Exelon Generation®

February 14, 2014
BW140002

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 18 and Braidwood Unit 2 Cycle 17 for MUR operation

References:
(1) Letter from Craig Lambert (Exelon Generation Company, LLC) to U. S. NRC, "Request for License amendment Regarding Measurement Uncertainty Recapture (MUR) Power Uprate", dated June 23, 2011

(2) Letter from J. S. Wiebe (U. S. NRC) to M. J. Pacilio, "Braidwood Station, Units 1 and 2, and Byron Station, Unit Nos. 1 and 2 – Issuance of Amendments Regarding Measurement Uncertainty Recapture Power Uprate (TAC Nos. MF2418, MF2419, MF2420, and MF2421)", dated February 7, 2014

The purpose of this letter is to transmit the Core Operating Limits Report (COLR) for Braidwood Unit 1 Cycle 18 and Braidwood Unit 2 Cycle 17, in accordance with Technical Specification 5.6.5, "Core Operating Limits Report (COLR)", to support Measurement Uncertainty Recapture (MUR) operation.

Braidwood Unit 1 Cycle 18 COLR, Revision 11 was implemented to support MUR during Braidwood Unit 1 Cycle 18 operation. Braidwood Unit 2 Cycle 17 COLR, Revision 7 was implemented to support MUR during Braidwood Unit 2 Cycle 17 operation. Note: The revision number is based on a numbering convention that continues from the previous revision of the COLR.

If you have any questions regarding this matter, please contact Phil Raush, Regulatory Assurance Manager, at (815) 417-2800.

Sincerely,

Mark Kanavos
Site Vice President
Braidwood Station

Attachment: Core Operating Limits Report (COLR) for Braidwood Unit 1 Cycle 18, Revision 11
Core Operating Limits Report (COLR) for Braidwood Unit 2 Cycle 17, Revision 7

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

CORE OPERATING LIMITS REPORT (COLR)

FOR

BRAIDWOOD UNIT 1 CYCLE 18

EXELON TRACKING ID:

COLR BRAIDWOOD 1 REVISION 11

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Braidwood Station Unit 1 Cycle 18 has been prepared in accordance with the requirements of Technical Specification 5.6.5 (ITS).

The Technical Specification Safety Limits and Limiting Conditions for Operation (LCOs) 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 (MTC)
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) Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits
LCO	3.9.1	Boron Concentration

The portions of the Technical Requirements Manual (TRM) 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)

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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 Safety Limits (SLs) (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.

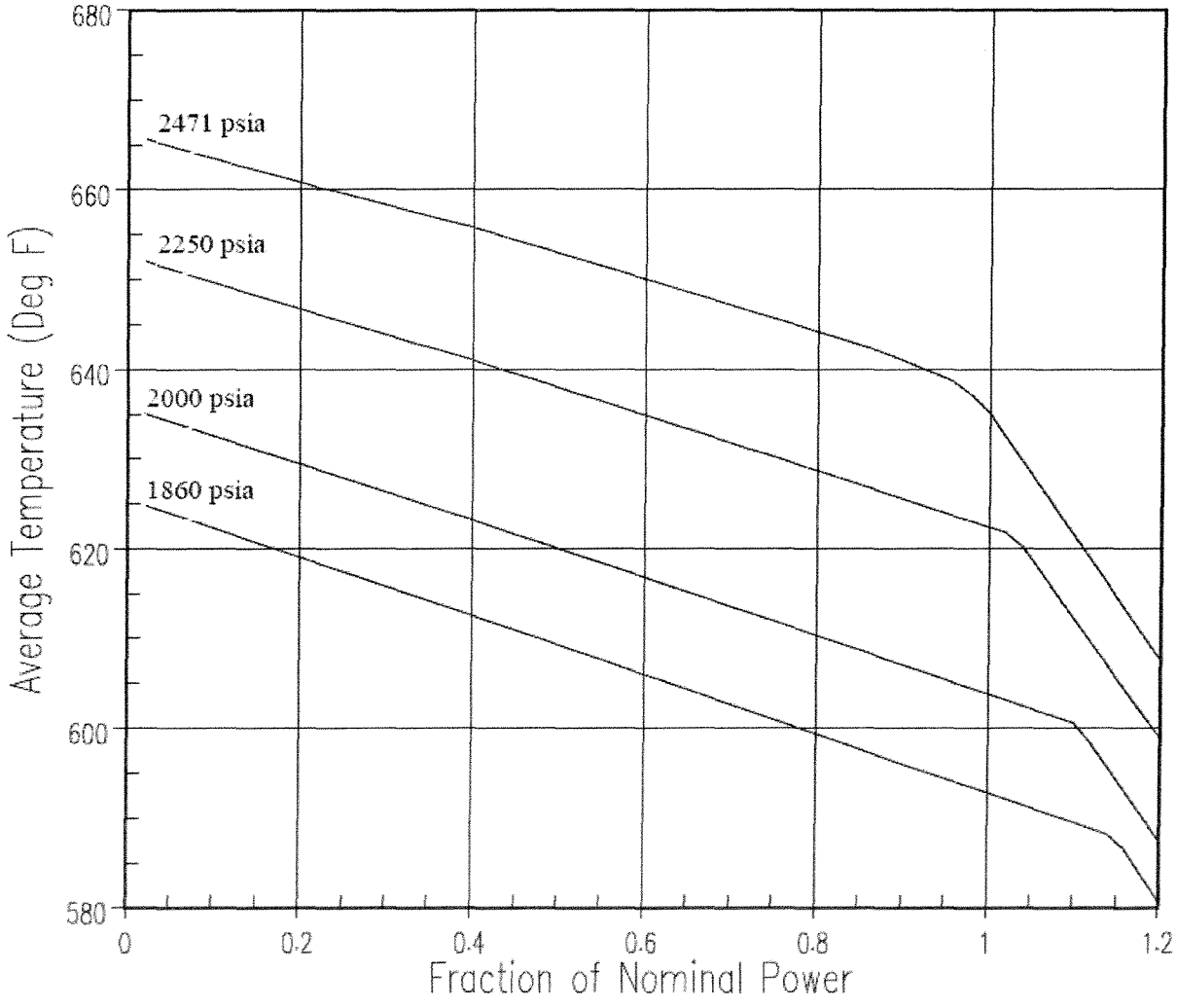


Figure 2.1.1: Reactor Core Limits

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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 limit for MODE 5 is:

2.2.2 SDM shall be greater than or equal to 1.3% $\Delta k/k$ (LCO 3.1.1, LCO 3.3.9; TRM TLCOs 3.1.i and 3.1.j).

2.3 Moderator Temperature Coefficient (MTC) (LCO 3.1.3)

The Moderator Temperature Coefficient (MTC) limits are:

2.3.1 The BOL/ARO/HZP-MTC upper limit shall be $+1.735 \times 10^{-5}$ $\Delta k/k/°F$.

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

2.3.3 The EOL/ARO/HFP-MTC Surveillance limit at 300 ppm shall be -3.7×10^{-4} $\Delta k/k/°F$.

2.3.4 The EOL/ARO/HFP-MTC Surveillance limit at 60 ppm shall be -4.3×10^{-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 Limits (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, with Bank A greater than or equal to 224 steps, 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.

