TS 5.6.5.d

Progress Energy

Serial: RNP-RA/05-0104

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United States Nuclear Regulatory Commission
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

TRANSMITTAL OF CORE OPERATING LIMITS REPORT

Ladies and Gentlemen:

In accordance with Technical Specifications 5.6.5.d, Carolina Power and Light Company, also known as Progress Energy Carolinas, Inc., is transmitting the H. B. Robinson Steam Electric Plant, Unit No. 2, Core Operating Limits Report (COLR) for Cycle 24.

If you have any questions concerning this matter, please contact me at (843) 857-1253.

Sincerely,

C. T. Baucom
Supervisor – Licensing/Regulatory Programs

RAC/rac

Attachment

c: Dr. W. D. Travers, NRC, Region II
NRC Resident Inspector, HBRSEP
C. P. Patel, NRC, NRR

A001

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United States Nuclear Regulatory Commission
Attachment to Serial: RNP-RA/05-0104
13 pages including cover page

H. B. ROBINSON STEAM ELECTRIC PLANT (HBRSEP), UNIT NO. 2

CYCLE 24 CORE OPERATING LIMITS REPORT, REVISION 0

Note: This report is Attachment 10.1 to HBRSEP, Unit No. 2, Fuel Management Procedure (FMP) - 001

HBRSEP UNIT NO. 2, CYCLE 24
CORE OPERATING LIMITS REPORT
REVISION 0

1.0 OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for HBRSEP Unit No. 2, Cycle 24 has been prepared per EC 58475 in accordance with the requirements of ITS 5.6.5.

The Improved Technical Specifications affected by this report and the methodologies used for the various parameters are listed below.

Parameter	ITS Reference	Applicable Methodology (Section 3.0 Number)
MTC	3.1.3	1, 2, 4, 15, 18, 19, 22
Shutdown Bank RILs	3.1.5	1, 2, 4, 8, 15, 18, 19, 22
Control Bank RILs	3.1.6	1, 2, 4, 8, 15, 18, 19, 22
$F_Q^V(Z)$	3.2.1, 3.2.3	1, 2, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 18, 19, 21, 22
$F_{\Delta H}$	3.2.2, 3.2.3	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22
AFD	3.2.1, 3.2.3	1, 2, 6, 7, 12, 13, 14, 15, 16, 18, 19, 21, 22
Shutdown Margin Requirements	3.1.1, 3.4.5, 3.4.6	1, 2, 4, 8, 15, 18, 19, 22
Refueling Boron Requirements	3.9.1	1, 2, 4, 8, 18, 19, 22
COLR	5.6.5	None

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 ITS 5.6.5 and the COLR Section 3.0.

2.1 Moderator Temperature Coefficient (ITS 3.1.3)

2.1.1 The Moderator Temperature Coefficient (MTC) limits are:

a) The Positive MTC (ARO) shall be less than or equal to +5.0 pcm/°F for power levels up to 50% RTP, and

b) The Positive MTC (ARO) shall be less than or equal to 0.0 pcm/°F at 50% RTP and above.

c) The Negative MTC (ARO/RTP) shall be less negative than -40.0 pcm/°F.

2.1.2 The 300 ppm Surveillance limit is:

At an equilibrium RTP-ARO boron concentration of 300 ppm the MTC shall be less negative than or equal to -32.49 pcm/°F.

2.1.3 The 60 ppm Surveillance limit is:

At an equilibrium RTP-ARO boron concentration of 60 ppm the MTC shall be less negative than or equal to -36.68 pcm/°F.

