Exelon Generation Company, LLC
1400 Opus Place
Downers Grove, IL 60515-5701

www.exeloncorp.com

Exelon Nuclear

January 29, 2001

LTR: BYRON 2001-0018
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: Byron Station Unit 1 Cycle 11 Core Operating Limits Report
Byron Station Unit 2 Cycle 9 Core Operating Limits Report

In accordance with Technical Specification 5.6.5, "Core Operating Limits Report (COLR)," item d., we are submitting a revised COLR for Byron Station Unit 1, Cycle 11 and Byron Station Unit 2, Cycle 9. Specifically, item 2.12.2 of each COLR was revised to reflect a revision made to our Technical Requirements Manual.

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

Respectfully,

William Levis
Site Vice President
Byron Station

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

WL/JL/dpk

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

A001

**ATTACHMENT 1**

**Revised Byron Station Unit 1 Cycle 11 COLR**

NUCLEAR FUEL MANAGEMENT DEPARTMENT
TRANSMITTAL OF DESIGN INFORMATION

| | | |
|---|---|---|
| ☒ SAFETY RELATED<br>☐ NON-SAFETY RELATED<br>☐ REGULATORY RELATED | Originating Organization<br>☒ Nuclear Fuel Management<br>☐ Other (specify) _____ | NFM ID # NFM0000119<br>Rev. No. 3<br>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

| | | |
|---|---|---|
| R. Ng<br>Preparer | Raymond Ng<br>Preparer's Signature | 11/15/00<br>Date |
| E. Wurz<br>Reviewer | Erich Wurz<br>Reviewer's Signature | 11/15/00<br>Date |
| D. Redden<br>NFM Supervisor | Approver's Signature | 11/15/00<br>Date |

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified NDITs: _____

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 3 of this TODI supersedes TODI NFM0000119, Rev. 2. This revision 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 ≤ 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 (Raymond Ng) with a copy of Byron Station's completed Plant Review and COLR submittal to the NRC.

Source of Information:
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.

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

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

## 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 | 3.3.1 | 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) |

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

## 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.

### 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 $+3.7 \times 10^{-5}$ $\Delta k/k/°F$.

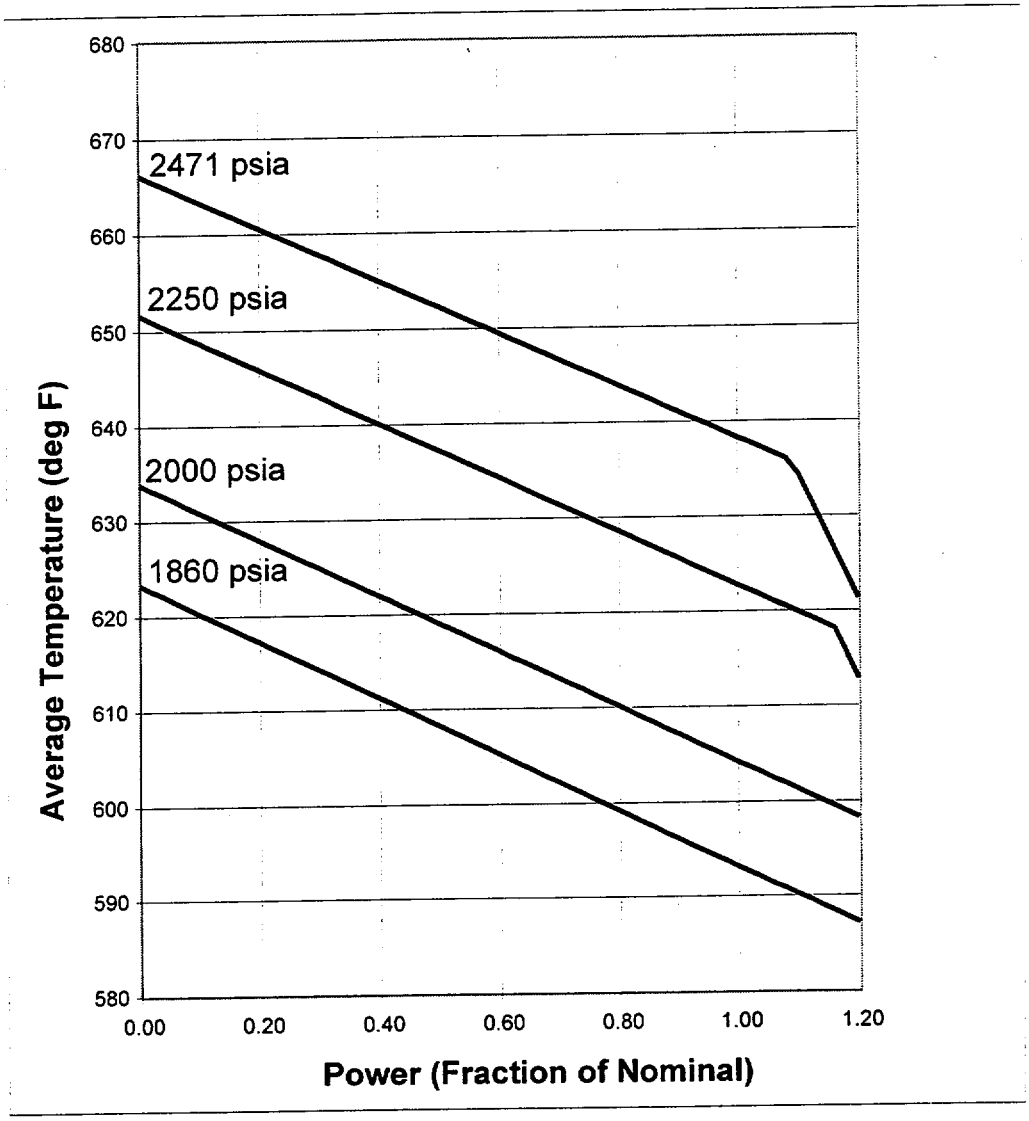
2.3.2 The EOL/ARO/HFP-MTC lower limit shall be $-4.1 \times 10^{-4}$ $\Delta k/k/°F$.

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

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

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

**Figure 2.1.1: Reactor Core Limits**



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

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)

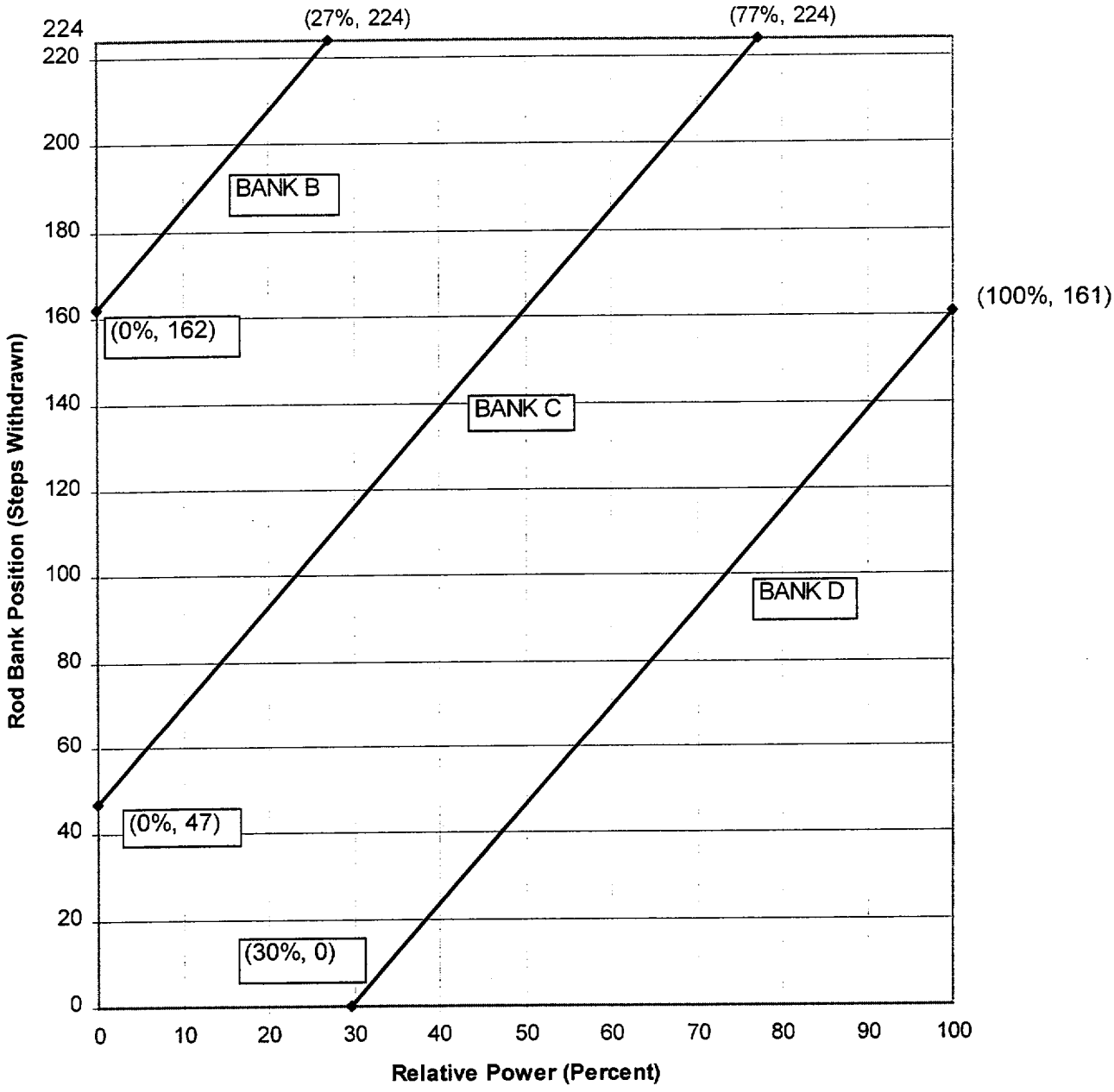
2.5.1 The control banks shall be limited in physical insertion as shown in Figure 2.5.1.