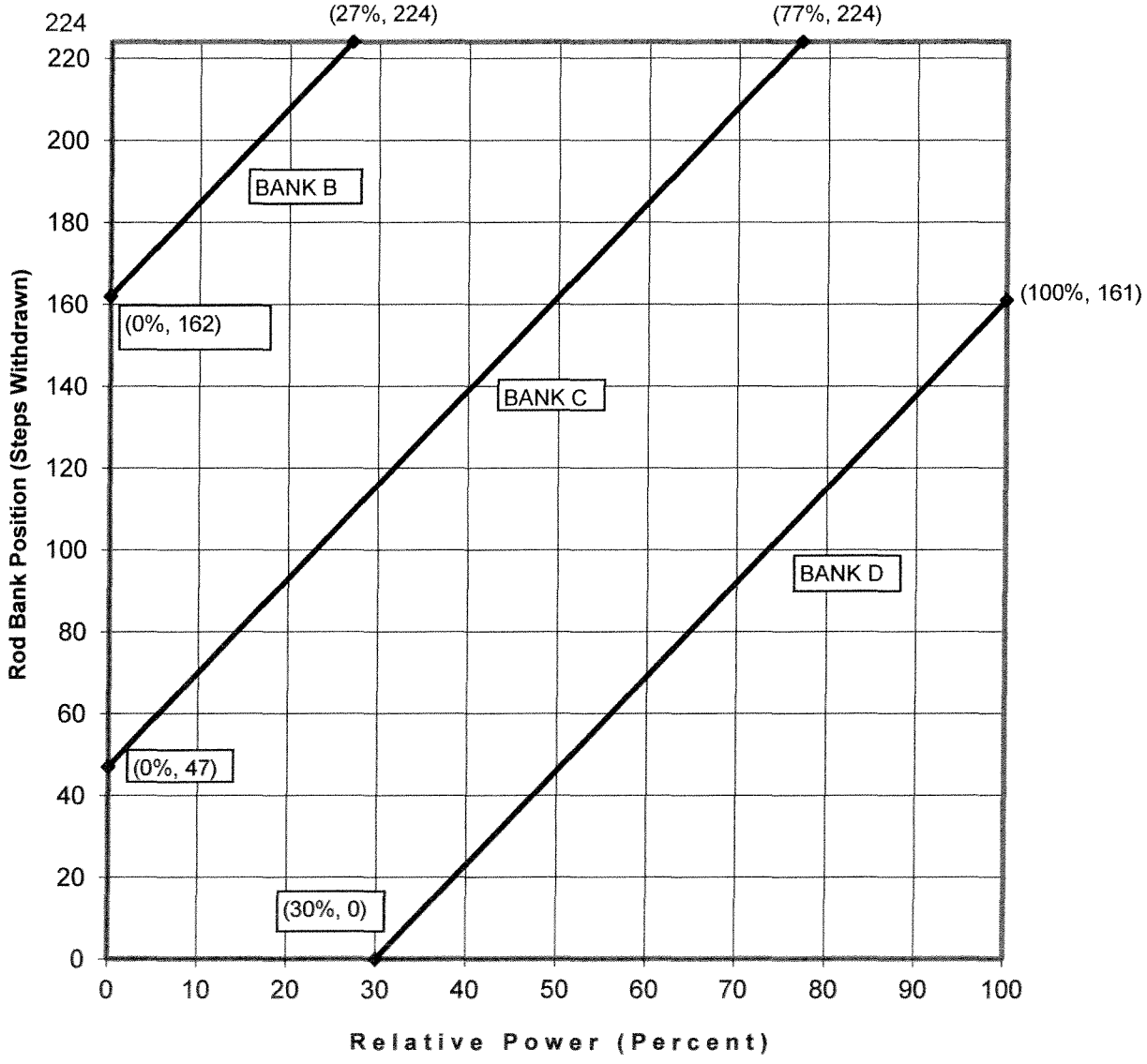
2.5.3 The control banks shall be operated in sequence by withdrawal of Bank A, Bank B, Bank C and Bank D. The control banks shall be sequenced in reverse order upon insertion.

2.5.4 Each control bank not fully withdrawn from the core shall be operated with the following overlap limits as a function of park position:

Park Position (step)	Overlap Limit (step)
227	112
228	113
229	114

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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



CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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

2.6.1 Total Peaking Factor:

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

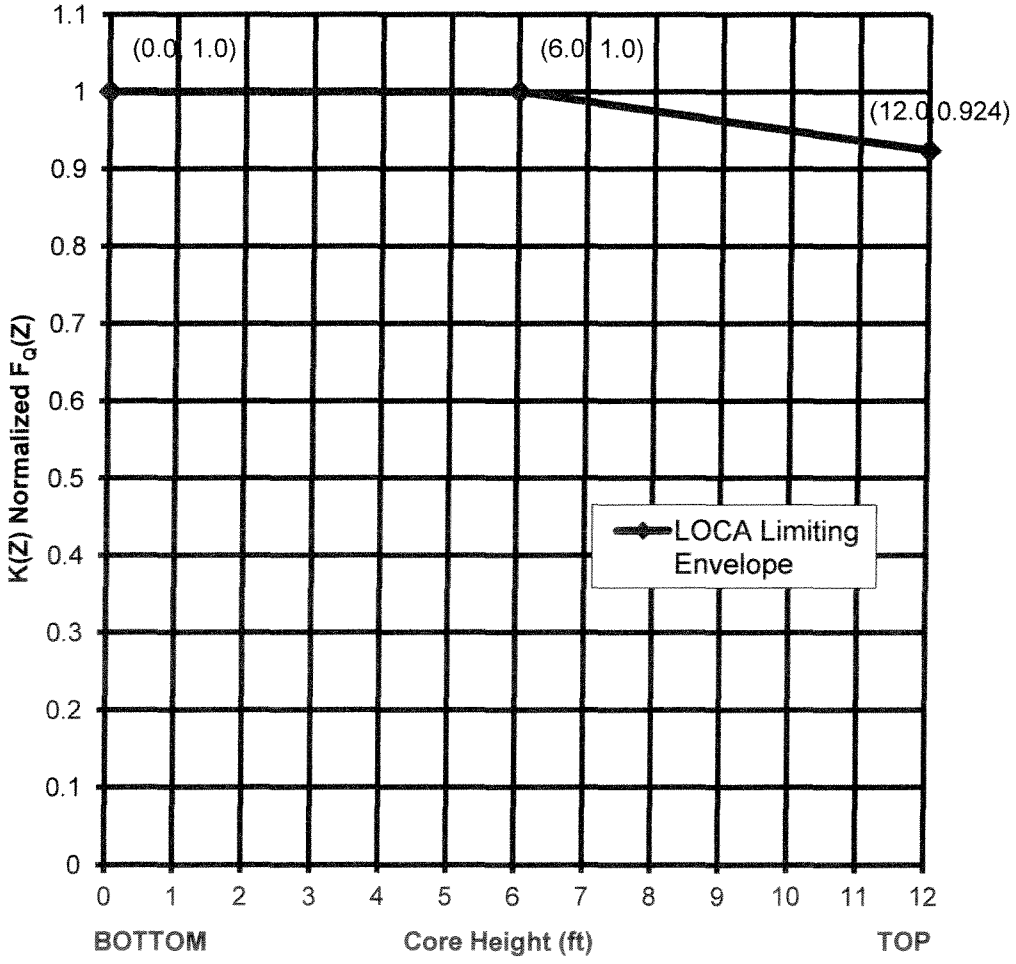
$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} xK(Z) \quad \text{for } P > 0.5$$

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.

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 18

2.6.2 W(Z) Values:

a) When the Power Distribution Monitoring System (PDMS) is OPERABLE, W(Z) = 1.00000 for all axial points.

b) When PDMS is inoperable, W(Z) is provided as:

1) Table 2.6.2.a are the normal operation W(Z) values for the full cycle and correspond to the AXIAL FLUX DIFFERENCE (AFD) Acceptable Operation Limits provided in Figure 2.8.1.a. The normal operation W(Z) values have been determined at burnups of 150, 6000, 14000, and 20000 MWD/MTU.

2) The EOL-only normal operation W(Z) values provided in Table 2.6.2.b may be used for cycle burnups ≥ 18000 MWD/MTU. The EOL-only W(Z) values correspond to the REDUCED AXIAL FLUX DIFFERENCE (AFD) Acceptable Operation Limits provided in Figure 2.8.1.b. The EOL-only normal operation W(Z) values have been determined at burnups of 18000 and 20000 MWD/MTU and the last column of W(Z) values is a duplicate of the 20000 MWD/MTU values. If invoked, the EOL-only W(Z) values are to be used for the remainder of the cycle unless superseded by a subsequent analysis.

Table 2.6.2.c 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.c.