2.2 Shutdown Banks Insertion Limits (ITS 3.1.5)

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

2.3 Control Bank Insertion Limits (ITS 3.1.6)

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

2.4 **Heat Flux Hot Channel Factor - F_Q^V (Z) (ITS 3.2.1, 3.2.3)**

$F_Q^V(Z) \leq (CFQ/P) \times K(Z)$ for $P > 0.5$

$F_Q^V(Z) < (CFQ/0.5) \times K(Z)$ for $P \leq 0.5$

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

2.4.1 CFQ = 2.46 for ROB-14, ROB-16, ROB-17, ROB-18, ROB-19, ROB-20 and ROB2-24 reload batches

2.4.2 K(Z) is specified in Figure 2.0

2.5 **Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}$ (ITS 3.2.2, 3.2.3)**

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

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

2.5.1 $F_{\Delta H}$ is the measured $F_{\Delta H}^N$ multiplied by the measurement uncertainty (1.04)

2.5.2 $F_{\Delta H}^{RTP}$ = 1.80 for ROB-14, ROB-16, ROB-17, ROB-18, ROB-19, ROB-20 and ROB2-24 reload batches

2.5.3 $PF_{\Delta H}$ = 0.2

2.6 **Axial Flux Difference (ITS 3.2.1, 3.2.3)**

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 Figures 3.1 and 3.2

2.6.3 The AFD Acceptable Operation Limits are specified in Figure 4.0

2.7 **Shutdown Margin Requirements (SDM) (ITS 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.1.8, 3.4.5, 3.4.6, 3.9.1)**

2.7.1 The Mode 1 and Mode 2 required SDM versus RCS boron concentration is presented in Figure 5.0.

2.7.2 The Mode 3 SDM requirements are as follows:

a) With at least 2 reactor coolant pumps in operation, the SDM shall be greater than or equal to that specified in Figure 5.0.

b) With less than 2 reactor coolant pumps in operation and the rod control system capable of rod withdrawal, the SDM shall be greater than or equal to 4% Δk/k.

c) With less than 2 reactor coolant pumps in operation and with the rod control system not capable of rod withdrawal, the SDM shall be greater than or equal to that specified in Figure 5.0.

2.7.3 The Mode 4 SDM requirements are as follows:

a) With at least 2 reactor coolant pumps in operation, the SDM shall be greater than or equal to that specified in Figure 5.0.

b) With less than 2 reactor coolant pumps in operation and the rod control system capable of rod withdrawal, the SDM shall be greater than or equal to 4% Δk/k.

c) With less than 2 reactor coolant pumps in operation and with the rod control system not capable of rod withdrawal, the SDM shall be greater than or equal to that specified in Figure 5.0.

2.7.4 The minimum required SDM for Mode 5 is 1% Δk/k.

2.7.5 The minimum required SDM for Mode 6 is 6% Δk/k.

2.8 **Refueling Boron Concentration (ITS 3.9.1)**

2.8.1 In Mode 6 the minimum boron concentration shall be 1950 ppm.

3.0 METHODOLOGY REFERENCES

1) Not Used For Cycle 24

2) XN-NF-84-73(A), Revision 5, "Exxon Nuclear Methodology For PWRs: Analysis of Chapter 15 Events," Siemens Power Corporation, October 1990.

3) XN-NF-82-21(A), Revision 1, "Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations," Exxon Nuclear Company, September 1983.

4) EMF-84-093(A), Revision 1, "Steamline Break Methodology for PWRs," Siemens Power Corporation, February 1999.

5) XN-75-32(A) Supplements 1, 2, 3, and 4, "Computational Procedure for Evaluating Fuel Rod Bow," Exxon Nuclear Company, October 1983.

6) XN-NF-82-49(A), Revision 1 (April 1989) and Supplement 1 (December 1994), "Exxon Nuclear Company Evaluation Model Revised EXEM PWR Small Break Model," Siemens Power Corporation.

7) EMF-2087(A), "SEM/PWR-98: ECCS Evaluation Model for PWR LBLOCA Applications," Siemens Power Corporation, June 1999.

8) XN-NF-78-44(A)," A Generic Analysis of the Control Rod Ejection Transient for Pressurized Water Reactors," Exxon Nuclear Company, October 1983

9) Not Used For Cycle 24

10) Not Used For Cycle 24

11) 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, October 1986.

