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April 12, 2001

LTR: BYRON 2001-0064
File: 2.01.0700

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: Correction to Byron Station Unit 1 Cycle 11 Core Operating Limits Report and Byron Station Unit 2 Cycle 9 Core Operating Limits Report

Reference: Letter from Richard Lopriore (Exelon) to NRC Document Control Desk, "Revised Byron Station Unit 1 Cycle 11 Core Operating Limits Report; Revised Byron Station Unit 2 Cycle 9 Core Operating Limits Report," dated March 6, 2001

In the referenced letter we transmitted the revised Core Operating Limits Reports (COLR) for Byron Station Unit 1 and Unit 2. Subsequent to the submittal, we discovered an error in Section 2.9, "Departure from Nucleate Boiling (DNBR)," of each report. Specifically, Section 2.9.1 incorrectly listed the DNBR axial power shape limit as 1.4. The correct limit should have been listed as 1.572. This correct limit was always installed in the software that calculates and compares the DNBR limits (i.e., Power Distribution Monitoring System.) The error was only administrative in nature in that it was not properly reflected in the COLRs. This reporting error was documented in Exelon's corrective action program.

Should you have any questions concerning these reports, please contact P. Reister, Regulatory Assurance Manager, at (815) 234-5441, extension 2280.

Respectfully,

Richard P. Lopriore
Site Vice President
Byron Nuclear Generating Station

Attachments: 1) Revised to Byron Station Unit 1 Cycle 11 COLR
2) Revised to Byron Station Unit 2 Cycle 9 COLR

RPL/JL/dpk

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Byron Station

A001

ATTACHMENT 1

Revised Byron Station Unit 1 Cycle 11 Core Operating Limits Report

NUCLEAR FUEL MANAGEMENT DEPARTMENT
TRANSMITTAL OF DESIGN INFORMATION **DG01-000183**

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) _____	NFM ID # NFM0000119 Rev. No. 6 Page 1 of 19

Station Byron Unit 1 Cycle 11 Generic _____

To: Kenneth N. Kovar – Byron

Subject Byron Unit 1 Cycle 11 Core Operating Limits Report in ITS Format and W(z) Function

Brian L. Manges Preparer	Brian L Manges Preparer's Signature	3/14/2001 Date
Tyrone L. Stevens Reviewer	Tyrone L Stevens Reviewer's Signature	3/14/01 Date
D. Redden NFM Supervisor	Approver's Signature	3/14/01 Date

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified TODIs: _____

Description of Information:
Attached is the Byron Unit 1 Cycle 11 Core Operating Limits Report (COLR) in the ITS format and W(z) function.

Purpose of Information:

Revision 6 of this TODI supercedes Revision 5. Revision 6 corrects the $DNBR_{APSL}$ Limit in Subsection 2.9. Revision 5 modified the COLR to reflect operation with BEACON PDMS and a RAOC Delta-I Band when BEACON is out of service. It also re-numbers Sections 2.9, 2.10, 2.11, and 2.12 to 2.10, 2.11, 2.12 and 2.13, respectively. In addition the pressurizer pressure DNB limit was returned to the original value of 2219 psig per the request of Byron Station. This action undoes Revision 4 of this TODI. Revision 4 changes Section 2.11.1 of the COLR to reflect the correct pressurizer pressure DNB Limit. Revision 3 modifies Section 2.12.2 of the COLR to support the requirement for the new TRM TLCO 3.1.g. Revision 2 incorporated the correct K(Z) curve for Assembly Burnup $\leq$ 4000 MWD/MTU case. Revision 1 incorporated new W(z) values as a result of an evaluation of the Cycle 10 temperature coastdown effects on the Cycle 11 Design. This COLR incorporates the BY1C11 cycle-specific parameters and the Expanded COLR format which includes Reactor Core Safety Limits, Reactor Trip System Instrumentation, and RCS DNB Parameters. Furthermore, the analytical limit of 224 rods out position is included. Byron Station is requested to perform a Plant Review of this document. Upon completion of the Plant Review, Byron Station is to transmit the COLR portion to the Nuclear Regulatory Commission pursuant to Technical Specification 5.6.5. Please provide NFM (Brian Manges) with a copy of Byron Station's completed Plant Review and COLR submittal to the NRC.

Source of Information: See References

Supplemental Distribution: P. E. Reister / J. E. Langan (BY)

References:

1) TODI NFM000112, Seq. 0, "BY1C11 Minimum Required Boron Concentration for Modes 3, 4, 5, and 6 and Control Rod Testing," dated August 4, 2000.

2) Westinghouse Letter 00CB-G-0107 (CAC-00-259), "Byron 1 Cycle 11 Input for COLR," dated September 1, 2000.

3) Byron Technical Specification Amendment 113, dated May 15, 2000

4) TODI NFM0000099, Rev. 1, "BY1C11 Reload Design Initialization," dated August 3, 2000.

5) Westinghouse Letter 00CB-G-0116 (CAC-00-280), "Byron 1 Cycle 11 Input for COLR Revision 1," dated September 18, 2000.

6) TODI NFM0000188, Seq. 0, "Pressurizer Pressure DNB Limit," A. W. Wong to D. Wozniak and T. Luke, December 15, 2000.

7) "Byron 1 Cycle 11 BEACON DMM Model Delivery", Westinghouse Letter 01CB-G-013 (ASD-01-48), dated February 8, 2001

8) "Byron and Braidwood Units 1 and 2 – Issuance of Amendments to Technical Specifications for Implementation of the Best Estimate Analyzer for Core Operations Nuclear Power Distribution Monitoring System (TAC Nos: MA8254, MA8255, MA8252, MA8253), G. F Dick to Oliver Kingsley, dated February 13, 2001

9) "Byron 1 Cycle 11 Safety Assessment for BEACON Implementation", Letter 01CB-G-022 (CAC-01-43), Jeffrey Guthridge to B. L. Manges

10) "DNBR Limits for COLR", Westinghouse Letter 01CB-G-038 (CAC-01-79), dated March 14, 2001

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Byron Station Unit 1 Cycle 11 has been prepared in accordance with the requirements of Technical Specification 5.6.5 (ITS).

The Technical Specifications affected by this report are listed below:

SL	2.1.1	Reactor Core Safety Limits (SLs)
LCO	3.1.1	Shutdown Margin (SDM)
LCO	3.1.3	Moderator Temperature Coefficient
LCO	3.1.4	Rod Group Alignment Limits
LCO	3.1.5	Shutdown Bank Insertion Limits
LCO	3.1.6	Control Bank Insertion Limits
LCO	3.1.8	Physics Tests Exceptions – Mode 2
LCO	3.2.1	Heat Flux Hot Channel Factor ($F_Q(Z)$)
LCO	3.2.2	Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)
LCO	3.2.3	Axial Flux Difference (AFD)
LCO	3.2.5	Departure from Nucleate Boiling Ratio (DNBR)
LCO	3.3.1	Reactor Trip System (RTS) Instrumentation
LCO	3.3.9	Boron Dilution Protection System (BDPS)
LCO	3.4.1	Reactor Coolant System (RCS) DNB Parameters
LCO	3.9.1	Boron Concentration

The portions of the Technical Requirements Manual affected by this report are listed below:

TRM TLCO 3.1.b	Boration Flow Paths - Operating
TRM TLCO 3.1.d	Charging Pumps - Operating
TRM TLCO 3.1.f	Borated Water Sources - Operating
TRM TLCO 3.1.g	Position Indication System – Shutdown
TRM TLCO 3.1.h	Shutdown Margin (SDM) – MODE 1 and MODE 2 with keff ≥ 1.0
TRM TLCO 3.1.i	Shutdown Margin (SDM) – MODE 5
TRM TLCO 3.1.j	Shutdown and Control Rods
TRM TLCO 3.1.k	Position Indication System – Shutdown (Special Test Exception)

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 are applicable for the entire cycle unless otherwise identified. These limits have been developed using the NRC-approved methodologies specified in Technical Specification 5.6.5.

2.1 Reactor Core Limits (SL 2.1.1)

2.1.1 In Modes 1 and 2, the combination of Thermal Power, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the limits specified in Figure 2.1.1.

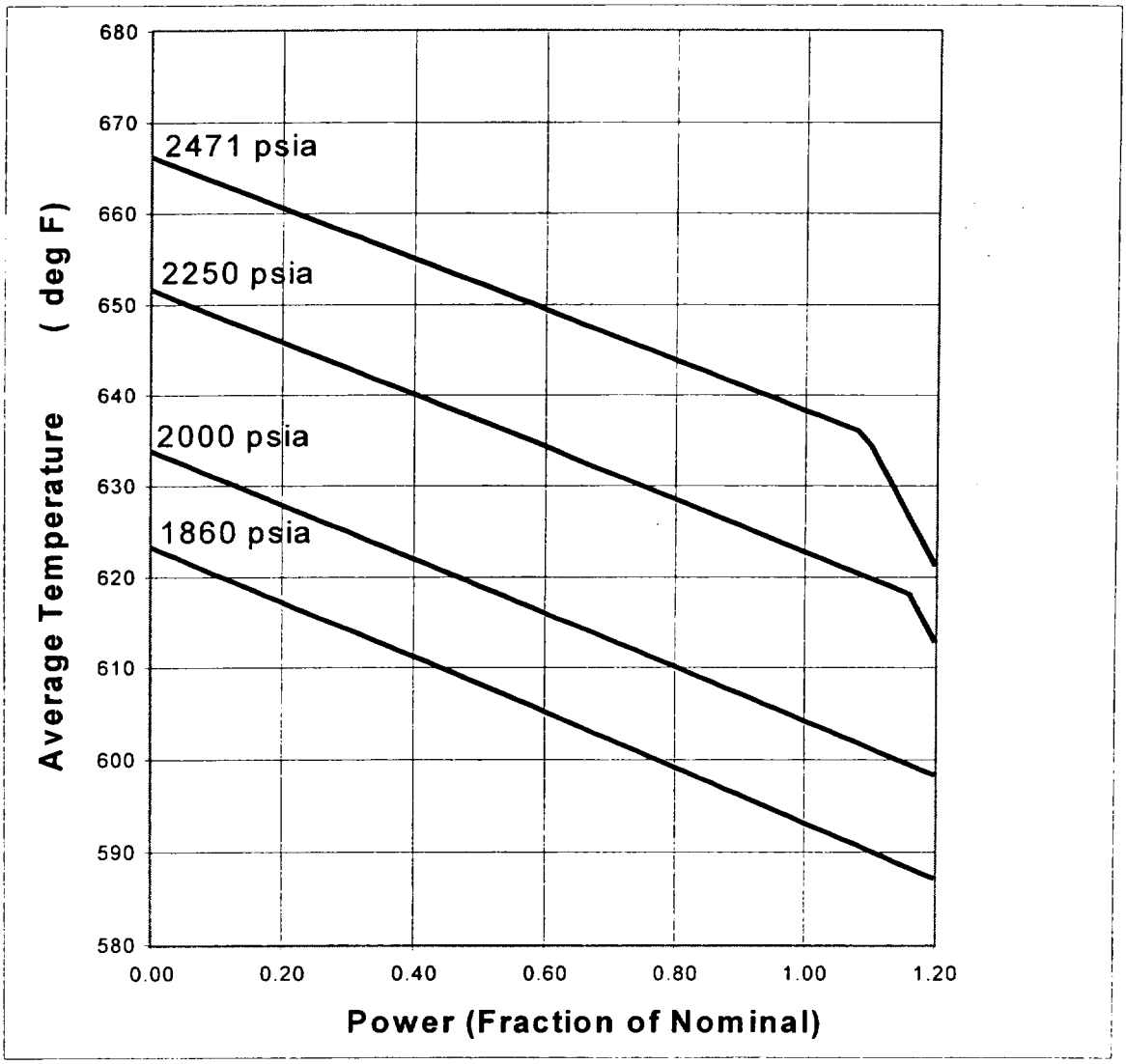


Figure 2.1.1: Reactor Core Limits

2.2 Shutdown Margin (SDM)

The SDM limit for MODES 1, 2, 3, and 4 is:

2.2.1 The SDM shall be greater than or equal to 1.3% $\Delta k/k$ (LCOs 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.1.8, 3.3.9; TRM TLCOs 3.1.b, 3.1.d, 3.1.f, 3.1.h, and 3.1.j).

