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Exelon Nuclear

June 5, 2001
BW010055

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Subject: Core Operating Limits Report, Braidwood Unit 1 Cycle 9A Sequence Number 0 and Braidwood Unit 2 Cycle 9A Sequence Number 0

The purpose of this letter is to transmit the Core Operating Limits Reports (COLRs) for Braidwood Unit 1 Cycle 9A Sequence Number 0 and Braidwood Unit 2 Cycle 9A Sequence Number 0, in accordance with Technical Specification 5.6.5, "Core Operating Limits Report (COLR)." These versions of the COLRs were recently implemented to support implementation of the Best Estimate Loss of Coolant Accident Analysis Methodology in conjunction with Power Uprate.

If you have any questions regarding this matter, please contact Ms. A. Ferko, Regulatory Assurance Manager at (815) 458-2801, extension 2699.

Respectfully,

James D. von Suskil
Site Vice President
Braidwood Station

Attachments: 1. Core Operating Limits Report, Braidwood Unit 1 Cycle 9A Sequence Number 0

2. Core Operating Limits Report, Braidwood Unit 2 Cycle 9A Sequence Number 0

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

A001

ATTACHMENT 1

Core Operating Limits Report

Braidwood Unit 1, Cycle 9A, Sequence Number 0

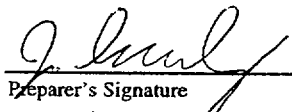
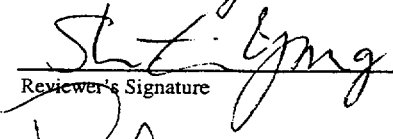
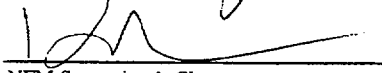
NUCLEAR FUEL MANAGEMENT DEPARTMENT
TRANSMITTAL OF DESIGN INFORMATION

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) _____	TODI No. NFM0100052 Seq. No. 0 Page 1 of 14

Station Braidwood Unit 1 Cycle 9A Generic _____

To: Lonnie K. Kepley - Braidwood

Subject Braidwood Unit 1 Cycle 9A Core Operating Limits Report in ITS Format and W(z) Function

J. Gurley Preparer	 Preparer's Signature	4/19/01 Date
S. Yang Reviewer	 Reviewer's Signature	4/19/01 Date
D. Redden NFM Supervisor	 NFM Supervisor's Signature	4/20/01 Date

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified TODIs: _____

Description of Information:

Attached is the Braidwood Unit 1 Cycle 9A Core Operating Limits Report (COLR) in the ITS format and W(z) function.

Purpose of Information:

COLR with uprate values. Braidwood Station is requested to perform a plant review of this document. Upon completion of the plant review, Braidwood Station is to transmit the COLR portion to the Nuclear Regulatory Commission pursuant to Technical Specification 5.6.5. Please provide NFM (Tyrone L. Stevens) with a copy of Braidwood Station's completed plant review and COLR submittal to the NRC.

Source of Information:

Westinghouse Letter CAC-01-130, "Braidwood 1 Cycle 9A COLR data for 3586.6 MWt Operation, " dated April 12, 2001.
NFM0100054, "RCS Average Temperature DNB Limit, " Seq. 0, dated April 14, 2001.

Supplemental Distribution: A. Ferko / L. S. Dworakowski (BR)

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Braidwood Station Unit 1 Cycle 9A 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 $k_{eff} \geq 1.0$
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.

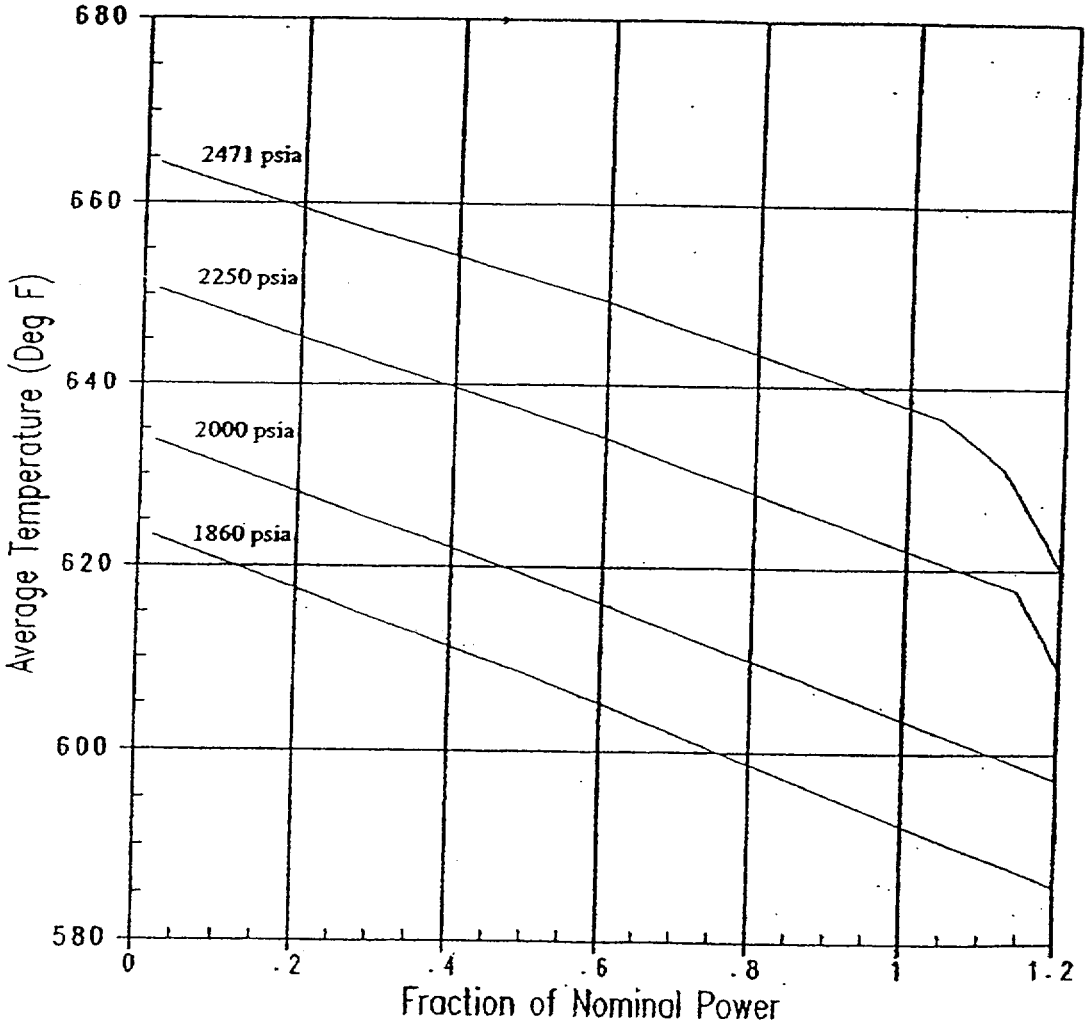


Figure 2.1.1: Reactor Core Limits

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% Δk/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% Δk/k (LCO 3.1.1).

2.2.2.2 SDM shall be greater than or equal to 1.3% Δk/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 $+3.4 \times 10^{-5}$ Δk/k/°F.

