), Revision 5, "Advanced Nuclear Fuels Methodology for Pressurized Water Reactors: Analysis of Chapter 15 Events," Advanced Nuclear Fuels Corporation.

c) XN-NF-82-21(A), Revision 1, "Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations," Exxon Nuclear Company.

d) ANF-84-093(A), and Supplement 1, "Steamline Break Methodology for PWRs," Advanced Nuclear Fuels Corporation.

e) XN-75-32(A) Supplements 1, 2, 3, and 4, "Computational Procedure for Evaluating Fuel Rod Bow,"Exxon Nuclear Company.

f) XN-NF-82-49(P), Revision 1 Supplement 1, "Exxon Nuclear Company Evaluation Model Revised EXEM PWR Small Break Model," Siemens Power Corporation.

g) XN-NF-82-20(A), Revision 1 and Supplement 1, 2, 3, and 4, "Exxon Nuclear Company Evaluation Model EXEM/PWR ECCS Model Updates," Exxon Nuclear Company.

XN-NF-82-07(A), Revision 1, Exxon Nuclear Company ECCS Cladding Swelling and Rupture Model," Exxon Nuclear Company.

XN-NF-81-58(A), Revision 2 and Supplements 1, 2, 3, and 4, "RODEX2 Fuel Rod Thermal Response Evaluation Model," Exxon Nuclear Company.

XN-NF-85-16(A), Volume 1 and Supplements 1, 2, and 3, Volume 2, Revision 1, and Supplement 1, "PWR 17x17 Fuel Cooling Test Program," Exxon Nuclear Company.

XN-NF-85-105(A), and Supplement 1, "Scaling of FCTF Based Reflood Heat Transfer Correlation for Other Bundle Designs," Exxon Nuclear Company.

h) XN-NF-78-44(A), "A Generic Analysis of the Control Rod Ejection Transient for Pressurized Water Reactors," Exxon Nuclear Company.

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i) XN-NF-621(A) Revision 1, "Exxon Nuclear DNB Correlation for PWR Fuel Designs," Exxon Nuclear Company.

j) ANF-1224(A) and Supplement 1, "Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel," Advanced Nuclear Fuels Corporation.

k) XN-NF-82-06(A), Revision 1 and Supplements 2, 4, and 5, "Qualification of Exxon Nuclear Fuel for Extended Burnup (PWR)," Exxon Nuclear Company.

p) ANF-88-054(A), "PDC-3: Advance Nuclear Fuels Corporation Power Distribution Control for Pressurized Water Reactors and Application of PDC-3 to H. B. Robinson Unit 2," Advanced Nuclear Fuels Corporation.

q) ANF-88-133(A), and Supplement 1, "Qualification of Advanced Nuclear Fuels PWR Design Methodology for Rod Burnups of 62 GWd/MTU," Advanced Nuclear Fuels Corporation.

Letter, R. A. Copeland (SPC) to F. Orr (USNRC), "Response to NRC Comments about SPC SBLOCA Model," RAC:94:037, March 17, 1994.

Letter, R. A. Copeland (SPC) to F. Orr (USNRC), "Revised Small Break LOCA Application Criteria," RAC:94:108, July 27, 1994.

Letter, G. M. Holahan (USNRC) to R. A. Copeland (SPC), "Acceptance for Referencing of the Topical Report XN-NF-82-49(P), Revision 1, Supplement 1, 'Exxon Nuclear Company Evaluation Model Revised EXEM PWR Small Break Model' (TAC No. M83302)," October 3, 1994.

Note: The current Revision 1 Supplement issue of this report does not reflect the changes established during the review. Since the SER has been issued, the correspondence will be incorporated into the 'A' version along with the changes that have been required by the review, e.g., the use of a 3 radial core region model instead of a single radial region model.)