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**



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

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

2.6.1

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

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

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) 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, 10000, and 18000 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. 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

**Figure 2.6.1: K(Z) - Normalized Fq(Z) as a Function of Core Height (Assembly Average > 4000 MWD/MTU)**

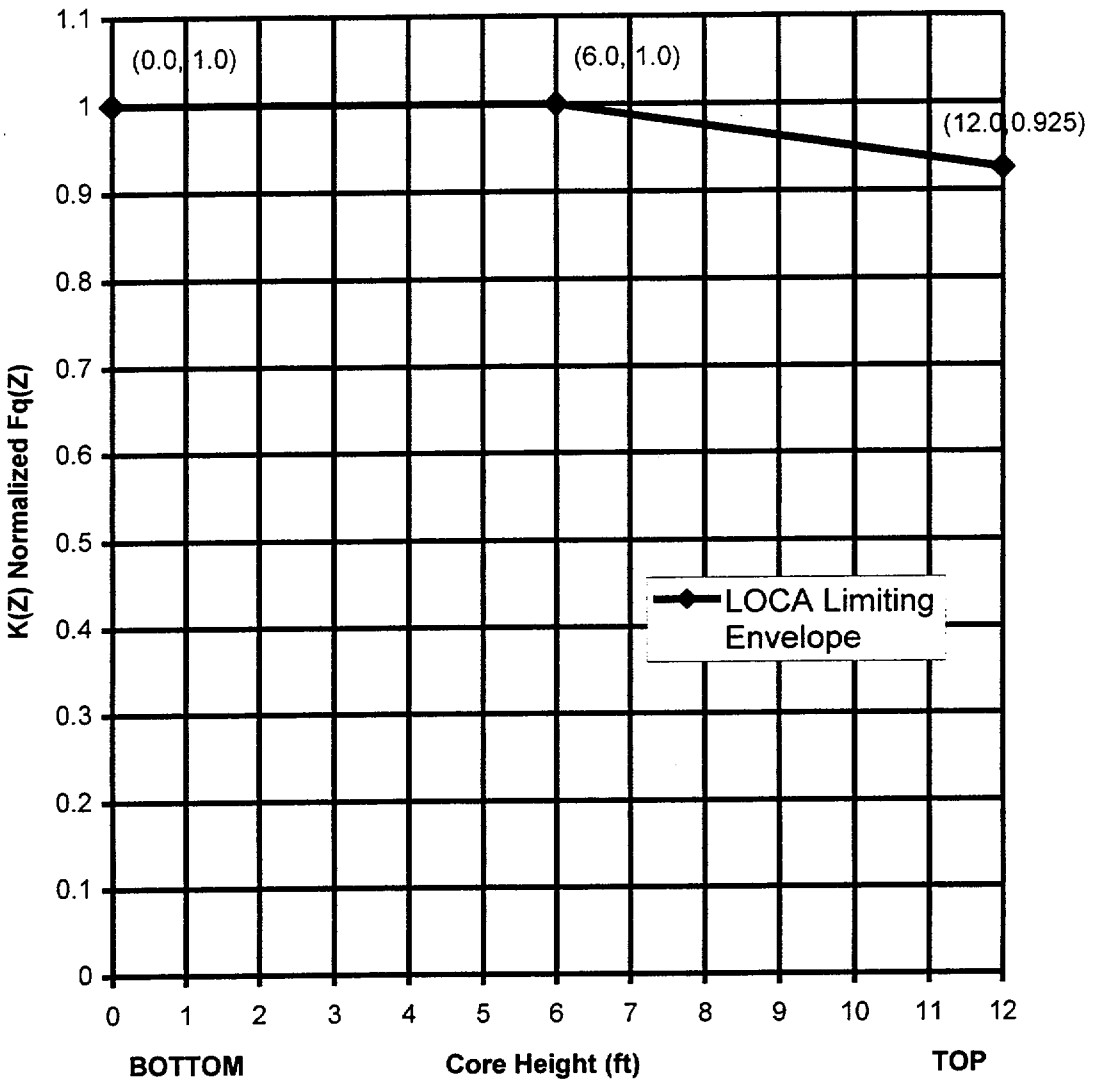
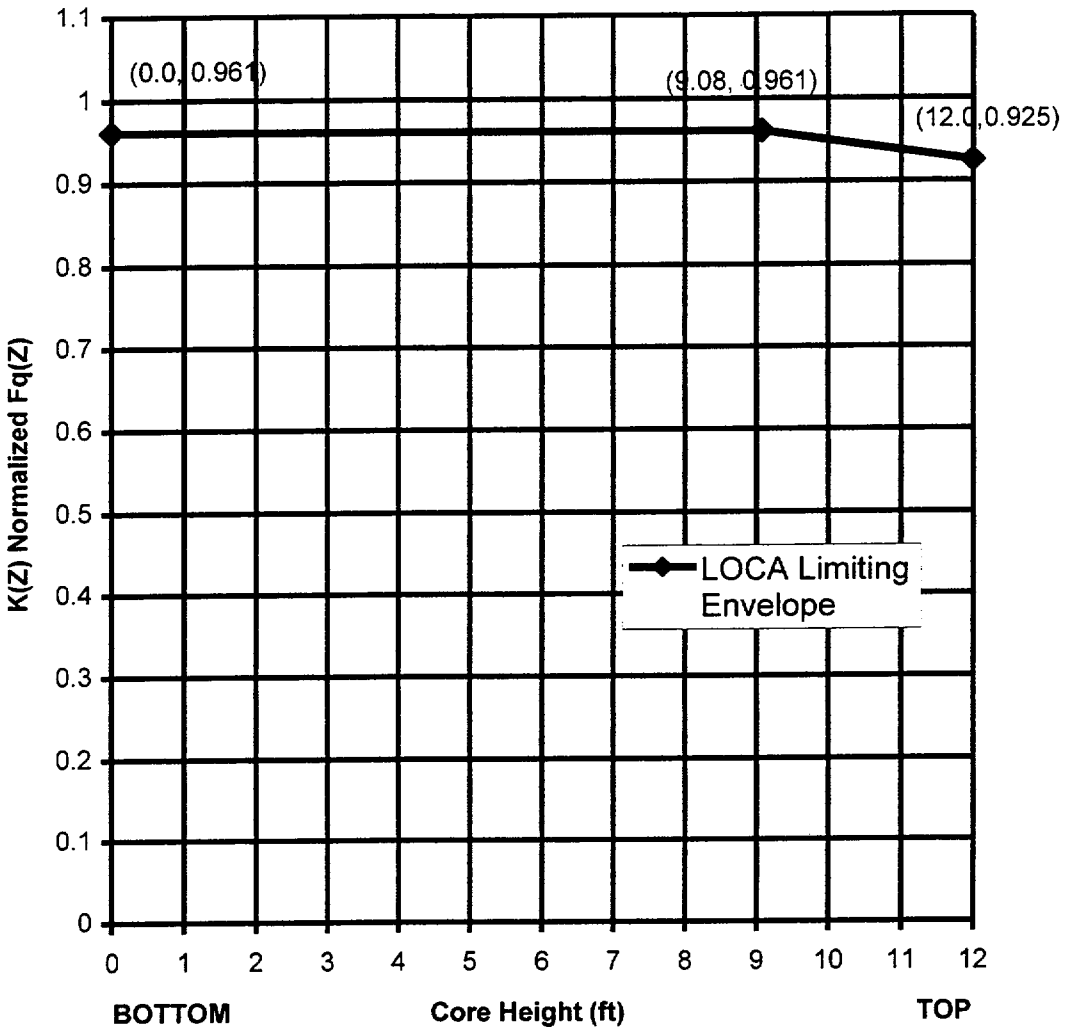


**Figure 2.6.1.a: K(Z) - Normalized Fq(Z) as a Function of Core Height (Assembly BU ≤ 4000 MWD/MTU)**



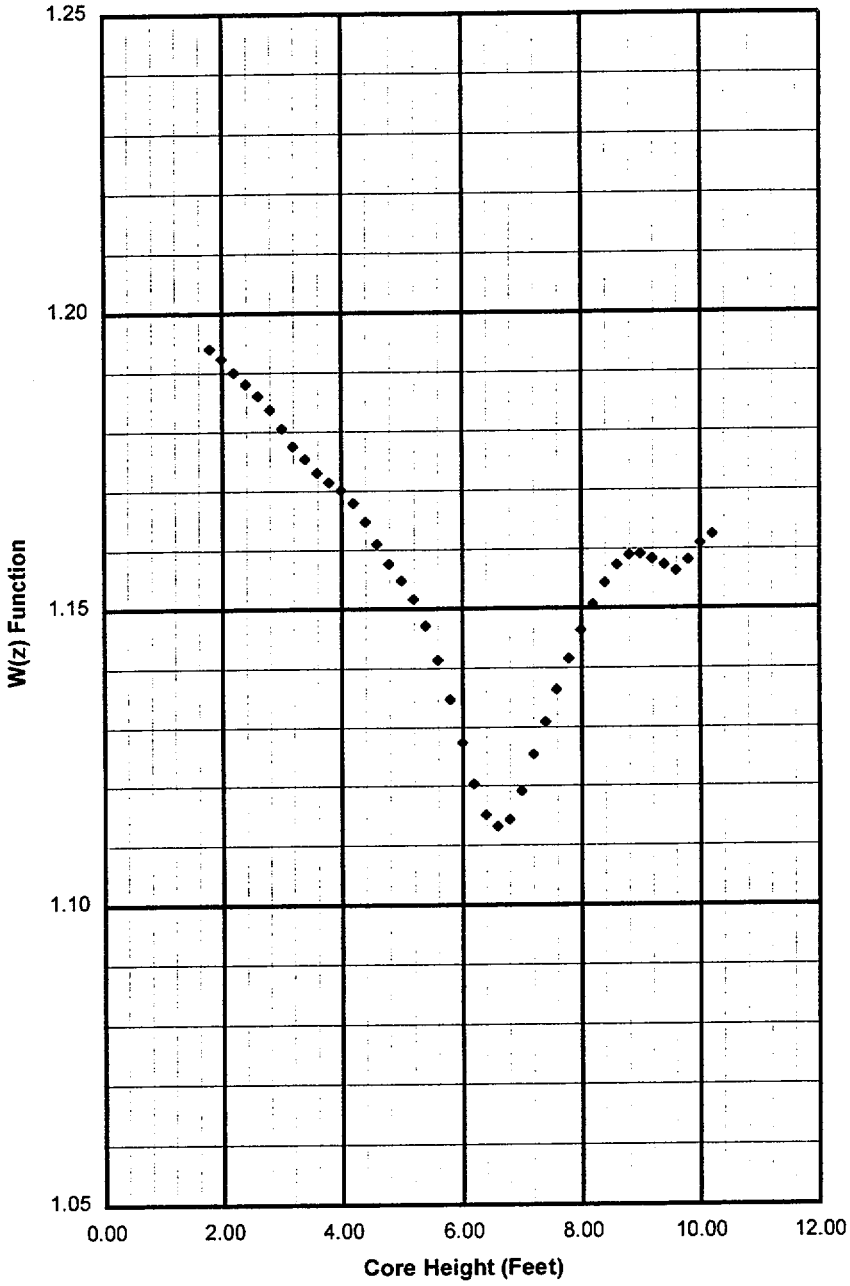
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