12) Not Used For Cycle 24

13) Not Used For Cycle 24

14) Not Used For Cycle 24

15) Not Used For Cycle 24

16) ANF-88-054(A), "PDC-3: Advanced 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, October 1990.

17) 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, December 1991.

18) ANF-89-151(A), and correspondence "ANF-RELAP Methodology for Pressurized Water Reactors: Analysis of Non-LOCA Chapter 15 Events," Advanced Nuclear Fuels Corporation, May 1992.

19) EMF-92-081(A), Revision 1, "Statistical Setpoint/Transient Methodology for Westinghouse Type Reactors," Siemens Power Corporation, February 2000.

20) EMF-92-153(A) and Supplement 1, Revision 1, "HTP: Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel," Siemens Power Corporation, January 2005.

21) XN-NF-85-92(A), "Exxon Nuclear Uranium Dioxide/Gadolinia Irradiation Examination and Thermal Conductivity Results," Exxon Nuclear Company, November 1986.

22) EMF-96-029(A), Volume 1, Volume 2 and Attachment, "Reactor Analysis System for PWRs," Siemens Power Corporation, January 1997.

23) EMF-92-116(A), "Generic Mechanical Design Criteria for PWR Fuel Designs," Siemens Power Corporation, February 1999.

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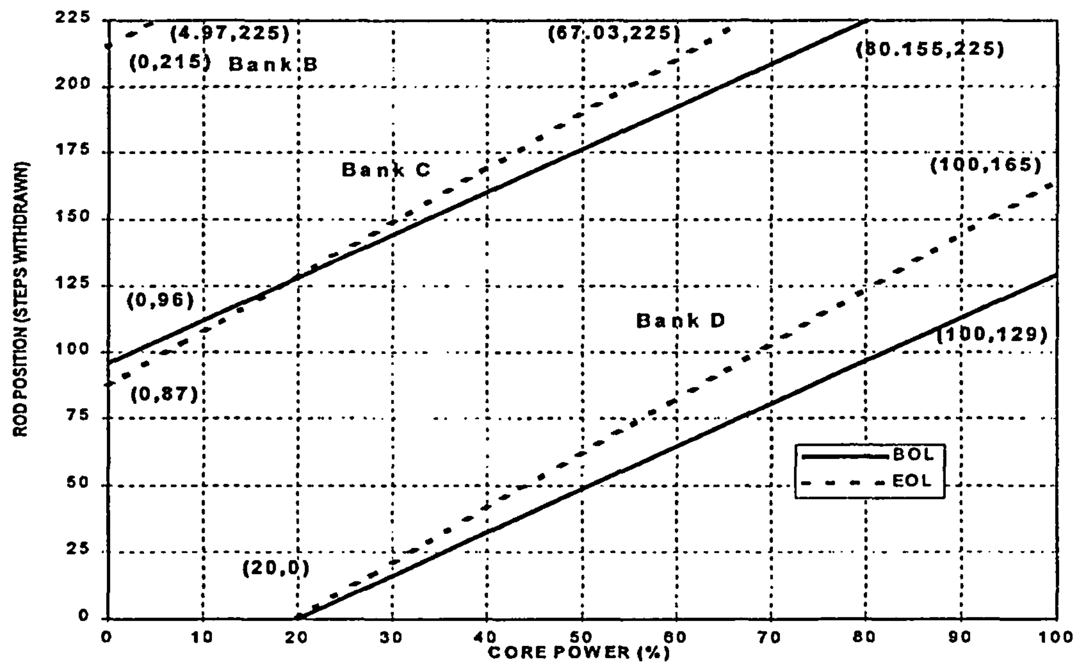
Figure 1.0, Control Group Insertion Limits for Three Loop Operation



NOTE: The breakpoint between BOL and EOL RIL occurs at 50% of the cycle as defined by burnup. For Cycle 24, this burnup occurs at 257 EFPDs (9000 MWD/MTU). Control rod banks shall always be withdrawn and inserted in the prescribed sequence. For withdrawal, the sequence is Control "A", Control "B", Control "C", and Control "D". The insertion sequence is the reverse of the withdrawal sequence. Overlap of consecutive control banks shall not exceed the prescribed setpoint for automatic overlap. The setpoint is 97 steps. Control bank A must be withdrawn from the core prior to power operation. At BOL and 0% core power, Control bank B will be at or above step 224.