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report

Control Group Insertion Limits For Three–Loop Operation

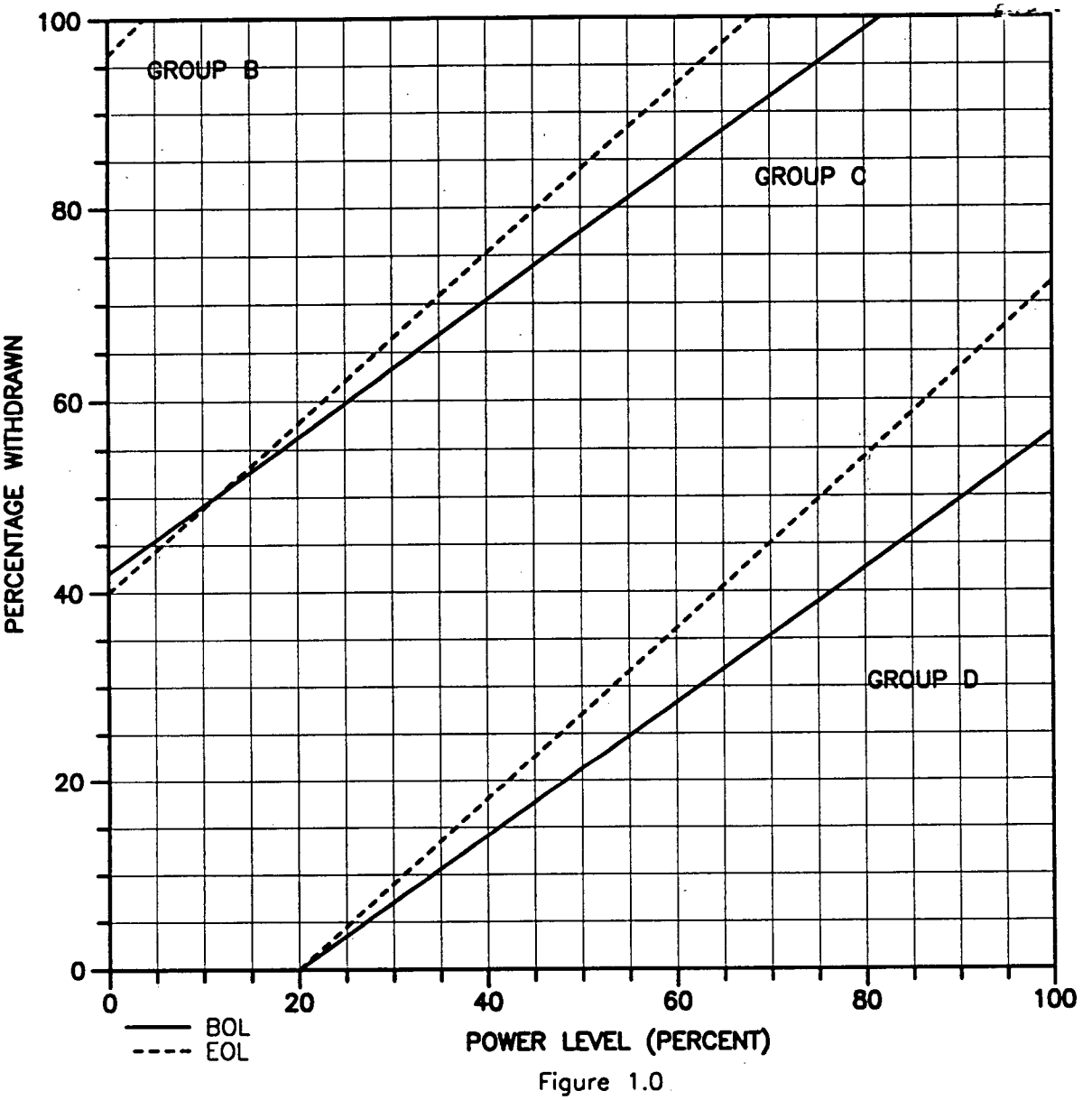


Figure 1.0

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report