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 F_Q measurement uncertainty = 1.05 when PDMS is inoperable (U_{qu} is defined by PDMS when OPERABLE.)
U_e = Engineering uncertainty factor = 1.03

2.6.4 PDMS Alarms:

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

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

Table 2.6.2.a
Full Cycle W(Z) versus Core Height for AFD Acceptable Operation Limits in Figure 2.8.1.a
(Top and Bottom 8% Excluded per WCAP-10216)

Height (feet)	150 MWD/MTU	6000 MWD/MTU	14000 MWD/MTU	20000 MWD/MTU
0.00 (core bottom)	1.2611	1.3994	1.4556	1.3930
0.20	1.2416	1.3664	1.4242	1.3769
0.40	1.2308	1.3529	1.4157	1.3643
0.60	1.2206	1.3413	1.3999	1.3535
0.80	1.2122	1.3127	1.3759	1.3391
1.00	1.2039	1.2794	1.3601	1.3321
1.20	1.1934	1.2625	1.3372	1.3222
1.40	1.1912	1.2488	1.3182	1.3123
1.60	1.1960	1.2313	1.3003	1.2995
1.80	1.2039	1.2159	1.2844	1.2876
2.00	1.1920	1.1985	1.2703	1.2747
2.20	1.1781	1.1857	1.2586	1.2568
2.40	1.1652	1.1780	1.2459	1.2410
2.60	1.1530	1.1693	1.2321	1.2221
2.80	1.1472	1.1631	1.2201	1.2043
3.00	1.1406	1.1587	1.2072	1.1879
3.20	1.1381	1.1550	1.1935	1.1862
3.40	1.1391	1.1513	1.1905	1.1845
3.60	1.1438	1.1466	1.1871	1.1816
3.80	1.1477	1.1411	1.1832	1.1809
4.00	1.1506	1.1354	1.1788	1.1792
4.20	1.1523	1.1281	1.1724	1.1762
4.40	1.1540	1.1207	1.1660	1.1806
4.60	1.1538	1.1117	1.1579	1.1902
4.80	1.1534	1.1037	1.1494	1.1970
5.00	1.1521	1.0989	1.1395	1.2025
5.20	1.1497	1.1049	1.1343	1.2065
5.40	1.1454	1.1109	1.1367	1.2090
5.60	1.1499	1.1162	1.1373	1.2085
5.80	1.1549	1.1205	1.1369	1.2192
6.00	1.1621	1.1250	1.1458	1.2328
6.20	1.1776	1.1276	1.1566	1.2445
6.40	1.1924	1.1311	1.1662	1.2532
6.60	1.2043	1.1339	1.1741	1.2579
6.80	1.2152	1.1443	1.1793	1.2608
7.00	1.2252	1.1546	1.1825	1.2597
7.20	1.2324	1.1635	1.1840	1.2546
7.40	1.2389	1.1705	1.1830	1.2486
7.60	1.2426	1.1751	1.1780	1.2367
7.80	1.2463	1.1772	1.1733	1.2248
8.00	1.2492	1.1850	1.1678	1.2109
8.20	1.2473	1.1910	1.1611	1.1922
8.40	1.2433	1.1990	1.1564	1.1745
8.60	1.2399	1.2050	1.1554	1.1578
8.80	1.2344	1.2230	1.1545	1.1449
9.00	1.2271	1.2430	1.1527	1.1420
9.20	1.2188	1.2640	1.1508	1.1528
9.40	1.2155	1.2820	1.1490	1.1920
9.60	1.2165	1.2980	1.1580	1.2370
9.80	1.2260	1.3140	1.1920	1.2750
10.00	1.2350	1.3280	1.2210	1.3090
10.20	1.2430	1.3370	1.2540	1.3400
10.40	1.2500	1.3380	1.2750	1.3684
10.60	1.2690	1.3320	1.2960	1.3981
10.80	1.2710	1.3232	1.3050	1.4189
11.00	1.2680	1.3162	1.3060	1.4327
11.20	1.2730	1.3305	1.2820	1.4097
11.40	1.2770	1.3523	1.2880	1.4056
11.60	1.2800	1.3616	1.2700	1.3896
11.80	1.2840	1.3721	1.2614	1.3805
12.00 (core top)	1.2920	1.3923	1.2522	1.3773

Note: W(Z) values at 20000 MWD/MTU may be applied to cycle burnups greater than 20000 MWD/MTU to prevent W(Z) function extrapolation

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

Table 2.6.2.b
EOL-only W(Z) versus Core Height
for AFD Acceptable Operation Limits in Figure 2.8.1.b
(Top and Bottom 8% Excluded per WCAP-10216)

Height (feet)	18000 MWD/MTU	20000 MWD/MTU	25486 MWD/MTU
0.00 (core bottom)	1.2938	1.2470	1.2470
0.20	1.2747	1.2337	1.2337
0.40	1.2661	1.2232	1.2232
0.60	1.2585	1.2208	1.2208
0.80	1.2481	1.2171	1.2171
1.00	1.2415	1.2124	1.2124
1.20	1.2282	1.2050	1.2050
1.40	1.2172	1.1975	1.1975
1.60	1.2097	1.1878	1.1878
1.80	1.2025	1.1784	1.1784
2.00	1.1941	1.1680	1.1680
2.20	1.1821	1.1538	1.1538
2.40	1.1715	1.1425	1.1425
2.60	1.1596	1.1321	1.1321
2.80	1.1517	1.1272	1.1272
3.00	1.1451	1.1253	1.1253
3.20	1.1396	1.1262	1.1262
3.40	1.1370	1.1269	1.1269
3.60	1.1405	1.1332	1.1332
3.80	1.1453	1.1436	1.1436
4.00	1.1524	1.1577	1.1577
4.20	1.1574	1.1696	1.1696
4.40	1.1617	1.1806	1.1806
4.60	1.1643	1.1902	1.1902
4.80	1.1701	1.1970	1.1970
5.00	1.1746	1.2025	1.2025
5.20	1.1777	1.2065	1.2065
5.40	1.1799	1.2090	1.2090
5.60	1.1795	1.2085	1.2085
5.80	1.1850	1.2192	1.2192
6.00	1.1969	1.2328	1.2328
6.20	1.2090	1.2445	1.2445
6.40	1.2187	1.2532	1.2532
6.60	1.2252	1.2579	1.2579
6.80	1.2287	1.2608	1.2608
7.00	1.2289	1.2597	1.2597
7.20	1.2261	1.2546	1.2546
7.40	1.2216	1.2486	1.2486
7.60	1.2119	1.2367	1.2367
7.80	1.2026	1.2248	1.2248
8.00	1.1912	1.2109	1.2109
8.20	1.1767	1.1922	1.1922
8.40	1.1635	1.1745	1.1745
8.60	1.1530	1.1578	1.1578
8.80	1.1436	1.1449	1.1449
9.00	1.1392	1.1420	1.1420
9.20	1.1424	1.1528	1.1528
9.40	1.1620	1.1920	1.1920
9.60	1.1907	1.2370	1.2370
9.80	1.2284	1.2750	1.2750
10.00	1.2614	1.3090	1.3090
10.20	1.2952	1.3400	1.3400
10.40	1.3221	1.3684	1.3684
10.60	1.3504	1.3981	1.3981
10.80	1.3675	1.4189	1.4189
11.00	1.3765	1.4327	1.4327
11.20	1.3498	1.4097	1.4097
11.40	1.3487	1.4056	1.4056
11.60	1.3296	1.3896	1.3896
11.80	1.3191	1.3805	1.3805
12.00 (core top)	1.3108	1.3773	1.3773

Note: W(Z) values at 20000 MWD/MTU may be applied to cycle burnups greater than 20000 MWD/MTU to prevent W(Z) function extrapolation

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

Table 2.6.2.c
Penalty Factors in Excess of 2% per 31 EFPD

Cycle Burnup (MWD/MTU)	Penalty Factor $F^C_Q(z)$
0	1.0200
150	1.0200
600	1.0567
854	1.0638
1030	1.0668
1270	1.0615
1558	1.0500
2086	1.0300
2300	1.0240
2614	1.0200
3142	1.0200
3560	1.0225
4050	1.0200
17395	1.0200
18050	1.0256
18627	1.0290
19000	1.0293
19500	1.0279
20563	1.0200
25486	1.0200

Notes:

Linear interpolation is adequate for intermediate cycle burnups.

All cycle burnups outside the range of Table 2.6.2.c shall use a 2% penalty factor for compliance with the 3.2.1.2 Surveillance Requirements.

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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 (RTP)
$F^{RTP}_{\Delta H} = 1.70$
$PF_{\Delta H} = 0.3$

2.7.2 Uncertainty:

The uncertainty, $U_{F\Delta H}$, to be applied to the Nuclear Enthalpy Rise Hot Channel Factor $F^N_{\Delta H}$ 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 when PDMS is inoperable ($U_{F\Delta Hm}$ is defined by PDMS when OPERABLE.)

2.7.3 PDMS Alarms:

$F^N_{\Delta H}$ Warning Setpoint = 2% $F^N_{\Delta H}$ Margin
$F^N_{\Delta H}$ Alarm Setpoint = 0% $F^N_{\Delta H}$ 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 the Figures described below or the latest valid PDMS Surveillance Report, whichever is more conservative.

a) Figure 2.8.1.a is the full cycle AFD Acceptable Operation Limits associated with the full cycle W(Z) values in Table 2.6.2.a.

b) Figure 2.8.1.b is the Reduced AFD Acceptable Operation Limits which may be applied after 18000 MWD/MTU. The Reduced AFD Acceptable Operation Limits are associated with the EOL-only W(Z) values in Table 2.6.2.b. Prior to changing to Figure 2.8.1.b, confirm that the plant is within the specified AFD envelope.