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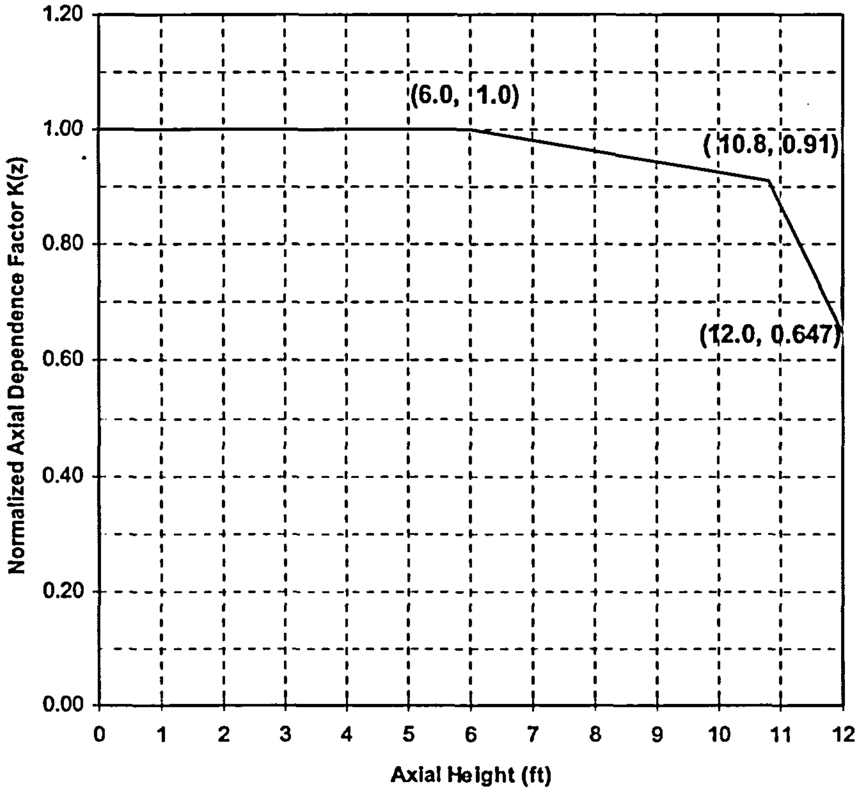
Figure 2.0, Normalized Axial Dependence Factor K(z) for Fq Versus Elevation



NOTE: For power levels below 32% RTP, the K(z) at all axial levels is 1.0. It is conservative to apply the above figure to power levels below 32% RTP.