The SDM limits for MODE 5 are:

2.2.2.1 SDM shall be greater than or equal to 1.0% $\Delta k/k$ (LCO 3.1.1).

2.2.2.2 SDM shall be greater than or equal to 1.3% $\Delta k/k$ (LCO 3.3.9; TRM TLCO 3.1.i and 3.1.j).

2.3 Moderator Temperature Coefficient (LCO 3.1.3)

The Moderator Temperature Coefficient (MTC) limits are:

2.3.1 The BOL/ARO/HZP-MTC upper limit shall be $+3.7 \times 10^{-5}$ $\Delta k/k/°F$.

2.3.2 The EOL/ARO/HFP-MTC lower limit shall be -4.1×10^{-4} $\Delta k/k/°F$.

2.3.3 The EOL/ARO/HFP-MTC Surveillance limit at 300 ppm shall be less negative than or equal to -3.2×10^{-4} $\Delta k/k/°F$.

where: BOL stands for Beginning of Cycle Life
ARO stands for All Rods Out
HZP stands for Hot Zero Thermal Power
EOL stands for End of Cycle Life
HFP stands for Hot Full Thermal Power

2.4 Shutdown Bank Insertion Limit (LCO 3.1.5)

2.4.1 All shutdown banks shall be fully withdrawn to at least 224 steps.

2.5 Control Bank Insertion Limits (LCO 3.1.6)

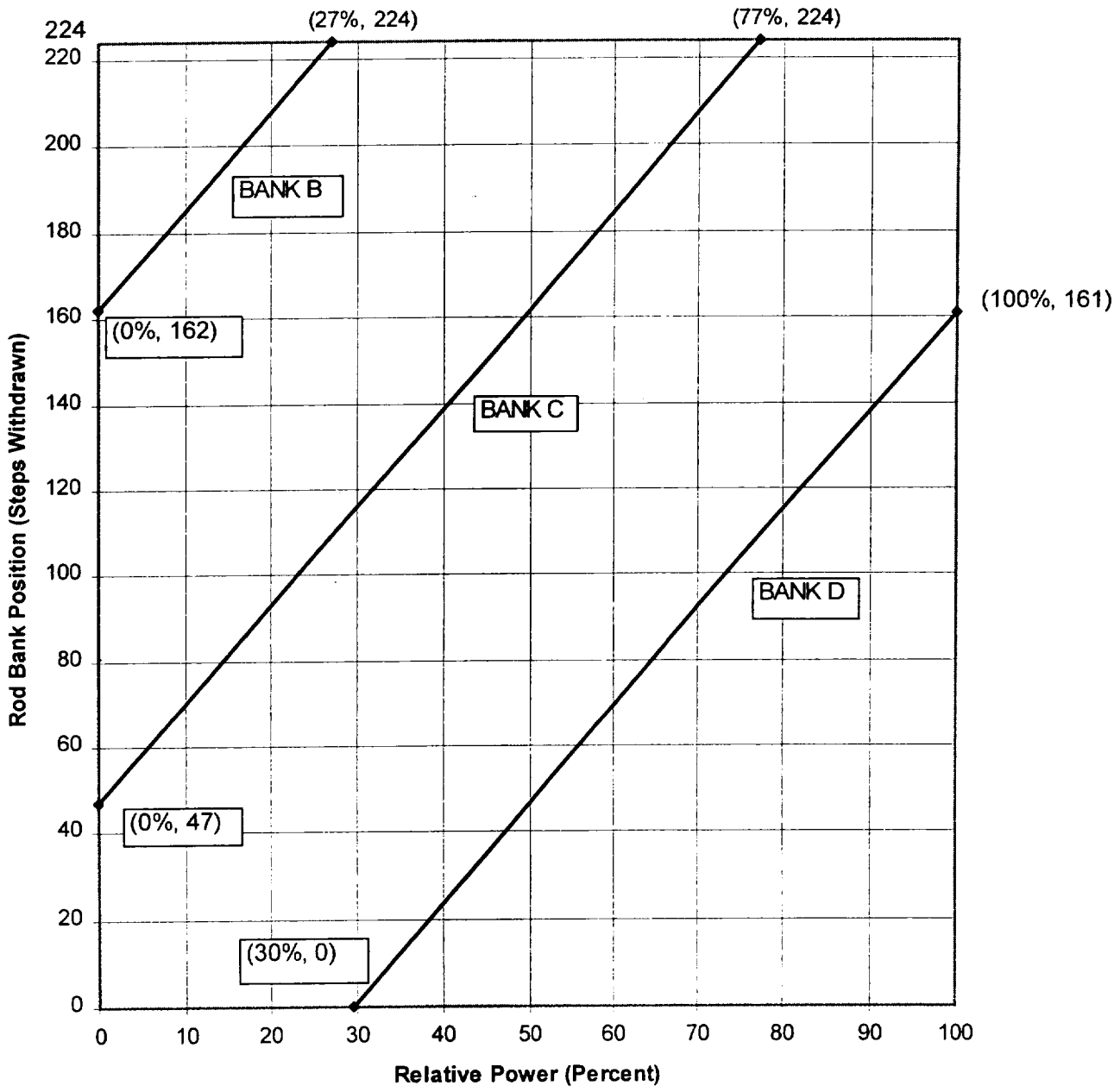
2.5.1 The control banks shall be limited in physical insertion as shown in Figure 2.5.1.

2.5.2 Each control bank shall be considered fully withdrawn from the core at greater than or equal to 224 steps.

2.5.3 The control banks shall be operated in sequence by withdrawal of Bank A, Bank B, Bank C and Bank D. The control banks shall be sequenced in reverse order upon insertion.

2.5.4 Each control bank not fully withdrawn from the core shall be operated with a 113 step overlap limit.

Figure 2.5.1:
Control Bank Insertion Limits Versus Percent Rated Thermal Power



2.6 Heat Flux Hot Channel Factor ($F_Q(Z)$) (LCO 3.2.1)

2.6.1

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{0.5} xK(Z) \quad \text{for } P \leq 0.5$$

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} xK(Z) \quad \text{for } P > 0.5$$

where: P = the ratio of THERMAL POWER to RATED THERMAL POWER

F_Q^{RTP} = 2.60

K(Z) for assembly average burnup > 4000 MWD/MTU is provided in Figure 2.6.1. K(Z) for assembly average burnup ≤ 4000 MWD/MTU is provided in Figure 2.6.1.a.

2.6.2 W(Z) Values:

a) When PDMS is OPERABLE, W(Z) = 1.00000 for all axial points.

b) When PDMS is Inoperable, W(Z) is provided in Figures 2.6.2.a through 2.6.2.d

The normal operation W(Z) values have been determined at burnups of 150, 4000, 12000 and 20000 MWD/MTU.

Table 2.6.2 shows the $F^C_Q(z)$ penalty factors that are greater than 2% per 31 Effective Full Power Days (EFPD). These values shall be used to increase the $F^W_Q(z)$ as per Surveillance Requirement 3.2.1.2. A 2% penalty factor shall be used at all cycle burnups that are outside the range of Table 2.6.2.

Multiplication Factor = 1.02

2.6.3 Uncertainty:

The uncertainty, U_{FQ}, to be applied to the Heat Flux Hot Channel Factor $F_Q(Z)$ shall be calculated by the following formula

$$U_{FQ} = U_{qu} \bullet U_e$$

where:

U_{qu} = Base FQ measurement uncertainty = 1.05 when PDMS is Inoperable
U_e = Engineering uncertainty factor = 1.03

2.6.4 PDMS Alarms:

$F_Q(Z)$ Warning Setpoint ≥ 2% of $F_Q(Z)$ Margin
$F_Q(Z)$ Alarm Setpoint ≥ 0% of $F_Q(Z)$ Margin

Figure 2.6.1: K(Z) - Normalized $F_Q(Z)$ as a Function of Core Height (Assembly BU > 4000 MWD/MTU)

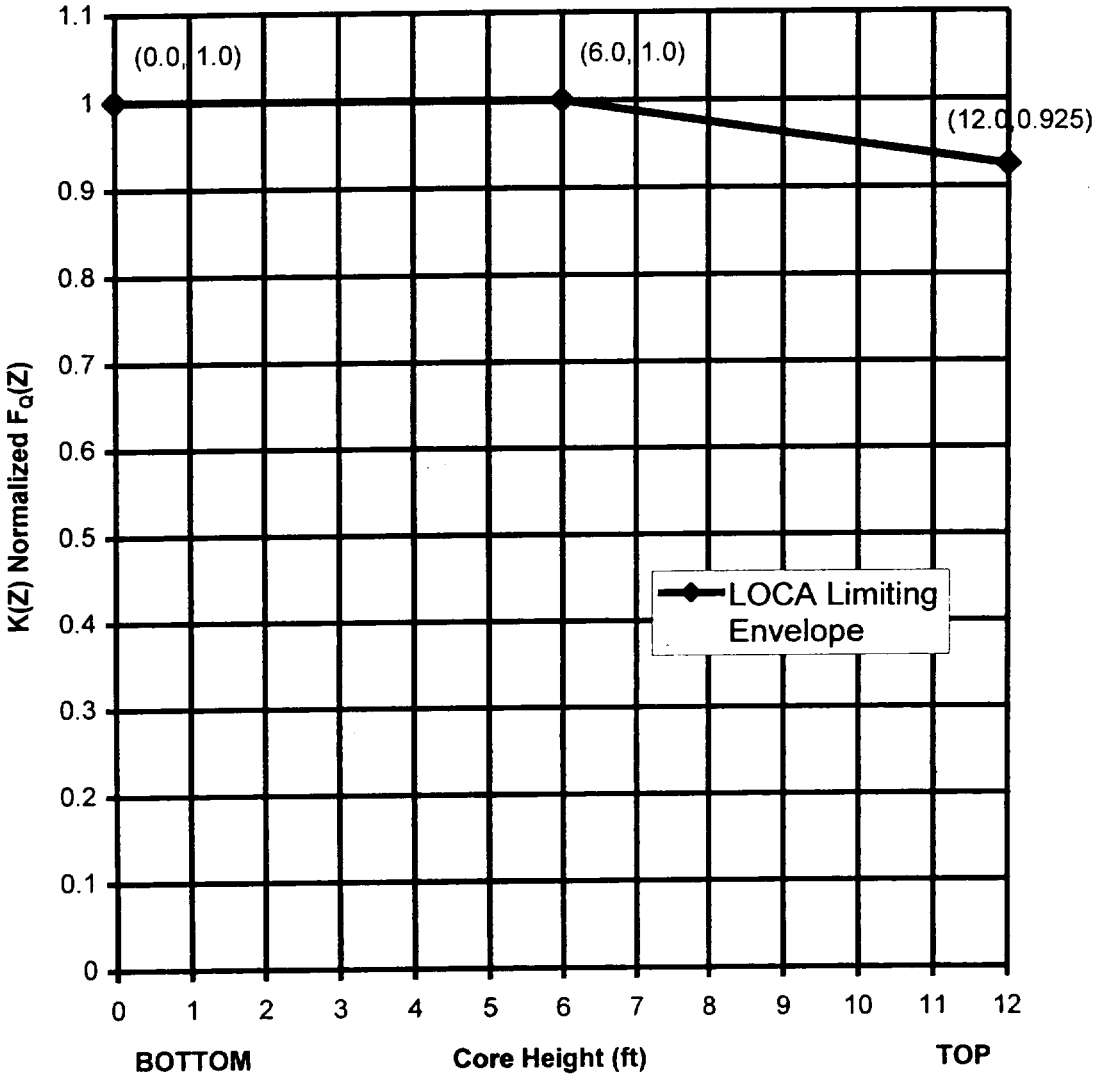
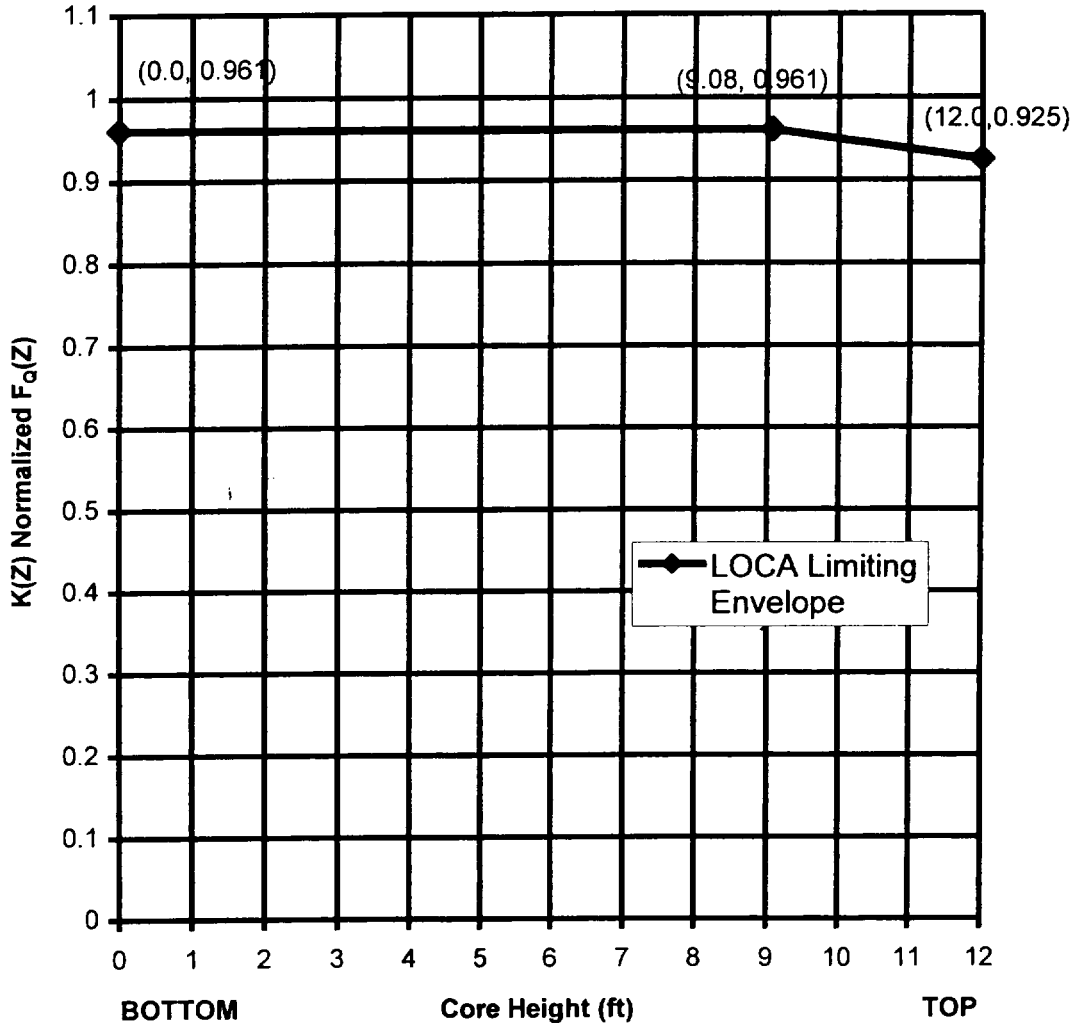


Figure 2.6.1.a: K(Z) - Normalized $F_Q(Z)$ as a Function of Core Height (Assembly BU ≤ 4000 MWD/MTU)