2.3.2 The EOL/ARO/HFP-MTC lower limit shall be -4.6×10^{-4} Δk/k/°F.

2.3.3 The EOL/ARO/HFP-MTC Surveillance limit at 300 ppm shall be less negative than or equal to -3.7×10^{-4} Δk/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)

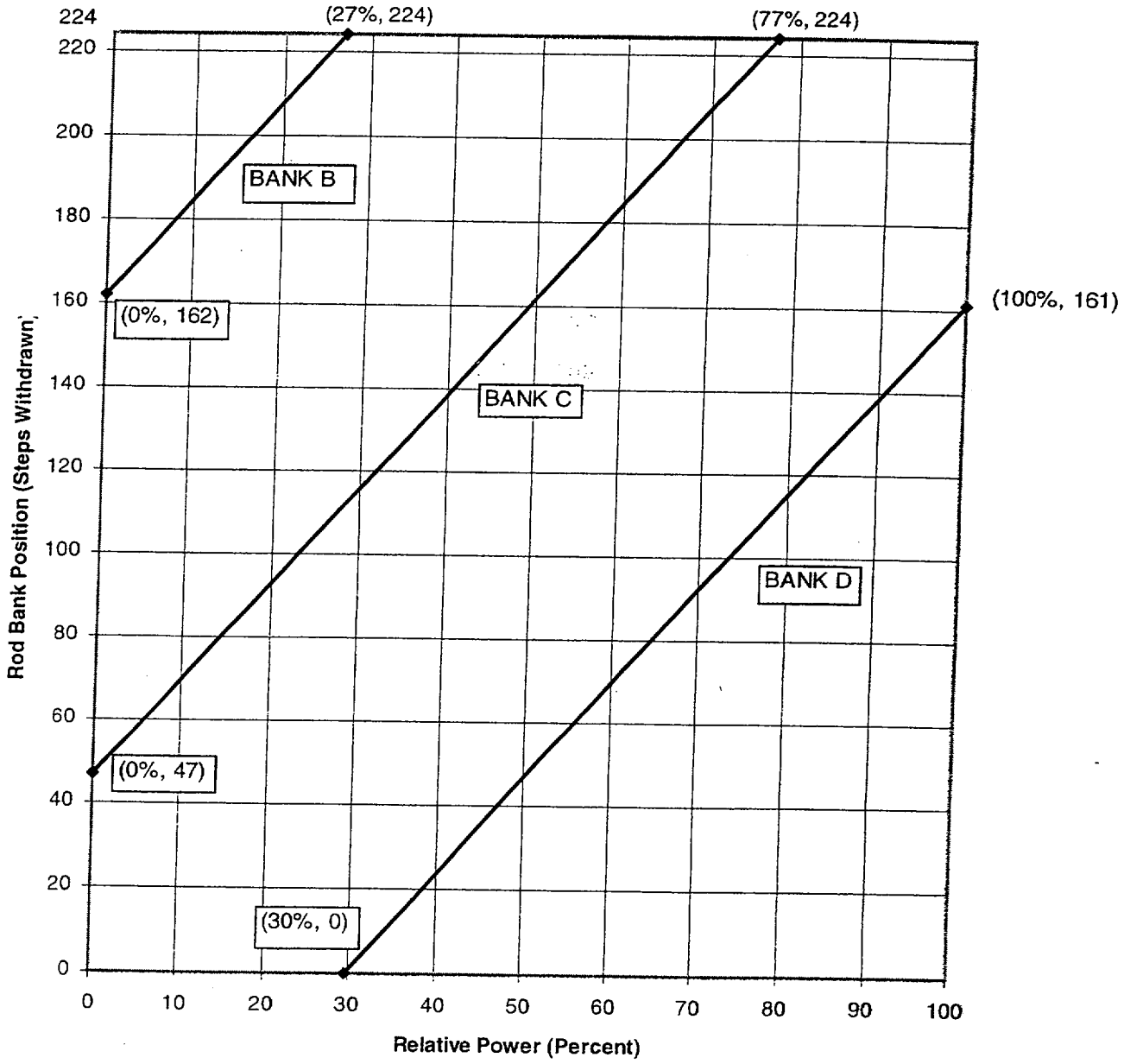
2.5.1 The control banks shall be limited in physical insertion as shown in Figure 2.5.1.

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) is provided in Figure 2.6.1.

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.c

The normal operation W(Z) values have been determined at burnups of 16501, 18000, and 20000 MWD/MTU.

For this cycle, the $F^C_Q(z)$ penalty factors are equal to 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.

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

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

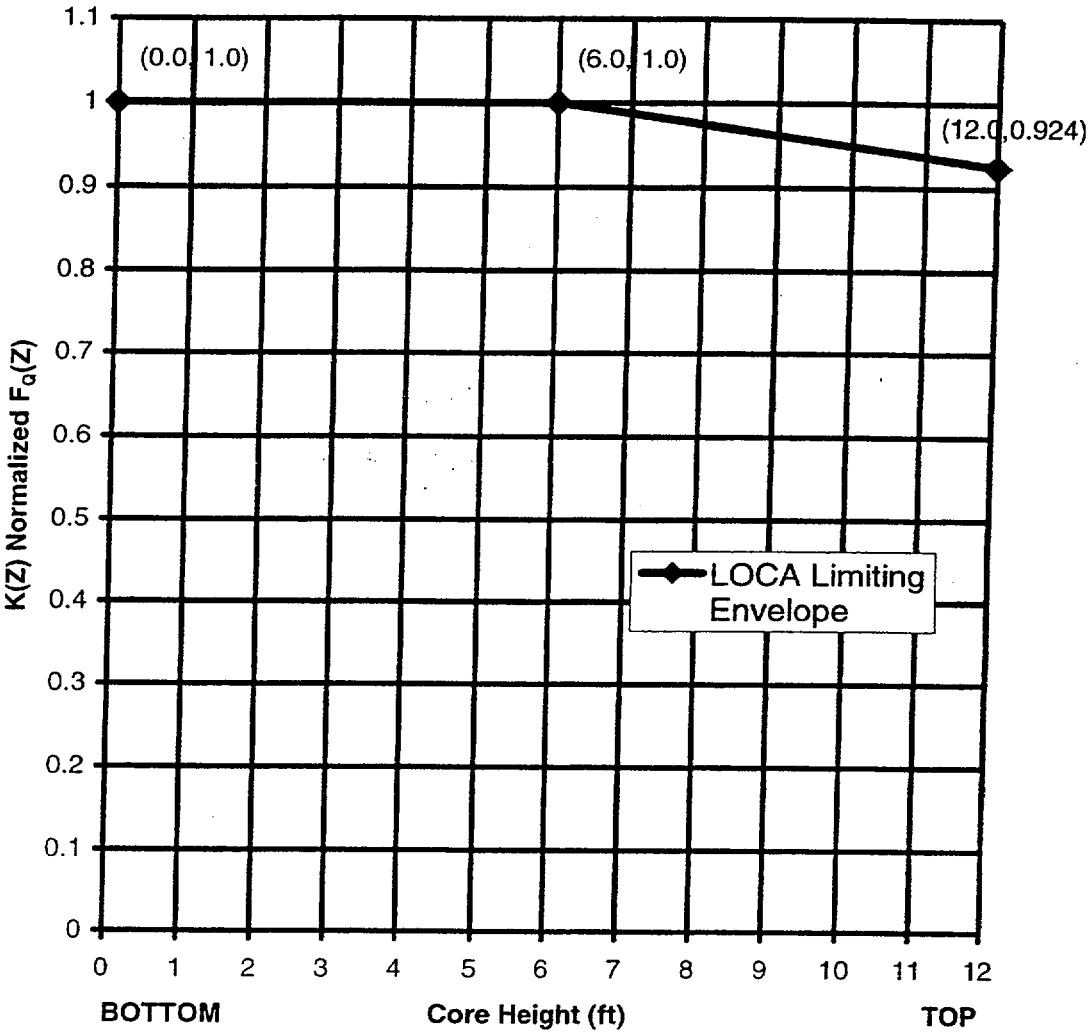
where:

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



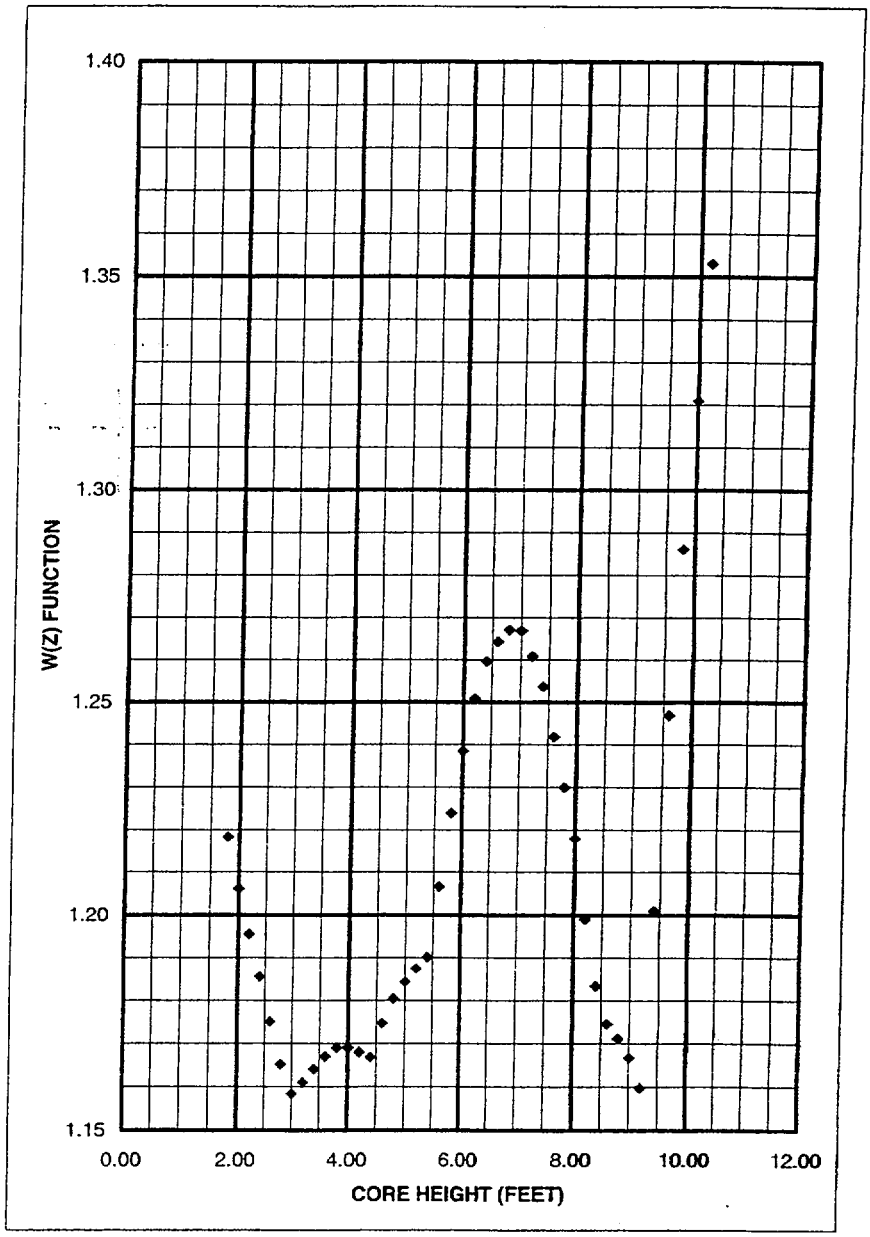
CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 9A

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	1.2183
2.00	1.2060
2.20	1.1955
2.40	1.1855
2.60	1.1750
2.80	1.1652
3.00	1.1584
3.20	1.1610
3.40	1.1640
3.60	1.1670
3.80	1.1690
4.00	1.1690
4.20	1.1680
4.40	1.1668
4.60	1.1746
4.80	1.1804
5.00	1.1843
5.20	1.1875
5.40	1.1901
5.60	1.2065
5.80	1.2240
6.00	1.2385
6.20	1.2509
6.40	1.2596
6.60	1.2643
6.80	1.2671
7.00	1.2669
7.20	1.2608
7.40	1.2537
7.60	1.2418
7.80	1.2299
8.00	1.2179
8.20	1.1991
8.40	1.1833
8.60	1.1745
8.80	1.1711
9.00	1.1667
9.20	1.1598
9.40	1.2010
9.60	1.2470
9.80	1.2860
10.00	1.3210
10.20	1.3530
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

Braidwood Unit 1 Cycle 9A

Figure 2.6.2.a

Summary of W(Z) Function at 16501 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



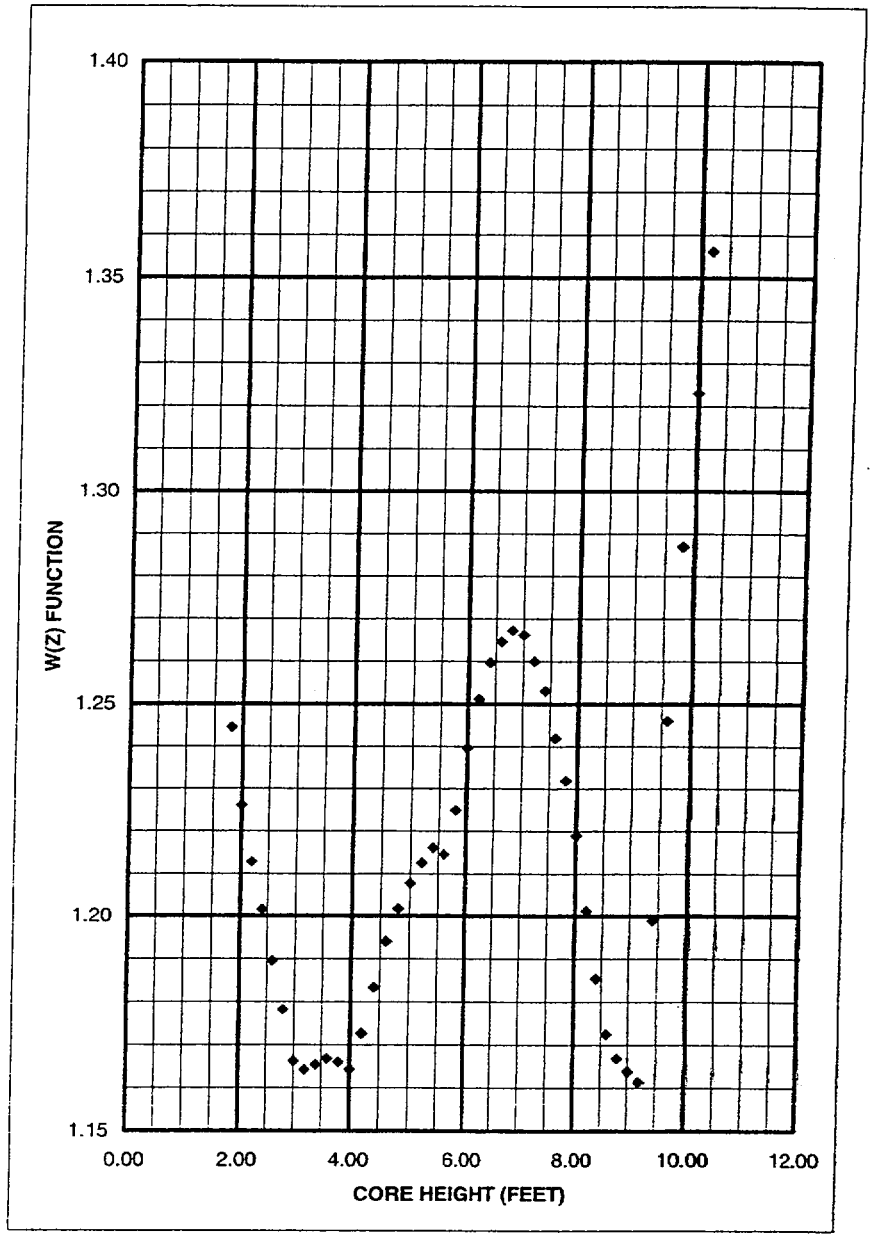
CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 9A

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	1.2445
2.00	1.2262
2.20	1.2128
2.40	1.2015
2.60	1.1895
2.80	1.1782
3.00	1.1661
3.20	1.1641
3.40	1.1653
3.60	1.1667
3.80	1.1659
4.00	1.1642
4.20	1.1726
4.40	1.1834
4.60	1.1941
4.80	1.2017
5.00	1.2078
5.20	1.2126
5,40	1.2162
5.60	1.2146
5.80	1.2250
6.00	1.2396
6.20	1.2511
6.40	1.2597
6.60	1.2645
6.80	1.2672
7.00	1.2661
7.20	1.2600
7.40	1.2530
7.60	1.2419
7.80	1.2319
8.00	1.2190
8.20	1.2012
8.40	1.1854
8.60	1.1725
8.80	1.1668
9.00	1.1637
9.20	1.1614
9.40	1.1990
9.60	1.2460
9.80	1.2870
10.00	1.3230
10.20	1.3560
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

Braidwood Unit 1 Cycle 9A

Figure 2.6.2.b

Summary of W(Z) Function at 18000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