| Height (Feet) | 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 | 1.1939 |
| 2.00 | 1.1922 |
| 2.20 | 1.1899 |
| 2.40 | 1.1879 |
| 2.60 | 1.1860 |
| 2.80 | 1.1836 |
| 3.00 | 1.1805 |
| 3.20 | 1.1775 |
| 3.40 | 1.1754 |
| 3.60 | 1.1730 |
| 3.80 | 1.1714 |
| 4.00 | 1.1700 |
| 4.20 | 1.1679 |
| 4.40 | 1.1647 |
| 4.60 | 1.1609 |
| 4.80 | 1.1575 |
| 5.00 | 1.1547 |
| 5.20 | 1.1516 |
| 5.40 | 1.1471 |
| 5.60 | 1.1412 |
| 5.80 | 1.1346 |
| 6.00 | 1.1273 |
| 6.20 | 1.1202 |
| 6.40 | 1.1151 |
| 6.60 | 1.1131 |
| 6.80 | 1.1143 |
| 7.00 | 1.1190 |
| 7.20 | 1.1253 |
| 7.40 | 1.1308 |
| 7.60 | 1.1363 |
| 7.80 | 1.1415 |
| 8.00 | 1.1462 |
| 8.20 | 1.1506 |
| 8.40 | 1.1543 |
| 8.60 | 1.1573 |
| 8.80 | 1.1589 |
| 9.00 | 1.1590 |
| 9.20 | 1.1583 |
| 9.40 | 1.1573 |
| 9.60 | 1.1562 |
| 9.80 | 1.1581 |
| 10.00 | 1.1609 |
| 10.20 | 1.1624 |
| 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)



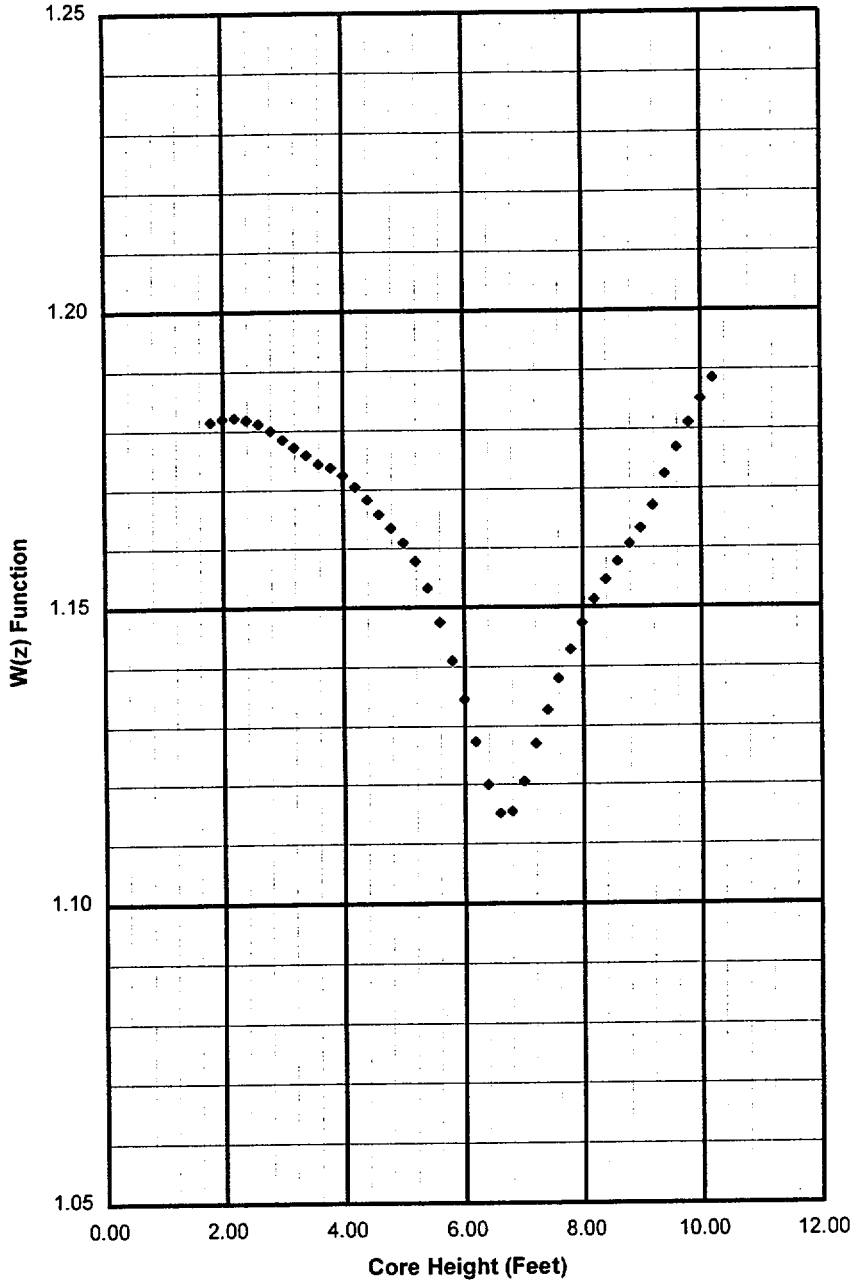
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

| Height (Feet) | 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 | 1.1815 |
| 2.00 | 1.1820 |
| 2.20 | 1.1821 |
| 2.40 | 1.1818 |
| 2.60 | 1.1811 |
| 2.80 | 1.1799 |
| 3.00 | 1.1785 |
| 3.20 | 1.1772 |
| 3.40 | 1.1758 |
| 3.60 | 1.1744 |
| 3.80 | 1.1736 |
| 4.00 | 1.1724 |
| 4.20 | 1.1704 |
| 4.40 | 1.1681 |
| 4.60 | 1.1657 |
| 4.80 | 1.1634 |
| 5.00 | 1.1609 |
| 5.20 | 1.1578 |
| 5.40 | 1.1532 |
| 5.60 | 1.1474 |
| 5.80 | 1.1410 |
| 6.00 | 1.1345 |
| 6.20 | 1.1274 |
| 6.40 | 1.1199 |
| 6.60 | 1.1150 |
| 6.80 | 1.1153 |
| 7.00 | 1.1204 |
| 7.20 | 1.1270 |
| 7.40 | 1.1326 |
| 7.60 | 1.1379 |
| 7.80 | 1.1428 |
| 8.00 | 1.1473 |
| 8.20 | 1.1512 |
| 8.40 | 1.1545 |
| 8.60 | 1.1575 |
| 8.80 | 1.1605 |
| 9.00 | 1.1632 |
| 9.20 | 1.1671 |
| 9.40 | 1.1724 |
| 9.60 | 1.1768 |
| 9.80 | 1.1809 |
| 10.00 | 1.1849 |
| 10.20 | 1.1885 |
| 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)



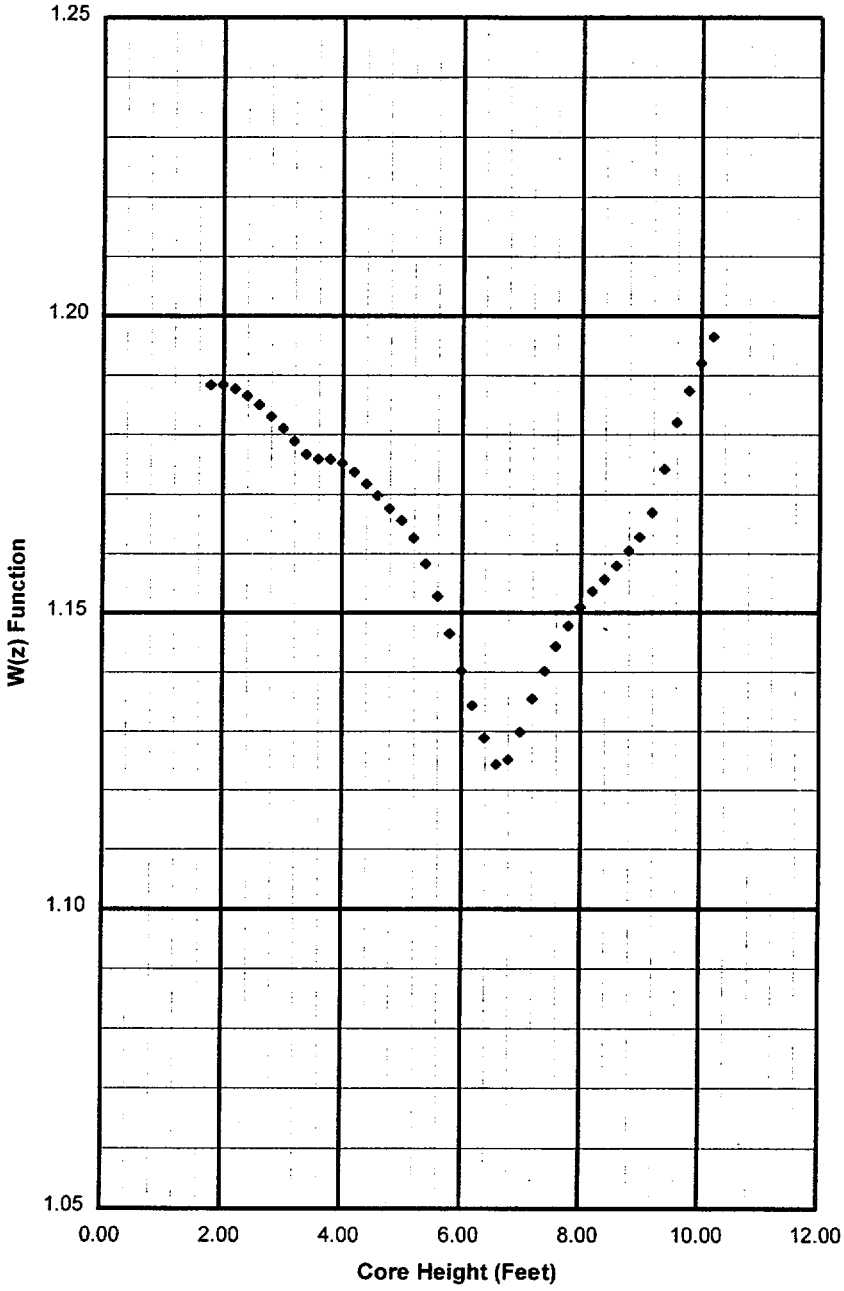
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