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 $DNBR_{APSL} \geq 1.563$

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

2.9.2 PDMS Alarms:

DNBR Warning Setpoint = 2% DNBR Margin
DNBR Alarm Setpoint = 0% DNBR Margin

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

(Full Cycle)

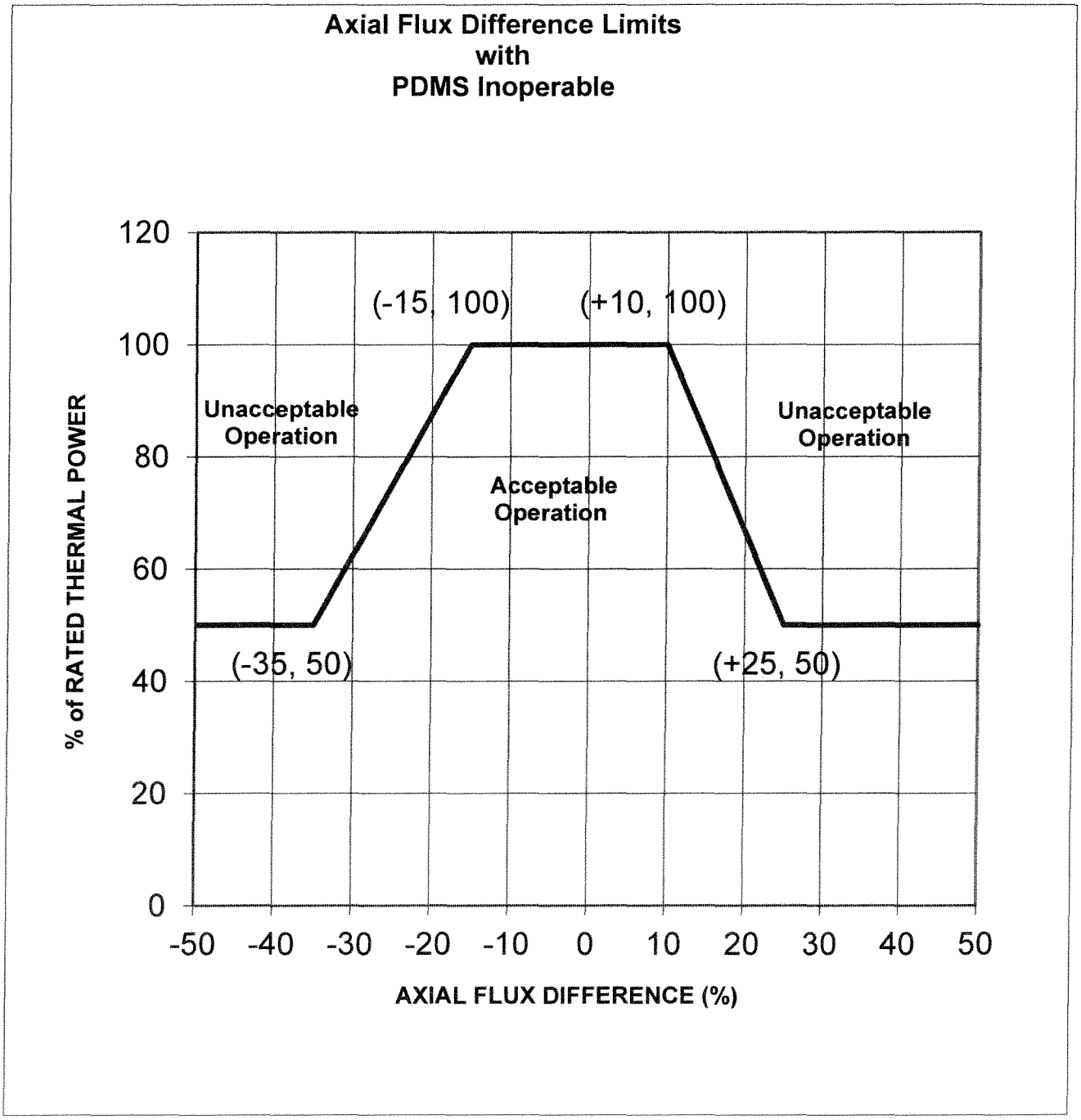
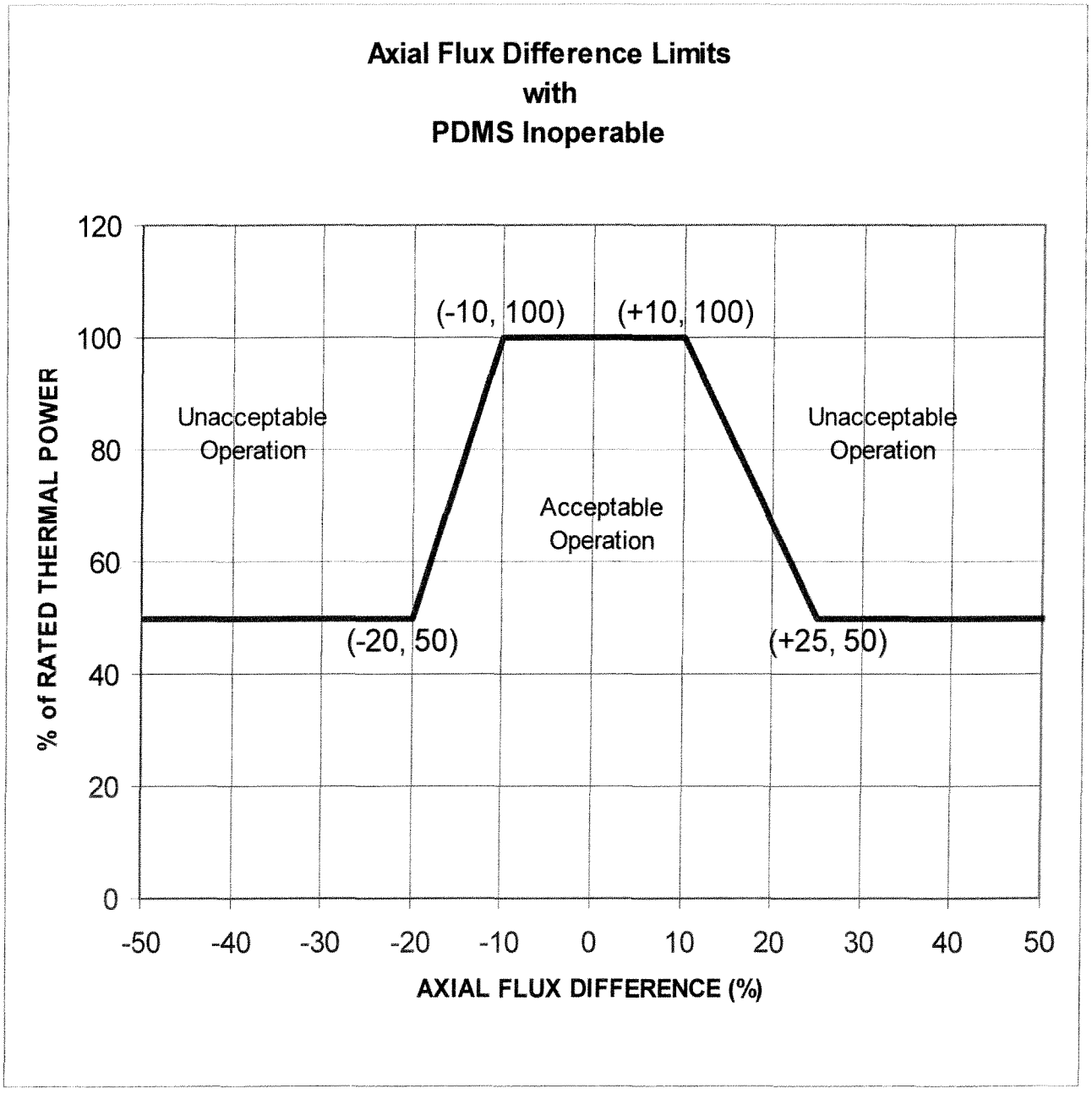


Figure 2.8.1.b:
Reduced Axial Flux Difference Limits
as a Function of Rated Thermal Power

(Cycle burnup ≥ 18000 MWD/MTU)



CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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

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 0.00135 / psi.