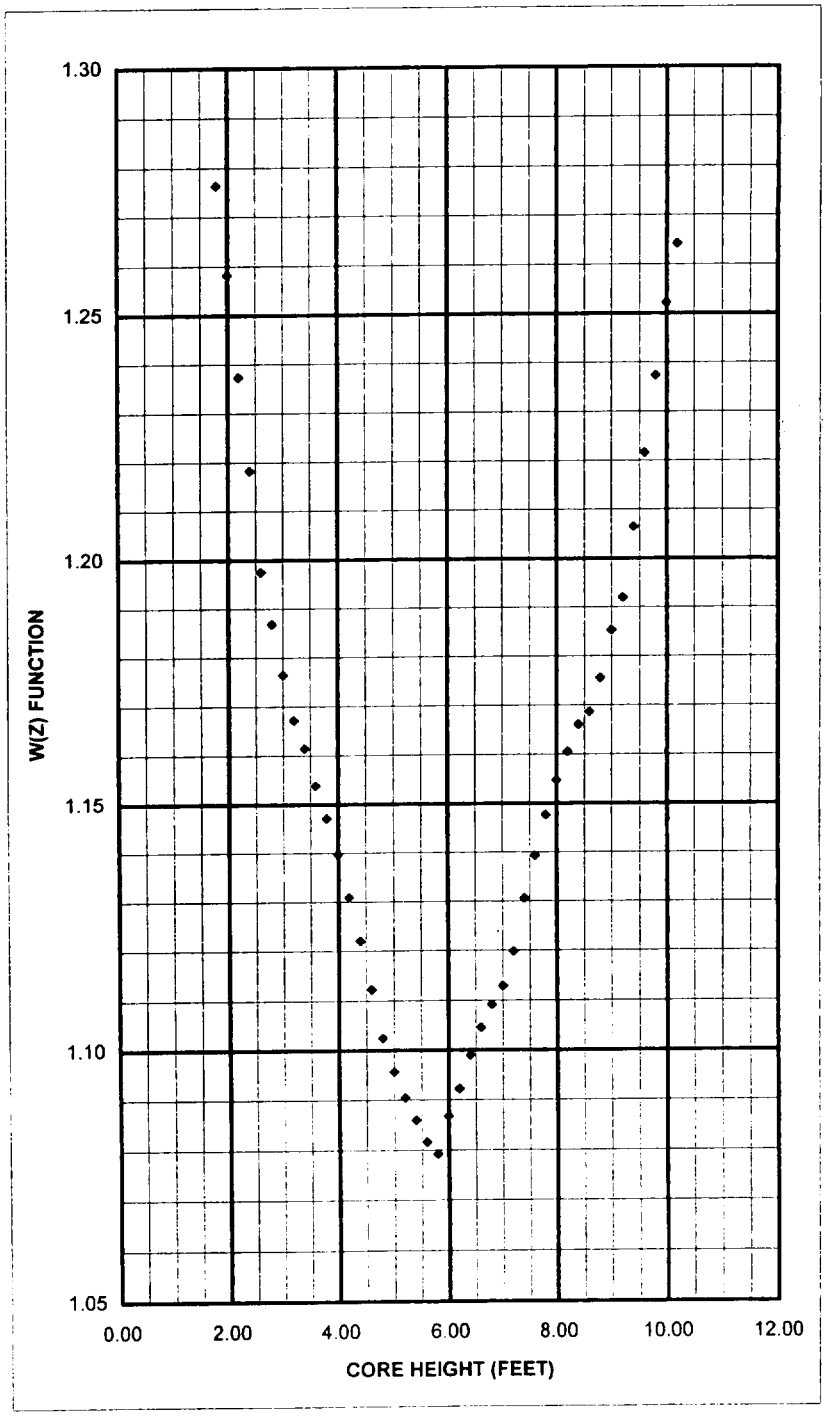
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2763
2.00	1.2581
2.20	1.2373
2.40	1.2182
2.60	1.1974
2.80	1.1868
3.00	1.1764
3.20	1.1671
3.40	1.1614
3.60	1.1538
3.80	1.1471
4.00	1.1396
4.20	1.1308
4.40	1.1220
4.60	1.1122
4.80	1.1024
5.00	1.0956
5.20	1.0904
5.40	1.0859
5.60	1.0815
5.80	1.0791
6.00	1.0867
6.20	1.0922
6.40	1.0989
6.60	1.1045
6.80	1.1091
7.00	1.1128
7.20	1.1198
7.40	1.1305
7.60	1.1392
7.80	1.1476
8.00	1.1547
8.20	1.1605
8.40	1.1660
8.60	1.1686
8.80	1.1755
9.00	1.1852
9.20	1.1919
9.40	1.2064
9.60	1.2216
9.80	1.2373
10.00	1.2521
10.20	1.2642
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 1 Cycle 11

Figure 2.6.2.a

Summary of W(Z) Function at 150 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



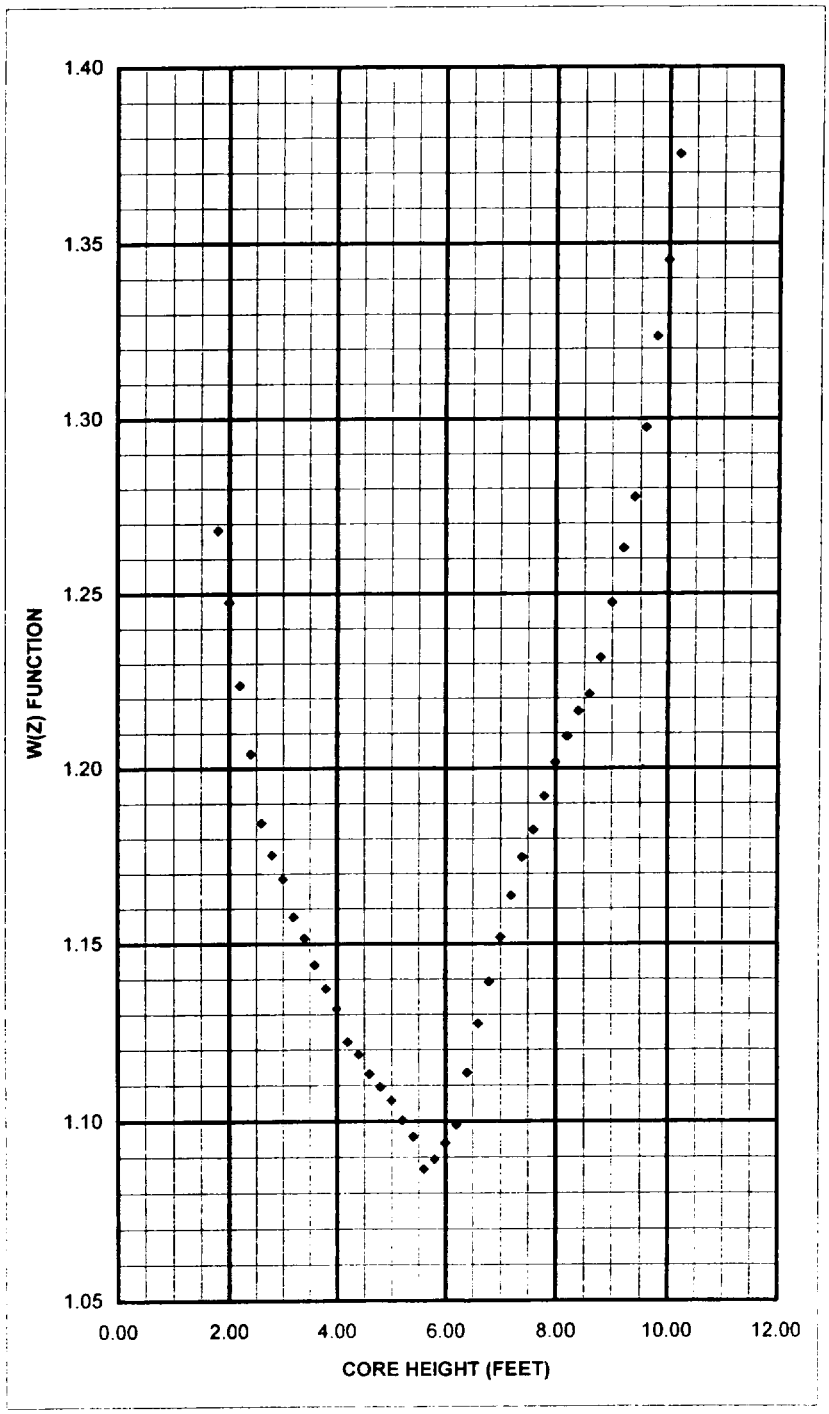
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2681
2.00	1.2475
2.20	1.2237
2.40	1.2041
2.60	1.1844
2.80	1.1751
3.00	1.1684
3.20	1.1575
3.40	1.1516
3.60	1.1439
3.80	1.1372
4.00	1.1315
4.20	1.1221
4.40	1.1186
4.60	1.1131
4.80	1.1095
5.00	1.1057
5.20	1.1002
5.40	1.0956
5.60	1.0866
5.80	1.0893
6.00	1.0938
6.20	1.0989
6.40	1.1135
6.60	1.1273
6.80	1.1391
7.00	1.1518
7.20	1.1636
7.40	1.1744
7.60	1.1824
7.80	1.1919
8.00	1.2016
8.20	1.2090
8.40	1.2162
8.60	1.2211
8.80	1.2316
9.00	1.2473
9.20	1.2629
9.40	1.2775
9.60	1.2974
9.80	1.3235
10.00	1.3452
10.20	1.3753
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 1 Cycle 11

Figure 2.6.2.b

Summary of W(Z) Function at 4000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



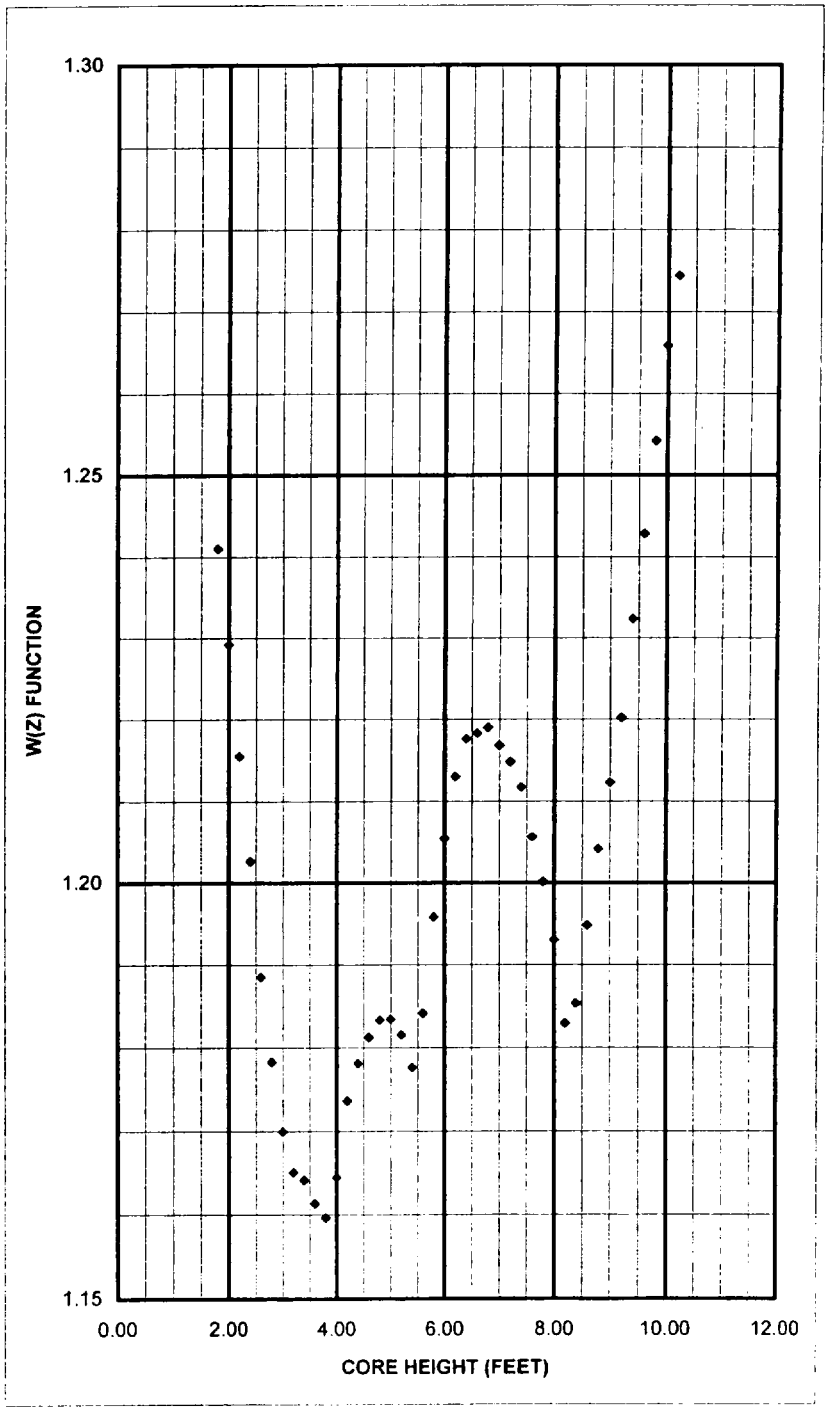
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2410
2.00	1.2292
2.20	1.2155
2.40	1.2026
2.60	1.1885
2.80	1.1783
3.00	1.1699
3.20	1.1650
3.40	1.1641
3.60	1.1613
3.80	1.1596
4.00	1.1644
4.20	1.1736
4.40	1.1781
4.60	1.1812
4.80	1.1833
5.00	1.1834
5.20	1.1815
5.40	1.1776
5.60	1.1841
5.80	1.1958
6.00	1.2054
6.20	1.2130
6.40	1.2176
6.60	1.2183
6.80	1.2190
7.00	1.2168
7.20	1.2148
7.40	1.2117
7.60	1.2056
7.80	1.2001
8.00	1.1930
8.20	1.1829
8.40	1.1853
8.60	1.1948
8.80	1.2041
9.00	1.2123
9.20	1.2202
9.40	1.2323
9.60	1.2428
9.80	1.2542
10.00	1.2658
10.20	1.2744
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 1 Cycle 11

Figure 2.6.2.c

Summary of W(Z) Function at 12000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2306
2.00	1.2201
2.20	1.2066
2.40	1.1935
2.60	1.1756
2.80	1.1618
3.00	1.1558
3.20	1.1535
3.40	1.1571
3.60	1.1627
3.80	1.1750
4.00	1.1863
4.20	1.2094
4.40	1.2185
4.60	1.2273
4.80	1.2322
5.00	1.2350
5.20	1.2339
5.40	1.2395
5.60	1.2566
5.80	1.2702
6.00	1.2818
6.20	1.2894
6.40	1.2951
6.60	1.2948
6.80	1.2935
7.00	1.2900
7.20	1.2851
7.40	1.2785
7.60	1.2676
7.80	1.2568
8.00	1.2431
8.20	1.2266
8.40	1.2251
8.60	1.2227
8.80	1.2198
9.00	1.2169
9.20	1.2166
9.40	1.2508
9.60	1.2853
9.80	1.3174
10.00	1.3483
10.20	1.3756
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 1 Cycle 11

Figure 2.6.2.d

Summary of W(Z) Function at 20000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)