| Height (Feet) | 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 | 1.1883 |
| 2.00 | 1.1882 |
| 2.20 | 1.1876 |
| 2.40 | 1.1865 |
| 2.60 | 1.1850 |
| 2.80 | 1.1830 |
| 3.00 | 1.1810 |
| 3.20 | 1.1788 |
| 3.40 | 1.1767 |
| 3.60 | 1.1759 |
| 3.80 | 1.1758 |
| 4.00 | 1.1751 |
| 4.20 | 1.1736 |
| 4.40 | 1.1717 |
| 4.60 | 1.1697 |
| 4.80 | 1.1676 |
| 5.00 | 1.1655 |
| 5.20 | 1.1626 |
| 5.40 | 1.1583 |
| 5.60 | 1.1527 |
| 5.80 | 1.1464 |
| 6.00 | 1.1402 |
| 6.20 | 1.1343 |
| 6.40 | 1.1289 |
| 6.60 | 1.1244 |
| 6.80 | 1.1252 |
| 7.00 | 1.1299 |
| 7.20 | 1.1355 |
| 7.40 | 1.1401 |
| 7.60 | 1.1442 |
| 7.80 | 1.1478 |
| 8.00 | 1.1509 |
| 8.20 | 1.1535 |
| 8.40 | 1.1556 |
| 8.60 | 1.1579 |
| 8.80 | 1.1603 |
| 9.00 | 1.1627 |
| 9.20 | 1.1669 |
| 9.40 | 1.1742 |
| 9.60 | 1.1819 |
| 9.80 | 1.1873 |
| 10.00 | 1.1919 |
| 10.20 | 1.1964 |
| 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 10000 MWD/MTU**
(Top and Bottom 15% Excluded per WCAP-10216)



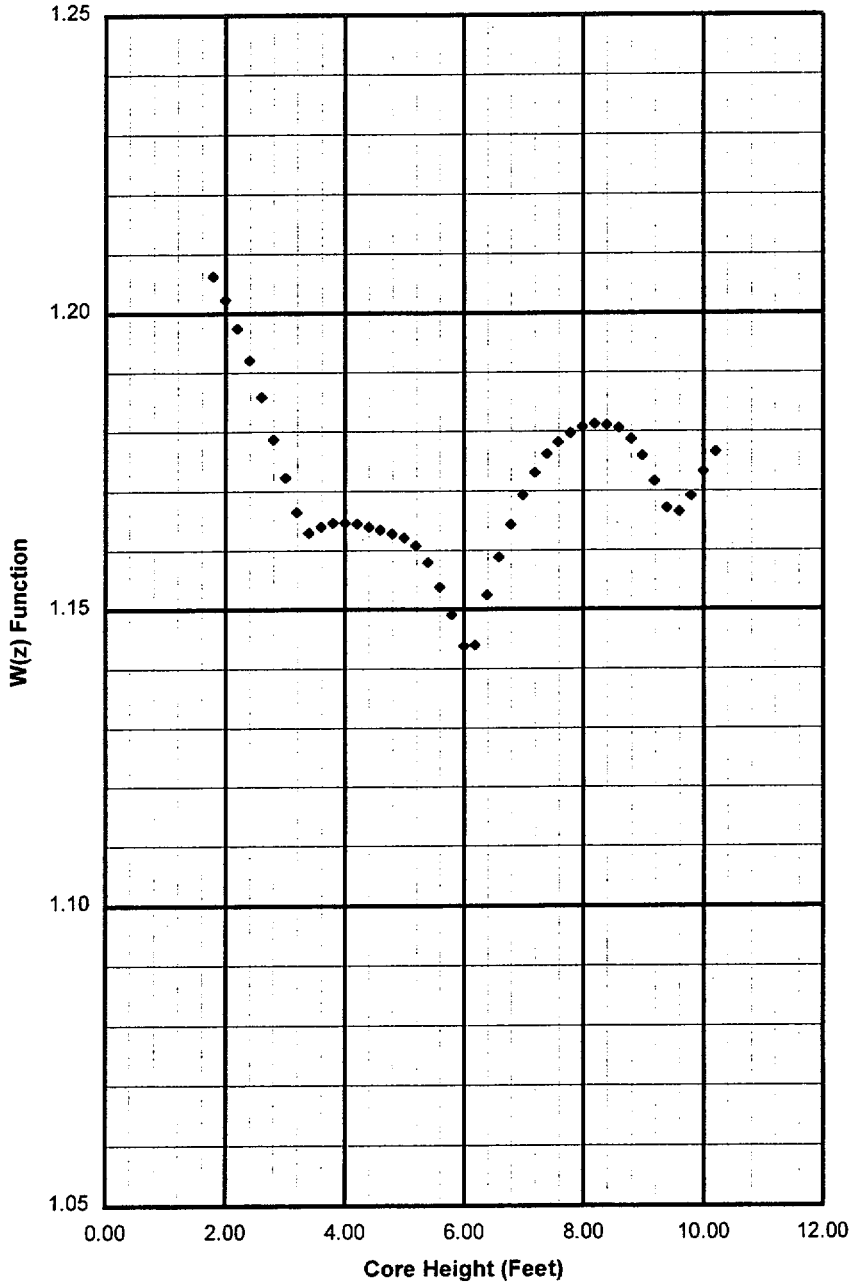
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 1 CYCLE 11

| Height (Feet) | 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 | 1.2062 |
| 2.00 | 1.2022 |
| 2.20 | 1.1974 |
| 2.40 | 1.1919 |
| 2.60 | 1.1857 |
| 2.80 | 1.1787 |
| 3.00 | 1.1722 |
| 3.20 | 1.1663 |
| 3.40 | 1.1629 |
| 3.60 | 1.1638 |
| 3.80 | 1.1645 |
| 4.00 | 1.1646 |
| 4.20 | 1.1644 |
| 4.40 | 1.1639 |
| 4.60 | 1.1633 |
| 4.80 | 1.1627 |
| 5.00 | 1.1621 |
| 5.20 | 1.1607 |
| 5.40 | 1.1579 |
| 5.60 | 1.1538 |
| 5.80 | 1.1491 |
| 6.00 | 1.1437 |
| 6.20 | 1.1440 |
| 6.40 | 1.1524 |
| 6.60 | 1.1587 |
| 6.80 | 1.1642 |
| 7.00 | 1.1691 |
| 7.20 | 1.1730 |
| 7.40 | 1.1761 |
| 7.60 | 1.1782 |
| 7.80 | 1.1796 |
| 8.00 | 1.1806 |
| 8.20 | 1.1811 |
| 8.40 | 1.1810 |
| 8.60 | 1.1805 |
| 8.80 | 1.1787 |
| 9.00 | 1.1758 |
| 9.20 | 1.1715 |
| 9.40 | 1.1671 |
| 9.60 | 1.1664 |
| 9.80 | 1.1690 |
| 10.00 | 1.1731 |
| 10.20 | 1.1765 |
| 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 18000 MWD/MTU**
(Top and Bottom 15% Excluded per WCAP-10216)



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

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.

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

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

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

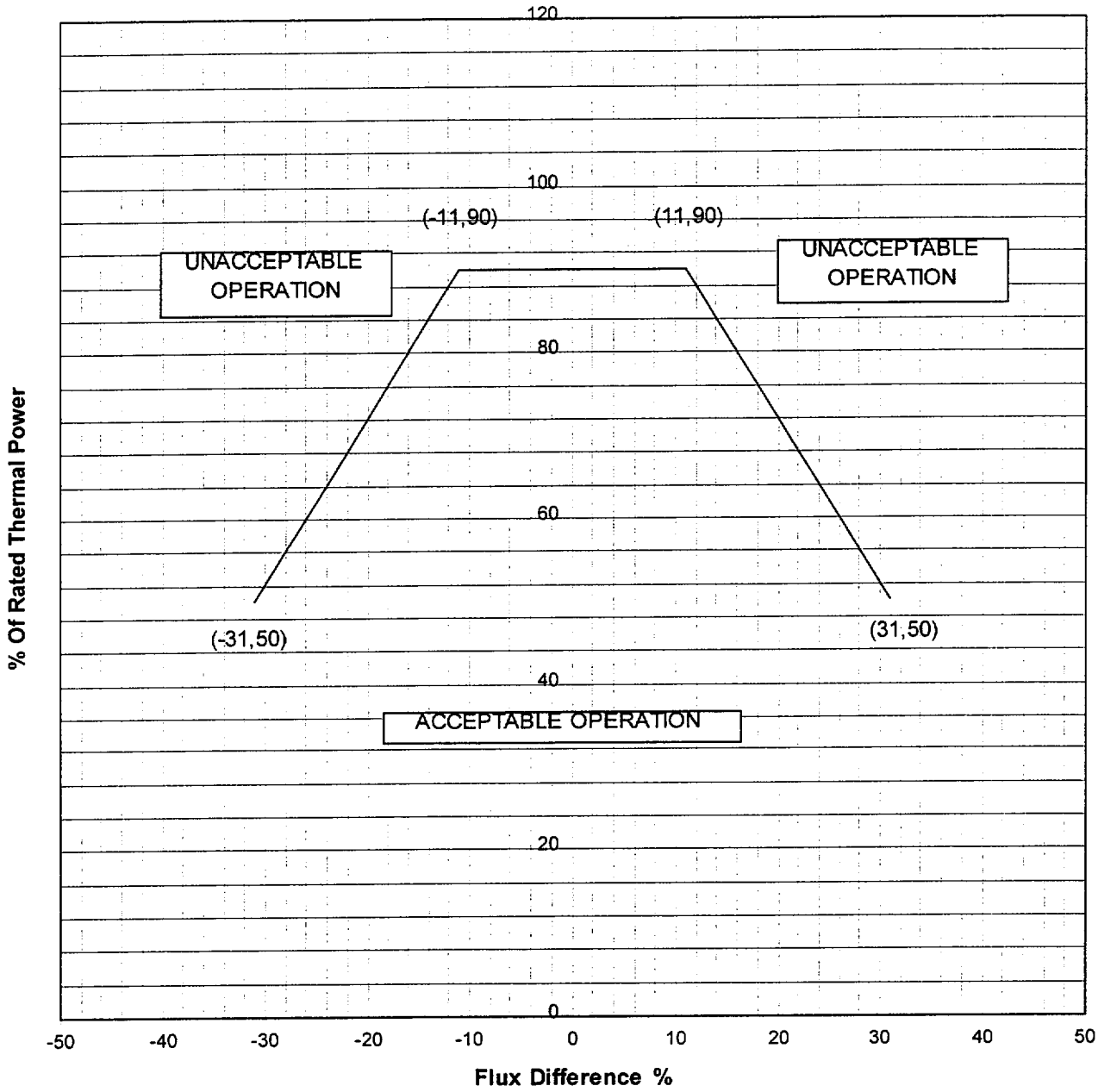
where: P = the ratio of THERMAL POWER to RATED THERMAL POWER
$F^{RTP}_{\Delta H} = 1.70$
$PF_{\Delta H} = 0.3$