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

2.10.13 The $f_1(\Delta I)$ "negative" breakpoint shall be -18% ΔI.

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

2.10.15 The $f_1(\Delta I)$ "negative" slope shall be -2.61% / % ΔI.

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

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

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.

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 1 CYCLE 18

2.12 Reactor Coolant System (RCS) Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) 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 the applicable value given in the Table below (LCO 3.9.1). The reported "prior to initial criticality" value also bounds the end-of-cycle requirements for the previous cycle.

2.13.2 To maintain keff ≤ 0.987 with all shutdown and control rods fully withdrawn in MODES 3, 4, or 5 (TRM TLCO 3.1.g Required Action B.2 and TRM TLCO 3.1.k.2), the Reactor Coolant System boron concentration shall be greater than or equal to the applicable value given in the Table below.

COLR Section	Conditions	Boron Concentration (ppm)
2.13.1	a) prior to initial criticality	1715
	b) for cycle burnups ≥ 0 MWD/MTU and < 16000 MWD/MTU	1839
	c) for cycle burnups ≥ 16000 MWD/MTU	1520
2.13.2	a) prior to initial criticality	1772
	b) all other times in life	2028

CORE OPERATING LIMITS REPORT (COLR)

FOR

BRAIDWOOD UNIT 2 CYCLE 17

EXELON TRACKING ID:

COLR BRAIDWOOD 2 REVISION 7

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Braidwood Station Unit 2 Cycle 17 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 (MTC)
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) Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits
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)

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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 Safety Limits (SLs) (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.

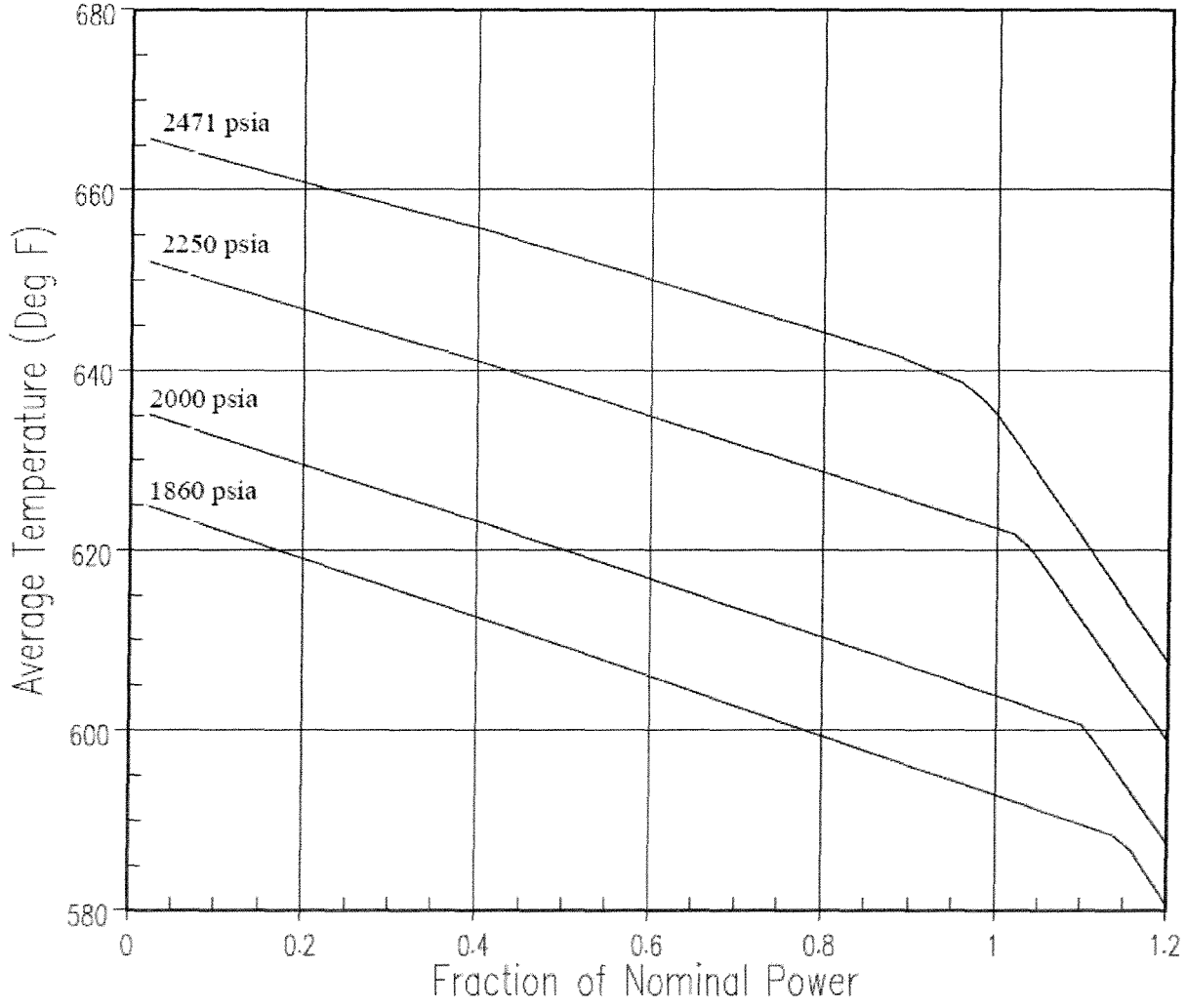


Figure 2.1.1: Reactor Core Limits

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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 limit for MODE 5 is:

2.2.2 SDM shall be greater than or equal to 1.3% Δk/k (LCO 3.1.1, LCO 3.3.9; TRM TLCOs 3.1.i and 3.1.j).

2.3 Moderator Temperature Coefficient (MTC) (LCO 3.1.3)

The Moderator Temperature Coefficient (MTC) limits are:

2.3.1 The BOL/ARO/HZP-MTC upper limit shall be $+1.799 \times 10^{-5}$ 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 -3.7×10^{-4} Δk/k/°F.

2.3.4 The EOL/ARO/HFP-MTC Surveillance limit at 60 ppm shall be -4.3×10^{-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 Limits (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, with Bank A greater than or equal to 224 steps, shall be limited in physical insertion as shown in Figure 2.5.1.

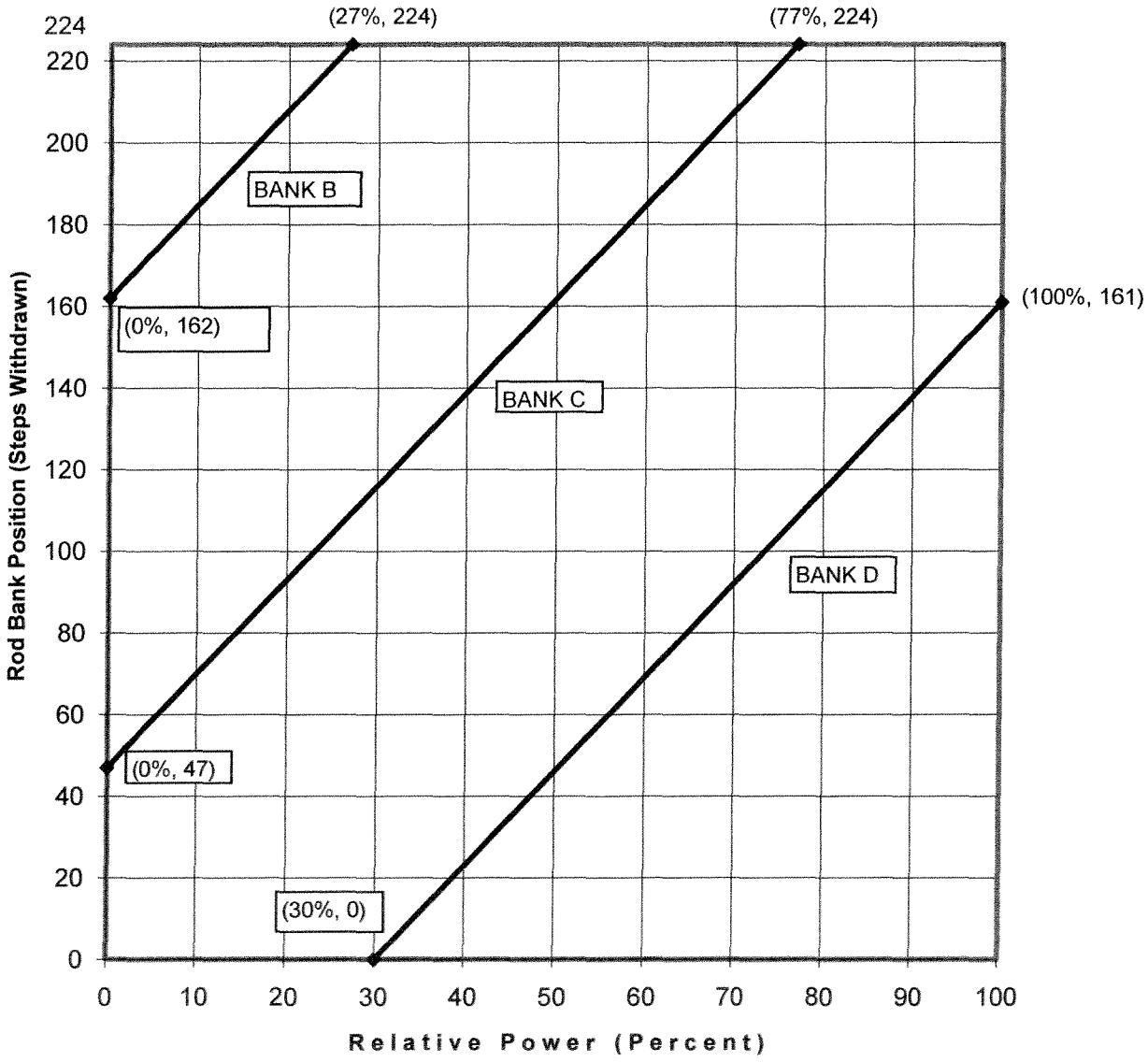
2.5.2 Each control bank shall be considered fully withdrawn from the core at greater than or equal to 224 steps.