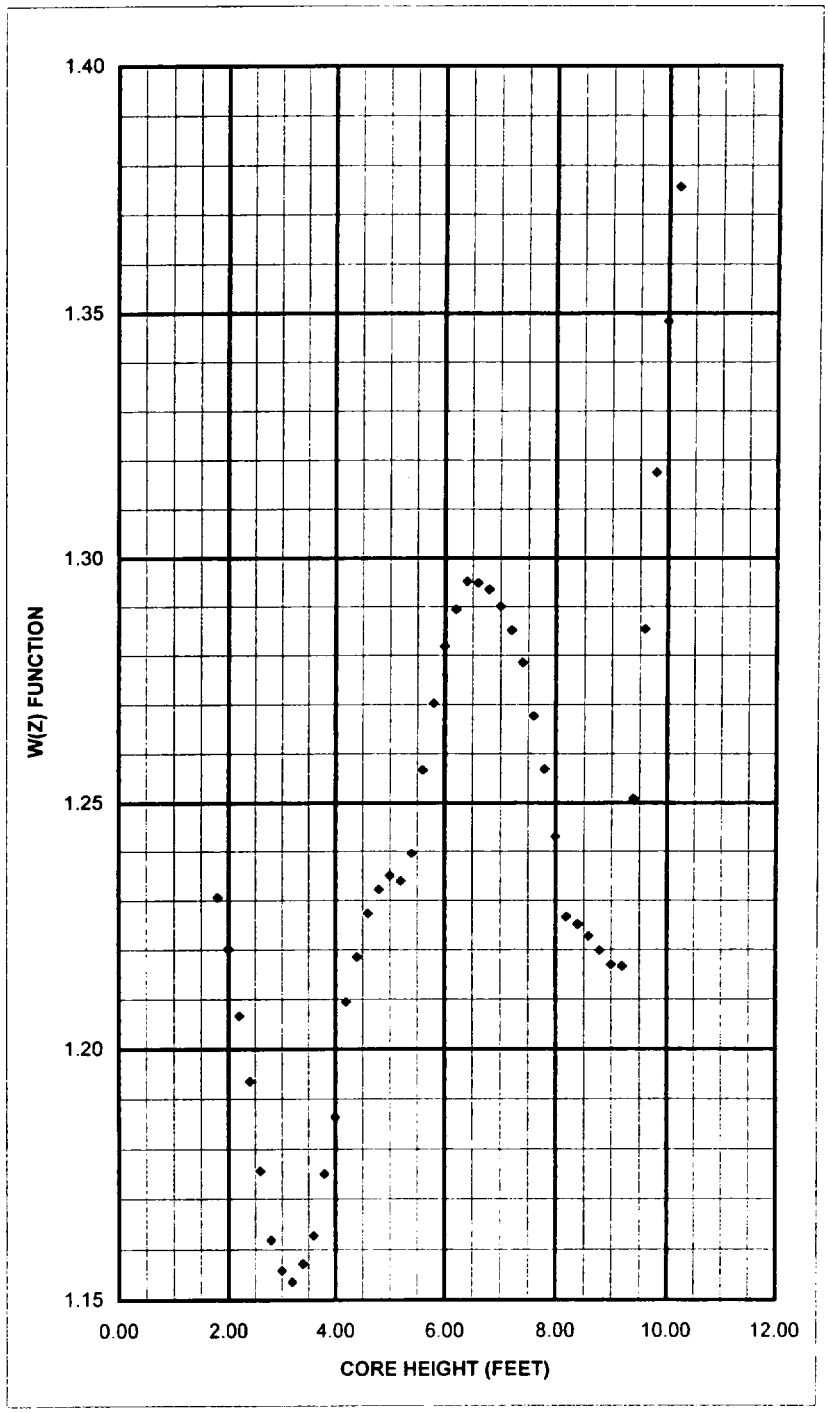


Table 2.6.2

Fq Margin Decreases in Excess of 2% per 31 EFPD

Cycle Burnup (MWD/MTU)	Max % Decrease in Fq Margin
150	4.15
314	4.31
479	4.40
643	4.40
808	4.27
972	3.99
1137	3.59
1301	3.09
1465	2.54
≥1630	2.00

Note: All cycle burnups outside the range of the table shall use a 2% decrease in Fq margin for compliance with the 3.2.1.2 Surveillance Requirements. Linear interpolation is adequate for intermediate cycle burnups.

2.7 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$) (LCO 3.2.2)

2.7.1 $F^N_{\Delta H} \leq F^{RTP}_{\Delta H}[1.0 + PF_{\Delta H}(1.0 - P)]$

where: P = the ratio of THERMAL POWER to RATED THERMAL POWER
$F^{RTP}_{\Delta H} = 1.70$
$PF_{\Delta H} = 0.3$

2.7.2 Uncertainty when PDMS is inoperable

The uncertainty, $U_{F\Delta H}$, to be applied to the Nuclear Enthalpy Rise Hot Channel Factor $F_{\Delta H}{}^N$ shall be calculated by the following formula:

$U_{F\Delta H} = U_{F\Delta Hm}$

where:

$U_{F\Delta Hm}$ = Base $F^N_{\Delta H}$ measurement uncertainty = 1.04

2.7.3 PDMS Alarms:

$F^N_{\Delta H}$ Warning Setpoint ≥ 2% of $F^N_{\Delta H}$ Margin
$F^N_{\Delta H}$ Alarm Setpoint ≥ 0% of $F^N_{\Delta H}$ Margin

2.8 Axial Flux Difference (AFD) (LCO 3.2.3)

2.8.1 When PDMS is Inoperable, the AXIAL FLUX DIFFERENCE (AFD) Acceptable Operation Limits are provided in Figure 2.8.1 or the latest valid PDMS Surveillance Report, whichever is more conservative.

2.8.2 When PDMS is OPERABLE, no AFD Acceptable Operation Limits are applicable.

2.9 Departure from Nucleate Boiling Ratio (DNBR) (LCO 3.2.5)

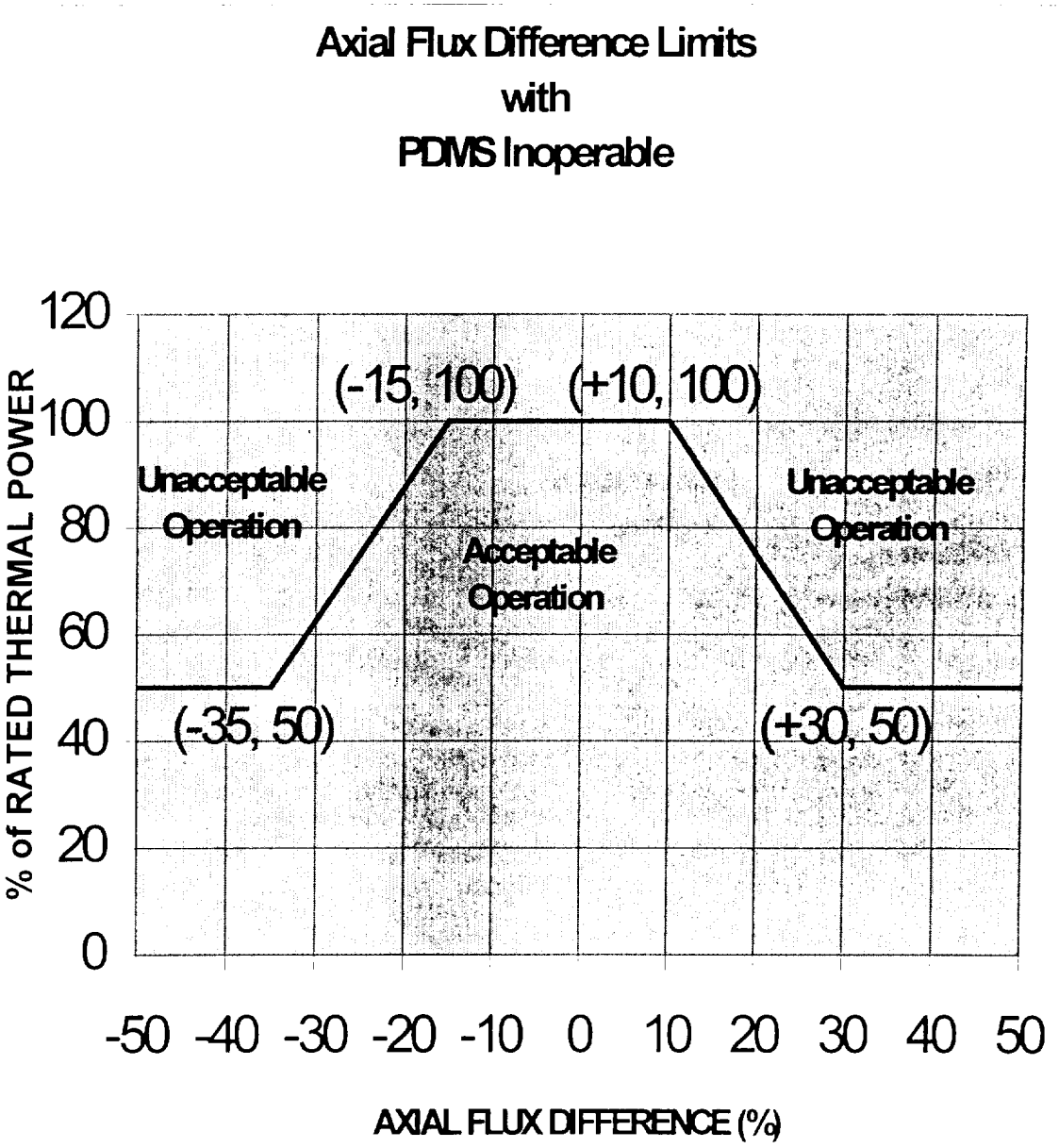
2.9.1 $DNBR_{APSL} \geq 1.572$

The Axial Power Shape Limiting DNBR ($DNBR_{APSL}$) is applicable with THERMAL POWER ≥ 50% RTP when PDMS is OPERABLE.

2.9.2 PDMS Alarms:

DNBR Warning Setpoint ≥ 2% of DNBR Margin
DNBR Alarm Setpoint ≥ 0% of DNBR Margin

Figure 2.8.1 Axial Flux Difference Limits as a Function of Rated Thermal Power



2.10 Reactor Trip System Overtemperature ΔT Setpoint Parameter Values (LCO 3.3.1)

2.10.1 The Overtemperature ΔT reactor trip setpoint K_1 shall be equal to 1.325.

2.10.2 The Overtemperature ΔT reactor trip setpoint T_{avg} coefficient K_2 shall be equal to 0.0297 / °F.

2.10.3 The Overtemperature ΔT reactor trip setpoint pressure coefficient K_3 shall be equal to 0.00181 / psig.

2.10.4 The nominal T_{avg} at RTP (indicated) T' shall be less than or equal to 588.4 °F.

2.10.5 The nominal RCS operating pressure (indicated) P' shall be equal to 2235 psig.

2.10.6 The measured reactor vessel ΔT lead/lag time constant τ_1 shall be equal to 8 sec.

2.10.7 The measured reactor vessel ΔT lead/lag time constant τ_2 shall be equal to 3 sec.

2.10.8 The measured reactor vessel ΔT lag time constant τ_3 shall be less than or equal to 2 sec.

2.10.9 The measured reactor vessel average temperature lead/lag time constant τ_4 shall be equal to 33 sec.

2.10.10 The measured reactor vessel average temperature lead/lag time constant τ_5 shall be equal to 4 sec.

2.10.11 The measured reactor vessel average temperature lag time constant τ_6 shall be less than or equal to 2 sec.

2.10.12 The $f_1(\Delta I)$ "positive" breakpoint shall be +10% ΔI.

2.10.13 The $f_1(\Delta I)$ "negative" breakpoint shall be -24% ΔI.

2.10.14 The $f_1(\Delta I)$ "positive" slope shall be +4.11% / % ΔI.

2.10.15 The $f_1(\Delta I)$ "negative" slope shall be -3.35% / % ΔI.

2.11 Reactor Trip System Overpower ΔT Setpoint Parameter Values (LCO 3.3.1)

2.11.1 The Overpower ΔT reactor trip setpoint K_4 shall be equal to 1.072.

2.11.2 The Overpower ΔT reactor trip setpoint T_{avg} rate/lag coefficient K_5 shall be equal to 0.02 / °F for increasing T_{avg}.

2.11.3 The Overpower ΔT reactor trip setpoint T_{avg} rate/lag coefficient K_5 shall be equal to 0 / °F for decreasing T_{avg}.

2.11.4 The Overpower ΔT reactor trip setpoint T_{avg} heatup coefficient K_6 shall be equal to 0.00245 / °F when $T > T''$.

2.11.5 The Overpower ΔT reactor trip setpoint T_{avg} heatup coefficient K_6 shall be equal to 0 / °F when $T \leq T''$.

2.11.6 The nominal T_{avg} at RTP (indicated) T'' shall be less than or equal to 588.4 °F.

2.11.7 The measured reactor vessel ΔT lead/lag time constant τ_1 shall be equal to 8 sec.

2.11.8 The measured reactor vessel ΔT lead/lag time constant τ_2 shall be equal to 3 sec.

2.11.9 The measured reactor vessel ΔT lag time constant τ_3 shall be less than or equal to 2 sec.

2.11.10 The measured reactor vessel average temperature lag time constant τ_6 shall be less than or equal to 2 sec.

2.11.11 The measured reactor vessel average temperature rate/lag time constant τ_7 shall be equal to 10 sec.

2.11.12 The $f_2(\Delta I)$ "positive" breakpoint shall be 0 for all ΔI.

2.11.13 The $f_2(\Delta I)$ "negative" breakpoint shall be 0 for all ΔI.

2.11.14 The $f_2(\Delta I)$ "positive" slope shall be 0 for all ΔI.

2.11.15 The $f_2(\Delta I)$ "negative" slope shall be 0 for all ΔI.

2.12 Reactor Coolant System (RCS) DNB Parameter Limits (LCO 3.4.1)

2.12.1 The pressurizer pressure shall be greater than or equal to 2219 psig.

2.12.2 The RCS average temperature (T_{avg}) shall be less than or equal to 591.2 °F.

2.12.3 The RCS total flow rate shall be greater than or equal to 371,400 gpm.

2.13 Boron Concentration

2.13.1 The refueling boron concentration shall be greater than or equal to 2000 ppm (LCO 3.9.1).

2.13.2 The Reactor Coolant System boron concentration shall be greater than or equal to 1894 ppm prior to initial criticality of Cycle 11, or greater than or equal to 2075 ppm at all other times in core life, to maintain adequate shutdown margin for MODES 3, 4, and 5 during performance of rod drop time measurements and during the surveillance of Digital Rod Position Indication (DRPI) for OPERABILITY (TLCO 3.1.g and TLCO 3.1.k)

ATTACHMENT 2

Revised Byron Station Unit 2 Cycle 9 Core Operating Limits Report

NUCLEAR FUEL MANAGEMENT DEPARTMENT
TRANSMITTAL OF DESIGN INFORMATION (TODI)

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) _____	TODI No. NFM9900202 Seq. No. 6 Page 1 of 19

Station Byron Unit 2 Cycle 9 Generic _____

To: Kenneth N. Kovar - Byron

Subject Byron Unit 2 Cycle 9 Core Operating Limits Report in ITS Format and W(z) Function

Brian L. Manges Preparer	Brian L Manges Preparer's Signature	3/14/2001 Date
Tyrone L. Stevens Reviewer	Tyrone L Stevens Reviewer's Signature	3/14/01 Date
D. Redden NFM Supervisor	E. Redden NFM Supervisor's Signature	3/14/01 Date

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified TODIs: _____

Description of Information:

Attached is the Byron Unit 2 Cycle 9 Core Operating Limits Report (COLR) in the ITS format and W(z) function.