2.8 Axial Flux Difference (AFD) (LCO 3.2.3)

2.8.1 The AXIAL FLUX DIFFERENCE (AFD) target band is +5, -10% of the target flux difference.

2.8.2 The AFD Acceptable Operation Limits are provided in Figure 2.8.1.

## FIGURE 2.8.1: Axial Flux Difference Limits As A Function of Rated Thermal Power



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

2.9 Reactor Trip System Overtemperature $\Delta T$ Setpoint Parameter Values (LCO 3.3.1)

2.9.1 The Overtemperature $\Delta T$ reactor trip setpoint $K_1$ shall be equal to 1.325.

2.9.2 The Overtemperature $\Delta T$ reactor trip setpoint $T_{avg}$ coefficient $K_2$ shall be equal to 0.0297 / °F.

2.9.3 The Overtemperature $\Delta T$ reactor trip setpoint pressure coefficient $K_3$ shall be equal to 0.00181 / psig.

2.9.4 The nominal $T_{avg}$ at RTP (indicated) T′ shall be less than or equal to 588.4 °F.

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

2.9.6 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_1$ shall be equal to 8 sec.

2.9.7 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_2$ shall be equal to 3 sec.

2.9.8 The measured reactor vessel $\Delta T$ lag time constant $\tau_3$ shall be less than or equal to 2 sec.

2.9.9 The measured reactor vessel average temperature lead/lag time constant $\tau_4$ shall be equal to 33 sec.

2.9.10 The measured reactor vessel average temperature lead/lag time constant $\tau_5$ shall be equal to 4 sec.

2.9.11 The measured reactor vessel average temperature lag time constant $\tau_6$ shall be less than or equal to 2 sec.

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

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

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

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

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

2.10 Reactor Trip System Overpower $\Delta T$ Setpoint Parameter Values (LCO 3.3.1)

2.10.1 The Overpower $\Delta T$ reactor trip setpoint $K_4$ shall be equal to 1.072.

2.10.2 The Overpower $\Delta T$ reactor trip setpoint $T_{avg}$ rate/lag coefficient $K_5$ shall be equal to 0.02 / °F for increasing $T_{avg}$.

2.10.3 The Overpower $\Delta T$ reactor trip setpoint $T_{avg}$ rate/lag coefficient $K_5$ shall be equal to 0 / °F for decreasing $T_{avg}$.

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

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

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

2.10.7 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_1$ shall be equal to 8 sec.

2.10.8 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_2$ shall be equal to 3 sec.

2.10.9 The measured reactor vessel $\Delta T$ lag time constant $\tau_3$ shall be less than or equal to 2 sec.

2.10.10 The measured reactor vessel average temperature lag time constant $\tau_6$ shall be less than or equal to 2 sec.

2.10.11 The measured reactor vessel average temperature rate/lag time constant $\tau_7$ shall be equal to 10 sec.

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

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

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

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

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

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

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

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

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

2.12 Boron Concentration

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

2.12.2 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 COLR

NUCLEAR FUEL MANAGEMENT DEPARTMENT
NUCLEAR DESIGN INFORMATION TRANSMITTAL

| | | |
|---|---|---|
| ☒ SAFETY RELATED<br>☐ NON-SAFETY RELATED<br>☐ REGULATORY RELATED | Originating Organization<br>☒ Nuclear Fuel Management<br>☐ Other (specify) _____ | NDIT No. NFM9900202<br>Seq. No. 3<br>Page 1 of 18 |

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

| | | |
|---|---|---|
| R. Ng<br>Preparer | Raymond Ng<br>Preparer's Signature | 11/15/00<br>Date |
| E. Wurz<br>Reviewer | Eric Wurz<br>Reviewer's Signature | 11/15/00<br>Date |
| D. Redden<br>NFM Supervisor | NFM Supervisor's Signature | 11/15/00<br>Date |

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified NDITs: _____

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 3 of this NDIT supersedes Sequence 2. 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 (Raymond Ng) with a copy of Byron Station's completed Plant Review and COLR submittal to the NRC.

Source of Information:
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.

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

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

## 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 | 3.3.1 | 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) |

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

## 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.

### 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 $+3.3 \times 10^{-5}$ $\Delta k/k/°F$.

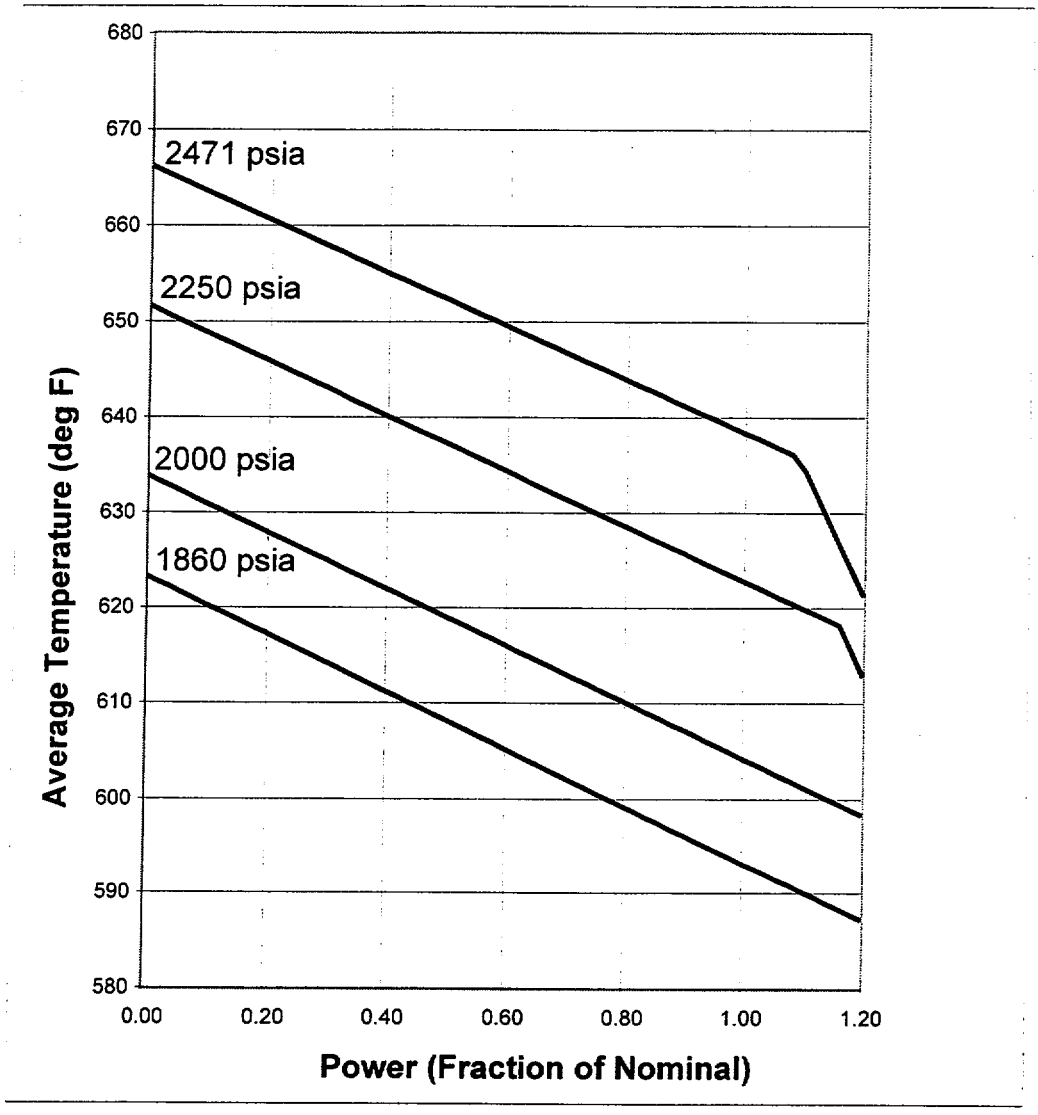
2.3.2 The EOL/ARO/HFP-MTC lower limit shall be $-4.1 \times 10^{-4}$ $\Delta k/k/°F$.