NORMALIZED AXIAL DEPENDENCE FACTOR FOR F_Q VERSUS ELEVATION

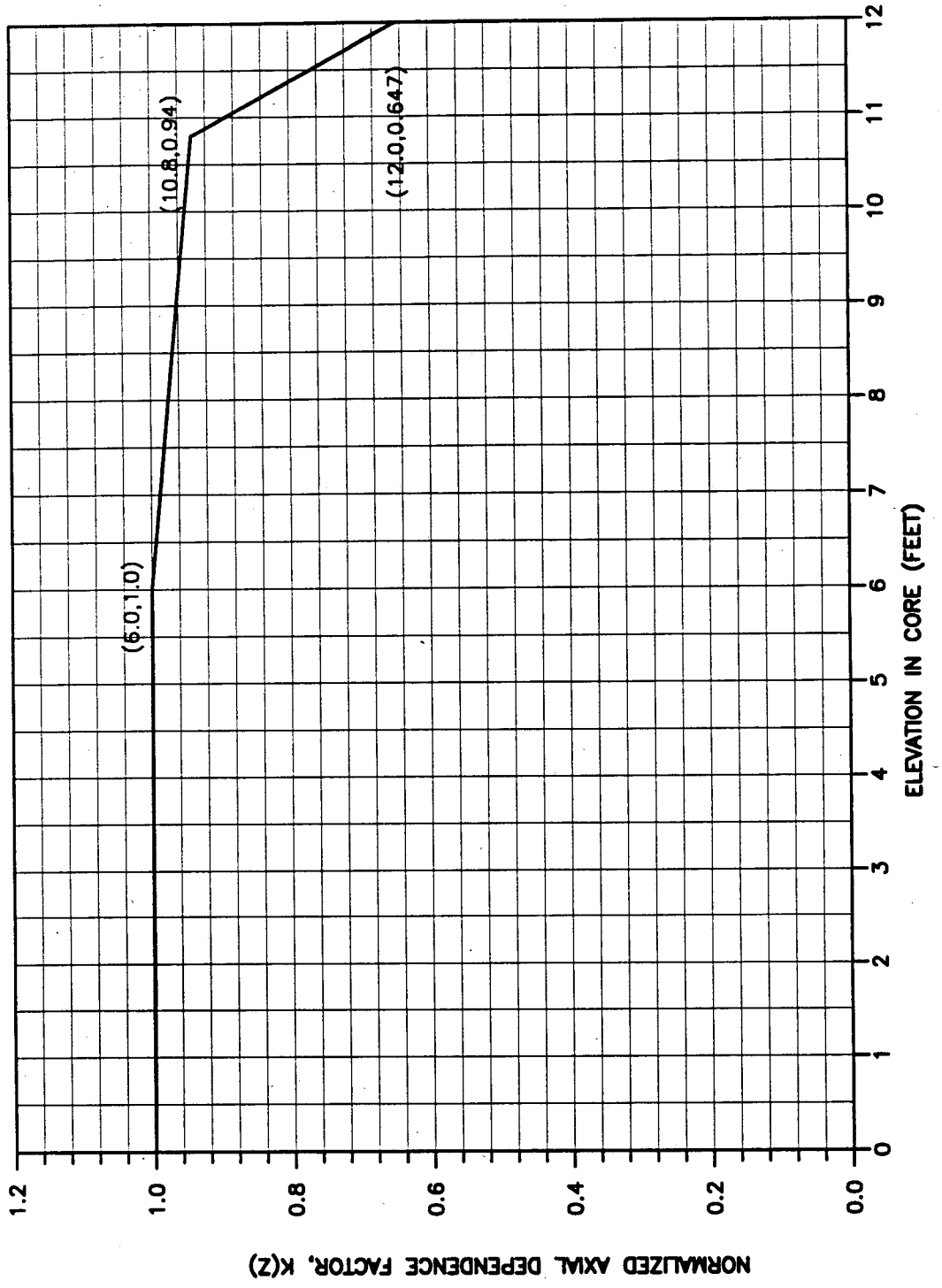
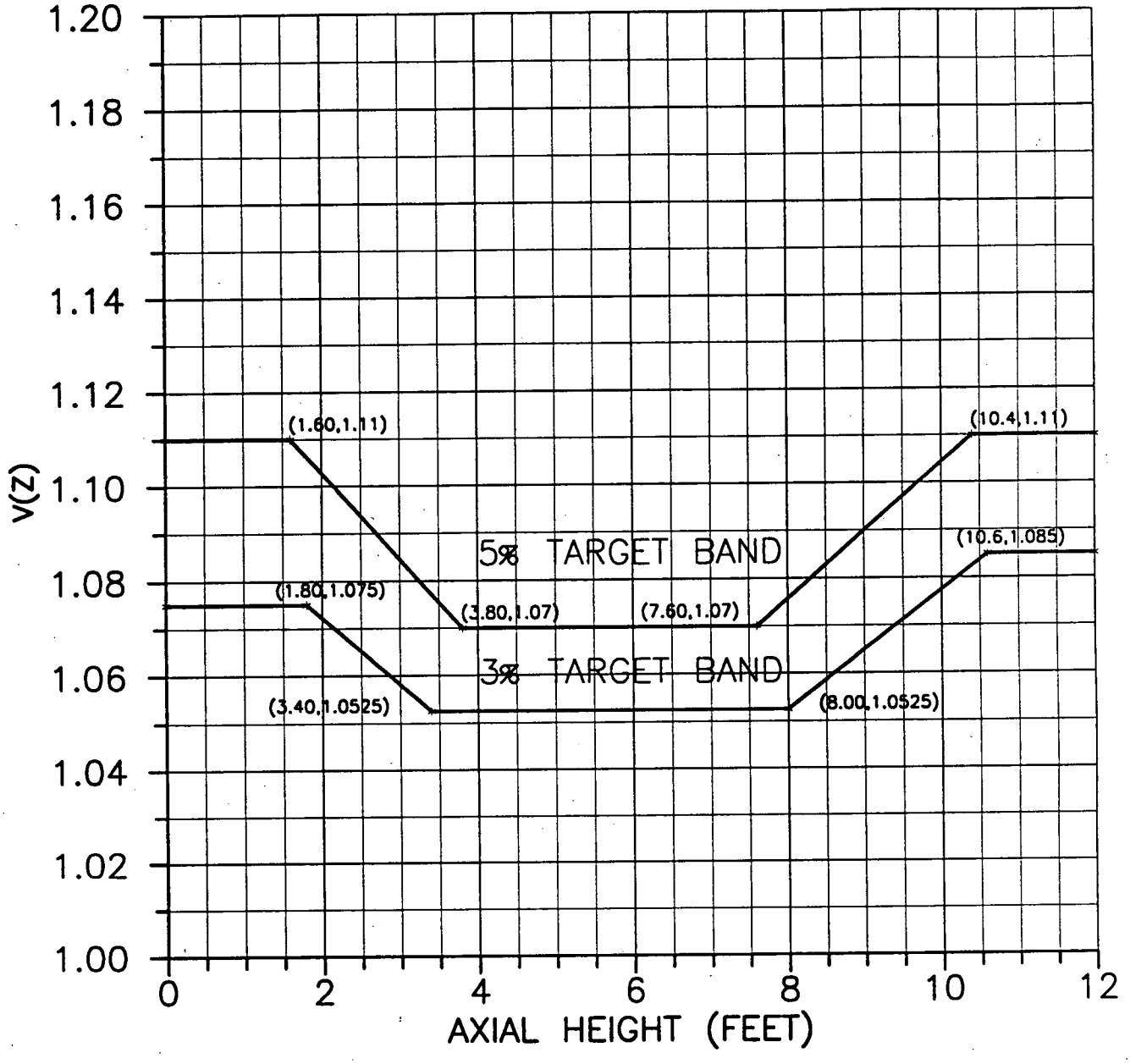