Purpose of Information:

Sequence 6 of this TODI supersedes Sequence 5. Sequence 6 corrects the $DNBR_{APSL}$ Limit in Subsection 2.9.1. Sequence 5 modified the COLR to reflect operation with BEACON PDMS and a RAOC Delta-I Band when BEACON is out of service. It also re-numbers Sections 2.9, 2.10, 2.11, and 2.12 to 2.10, 2.11, 2.12 and 2.13, respectively. In addition the pressurizer pressure DNB limit was returned to the original value of 2219 psig per the request of Byron Station. This action undoes Sequence 4 of this TODI. Sequence 4 changes Section 2.11.1 of the COLR to reflect the correct pressurizer pressure DNB Limit. Sequence 3 modifies Section 2.12.2 of the COLR to support the requirement for the new TRM TLCO 3.1.g. Sequence 2 revised Page 9 to include the correct Figure 2.6.1.a for the K(z) curve with assembly average burnup $\leq$ 4000 MWD/MTU. Sequence 1 added clarification for the minimum boron concentration for TLCO 3.1.k to include DRPI operability surveillance and it incorporated the Expanded COLR format which includes Reactor Core Safety Limits, Reactor Trip System Instrumentation, and RCS DNB parameters. The analytical 224 position limit for rods out was included in Sequence 1. Byron Station is requested to perform a Plant Review of this document. Upon completion of the Plant Review, Byron Station is to transmit the COLR portion to the Nuclear Regulatory Commission pursuant to Technical Specification 5.6.5. Please provide NFM (Brian Manges) with a copy of Byron Station's completed Plant Review and COLR submittal to the NRC.

Source of Information:

See References Section

Supplemental Distribution: P. E. Reister / J. Langan (BY)

References:

1) PND Calculation Number PC-01, Rev. 0, "Generation of W(z) Curve," Project Byron Unit 2 Cycle 9, dated September 24, 1999.

2) PND Calculation Number SP-18, "Unfavorable Exposure Time (UET) Analysis," Project Byron Unit 2 Cycle 9, dated July 23, 1999.

3) NDIT NFM9900158, Seq. 0, "Minimum Required Boron Concentration for Control Rod Drop Testing – BY2C9," dated August 13, 1999.

4) PSS Calculation Number PSSCN:99-015, "Byron Unit 2 Cycle 9 Bank Insertion Limits with 116 Step Separation," dated October 15, 1999.

5) CAC-99-346, Rev. 3, "Safety Assessment Summary for Byron Unit 2 Cycle 9," dated October 11, 1999.

6) Byron Technical Specification Amendment 113, dated May 15, 2000.

7) PND Calculation Number PNDCN:00-003, "Evaluation of SPIL Using 224 Steps Rod Withdrawn as Definition of ARO," dated May 8, 2000.

8) TODI NFM0000188, Seq. 0, "Pressurizer Pressure DNB Limit," A. W. Wong to D. Wozniak and T. Luke, December 15, 2000.

9) "Byron Unit 2 Cycle 9 BEACON DMM Model Delivery", Westinghouse Letter 01CB-G-005 (ASD-01-23), dated January 17, 2001

10)"BYRON STATION, UNITS 1 AND 2, AND BRAIDWOOD STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS TO TECHNICAL SPECIFICATIONS FOR IMPLEMENTATION OF THE BEST ESTIMATE ANALYZER FOR CORE OPERATIONS NUCLEAR POWER DISTRIBUTION MONITORING SYSTEM (TAC NOS: MA8254, MA8255, MA8252, AND MA8253", Letter from George F. Dick, Jr to Oliver D. Kingsley, dated February 13, 2001

11)"Byron 2 Cycle 9 Safety Assessment for BEACON Implementation", Letter 01CB-G-021 (CAC-01-42) Jeffrey Guthridge to B. L. Manges

12)"SPIL Evaluation with ΔI Band (+10,-15)", BY2C9 Calculation Note NR-10, Revision 0, dated February 15, 2001

13)"DNBR Limits for COLR", Westinghouse Letter 01CB-G-038 (CAC-01-79), dated March 14, 2001

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Byron Station Unit 2 Cycle 9 has been prepared in accordance with the requirements of Technical Specification 5.6.5 (ITS).

The Technical Specifications affected by this report are listed below:

SL	2.1.1	Reactor Core Safety Limits (SLs)
LCO	3.1.1	Shutdown Margin (SDM)
LCO	3.1.3	Moderator Temperature Coefficient
LCO	3.1.4	Rod Group Alignment Limits
LCO	3.1.5	Shutdown Bank Insertion Limits
LCO	3.1.6	Control Bank Insertion Limits
LCO	3.1.8	Physics Tests Exceptions – Mode 2
LCO	3.2.1	Heat Flux Hot Channel Factor ($F_Q(Z)$)
LCO	3.2.2	Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)
LCO	3.2.3	Axial Flux Difference (AFD)
LCO	3.2.5	Departure from Nucleate Boiling Ratio (DNBR)
LCO	3.3.1	Reactor Trip System (RTS) Instrumentation
LCO	3.3.9	Boron Dilution Protection System (BDPS)
LCO	3.4.1	Reactor Coolant System (RCS) DNB Parameters
LCO	3.9.1	Boron Concentration

The portions of the Technical Requirements Manual affected by this report are listed below:

TRM TLCO 3.1.b	Boration Flow Paths - Operating
TRM TLCO 3.1.d	Charging Pumps - Operating
TRM TLCO 3.1.f	Borated Water Sources - Operating
TRM TLCO 3.1.g	Position Indication System – Shutdown
TRM TLCO 3.1.h	Shutdown Margin (SDM) – MODE 1 and MODE 2 with keff $\geq$ 1.0
TRM TLCO 3.1.i	Shutdown Margin (SDM) – MODE 5
TRM TLCO 3.1.j	Shutdown and Control Rods
TRM TLCO 3.1.k	Position Indication System – Shutdown (Special Test Exception)

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 are applicable for the entire cycle unless otherwise identified. These limits have been developed using the NRC-approved methodologies specified in Technical Specification 5.6.5.

2.1 Reactor Core Limits (SL 2.1.1)

2.1.1 In Modes 1 and 2, the combination of Thermal Power, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the limits specified in Figure 2.1.1.

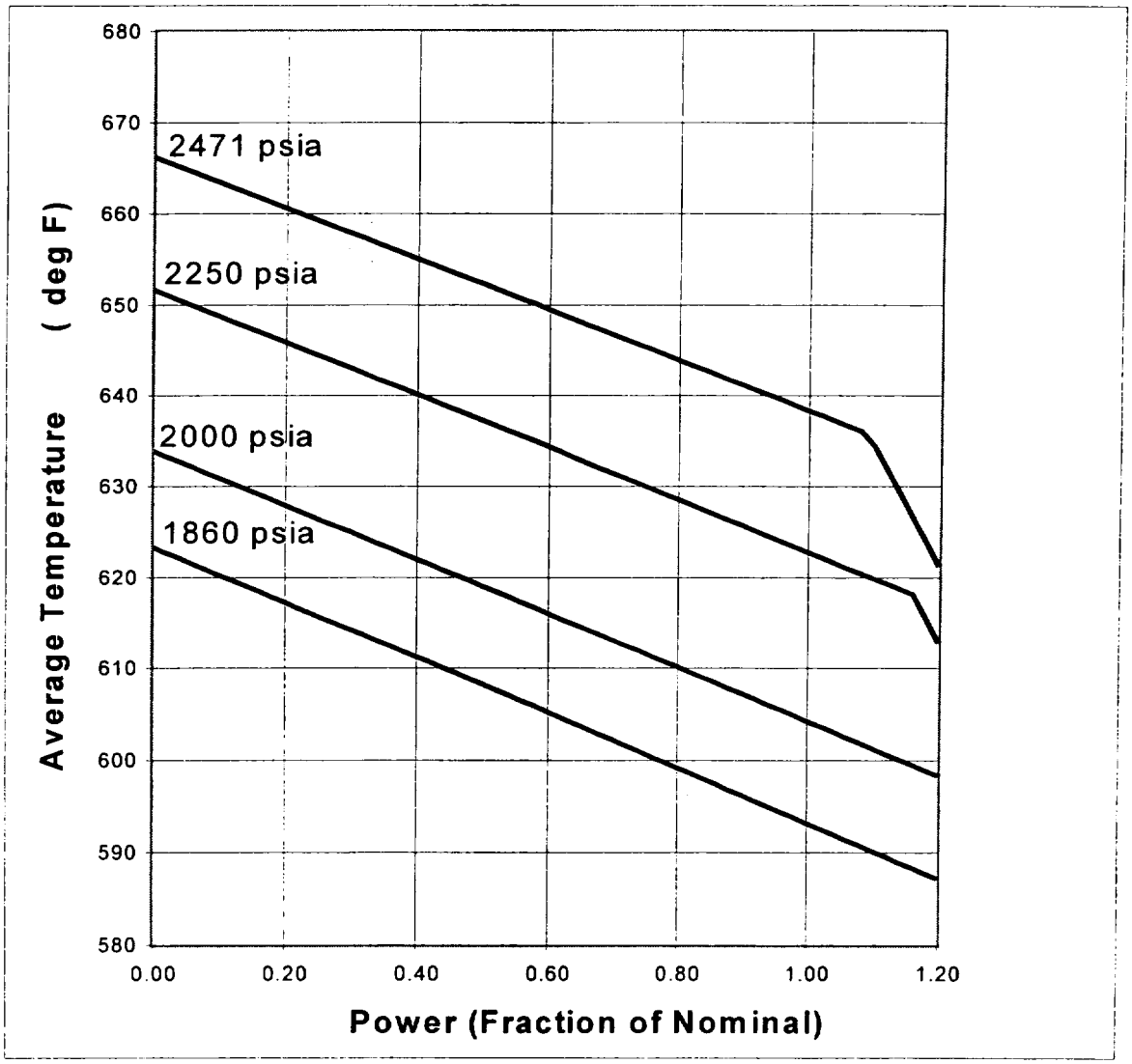


Figure 2.1.1: Reactor Core Limits

2.2 Shutdown Margin (SDM)

The SDM limit for MODES 1, 2, 3, and 4 is:

2.2.1 The SDM shall be greater than or equal to 1.3% $\Delta k/k$ (LCOs 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.1.8, 3.3.9; TRM TLCOs 3.1.b, 3.1.d, 3.1.f, 3.1.h, and 3.1.j).

The SDM limits for MODE 5 are:

2.2.2.1 SDM shall be greater than or equal to 1.0% $\Delta k/k$ (LCO 3.1.1).

2.2.2.2 SDM shall be greater than or equal to 1.3% $\Delta k/k$ (LCO 3.3.9; TRM TLCO 3.1.i and 3.1.j).

2.3 Moderator Temperature Coefficient (LCO 3.1.3)

The Moderator Temperature Coefficient (MTC) limits are:

2.3.1 The BOL/ARO/HZP-MTC upper limit shall be $+3.3 \times 10^{-5}$ $\Delta k/k/°F$.

2.3.2 The EOL/ARO/HFP-MTC lower limit shall be -4.1×10^{-4} $\Delta k/k/°F$.

2.3.3 The EOL/ARO/HFP-MTC Surveillance limit at 300 ppm shall be less negative than or equal to -3.2×10^{-4} $\Delta k/k/°F$.

where: BOL stands for Beginning of Cycle Life
ARO stands for All Rods Out
HZP stands for Hot Zero Thermal Power
EOL stands for End of Cycle Life
HFP stands for Hot Full Thermal Power