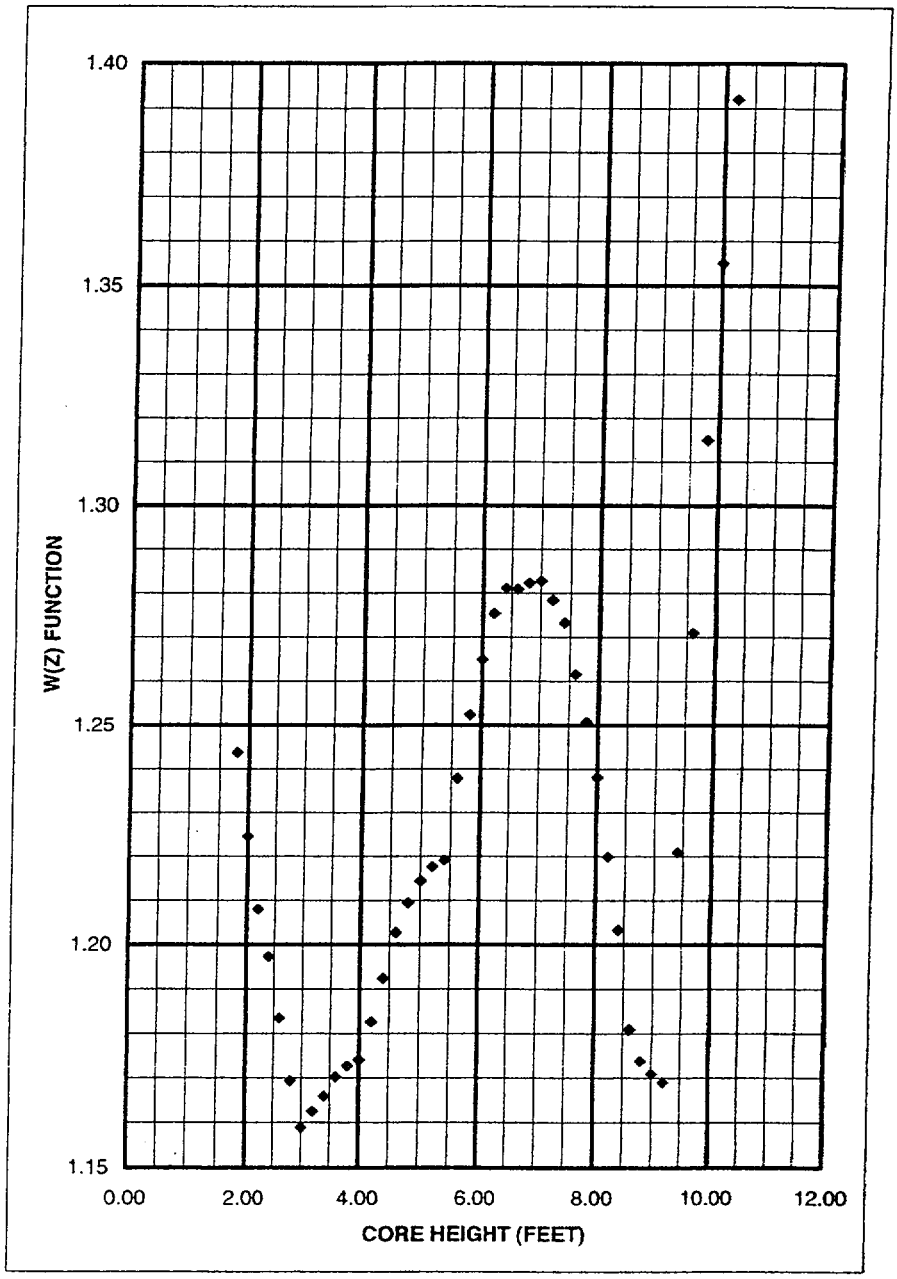
CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 9A

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	1.2438
2.00	1.2246
2.20	1.2079
2.40	1.1973
2.60	1.1834
2.80	1.1693
3.00	1.1589
3.20	1.1625
3.40	1.1659
3.60	1.1702
3.80	1.1726
4.00	1.1740
4.20	1.1825
4.40	1.1924
4.60	1.2027
4.80	1.2094
5.00	1.2143
5.20	1.2175
5.40	1.2191
5.60	1.2378
5.80	1.2524
6.00	1.2650
6.20	1.2754
6.40	1.2811
6.60	1.2809
6.80	1.2823
7.00	1.2828
7.20	1.2784
7.40	1.2733
7.60	1.2616
7.80	1.2508
8.00	1.2381
8.20	1.2199
8.40	1.2033
8.60	1.1809
8.80	1.1737
9.00	1.1709
9.20	1.1690
9.40	1.2210
9.60	1.2710
9.80	1.3150
10.00	1.3550
10.20	1.3920
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

Braidwood Unit 1 Cycle 9A

Figure 2.6.2.c

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



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)

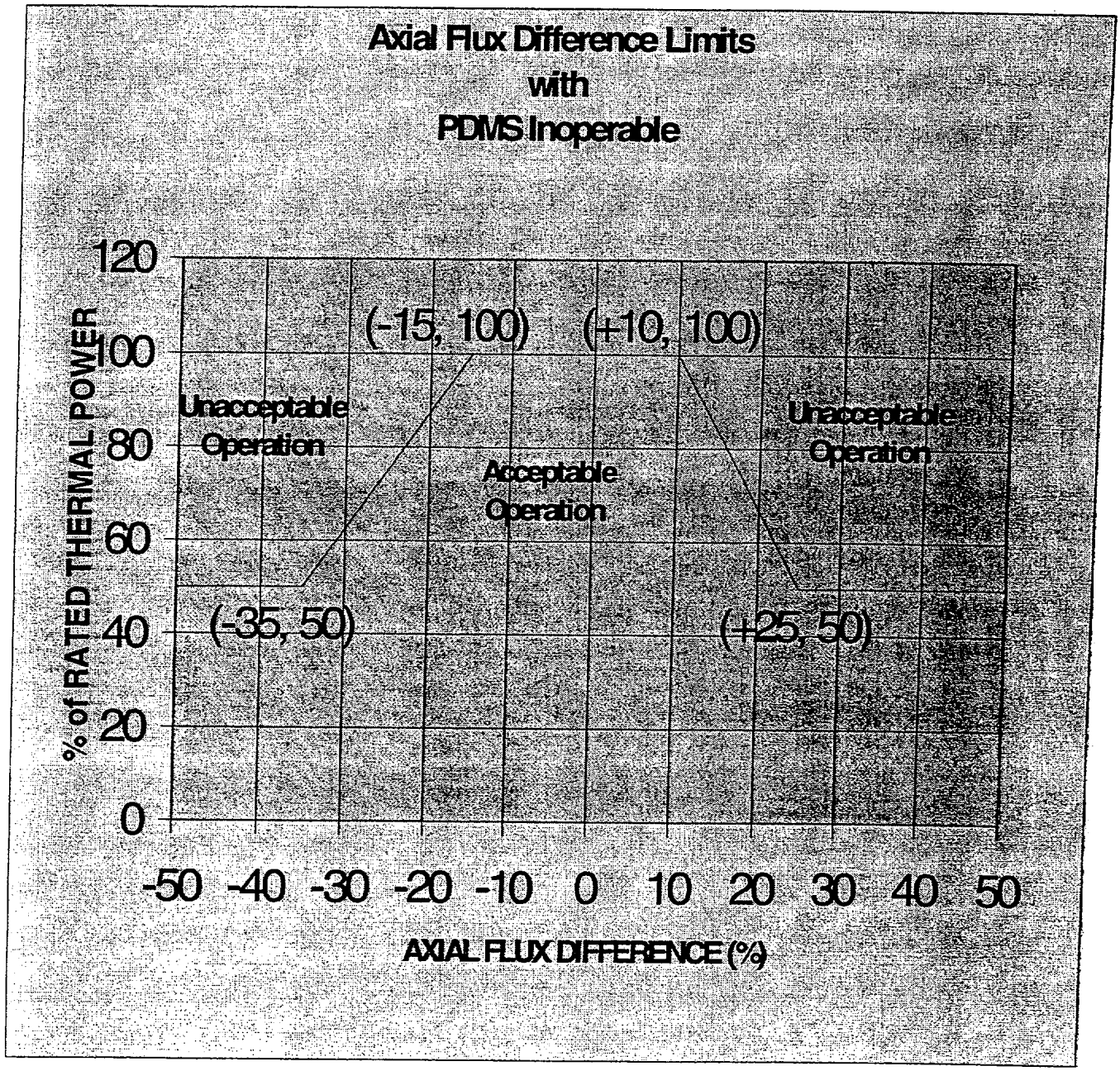
2.9.1 $DNBR_{APSL} \geq 1.536$

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 588.0 °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 (ΔI) "positive" breakpoint shall be +10% ΔI.