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

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

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

**Figure 2.1.1: Reactor Core Limits**



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

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)

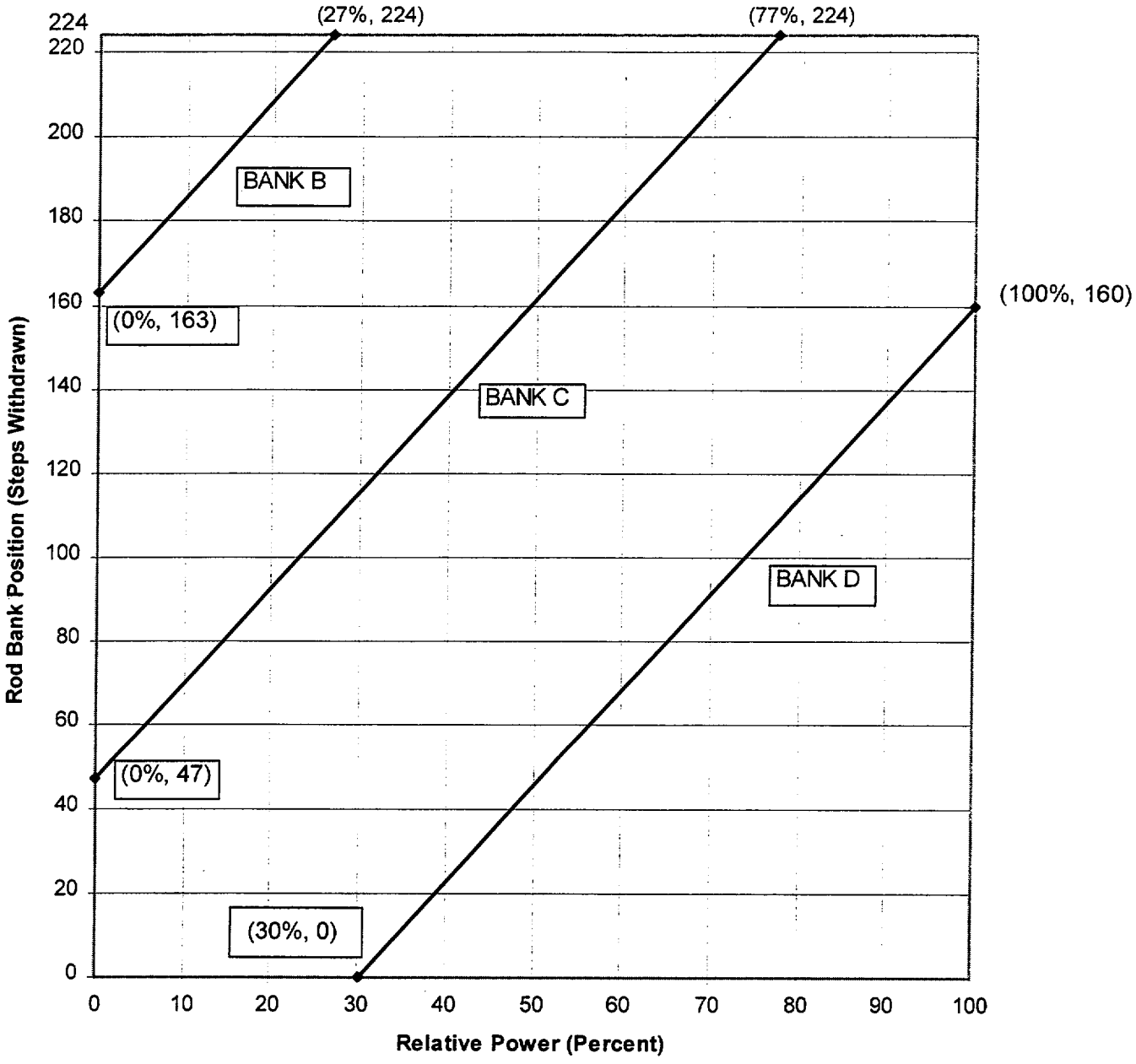
2.5.1 The control banks shall be limited in physical insertion as shown in Figure 2.5.1.

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**



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

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

2.6.1

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

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

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) 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 150, 8000 and 18800 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. 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

**Figure 2.6.1: K(Z) - Normalized Fq(Z) as a Function of Core Height (Assembly Average > 4000 MWD/MTU)**

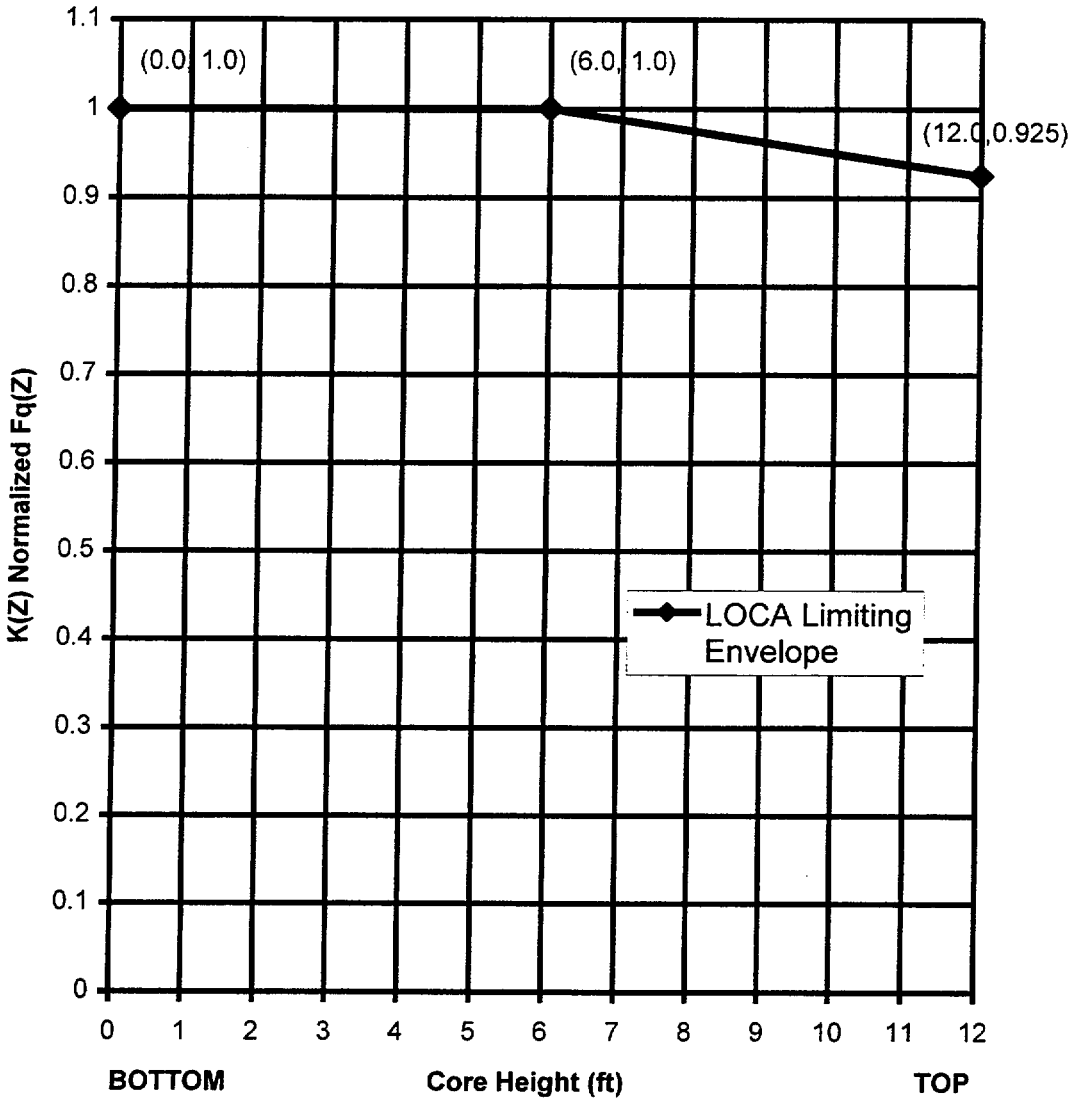
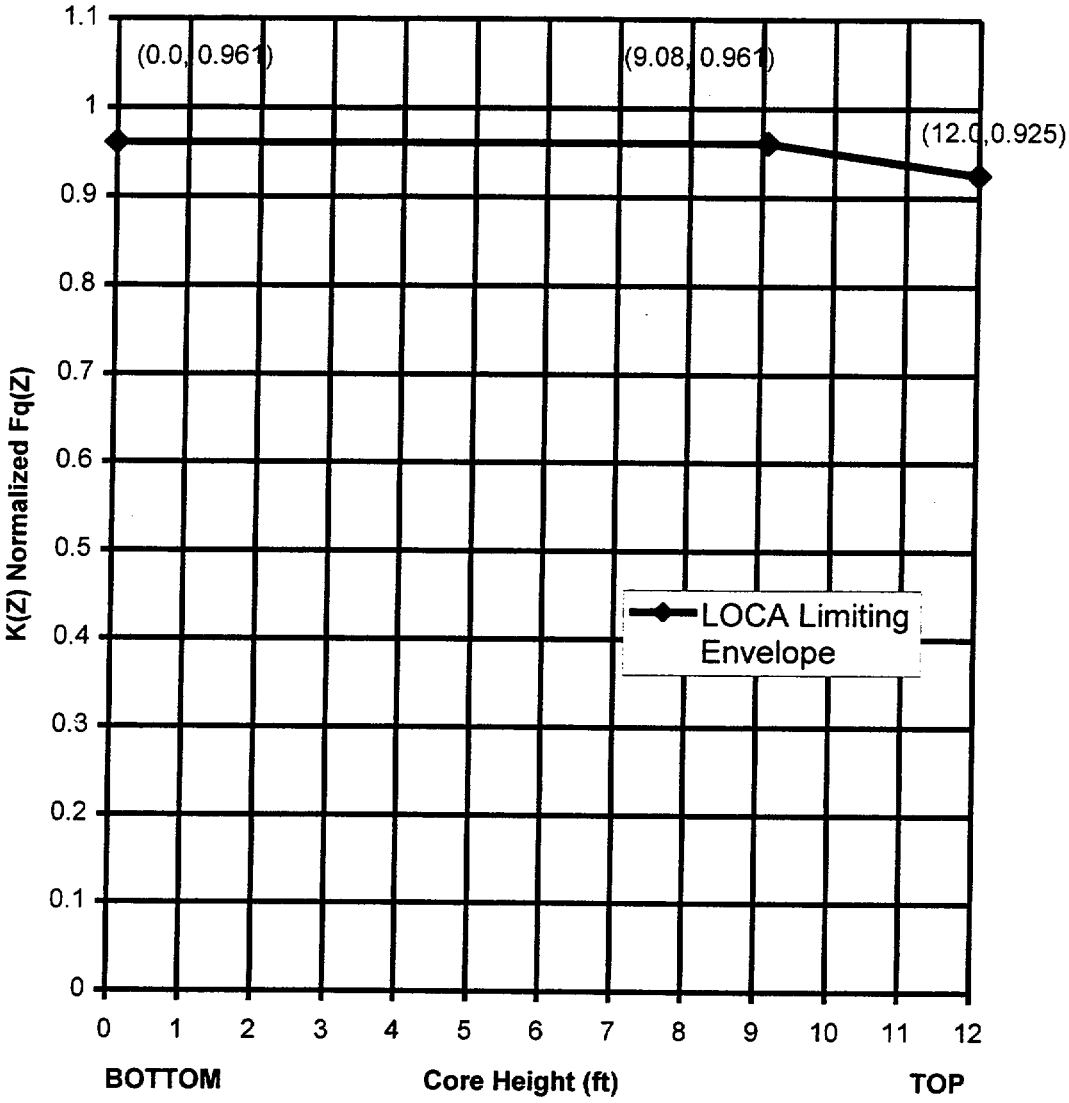