2.4 Shutdown Bank Insertion Limit (LCO 3.1.5)

2.4.1 All shutdown banks shall be fully withdrawn to at least 224 steps.

2.5 Control Bank Insertion Limits (LCO 3.1.6)

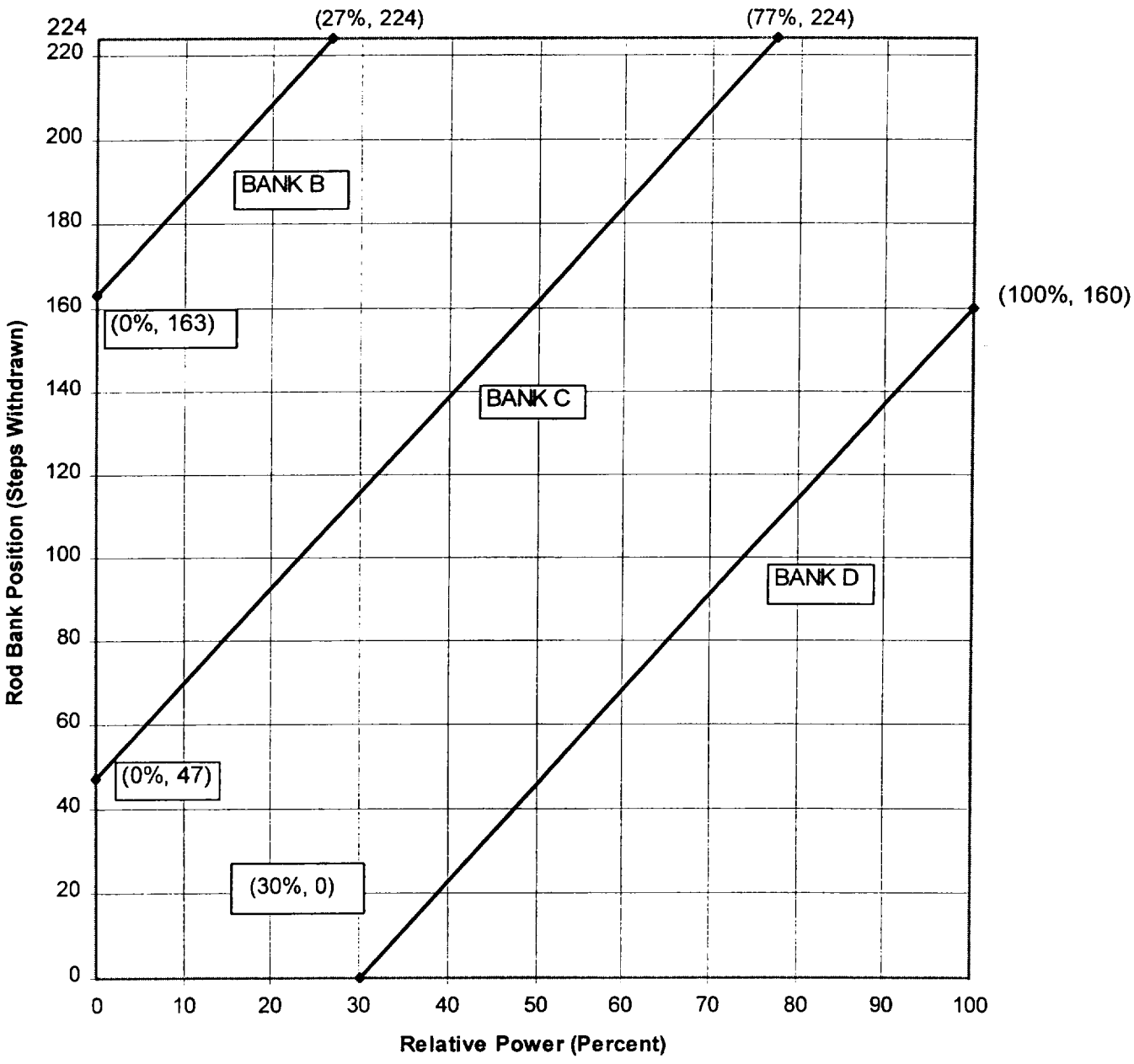
2.5.1 The control banks shall be limited in physical insertion as shown in Figure 2.5.1.

2.5.2 Each control bank shall be considered fully withdrawn from the core at greater than or equal to 224 steps.

2.5.3 The control banks shall be operated in sequence by withdrawal of Bank A, Bank B, Bank C and Bank D. The control banks shall be sequenced in reverse order upon insertion.

2.5.4 Each control bank not fully withdrawn from the core shall be operated with a 115 step overlap limit.

Figure 2.5.1:
Control Bank Insertion Limits Versus Percent Rated Thermal Power



2.6 Heat Flux Hot Channel Factor ($F_Q(Z)$) (LCO 3.2.1)

2.6.1

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{0.5} xK(Z) \quad \text{for } P \leq 0.5$$

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} xK(Z) \quad \text{for } P > 0.5$$

where: P = the ratio of THERMAL POWER to RATED THERMAL POWER

F_Q^{RTP} = 2.60

K(Z) for assembly average burnup > 4000 MWD/MTU is provided in Figure 2.6.1. K(Z) for assembly average burnup ≤ 4000 MWD/MTU is provided in Figure 2.6.1.a.

2.6.2 W(Z) Values:

a) When PDMS is OPERABLE, W(Z) = 1.00000 for all axial points.

b) When PDMS is Inoperable, W(Z) is provided in Figures 2.6.2.a through 2.6.2.d

The normal operation W(Z) values have been determined at burnups of 150, 3000, 10000 and 19000 MWD/MTU.

Table 2.6.2 shows the $F^C_Q(z)$ penalty factors that are greater than 2% per 31 Effective Full Power Days (EFPD). These values shall be used to increase the $F^W_Q(z)$ as per Surveillance Requirement 3.2.1.2. A 2% penalty factor shall be used at all cycle burnups that are outside the range of Table 2.6.2.

Multiplication Factor = 1.02

2.6.3 Uncertainty:

The uncertainty, U_{FQ}, to be applied to the Heat Flux Hot Channel Factor $F_Q(Z)$ shall be calculated by the following formula

$$U_{FQ} = U_{qu} \bullet U_e$$

where:

U_{qu} = Base FQ measurement uncertainty = 1.05 when PDMS is Inoperable
U_e = Engineering uncertainty factor = 1.03

2.6.4 PDMS Alarms:

$F_Q(Z)$ Warning Setpoint ≥ 2% of $F_Q(Z)$ Margin
$F_Q(Z)$ Alarm Setpoint ≥ 0% of $F_Q(Z)$ Margin

Figure 2.6.1: K(Z) - Normalized $F_Q(Z)$ as a Function of Core Height (Assembly BU > 4000 MWD/MTU)

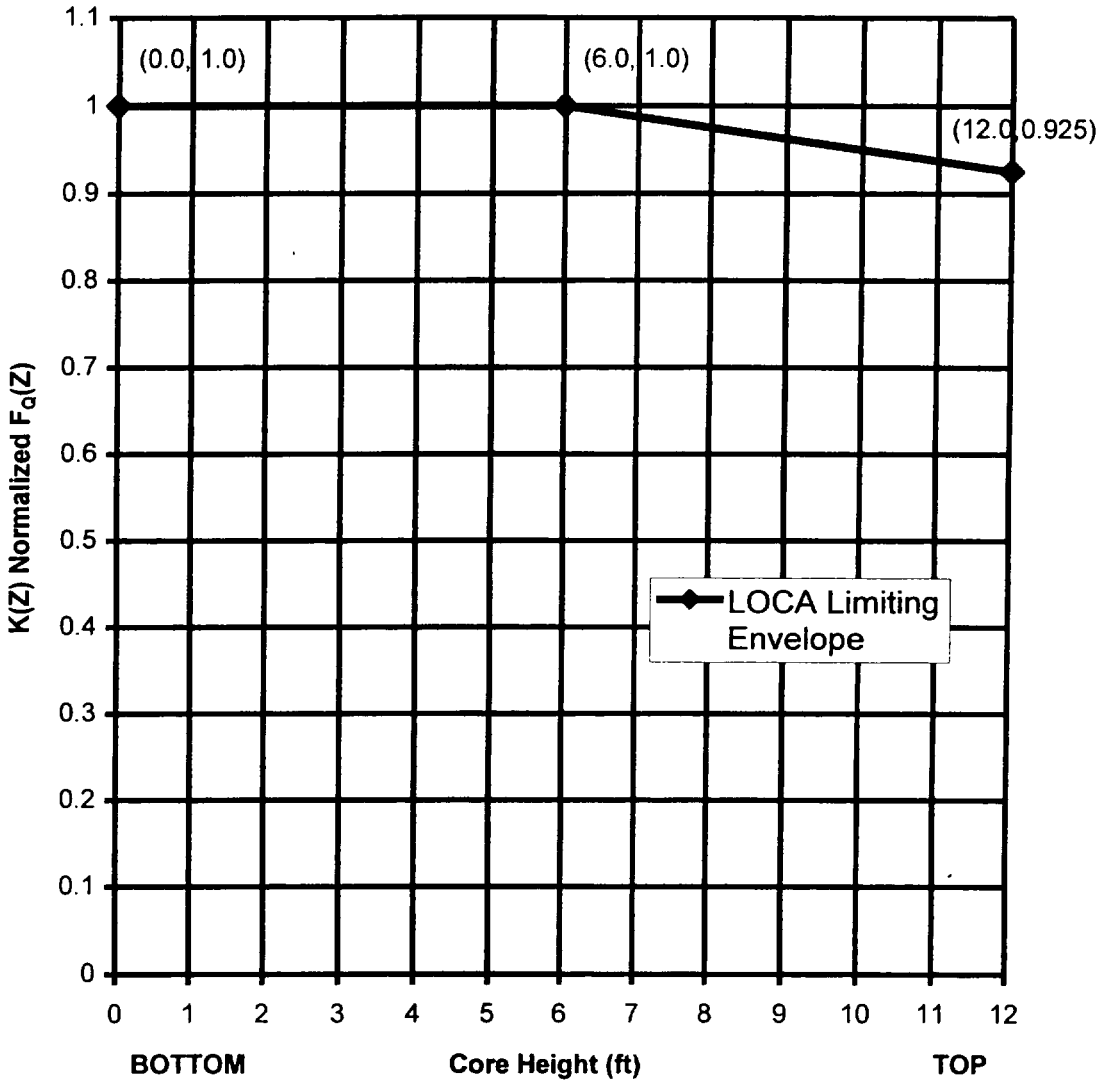
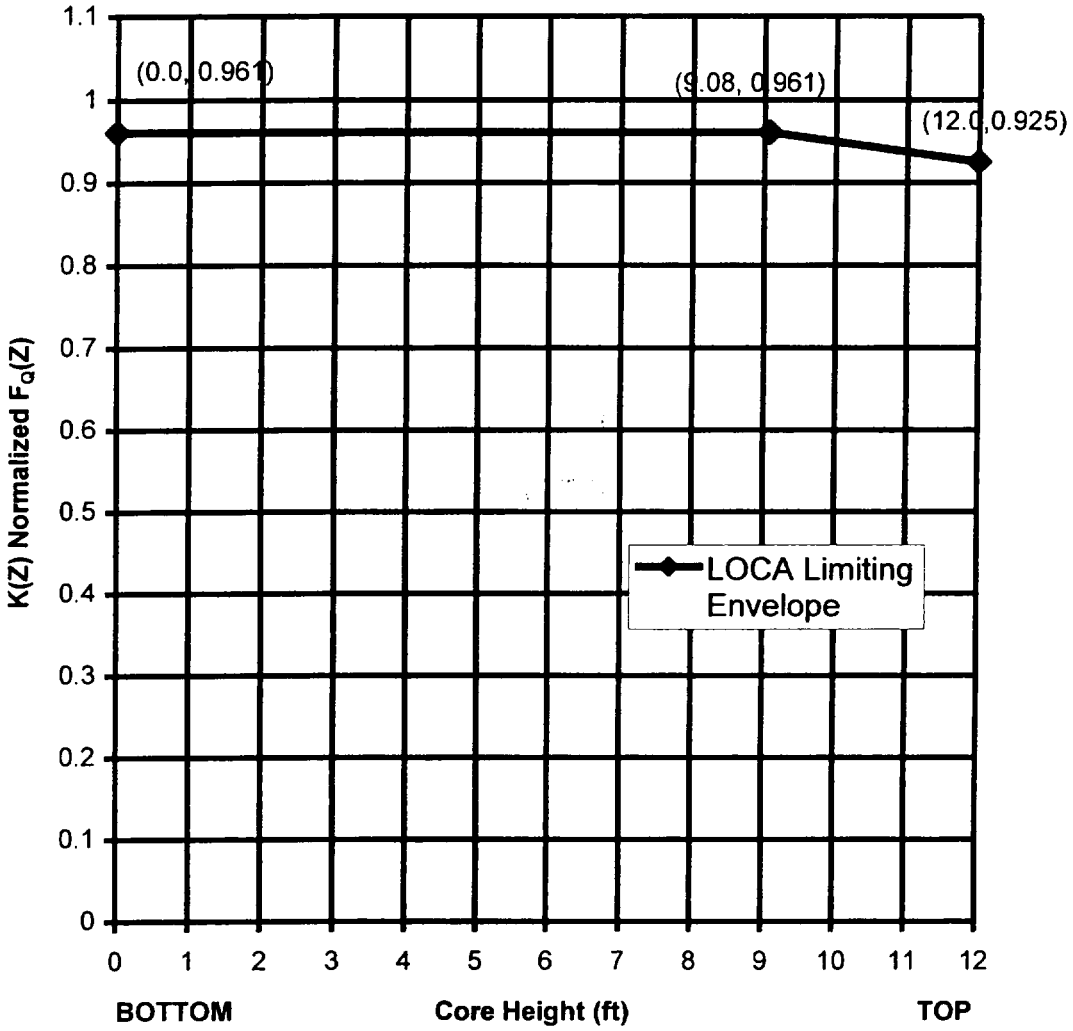


Figure 2.6.1.a: K(Z) - Normalized $F_Q(Z)$ as a Function of Core Height (Assembly BU ≤ 4000 MWD/MTU)