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 the following overlap limits as a function of park position:

Park Position (step)	Overlap Limit (step)
226	111
227	112
228	113
229	114

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



CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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

2.6.1 Total Peaking Factor:

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

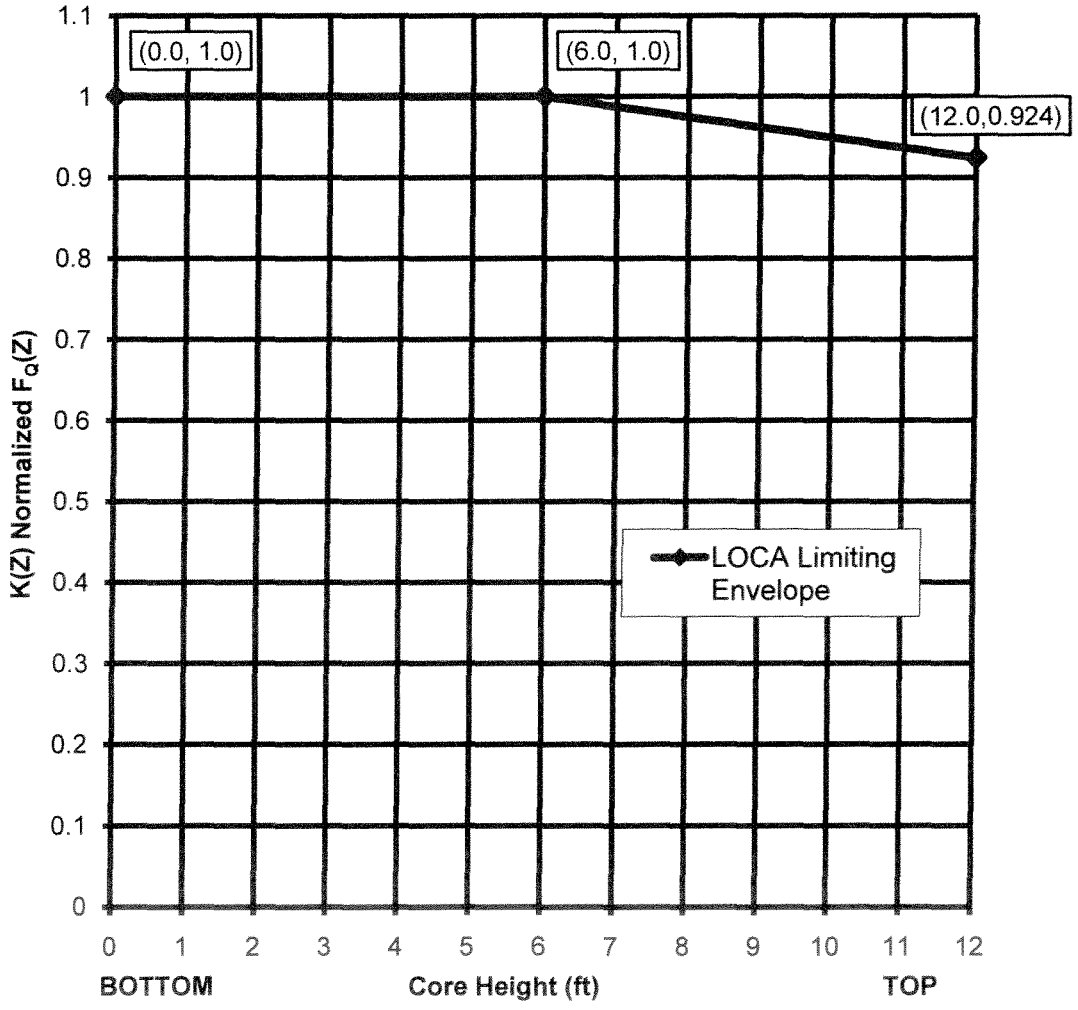
$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} xK(Z) \quad \text{for } P > 0.5$$

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.

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 17

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 as:

1) Table 2.6.2.a are the normal operation W(Z) values for the full cycle and correspond to the AXIAL FLUX DIFFERENCE (AFD) Acceptable Operation Limits provided in Figure 2.8.1.a. The normal operation W(Z) values have been determined at burnups of 150, 6000, 14000, and 20000 MWD/MTU.

2) The EOL-only normal operation W(Z) values provided in Table 2.6.2.b may be used for cycle burnups $\geq$ 18000 MWD/MTU. The EOL-only W(Z) values correspond to the REDUCED AXIAL FLUX DIFFERENCE (AFD) Acceptable Operation Limits provided in Figure 2.8.1.b. The EOL-only normal operation W(Z) values have been determined at burnups of 18000 and 20000 MWD/MTU and the last column of W(Z) values is a duplicate of the 20000 MWD/MTU values. If invoked, the EOL-only W(Z) values are to be used for the remainder of the cycle unless superseded by a subsequent analysis.

Table 2.6.2.c 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.c.

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 F_Q measurement uncertainty = 1.05 when PDMS is inoperable
(U_{qu} is defined by PDMS when OPERABLE.)
U_e = Engineering uncertainty factor = 1.03

2.6.4 PDMS Alarms:

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

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

Table 2.6.2.a

Full Cycle W(Z) versus Core Height for AFD Acceptable Operation Limits in Figure 2.8.1.a
(Top and Bottom 8% Excluded per WCAP-10216)