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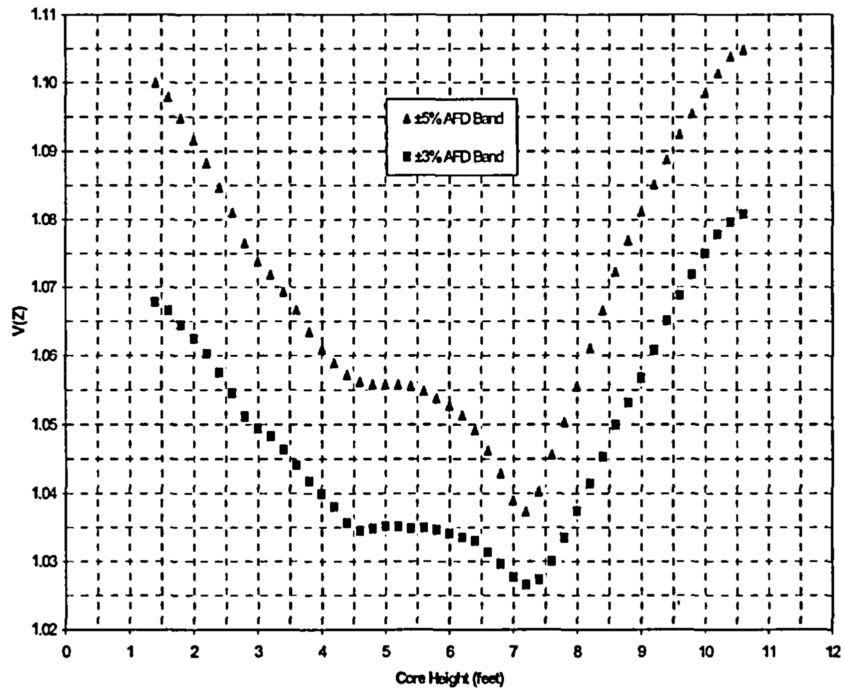
Figure 3.1 V(z) as a Function of Core Height



Height (Feet)	±5% V(Z)	±3% V(Z)
*0.0	1.0000	1.0000
*0.2	1.0000	1.0000
*0.4	1.0000	1.0000
*0.6	1.0000	1.0000
*0.8	1.0000	1.0000
*1.0	1.0000	1.0000
*1.2	1.0000	1.0000
1.4	1.0999	1.0679
1.6	1.0979	1.0666
1.8	1.0948	1.0644
2.0	1.0916	1.0624
2.2	1.0883	1.0603
2.4	1.0846	1.0575
2.6	1.0810	1.0545
2.8	1.0765	1.0511
3.0	1.0737	1.0494
3.2	1.0718	1.0483
3.4	1.0693	1.0463
3.6	1.0666	1.0441
3.8	1.0634	1.0418
4.0	1.0609	1.0399
4.2	1.0589	1.0380
4.4	1.0571	1.0356
4.6	1.0562	1.0345
4.8	1.0558	1.0348
5.0	1.0558	1.0352
5.2	1.0558	1.0351
5.4	1.0556	1.0349
5.6	1.0548	1.0349
5.8	1.0538	1.0347
6.0	1.0527	1.0341
6.2	1.0513	1.0335
6.4	1.0491	1.0330
6.6	1.0462	1.0313
6.8	1.0428	1.0297
7.0	1.0389	1.0277
7.2	1.0373	1.0266
7.4	1.0402	1.0273
7.6	1.0456	1.0300
7.8	1.0503	1.0335
8.0	1.0555	1.0374
8.2	1.0610	1.0414
8.4	1.0666	1.0453
8.6	1.0722	1.0499
8.8	1.0769	1.0531
9.0	1.0811	1.0567
9.2	1.0851	1.0608
9.4	1.0888	1.0651
9.6	1.0925	1.0688
9.8	1.0955	1.0719
10.0	1.0985	1.0750
10.2	1.1014	1.0778
10.4	1.1038	1.0796
10.6	1.1048	1.0808
*10.8	1.0000	1.0000
*11.0	1.0000	1.0000
*11.2	1.0000	1.0000
*11.4	1.0000	1.0000
*11.6	1.0000	1.0000
*11.8	1.0000	1.0000
*12.0	1.0000	1.0000

Note: V(z) data applicable for $0 \leq$ burnup < 11,000 MWD/MTU.