2.10.13 The f_1 (ΔI) "negative" breakpoint shall be -18% ΔI.

2.10.14 The f_1 (ΔI) "positive" slope shall be +3.47% / % ΔI.

2.10.15 The f_1 (ΔI) "negative" slope shall be -2.61% / % 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 588.0 °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 2209 psig.

2.12.2 The RCS average temperature (T_{avg}) shall be less than or equal to 593.1 °F.

2.12.3 The RCS total flow rate shall be greater than or equal to 386,000 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 1969 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).

ATTACHMENT 2

Core Operating Limits Report

Braidwood Unit 2, Cycle 9A, Sequence Number 0

NUCLEAR FUEL MANAGEMENT DEPARTMENT
TRANSMITTAL OF DESIGN INFORMATION

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) _____	TODI No. NFM0100053 Seq. No. 0 Page 1 of 14

Station Braidwood Unit 2 Cycle 9A Generic _____

To: Lonnie K. Kepley - Braidwood

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

J. Gurley Preparer	J. Gurley Preparer's Signature	4/19/01 Date
S. Yang Reviewer	S. Yang Reviewer's Signature	4/19/01 Date
D. Redden NFM Supervisor	NFM Supervisor's Signature	4/20/01 Date

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified TODIs: _____

Description of Information:

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

Purpose of Information:

COLR with uprate values. Braidwood Station is requested to perform a plant review of this document. Upon completion of the plant review, Braidwood Station is to transmit the COLR portion to the Nuclear Regulatory Commission pursuant to Technical Specification 5.6.5. Please provide NFM (Tyrone L. Stevens) with a copy of Braidwood Station's completed plant review and COLR submittal to the NRC.

Source of Information:

Westinghouse Letter CAC-01-131, "Braidwood 2 Cycle 9A COLR data for 3586.6 MWt Operation, " dated April 12, 2001.
NFM0100054, "RCS Average Temperature DNB Limit, " Seq. 0, dated April 14, 2001.

Supplemental Distribution: A. Ferko / L. S. Dworakowski (BR)

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Braidwood Station Unit 2 Cycle 9A 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.

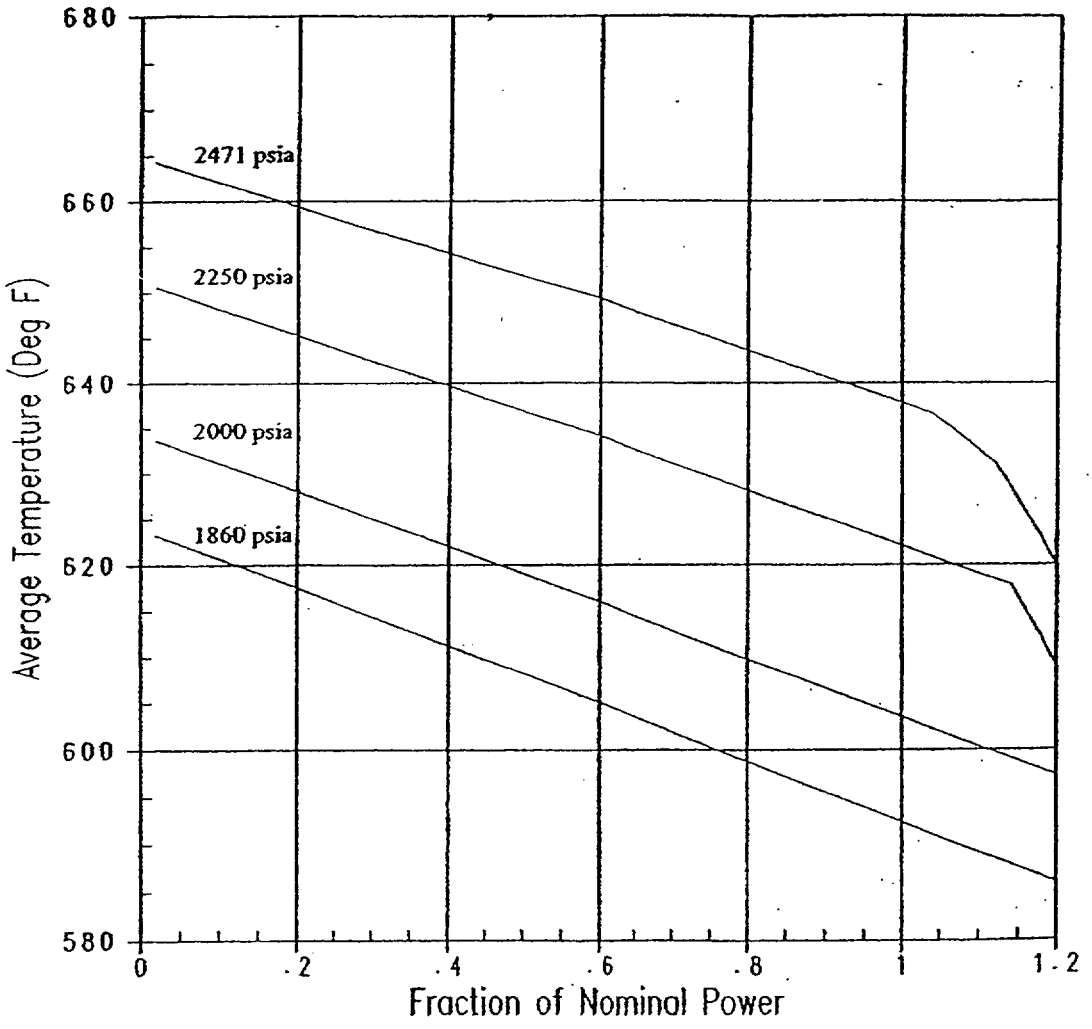


Figure 2.1.1: Reactor Core Limits

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% Δk/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% Δk/k (LCO 3.1.1).

2.2.2.2 SDM shall be greater than or equal to 1.3% Δk/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 $+4.1 \times 10^{-5}$ Δk/k/°F.

2.3.2 The EOL/ARO/HFP-MTC lower limit shall be -4.6×10^{-4} Δk/k/°F.

2.3.3 The EOL/ARO/HFP-MTC Surveillance limit at 300 ppm shall be less negative than or equal to -3.7×10^{-4} Δk/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)