Height (feet)	150 MWD/MTU	6000 MWD/MTU	14000 MWD/MTU	20000 MWD/MTU
0.00 (core bottom)	1.2875	1.4463	1.4340	1.4172
0.20	1.2772	1.4175	1.4200	1.3924
0.40	1.2740	1.4005	1.4030	1.3792
0.60	1.2698	1.3866	1.3870	1.3687
0.80	1.2558	1.3654	1.3530	1.3432
1.00	1.2465	1.3486	1.3410	1.3247
1.20	1.2488	1.3320	1.3250	1.3153
1.40	1.2598	1.3231	1.3130	1.2995
1.60	1.2461	1.3017	1.2970	1.2786
1.80	1.2337	1.2821	1.2830	1.2604
2.00	1.2207	1.2615	1.2680	1.2401
2.20	1.2059	1.2383	1.2490	1.2177
2.40	1.1926	1.2175	1.2389	1.1982
2.60	1.1768	1.1958	1.2262	1.1820
2.80	1.1694	1.1796	1.2142	1.1720
3.00	1.1618	1.1758	1.2020	1.1660
3.20	1.1531	1.1719	1.1871	1.1625
3.40	1.1475	1.1675	1.1736	1.1600
3.60	1.1426	1.1616	1.1616	1.1625
3.80	1.1375	1.1557	1.1594	1.1647
4.00	1.1332	1.1493	1.1563	1.1652
4.20	1.1339	1.1409	1.1517	1.1668
4.40	1.1345	1.1325	1.1471	1.1714
4.60	1.1341	1.1231	1.1410	1.1820
4.80	1.1328	1.1137	1.1338	1.1905
5.00	1.1304	1.1037	1.1257	1.1969
5.20	1.1270	1.0962	1.1280	1.2026
5.40	1.1227	1.0913	1.1314	1.2059
5.60	1.1231	1.0876	1.1327	1.2063
5.80	1.1300	1.0917	1.1322	1.2109
6.00	1.1366	1.0972	1.1432	1.2268
6.20	1.1414	1.1043	1.1574	1.2397
6.40	1.1451	1.1110	1.1694	1.2505
6.60	1.1479	1.1177	1.1784	1.2561
6.80	1.1487	1.1234	1.1855	1.2599
7.00	1.1495	1.1282	1.1906	1.2607
7.20	1.1474	1.1345	1.1918	1.2565
7.40	1.1565	1.1449	1.1920	1.2505
7.60	1.1655	1.1536	1.1882	1.2404
7.80	1.1738	1.1617	1.1836	1.2286
8.00	1.1812	1.1694	1.1761	1.2151
8.20	1.1870	1.1748	1.1655	1.1977
8.40	1.1924	1.1869	1.1543	1.1793
8.60	1.1957	1.2003	1.1391	1.1579
8.80	1.1995	1.2133	1.1345	1.1366
9.00	1.2019	1.2247	1.1392	1.1260
9.20	1.2110	1.2354	1.1443	1.1430
9.40	1.2222	1.2522	1.1532	1.1762
9.60	1.2325	1.2674	1.1600	1.2203
9.80	1.2427	1.2818	1.1799	1.2584
10.00	1.2523	1.2955	1.2068	1.2924
10.20	1.2597	1.3075	1.2398	1.3215
10.40	1.2577	1.3100	1.2631	1.3444
10.60	1.2327	1.3055	1.2845	1.3620
10.80	1.2356	1.3037	1.2958	1.3815
11.00	1.2318	1.3136	1.2937	1.3985
11.20	1.2407	1.3177	1.2817	1.3986
11.40	1.2411	1.3300	1.2884	1.3930
11.60	1.2445	1.3359	1.2720	1.3875
11.80	1.2498	1.3426	1.2651	1.3787
12.00 (core top)	1.2574	1.3584	1.2594	1.3764

Note: W(Z) values at 20000 MWD/MTU may be applied to cycle burnups greater than 20000 MWD/MTU to prevent W(Z) function extrapolation

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

Table 2.6.2.b
EOL-only W(Z) versus Core Height
for AFD Acceptable Operation Limits in Figure 2.8.1.b
(Top and Bottom 8% Excluded per WCAP-10216)

Height (feet)	18000 MWD/MTU	20000 MWD/MTU	25330 MWD/MTU
0.00 (core bottom)	1.2765	1.2566	1.2566
0.20	1.2625	1.2370	1.2370
0.40	1.2501	1.2263	1.2263
0.60	1.2395	1.2180	1.2180
0.80	1.2092	1.1977	1.1977
1.00	1.1941	1.1829	1.1829
1.20	1.1855	1.1770	1.1770
1.40	1.1761	1.1646	1.1646
1.60	1.1650	1.1480	1.1480
1.80	1.1591	1.1400	1.1400
2.00	1.1526	1.1328	1.1328
2.20	1.1456	1.1251	1.1251
2.40	1.1394	1.1193	1.1193
2.60	1.1349	1.1180	1.1180
2.80	1.1311	1.1187	1.1187
3.00	1.1287	1.1184	1.1184
3.20	1.1260	1.1182	1.1182
3.40	1.1273	1.1230	1.1230
3.60	1.1277	1.1268	1.1268
3.80	1.1278	1.1296	1.1296
4.00	1.1342	1.1445	1.1445
4.20	1.1400	1.1586	1.1586
4.40	1.1463	1.1714	1.1714
4.60	1.1559	1.1820	1.1820
4.80	1.1631	1.1905	1.1905
5.00	1.1687	1.1969	1.1969
5.20	1.1733	1.2026	1.2026
5.40	1.1771	1.2059	1.2059
5.60	1.1783	1.2063	1.2063
5.80	1.1803	1.2109	1.2109
6.00	1.1943	1.2268	1.2268
6.20	1.2081	1.2397	1.2397
6.40	1.2197	1.2505	1.2505
6.60	1.2267	1.2561	1.2561
6.80	1.2319	1.2599	1.2599
7.00	1.2344	1.2607	1.2607
7.20	1.2320	1.2565	1.2565
7.40	1.2281	1.2505	1.2505
7.60	1.2200	1.2404	1.2404
7.80	1.2103	1.2286	1.2286
8.00	1.1983	1.2151	1.2151
8.20	1.1823	1.1977	1.1977
8.40	1.1646	1.1793	1.1793
8.60	1.1431	1.1579	1.1579
8.80	1.1273	1.1366	1.1366
9.00	1.1230	1.1260	1.1260
9.20	1.1347	1.1430	1.1430
9.40	1.1566	1.1762	1.1762
9.60	1.1834	1.2203	1.2203
9.80	1.2138	1.2584	1.2584
10.00	1.2463	1.2924	1.2924
10.20	1.2792	1.3215	1.3215
10.40	1.3042	1.3444	1.3444
10.60	1.3256	1.3620	1.3620
10.80	1.3425	1.3815	1.3815
11.00	1.3499	1.3985	1.3985
11.20	1.3429	1.3986	1.3986
11.40	1.3414	1.3930	1.3930
11.60	1.3295	1.3875	1.3875
11.80	1.3204	1.3787	1.3787
12.00 (core top)	1.3151	1.3764	1.3764

Note: W(Z) values at 20000 MWD/MTU may be applied to cycle burnups greater than 20000 MWD/MTU to prevent W(Z) function extrapolation

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

Table 2.6.2.c Penalty Factors in Excess of 2% per 31 EFPD	
Cycle Burnup (MWD/MTU)	**Penalty Factor $F^C_Q(z)$**
0	1.0200
501	1.0200
677	1.0268
853	1.0350
1029	1.0410
1204	1.0460
1380	1.0490
1556	1.0470
2786	1.0200
11925	1.0200
12101	1.0211
12452	1.0222
12628	1.0224
13155	1.0211
13331	1.0200
17901	1.0200
18076	1.0225
18779	1.0223
18955	1.0210
19131	1.0200

Notes:

Linear interpolation is adequate for intermediate cycle burnups.

All cycle burnups outside the range of the table shall use a 2% penalty factor for compliance with the 3.2.1.2 Surveillance Requirements.

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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:

The uncertainty, $U_{F\Delta H}$, to be applied to the Nuclear Enthalpy Rise Hot Channel Factor $F^N_{\Delta H}$ 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 when PDMS is inoperable ($U_{F\Delta Hm}$ is defined by PDMS when OPERABLE.)

2.7.3 PDMS Alarms:

$F^N_{\Delta H}$ Warning Setpoint = 2% $F^N_{\Delta H}$ Margin
$F^N_{\Delta H}$ Alarm Setpoint = 0% $F^N_{\Delta H}$ 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 the Figures described below or the latest valid PDMS Surveillance Report, whichever is more conservative.

a) Figure 2.8.1.a is the full cycle AFD Acceptable Operation Limits associated with the full cycle W(Z) values in Table 2.6.2.a.

b) Figure 2.8.1.b is the Reduced AFD Acceptable Operation Limits which may be applied after 18000 MWD/MTU. The Reduced AFD Acceptable Operation Limits are associated with the EOL-only W(Z) values in Table 2.6.2.b. Prior to changing to Figure 2.8.1.b, confirm that the plant is within the specified AFD envelope.