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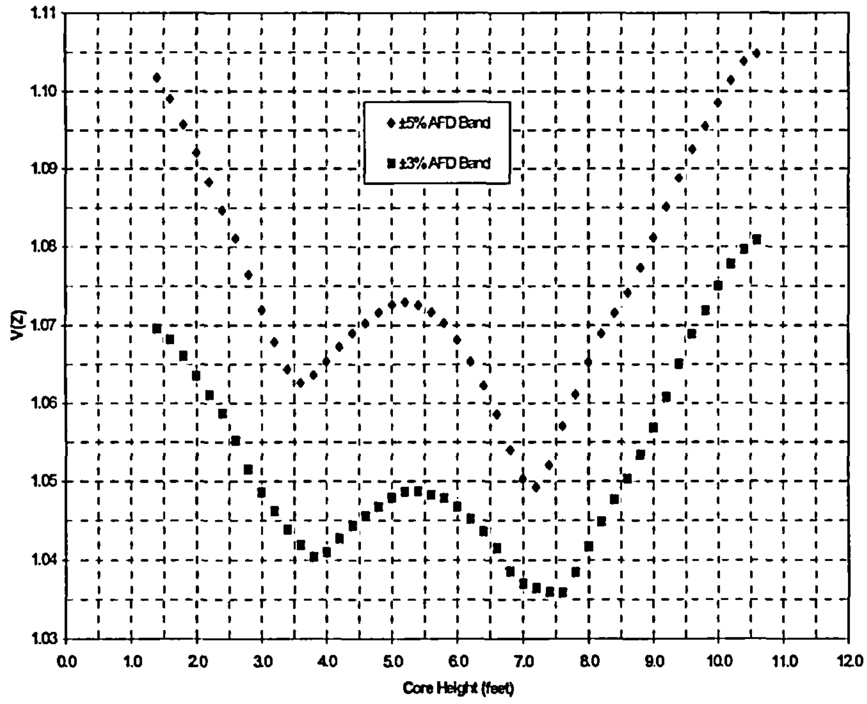
Figure 3.2 V(z) as a Function of Core Height



Height (Feet)	±5% V(Z)	±3% V(Z)
*0.0	1.0000	1.0000
*0.2	1.0000	1.0000
*0.4	1.0000	1.0000
*0.6	1.0000	1.0000
*0.8	1.0000	1.0000
*1.0	1.0000	1.0000
*1.2	1.0000	1.0000
1.4	1.1017	1.0696
1.6	1.0990	1.0682
1.8	1.0957	1.0660
2.0	1.0920	1.0635
2.2	1.0883	1.0611
2.4	1.0846	1.0587
2.6	1.0810	1.0552
2.8	1.0764	1.0515
3.0	1.0719	1.0486
3.2	1.0678	1.0462
3.4	1.0644	1.0439
3.6	1.0626	1.0419
3.8	1.0637	1.0404
4.0	1.0654	1.0410
4.2	1.0672	1.0427
4.4	1.0690	1.0443
4.6	1.0703	1.0456
4.8	1.0716	1.0468
5.0	1.0726	1.0479
5.2	1.0729	1.0487
5.4	1.0725	1.0488
5.6	1.0716	1.0483
5.8	1.0703	1.0479
6.0	1.0681	1.0468
6.2	1.0654	1.0452
6.4	1.0622	1.0436
6.6	1.0586	1.0415
6.8	1.0540	1.0385
7.0	1.0503	1.0370
7.2	1.0493	1.0364
7.4	1.0521	1.0359
7.6	1.0570	1.0359
7.8	1.0611	1.0385
8.0	1.0652	1.0417
8.2	1.0689	1.0448
8.4	1.0716	1.0476
8.6	1.0741	1.0503
8.8	1.0773	1.0534
9.0	1.0811	1.0569
9.2	1.0851	1.0608
9.4	1.0888	1.0651
9.6	1.0925	1.0688
9.8	1.0955	1.0719
10.0	1.0985	1.0750
10.2	1.1014	1.0778
10.4	1.1038	1.0796
10.6	1.1048	1.0808
*10.8	1.0000	1.0000
*11.0	1.0000	1.0000
*11.2	1.0000	1.0000
*11.4	1.0000	1.0000
*11.6	1.0000	1.0000
*11.8	1.0000	1.0000
*12.0	1.0000	1.0000

Note: V(z) data applicable for 11,000 ≤ burnup ≤ 18,540 MWD/MTU.