Figure 2.0

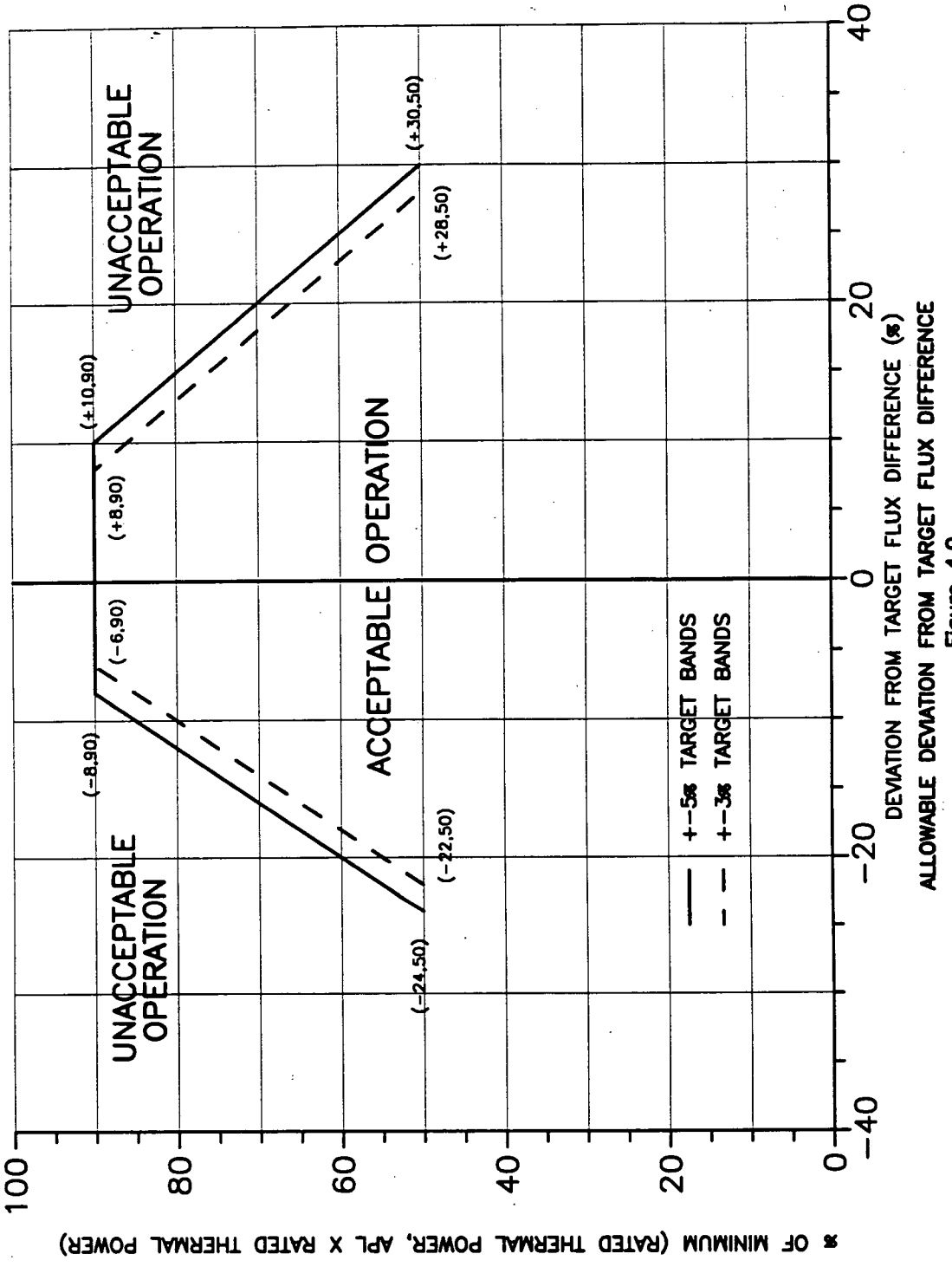
H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report



V(Z) AS A FUNCTION OF CORE HEIGHT

Figure 3.0

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report



ALLOWABLE DEVIATION FROM TARGET FLUX DIFFERENCE
Figure 4.0

H. B. Robinson Unit 2, Cycle 16
Core Operating Limits Report