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 $DNBR_{APSL} \geq 1.563$

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

2.9.2 PDMS Alarms:

DNBR Warning Setpoint = 2% DNBR Margin
DNBR Alarm Setpoint = 0% DNBR Margin

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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

(Full Cycle)

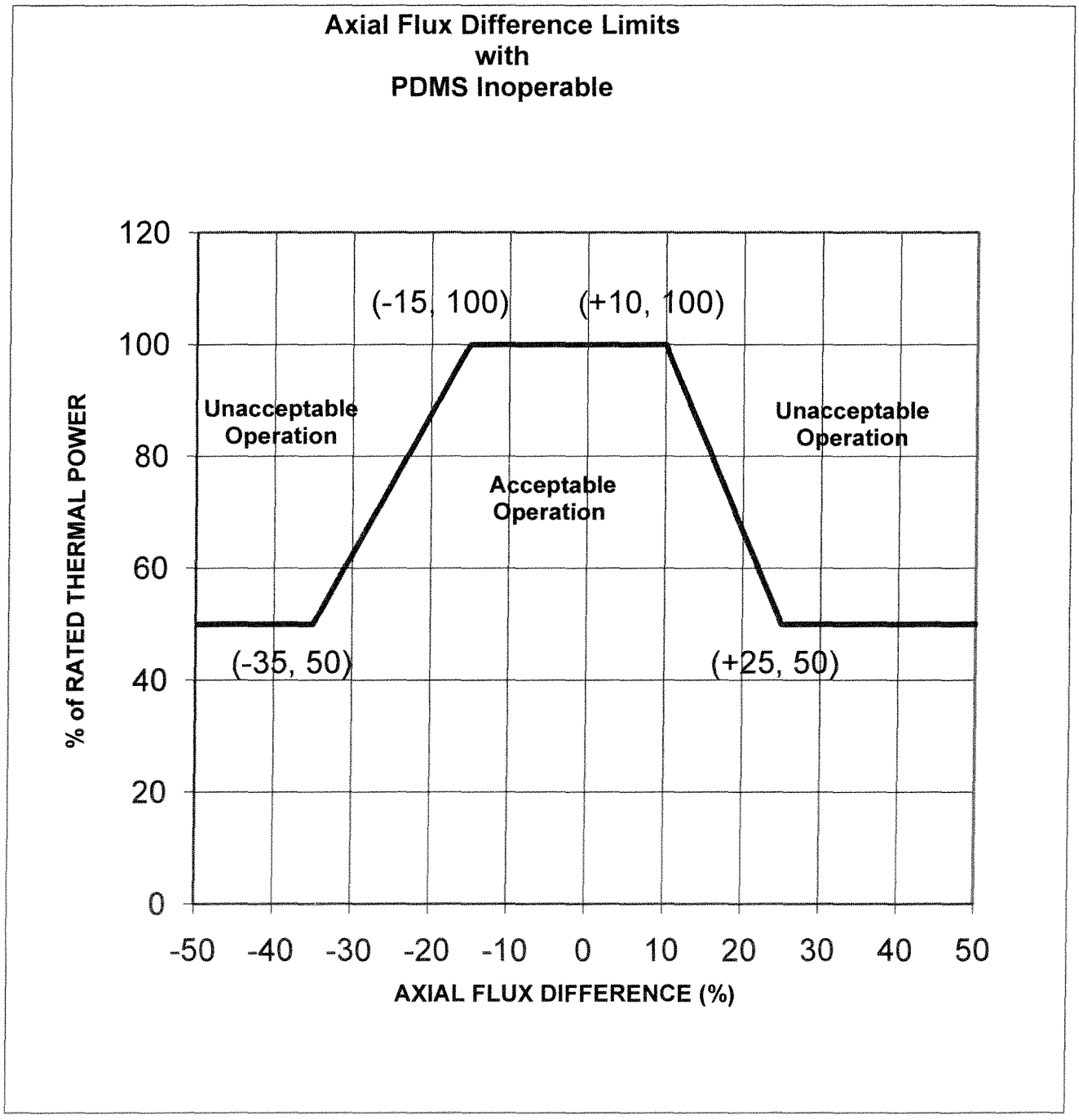
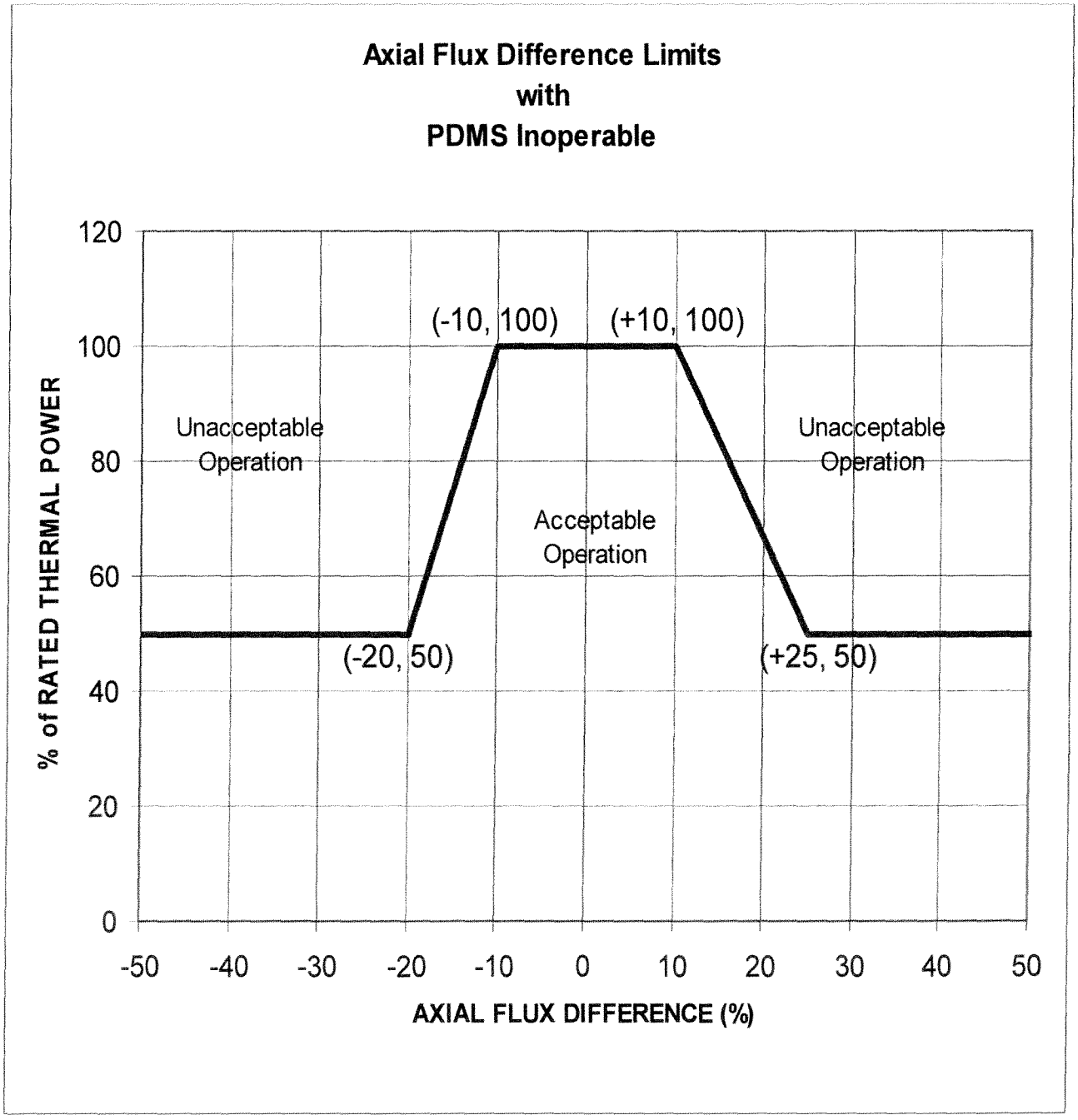


Figure 2.8.1.b:
Reduced Axial Flux Difference Limits
as a Function of Rated Thermal Power

(Cycle burnup ≥ 18000 MWD/MTU)



CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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

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 0.00135 / psi.

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

2.10.13 The $f_1(\Delta I)$ "negative" breakpoint shall be -18% ΔI.

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

2.10.15 The $f_1(\Delta I)$ "negative" slope shall be -2.61% / % ΔI.

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

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

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.

CORE OPERATING LIMITS REPORT (COLR) for BRAIDWOOD UNIT 2 CYCLE 17

2.12 Reactor Coolant System (RCS) Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) 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 the applicable value given in the Table below (LCO 3.9.1). The reported "prior to initial criticality" value also bounds the end-of-cycle requirements for the previous cycle.

2.13.2 To maintain keff ≤ 0.987 with all shutdown and control rods fully withdrawn in MODES 3, 4, or 5 (TRM TLCO 3.1.g Required Action B.2 and TRM TLCO 3.1.k.2), the Reactor Coolant System boron concentration shall be greater than or equal to the applicable values given in the Table below.

COLR Section	Conditions	Boron Concentration (ppm)
2.13.1	a) prior to initial criticality	1678
	b) for cycle burnups ≥ 0 MWD/MTU and < 16000 MWD/MTU	1796
	c) for Cycle Burnup ≥ 16,000 MWD/MTU	1506
2.13.2	a) prior to initial criticality	1747
	b) all other times in life	1992