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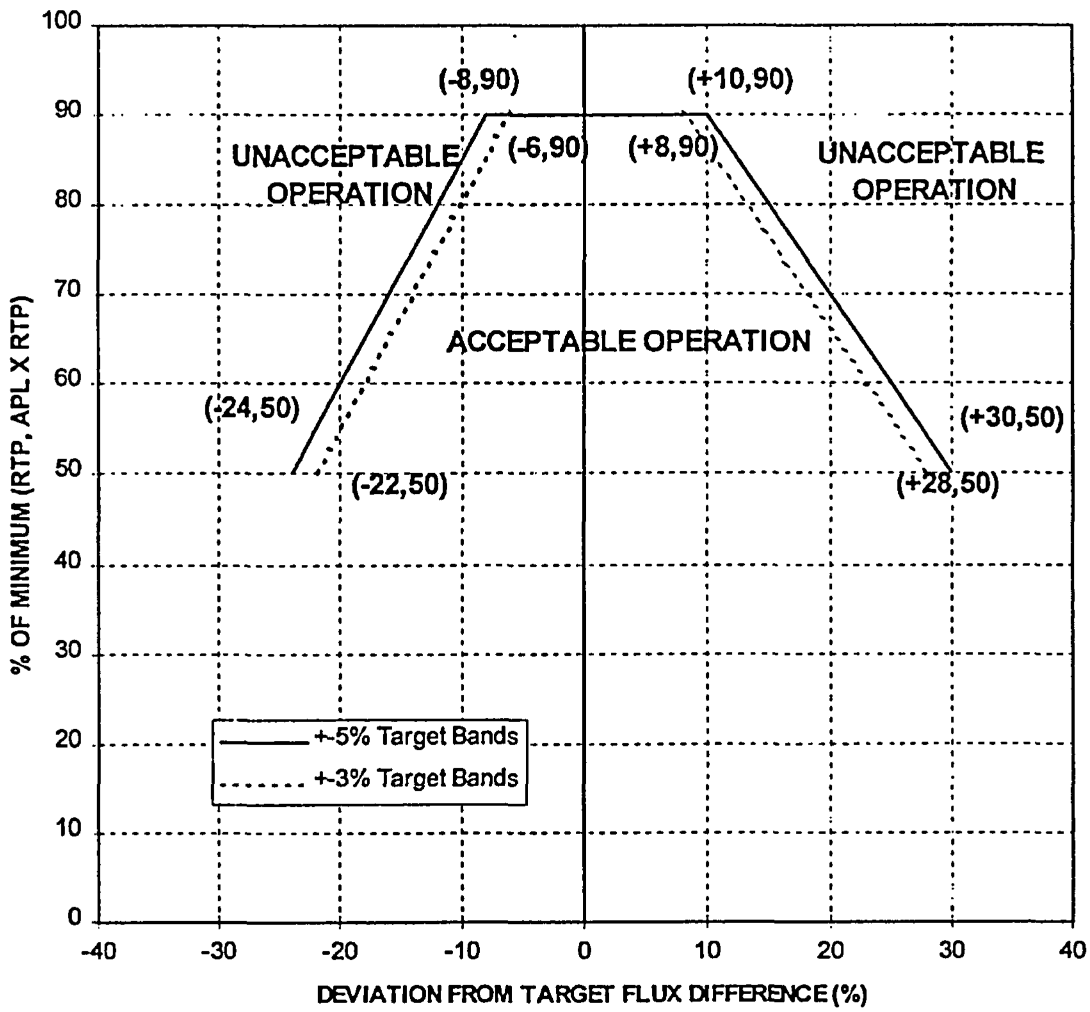
Figure 4.0, Allowable Deviation from Target Flux Difference



NOTE: For power levels above 90%, power operation is allowed within the target bands (±3% and ±5%).

Figure 5.0, Shutdown Margin Versus Boron Concentration