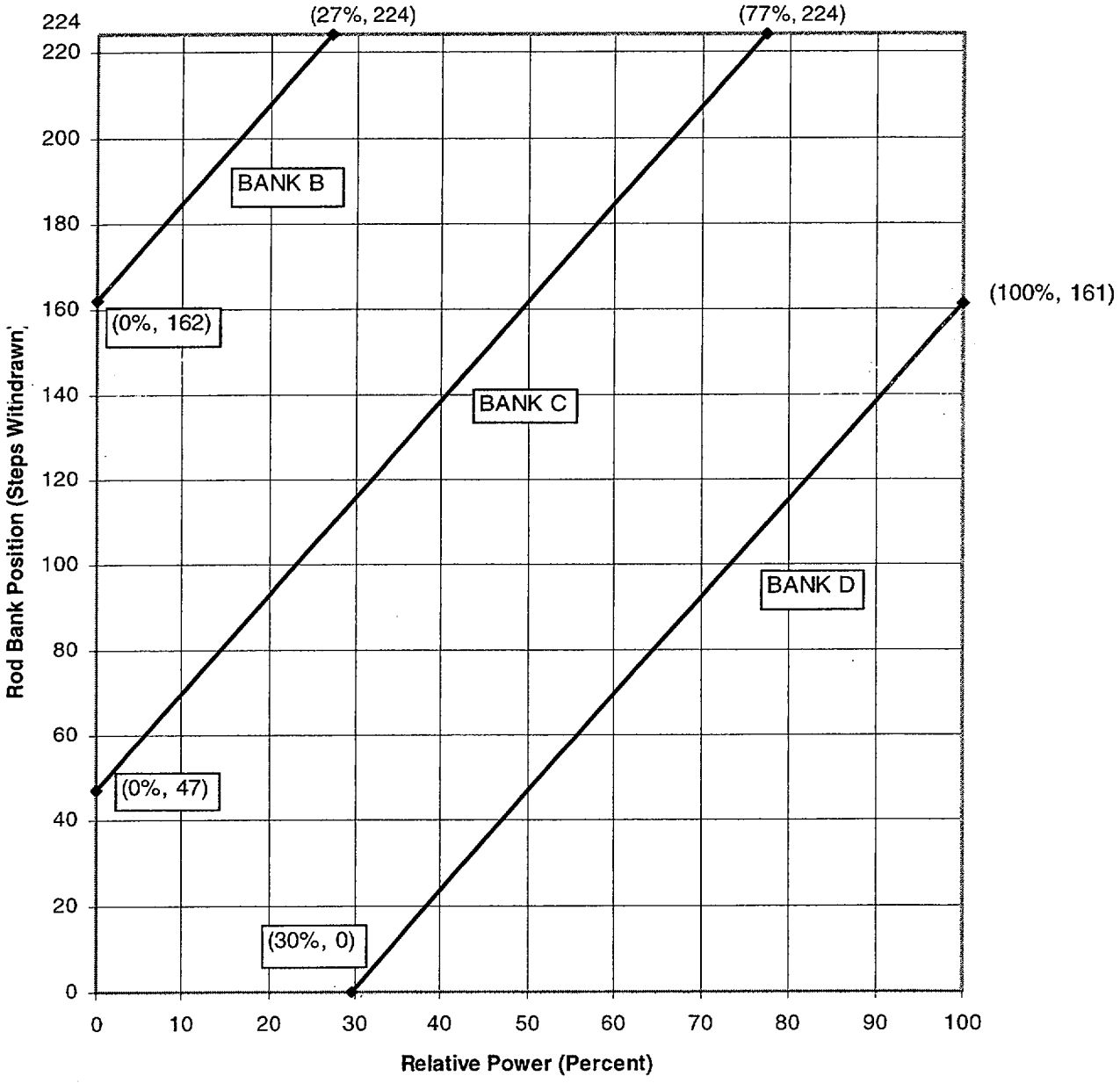
2.5.1 The control banks shall be limited in physical insertion as shown in Figure 2.5.1.

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) is provided in Figure 2.6.1.

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.c

The normal operation W(Z) values have been determined at burnups of 7901, 14000, and 18000 MWD/MTU.

For this cycle, the $F^C_Q(z)$ penalty factors are equal to 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.

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

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

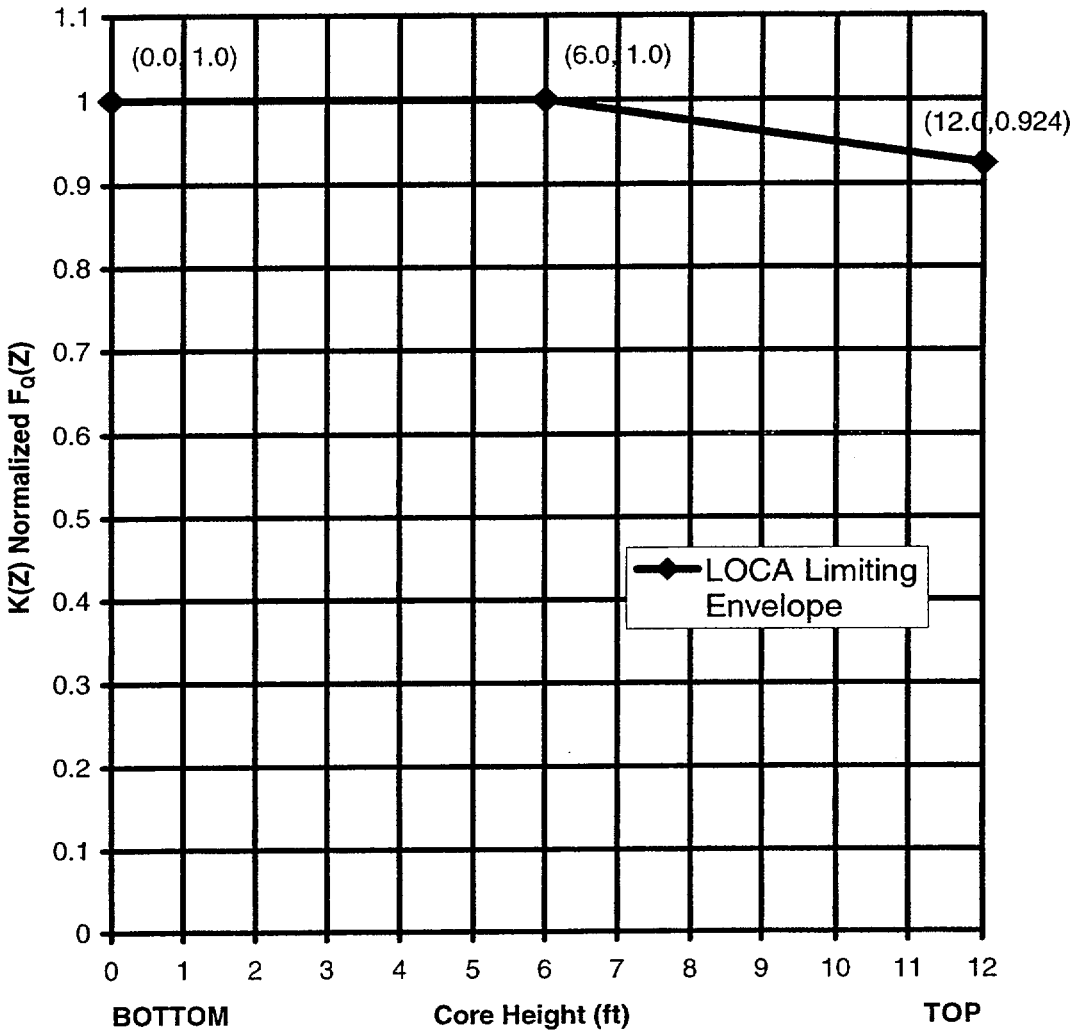
where:

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



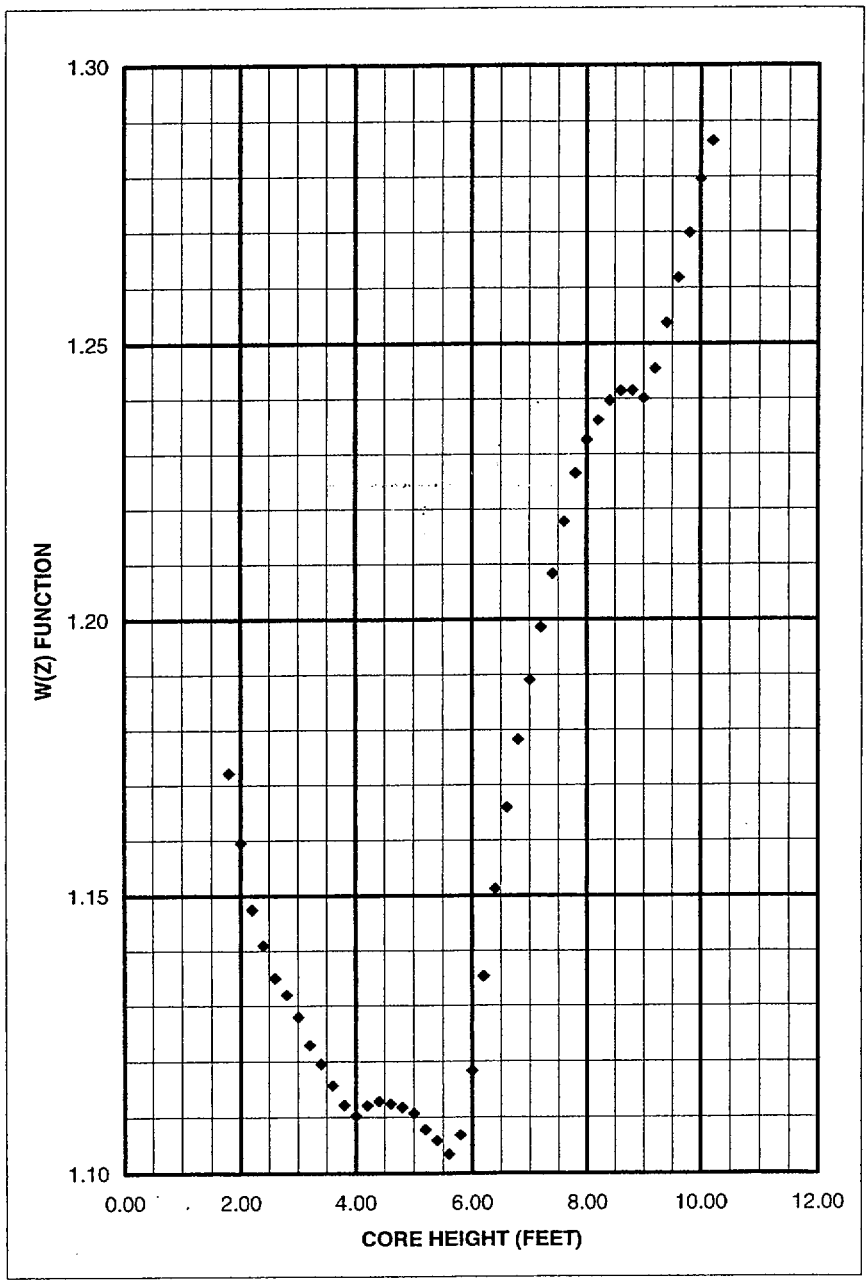
CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 9A

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	1.1722
2.00	1.1596
2.20	1.1476
2.40	1.1410
2.60	1.1351
2.80	1.1320
3.00	1.1280
3.20	1.1229
3.40	1.1195
3.60	1.1156
3.80	1.1121
4.00	1.1102
4.20	1.1120
4.40	1.1128
4.60	1.1123
4.80	1.1117
5.00	1.1107
5.20	1.1078
5.40	1.1058
5.60	1.1033
5.80	1.1068
6.00	1.1183
6.20	1.1354
6.40	1.1513
6.60	1.1659
6.80	1.1783
7.00	1.1891
7.20	1.1987
7.40	1.2083
7.60	1.2178
7.80	1.2265
8.00	1.2325
8.20	1.2361
8.40	1.2397
8.60	1.2414
8.80	1.2415
9.00	1.2401
9.20	1.2455
9.40	1.2537
9.60	1.2618
9.80	1.2699
10.00	1.2796
10.20	1.2864
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

Braidwood Unit 2 Cycle 9A

Figure 2.6.2.a

Summary of W(Z) Function at 7901 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



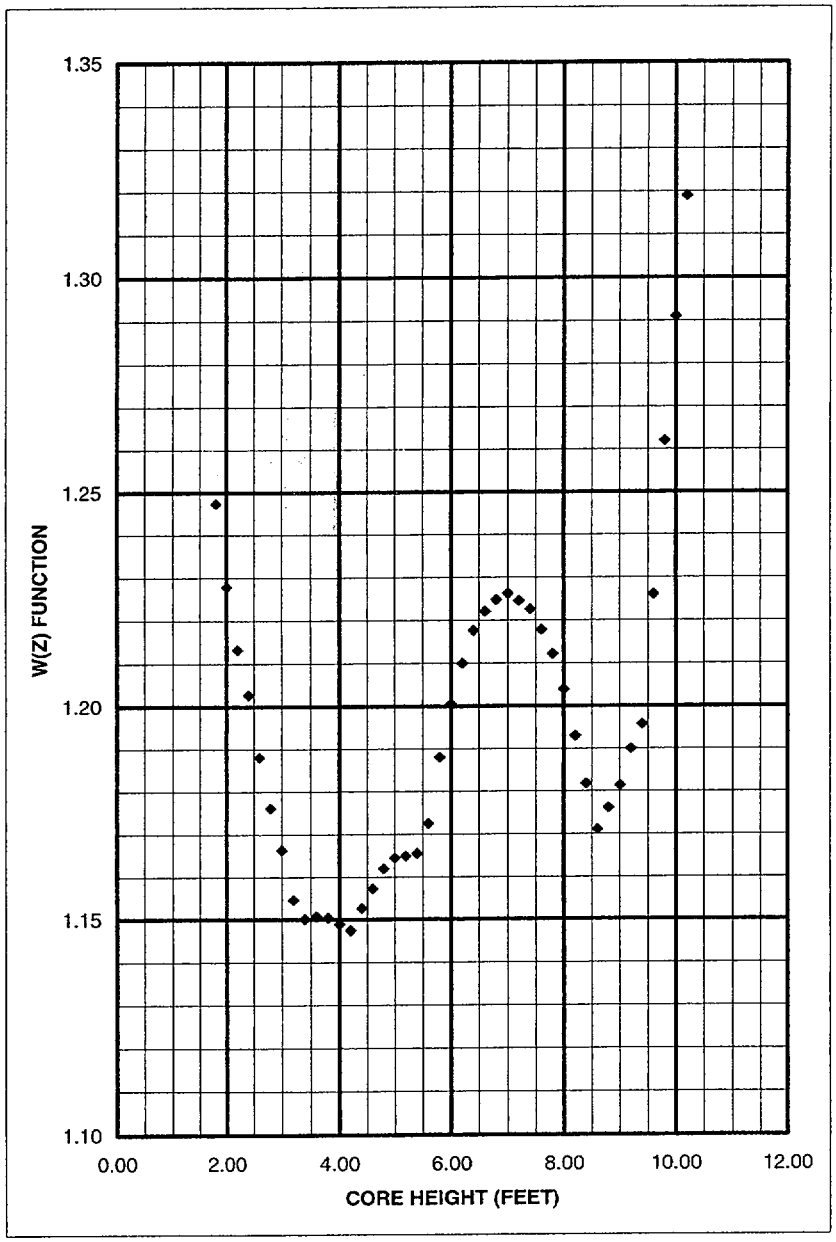
CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 9A

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	1.2474
2.00	1.2279
2.20	1.2133
2.40	1.2027
2.60	1.1881
2.80	1.1761
3.00	1.1664
3.20	1.1547
3.40	1.1501
3.60	1.1507
3.80	1.1504
4.00	1.1490
4.20	1.1475
4.40	1.1526
4.60	1.1574
4.80	1.1620
5.00	1.1645
5.20	1.1649
5.40	1.1656
5.60	1.1725
5.80	1.1880
6.00	1.2005
6.20	1.2100
6.40	1.2176
6.60	1.2222
6.80	1.2248
7.00	1.2262
7.20	1.2246
7.40	1.2227
7.60	1.2178
7.80	1.2122
8.00	1.2038
8.20	1.1929
8.40	1.1817
8.60	1.1710
8.80	1.1761
9.00	1.1813
9.20	1.1900
9.40	1.1957
9.60	1.2260
9.80	1.2620
10.00	1.2910
10.20	1.3190
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

Braidwood Unit 2 Cycle 9A

Figure 2.6.2.b

Summary of W(Z) Function at 14000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