**Figure 2.6.1.a: K(Z) - Normalized Fq(Z) as a Function of Core Height (Assembly Average ≤ 4000 MWD/MTU)**



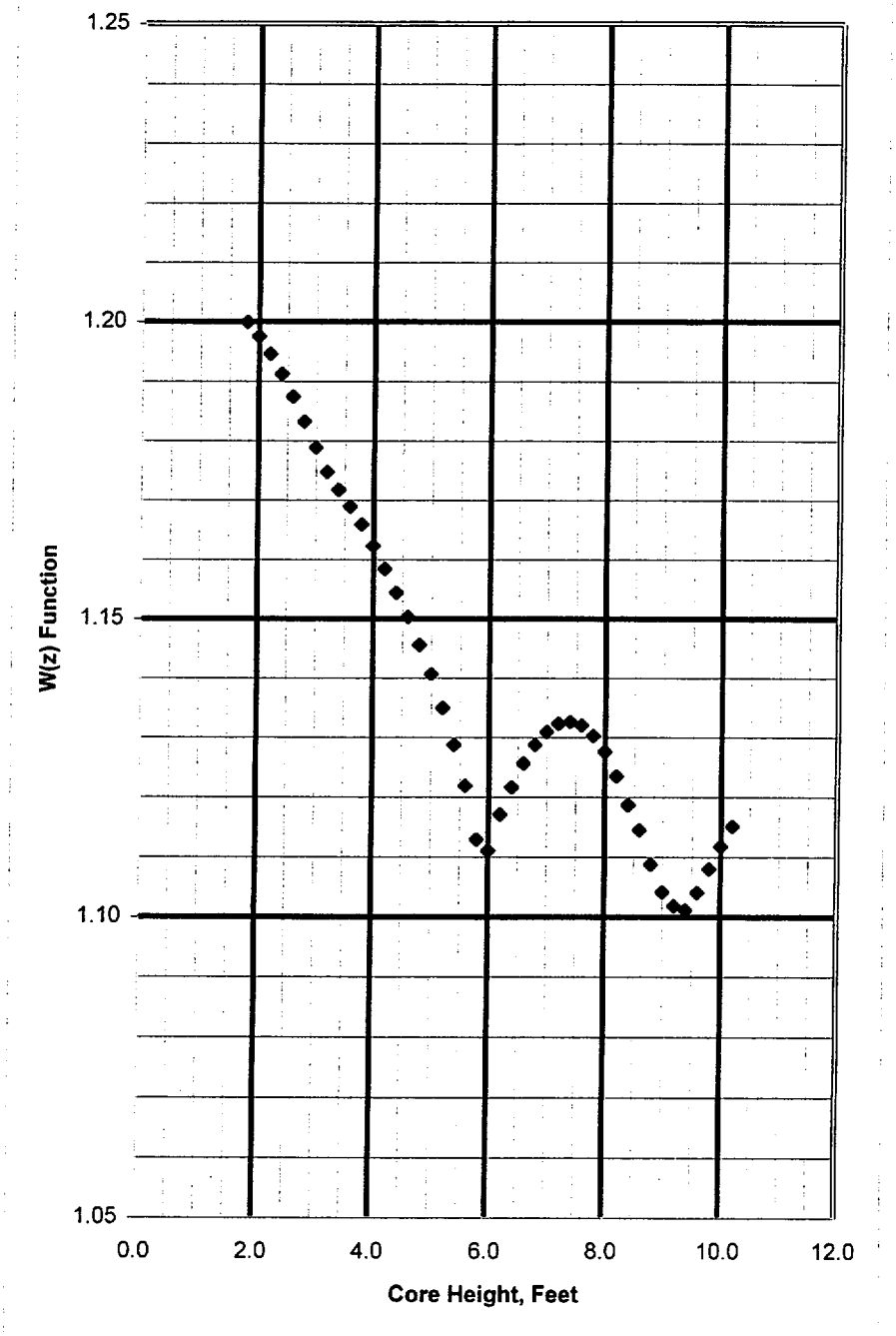
# CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

| Height Feet | Max W(z) |
|---|---|
| 0.0 | 1.0000 |
| 0.2 | 1.0000 |
| 0.4 | 1.0000 |
| 0.6 | 1.0000 |
| 0.8 | 1.0000 |
| 1.0 | 1.0000 |
| 1.2 | 1.0000 |
| 1.4 | 1.0000 |
| 1.6 | 1.0000 |
| 1.8 | 1.1999 |
| 2.0 | 1.1975 |
| 2.2 | 1.1946 |
| 2.4 | 1.1912 |
| 2.6 | 1.1874 |
| 2.8 | 1.1832 |
| 3.0 | 1.1788 |
| 3.2 | 1.1747 |
| 3.4 | 1.1717 |
| 3.6 | 1.1689 |
| 3.8 | 1.1659 |
| 4.0 | 1.1623 |
| 4.2 | 1.1584 |
| 4.4 | 1.1544 |
| 4.6 | 1.1503 |
| 4.8 | 1.1457 |
| 5.0 | 1.1407 |
| 5.2 | 1.1349 |
| 5.4 | 1.1287 |
| 5.6 | 1.1219 |
| 5.8 | 1.1129 |
| 6.0 | 1.1110 |
| 6.2 | 1.1171 |
| 6.4 | 1.1216 |
| 6.6 | 1.1256 |
| 6.8 | 1.1287 |
| 7.0 | 1.1309 |
| 7.2 | 1.1323 |
| 7.4 | 1.1326 |
| 7.6 | 1.1320 |
| 7.8 | 1.1302 |
| 8.0 | 1.1276 |
| 8.2 | 1.1235 |
| 8.4 | 1.1187 |
| 8.6 | 1.1145 |
| 8.8 | 1.1087 |
| 9.0 | 1.1041 |
| 9.2 | 1.1018 |
| 9.4 | 1.1011 |
| 9.6 | 1.1040 |
| 9.8 | 1.1080 |
| 10.0 | 1.1117 |
| 10.2 | 1.1151 |
| 10.4 | 1.0000 |
| 10.6 | 1.0000 |
| 10.8 | 1.0000 |
| 11.0 | 1.0000 |
| 11.2 | 1.0000 |
| 11.4 | 1.0000 |
| 11.6 | 1.0000 |
| 11.8 | 1.0000 |
| 12.0 | 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)



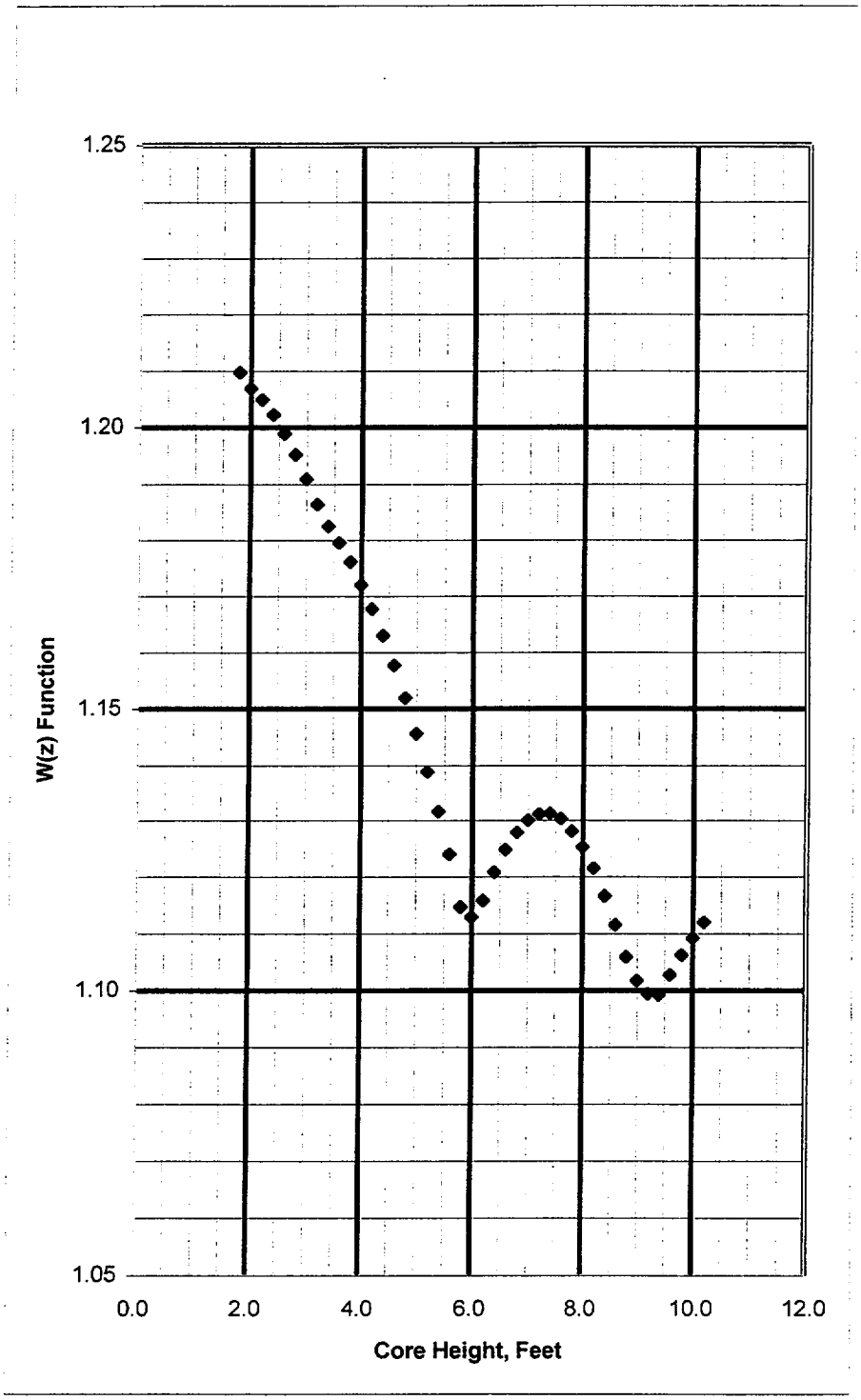
# CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