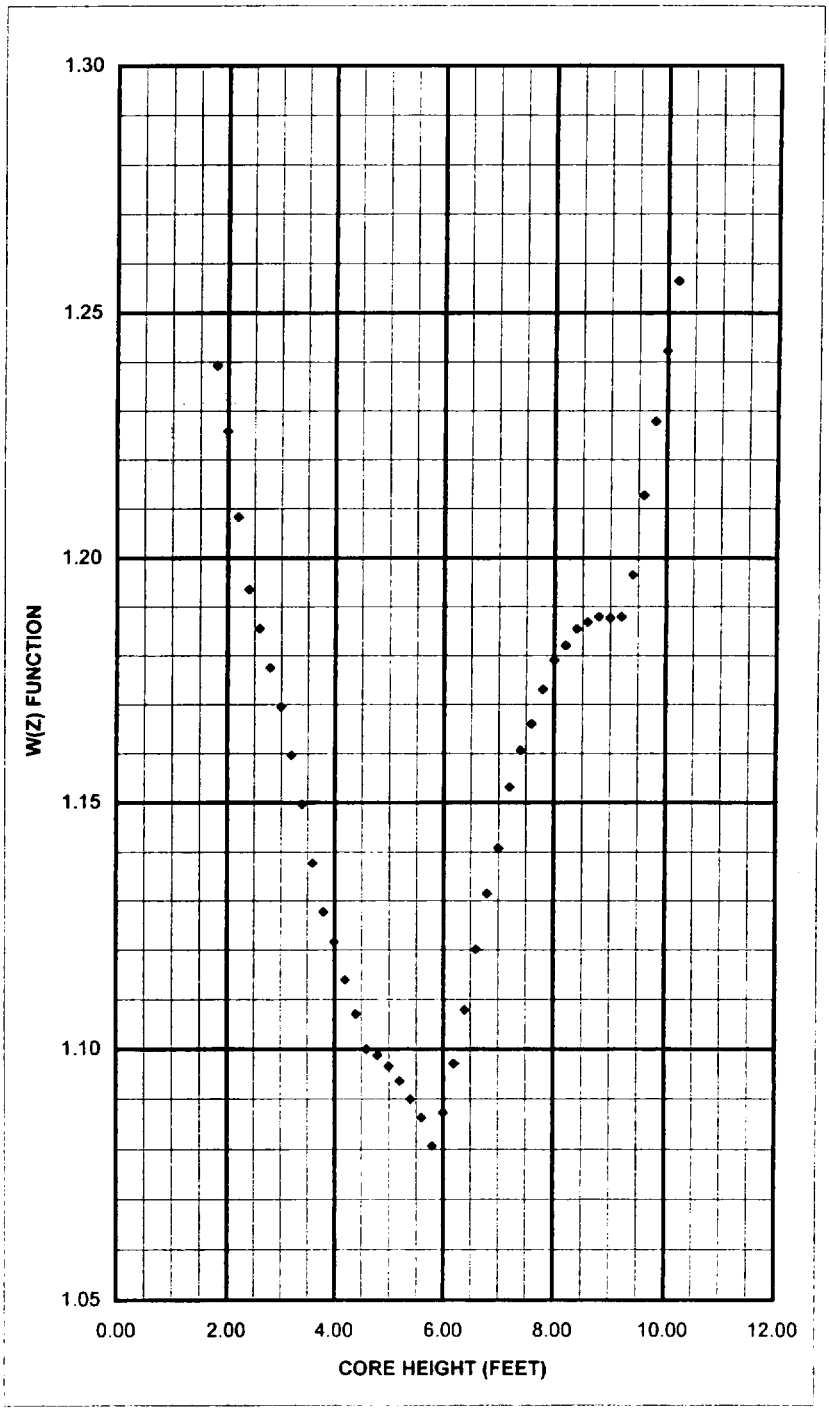
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2392
2.00	1.2258
2.20	1.2083
2.40	1.1934
2.60	1.1855
2.80	1.1775
3.00	1.1695
3.20	1.1596
3.40	1.1496
3.60	1.1376
3.80	1.1277
4.00	1.1216
4.20	1.1139
4.40	1.1070
4.60	1.0999
4.80	1.0987
5.00	1.0965
5.20	1.0935
5.40	1.0899
5.60	1.0862
5.80	1.0806
6.00	1.0872
6.20	1.0970
6.40	1.1078
6.60	1.1201
6.80	1.1314
7.00	1.1407
7.20	1.1531
7.40	1.1606
7.60	1.1660
7.80	1.1730
8.00	1.1790
8.20	1.1820
8.40	1.1854
8.60	1.1868
8.80	1.1879
9.00	1.1876
9.20	1.1879
9.40	1.1965
9.60	1.2127
9.80	1.2278
10.00	1.2422
10.20	1.2564
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 2 Cycle 9

Figure 2.6.2.a

Summary of W(Z) Function at 150 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



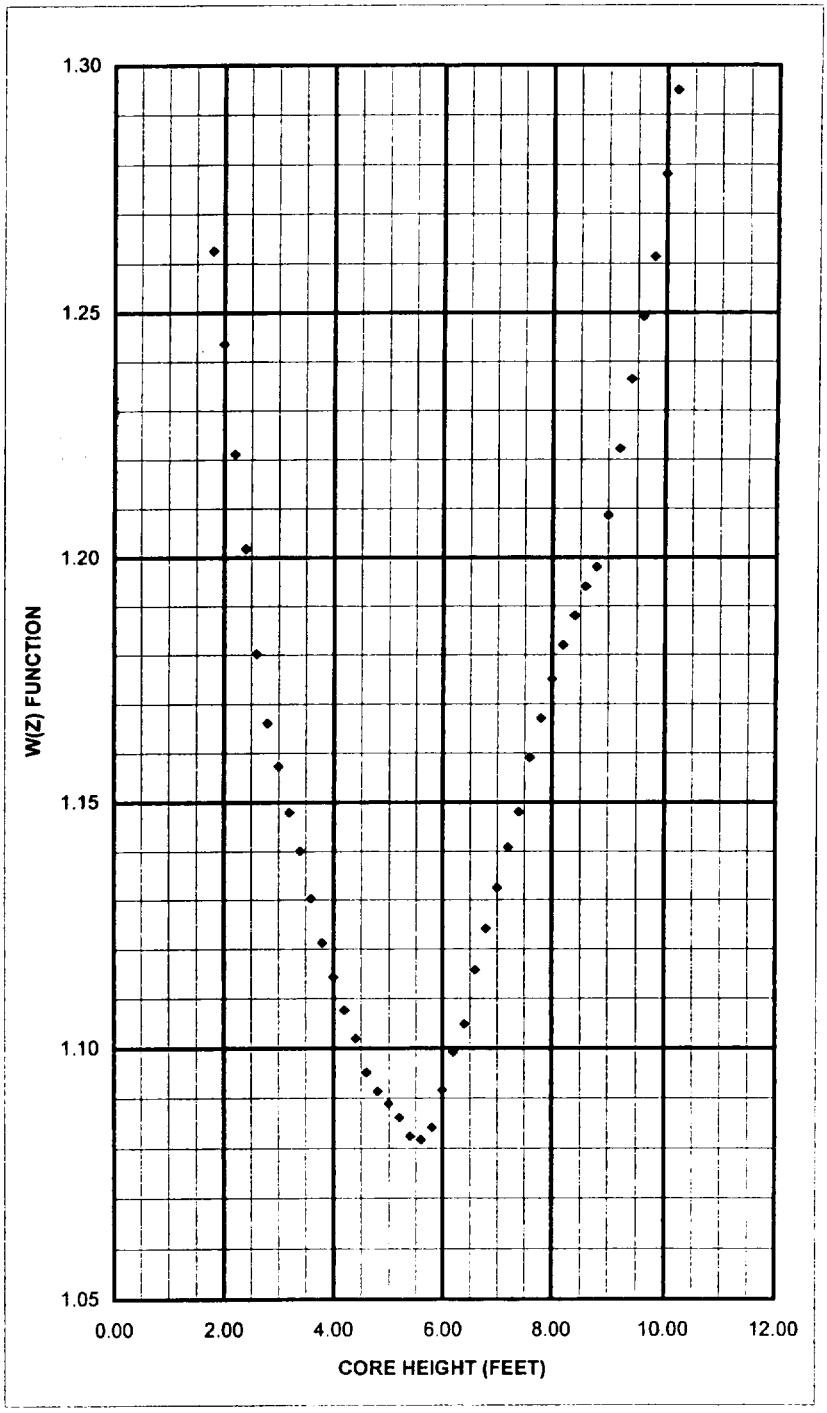
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2625
2.00	1.2436
2.20	1.2211
2.40	1.2018
2.60	1.1802
2.80	1.1661
3.00	1.1573
3.20	1.1479
3.40	1.1400
3.60	1.1302
3.80	1.1212
4.00	1.1143
4.20	1.1076
4.40	1.1019
4.60	1.0951
4.80	1.0913
5.00	1.0889
5.20	1.0861
5.40	1.0823
5.60	1.0817
5.80	1.0841
6.00	1.0916
6.20	1.0992
6.40	1.1048
6.60	1.1157
6.80	1.1241
7.00	1.1324
7.20	1.1408
7.40	1.1480
7.60	1.1590
7.80	1.1670
8.00	1.1750
8.20	1.1820
8.40	1.1880
8.60	1.1940
8.80	1.1980
9.00	1.2086
9.20	1.2222
9.40	1.2364
9.60	1.2491
9.80	1.2613
10.00	1.2780
10.20	1.2949
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 2 Cycle 9

Figure 2.6.2.b

Summary of W(Z) Function at 3000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



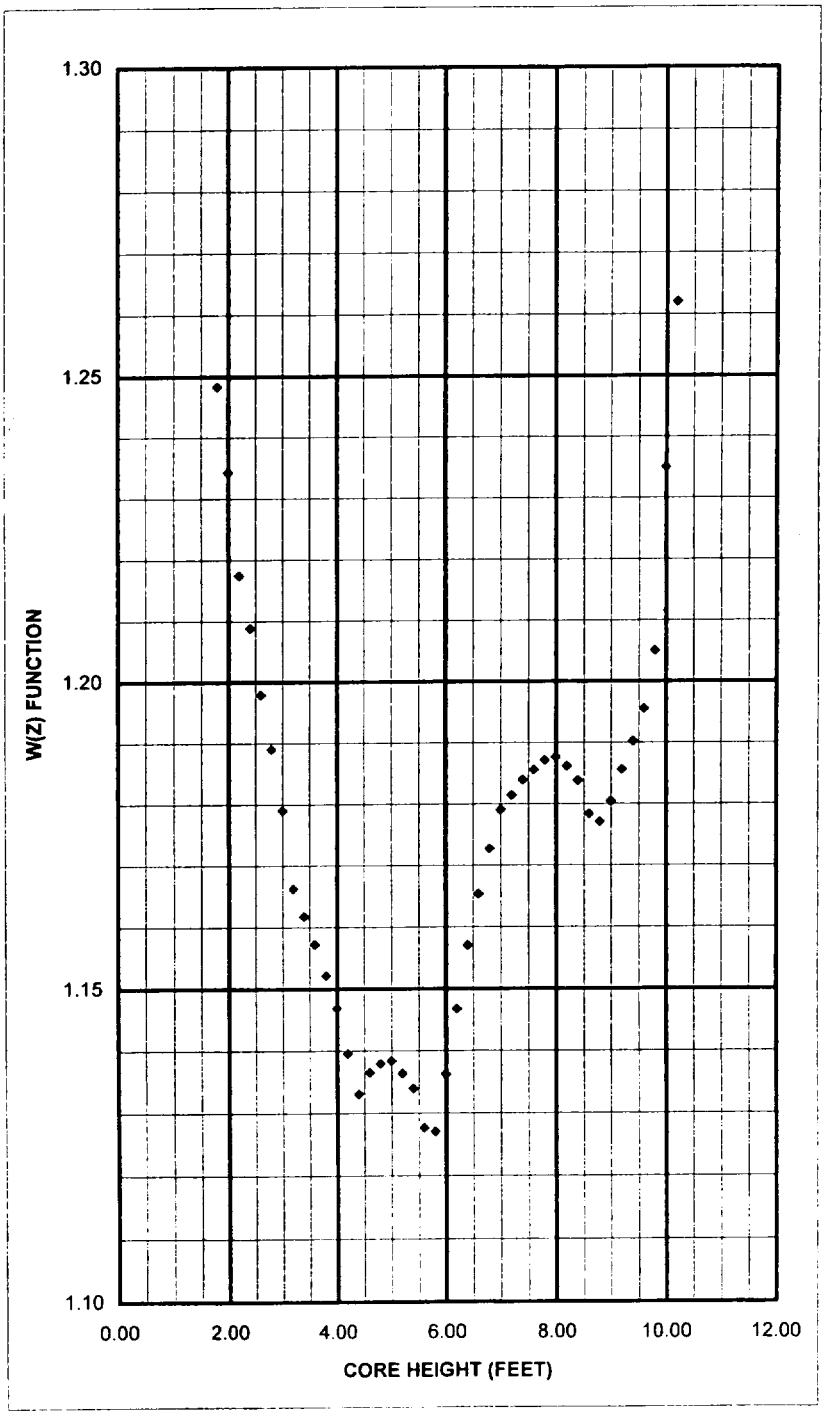
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2483
2.00	1.2343
2.20	1.2174
2.40	1.2088
2.60	1.1979
2.80	1.1890
3.00	1.1790
3.20	1.1662
3.40	1.1617
3.60	1.1572
3.80	1.1521
4.00	1.1468
4.20	1.1395
4.40	1.1330
4.60	1.1365
4.80	1.1379
5.00	1.1383
5.20	1.1363
5.40	1.1339
5.60	1.1276
5.80	1.1270
6.00	1.1362
6.20	1.1467
6.40	1.1570
6.60	1.1653
6.80	1.1727
7.00	1.1790
7.20	1.1814
7.40	1.1839
7.60	1.1855
7.80	1.1871
8.00	1.1876
8.20	1.1861
8.40	1.1838
8.60	1.1784
8.80	1.1771
9.00	1.1804
9.20	1.1856
9.40	1.1902
9.60	1.1955
9.80	1.2050
10.00	1.2350
10.20	1.2620
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 2 Cycle 9

Figure 2.6.2.c

Summary of W(Z) Function at 10000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

Height Feet	MAX W(Z)
0.00	1.0000
0.20	1.0000
0.40	1.0000
0.60	1.0000
0.80	1.0000
1.00	1.0000
1.20	1.0000
1.40	1.0000
1.60	1.0000
1.80	1.2482
2.00	1.2387
2.20	1.2238
2.40	1.2101
2.60	1.1957
2.80	1.1803
3.00	1.1636
3.20	1.1562
3.40	1.1578
3.60	1.1582
3.80	1.1586
4.00	1.1640
4.20	1.1744
4.40	1.1835
4.60	1.1931
4.80	1.1991
5.00	1.2023
5.20	1.2029
5.40	1.2022
5.60	1.1994
5.80	1.2084
6.00	1.2206
6.20	1.2304
6.40	1.2376
6.60	1.2424
6.80	1.2443
7.00	1.2444
7.20	1.2393
7.40	1.2339
7.60	1.2242
7.80	1.2153
8.00	1.2041
8.20	1.1899
8.40	1.1836
8.60	1.1754
8.80	1.1715
9.00	1.1720
9.20	1.2128
9.40	1.2459
9.60	1.2801
9.80	1.3035
10.00	1.3310
10.20	1.3680
10.40	1.0000
10.60	1.0000
10.80	1.0000
11.00	1.0000
11.20	1.0000
11.40	1.0000
11.60	1.0000
11.80	1.0000
12.00	1.0000

Byron Unit 2 Cycle 9

Figure 2.6.2.d

Summary of W(Z) Function at 19000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)