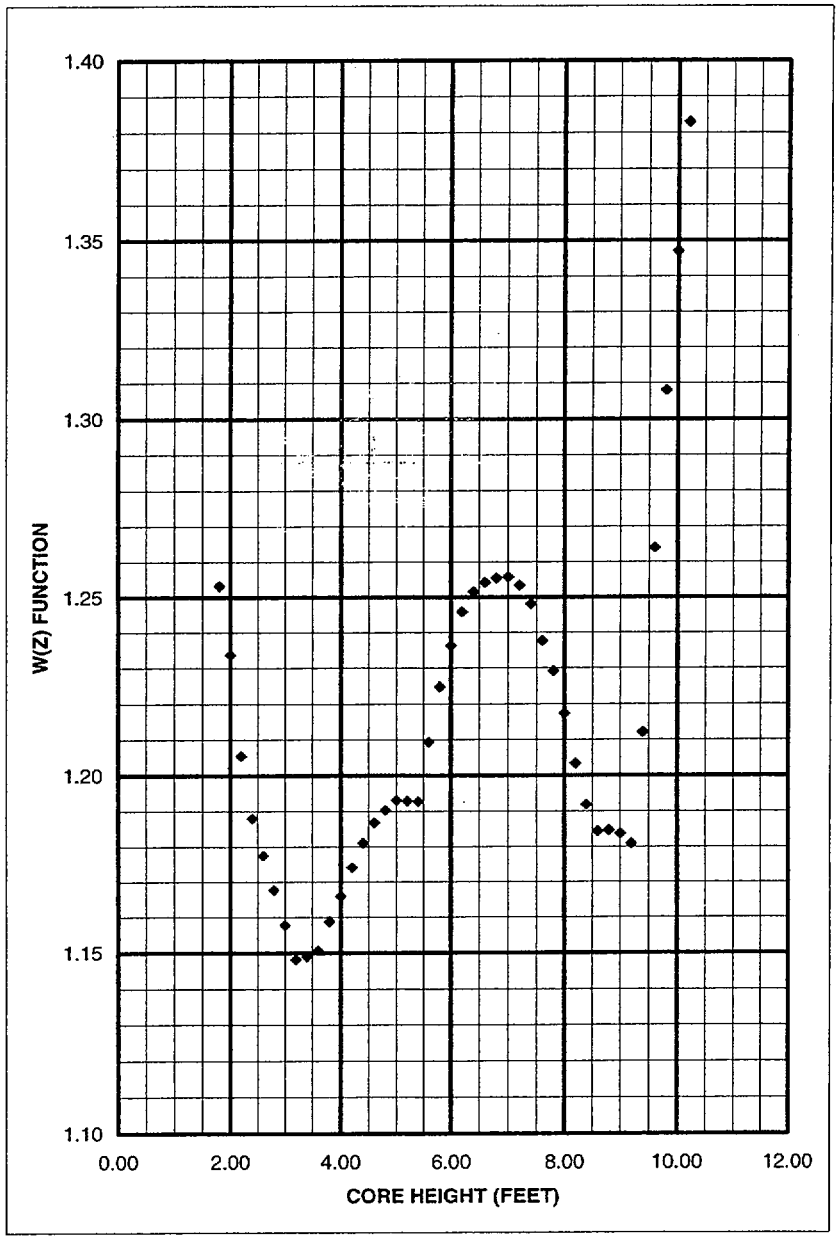
CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 9A

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	1.2532
2.00	1.2338
2.20	1.2055
2.40	1.1881
2.60	1.1776
2.80	1.1677
3.00	1.1578
3.20	1.1482
3.40	1.1489
3.60	1.1507
3.80	1.1588
4.00	1.1659
4.20	1.1741
4.40	1.1812
4.60	1.1868
4.80	1.1904
5.00	1.1931
5.20	1.1929
5.40	1.1928
5.60	1.2093
5.80	1.2248
6.00	1.2364
6.20	1.2459
6.40	1.2515
6.60	1.2541
6.80	1.2553
7.00	1.2557
7.20	1.2533
7.40	1.2481
7.60	1.2377
7.80	1.2292
8.00	1.2173
8.20	1.2033
8.40	1.1919
8.60	1.1844
8.80	1.1846
9.00	1.1837
9.20	1.1810
9.40	1.2120
9.60	1.2640
9.80	1.3080
10.00	1.3470
10.20	1.3830
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

Braidwood Unit 2 Cycle 9A

Figure 2.6.2.c

Summary of W(Z) Function at 18000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



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)

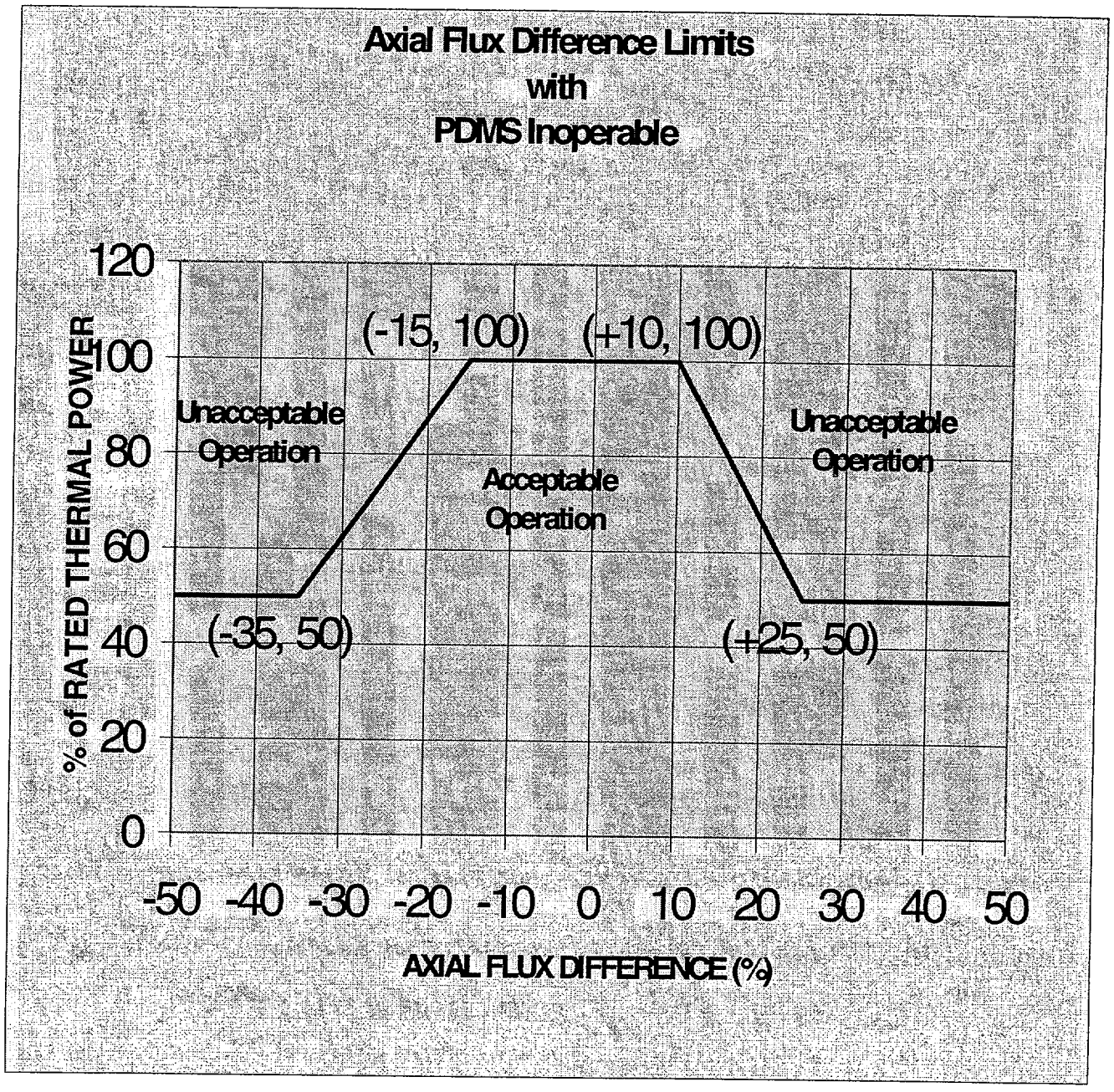
2.9.1 $DNBR_{APSL} \geq 1.536$

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 588.0 °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 (ΔI) "positive" breakpoint shall be +10% ΔI.

2.10.13 The f_1 (ΔI) "negative" breakpoint shall be -18% ΔI.

2.10.14 The f_1 (ΔI) "positive" slope shall be +3.47% / % ΔI.

2.10.15 The f_1 (ΔI) "negative" slope shall be -2.61% / % 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 588.0 °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 2209 psig.

2.12.2 The RCS average temperature (T_{avg}) shall be less than or equal to 593.1 °F.

2.12.3 The RCS total flow rate shall be greater than or equal to 386,000 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 2143 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).