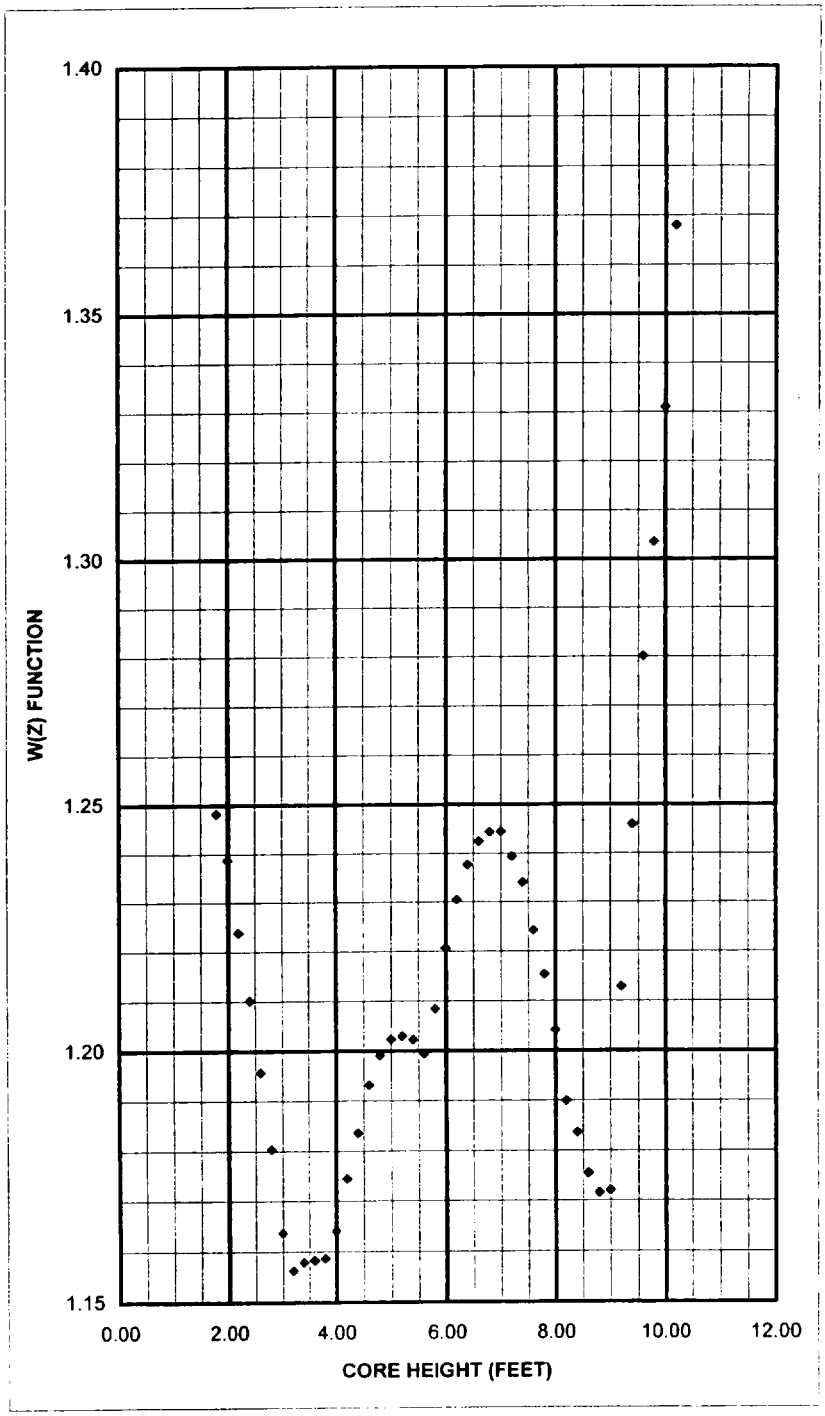


Table 2.6.2

Fq Margin Decreases in Excess of 2% per 31 EFPD

Cycle Burnup (MWD/MTU)	Max % Decrease in Fq Margin
150	3.54
275	3.50
400	3.48
525	3.44
650	3.38
775	3.29
900	3.15
1025	2.96
1150	2.69
1275	2.37
1400	2.01
1525	2.00

Note: All cycle burnups outside the range of the table shall use a 2% decrease in Fq margin for compliance with the 3.2.1.2 Surveillance Requirements. Linear interpolation is adequate for intermediate cycle burnups.

2.7 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$) (LCO 3.2.2)

2.7.1 $F^N_{\Delta H} \leq F^{RTP}_{\Delta H}[1.0 + PF_{\Delta H}(1.0 - P)]$

where: P = the ratio of THERMAL POWER to RATED THERMAL POWER
$F^{RTP}_{\Delta H} = 1.70$
$PF_{\Delta H} = 0.3$

2.7.2 Uncertainty when PDMS is inoperable

The uncertainty, $U_{F\Delta H}$, to be applied to the Nuclear Enthalpy Rise Hot Channel Factor $F_{\Delta H}{}^N$ shall be calculated by the following formula:

$U_{F\Delta H} = U_{F\Delta Hm}$

where:

$U_{F\Delta Hm}$ = Base $F^N_{\Delta H}$ measurement uncertainty = 1.04

2.7.3 PDMS Alarms:

$F^N_{\Delta H}$ Warning Setpoint ≥ 2% of $F^N_{\Delta H}$ Margin
$F^N_{\Delta H}$ Alarm Setpoint ≥ 0% of $F^N_{\Delta H}$ Margin

2.8 Axial Flux Difference (AFD) (LCO 3.2.3)

2.8.1 When PDMS is Inoperable, the AXIAL FLUX DIFFERENCE (AFD) Acceptable Operation Limits are provided in Figure 2.8.1 or the latest valid PDMS Surveillance Report, whichever is more conservative.

2.8.2 When PDMS is OPERABLE, no AFD Acceptable Operation Limits are applicable.

2.9 Departure from Nucleate Boiling Ratio (DNBR) (LCO 3.2.5)

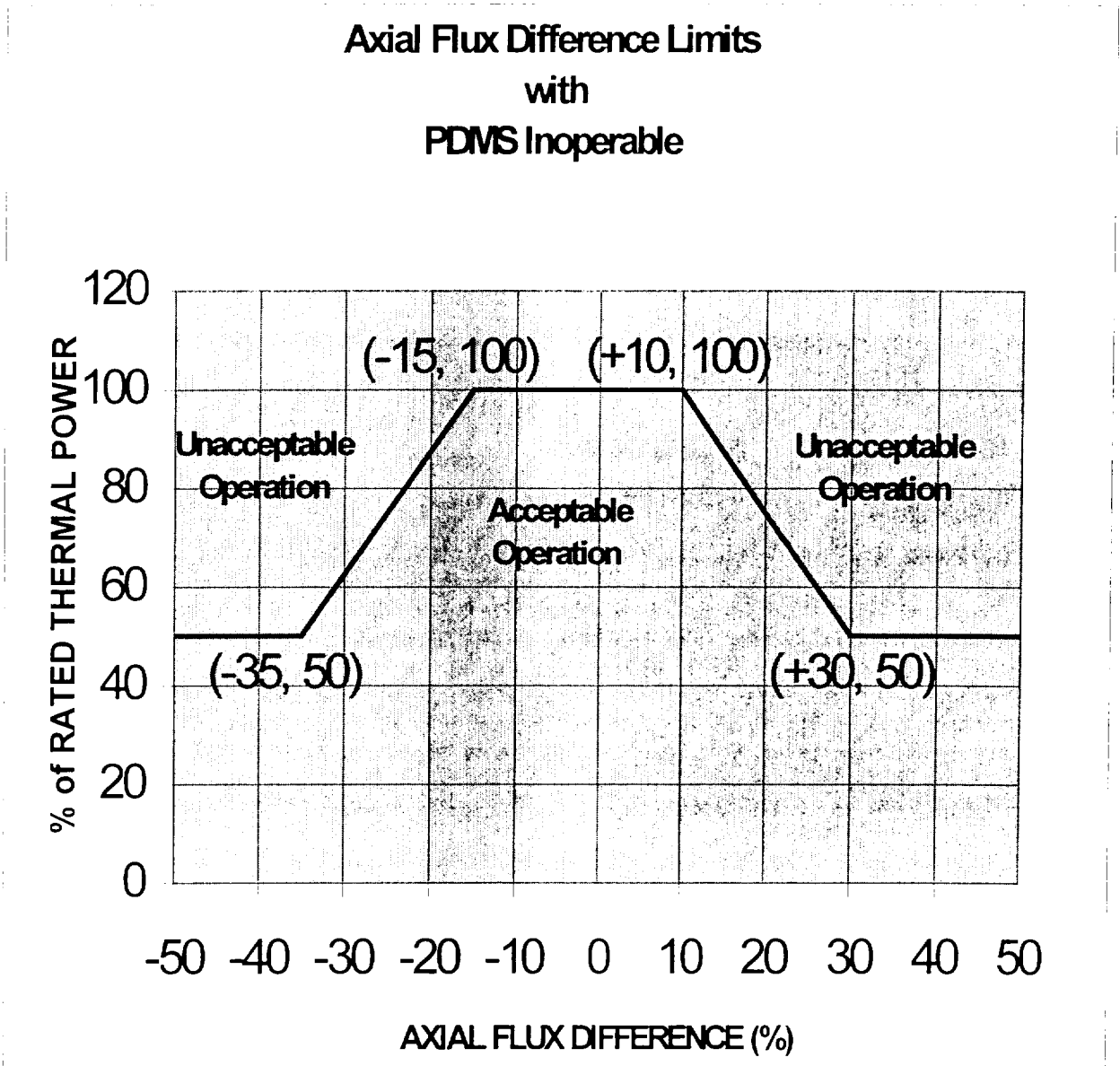
2.9.1 $DNBR_{APSL} \geq 1.572$

The Axial Power Shape Limiting DNBR ($DNBR_{APSL}$) is applicable with THERMAL POWER ≥ 50% RTP when PDMS is OPERABLE.

2.9.2 PDMS Alarms:

DNBR Warning Setpoint ≥ 2% of DNBR Margin
DNBR Alarm Setpoint ≥ 0% of DNBR Margin

Figure 2.8.1 Axial Flux Difference Limits as a Function of Rated Thermal Power



2.10 Reactor Trip System Overtemperature ΔT Setpoint Parameter Values (LCO 3.3.1)

2.10.1 The Overtemperature ΔT reactor trip setpoint K_1 shall be equal to 1.325.

2.10.2 The Overtemperature ΔT reactor trip setpoint T_{avg} coefficient K_2 shall be equal to 0.0297 / °F.

2.10.3 The Overtemperature ΔT reactor trip setpoint pressure coefficient K_3 shall be equal to 0.00181 / psig.

2.10.4 The nominal T_{avg} at RTP (indicated) T' shall be less than or equal to 588.4 °F.

2.10.5 The nominal RCS operating pressure (indicated) P' shall be equal to 2235 psig.

2.10.6 The measured reactor vessel ΔT lead/lag time constant τ_1 shall be equal to 8 sec.

2.10.7 The measured reactor vessel ΔT lead/lag time constant τ_2 shall be equal to 3 sec.

2.10.8 The measured reactor vessel ΔT lag time constant τ_3 shall be less than or equal to 2 sec.

2.10.9 The measured reactor vessel average temperature lead/lag time constant τ_4 shall be equal to 33 sec.

2.10.10 The measured reactor vessel average temperature lead/lag time constant τ_5 shall be equal to 4 sec.

2.10.11 The measured reactor vessel average temperature lag time constant τ_6 shall be less than or equal to 2 sec.

2.10.12 The $f_1(\Delta I)$ "positive" breakpoint shall be +10% ΔI.

2.10.13 The $f_1(\Delta I)$ "negative" breakpoint shall be -24% ΔI.

2.10.14 The $f_1(\Delta I)$ "positive" slope shall be +4.11% / % ΔI.

2.10.15 The $f_1(\Delta I)$ "negative" slope shall be -3.35% / % ΔI.

2.11 Reactor Trip System Overpower ΔT Setpoint Parameter Values (LCO 3.3.1)

2.11.1 The Overpower ΔT reactor trip setpoint K_4 shall be equal to 1.072.

2.11.2 The Overpower ΔT reactor trip setpoint T_{avg} rate/lag coefficient K_5 shall be equal to 0.02 / °F for increasing T_{avg}.

2.11.3 The Overpower ΔT reactor trip setpoint T_{avg} rate/lag coefficient K_5 shall be equal to 0 / °F for decreasing T_{avg}.

2.11.4 The Overpower ΔT reactor trip setpoint T_{avg} heatup coefficient K_6 shall be equal to 0.00245 / °F when $T > T''$.

2.11.5 The Overpower ΔT reactor trip setpoint T_{avg} heatup coefficient K_6 shall be equal to 0 / °F when $T \leq T''$.

2.11.6 The nominal T_{avg} at RTP (indicated) T'' shall be less than or equal to 588.4 °F.

2.11.7 The measured reactor vessel ΔT lead/lag time constant τ_1 shall be equal to 8 sec.

2.11.8 The measured reactor vessel ΔT lead/lag time constant τ_2 shall be equal to 3 sec.

2.11.9 The measured reactor vessel ΔT lag time constant τ_3 shall be less than or equal to 2 sec.

2.11.10 The measured reactor vessel average temperature lag time constant τ_6 shall be less than or equal to 2 sec.

2.11.11 The measured reactor vessel average temperature rate/lag time constant τ_7 shall be equal to 10 sec.

2.11.12 The $f_2(\Delta I)$ "positive" breakpoint shall be 0 for all ΔI.

2.11.13 The $f_2(\Delta I)$ "negative" breakpoint shall be 0 for all ΔI.

2.11.14 The $f_2(\Delta I)$ "positive" slope shall be 0 for all ΔI.

2.11.15 The $f_2(\Delta I)$ "negative" slope shall be 0 for all ΔI.

2.12 Reactor Coolant System (RCS) DNB Parameter Limits (LCO 3.4.1)

2.12.1 The pressurizer pressure shall be greater than or equal to 2219 psig.

2.12.2 The RCS average temperature (T_{avg}) shall be less than or equal to 591.2 °F.

2.12.3 The RCS total flow rate shall be greater than or equal to 371,400 gpm.

2.13 Boron Concentration

2.13.1 The refueling boron concentration shall be greater than or equal to 2000 ppm (LCO 3.9.1).

2.13.2 The Reactor Coolant System boron concentration shall be greater than or equal to 1919 ppm to maintain adequate shutdown margin for MODES 3, 4, and 5 during performance of rod drop time measurements and during the surveillance of Digital Rod Position Indication (DRPI) for OPERABILITY (TLCO 3.1.g and TLCO 3.1.k).