| Height Feet | Max W(z) |
|---|---|
| 0.0 | 1.0000 |
| 0.2 | 1.0000 |
| 0.4 | 1.0000 |
| 0.6 | 1.0000 |
| 0.8 | 1.0000 |
| 1.0 | 1.0000 |
| 1.2 | 1.0000 |
| 1.4 | 1.0000 |
| 1.6 | 1.0000 |
| 1.8 | 1.2097 |
| 2.0 | 1.2069 |
| 2.2 | 1.2049 |
| 2.4 | 1.2022 |
| 2.6 | 1.1989 |
| 2.8 | 1.1952 |
| 3.0 | 1.1909 |
| 3.2 | 1.1864 |
| 3.4 | 1.1825 |
| 3.6 | 1.1795 |
| 3.8 | 1.1761 |
| 4.0 | 1.1720 |
| 4.2 | 1.1677 |
| 4.4 | 1.1630 |
| 4.6 | 1.1577 |
| 4.8 | 1.1519 |
| 5.0 | 1.1456 |
| 5.2 | 1.1388 |
| 5.4 | 1.1316 |
| 5.6 | 1.1240 |
| 5.8 | 1.1147 |
| 6.0 | 1.1129 |
| 6.2 | 1.1158 |
| 6.4 | 1.1208 |
| 6.6 | 1.1248 |
| 6.8 | 1.1279 |
| 7.0 | 1.1300 |
| 7.2 | 1.1311 |
| 7.4 | 1.1312 |
| 7.6 | 1.1303 |
| 7.8 | 1.1281 |
| 8.0 | 1.1253 |
| 8.2 | 1.1215 |
| 8.4 | 1.1166 |
| 8.6 | 1.1115 |
| 8.8 | 1.1059 |
| 9.0 | 1.1017 |
| 9.2 | 1.0994 |
| 9.4 | 1.0992 |
| 9.6 | 1.1027 |
| 9.8 | 1.1062 |
| 10.0 | 1.1092 |
| 10.2 | 1.1120 |
| 10.4 | 1.0000 |
| 10.6 | 1.0000 |
| 10.8 | 1.0000 |
| 11.0 | 1.0000 |
| 11.2 | 1.0000 |
| 11.4 | 1.0000 |
| 11.6 | 1.0000 |
| 11.8 | 1.0000 |
| 12.0 | 1.0000 |

Byron Unit 2 Cycle 9

Figure 2.6.2.b

Summary of W(z) Function at 8000 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



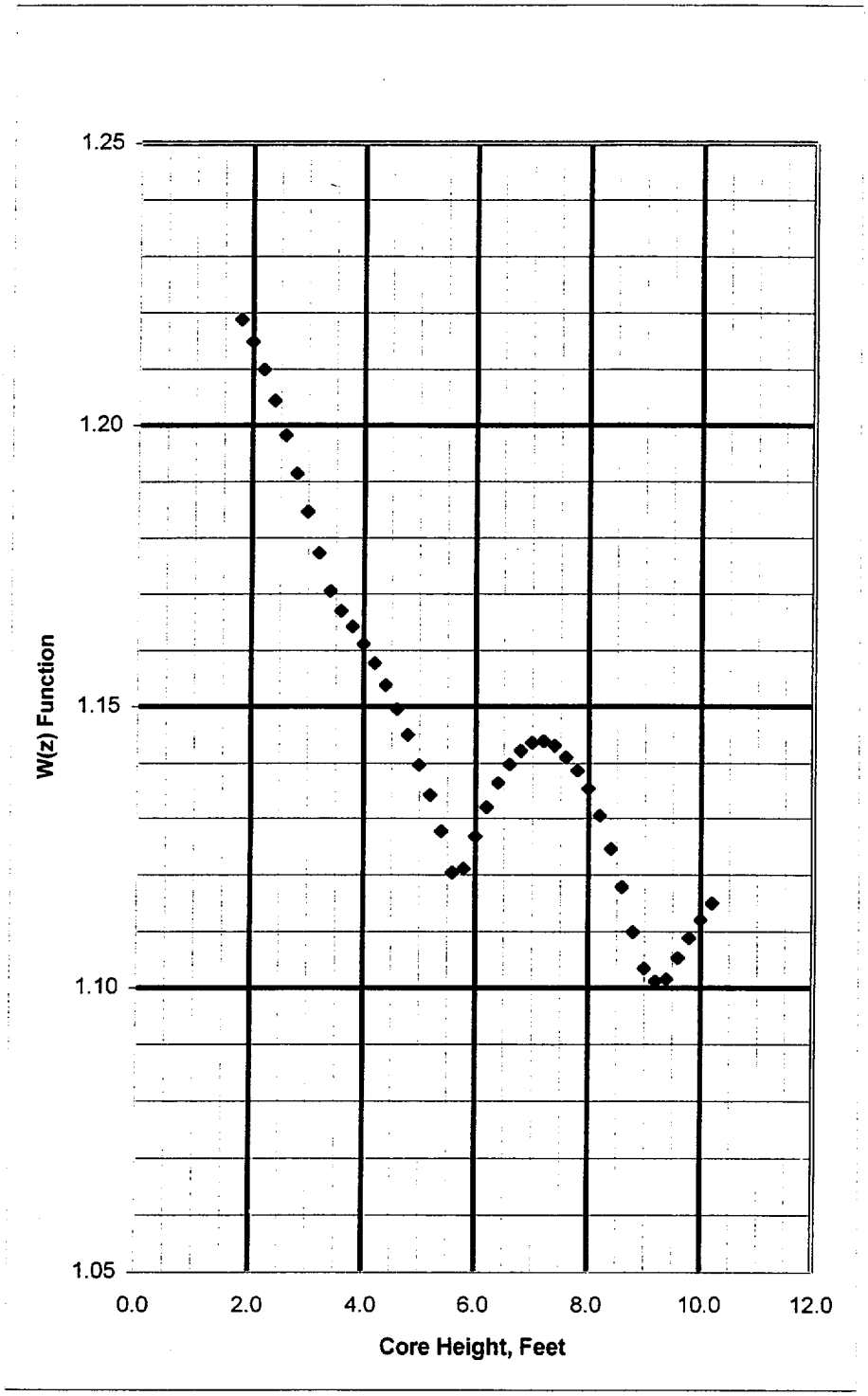
CORE OPERATING LIMITS REPORT (COLR) for BYRON UNIT 2 CYCLE 9

| Height Feet | Max W(z) |
|---|---|
| 0.0 | 1.0000 |
| 0.2 | 1.0000 |
| 0.4 | 1.0000 |
| 0.6 | 1.0000 |
| 0.8 | 1.0000 |
| 1.0 | 1.0000 |
| 1.2 | 1.0000 |
| 1.4 | 1.0000 |
| 1.6 | 1.0000 |
| 1.8 | 1.2188 |
| 2.0 | 1.2148 |
| 2.2 | 1.2099 |
| 2.4 | 1.2044 |
| 2.6 | 1.1982 |
| 2.8 | 1.1914 |
| 3.0 | 1.1846 |
| 3.2 | 1.1773 |
| 3.4 | 1.1705 |
| 3.6 | 1.1670 |
| 3.8 | 1.1642 |
| 4.0 | 1.1611 |
| 4.2 | 1.1577 |
| 4.4 | 1.1538 |
| 4.6 | 1.1495 |
| 4.8 | 1.1449 |
| 5.0 | 1.1396 |
| 5.2 | 1.1341 |
| 5.4 | 1.1276 |
| 5.6 | 1.1203 |
| 5.8 | 1.1210 |
| 6.0 | 1.1267 |
| 6.2 | 1.1319 |
| 6.4 | 1.1363 |
| 6.6 | 1.1397 |
| 6.8 | 1.1421 |
| 7.0 | 1.1435 |
| 7.2 | 1.1438 |
| 7.4 | 1.1430 |
| 7.6 | 1.1410 |
| 7.8 | 1.1386 |
| 8.0 | 1.1352 |
| 8.2 | 1.1304 |
| 8.4 | 1.1245 |
| 8.6 | 1.1178 |
| 8.8 | 1.1099 |
| 9.0 | 1.1034 |
| 9.2 | 1.1011 |
| 9.4 | 1.1015 |
| 9.6 | 1.1053 |
| 9.8 | 1.1088 |
| 10.0 | 1.1120 |
| 10.2 | 1.1149 |
| 10.4 | 1.0000 |
| 10.6 | 1.0000 |
| 10.8 | 1.0000 |
| 11.0 | 1.0000 |
| 11.2 | 1.0000 |
| 11.4 | 1.0000 |
| 11.6 | 1.0000 |
| 11.8 | 1.0000 |
| 12.0 | 1.0000 |

Byron Unit 2 Cycle 9

Figure 2.6.2.c

Summary of W(z) Function at 18800 MWD/MTU
(Top and Bottom 15% Excluded per WCAP-10216)



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

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.

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

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

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

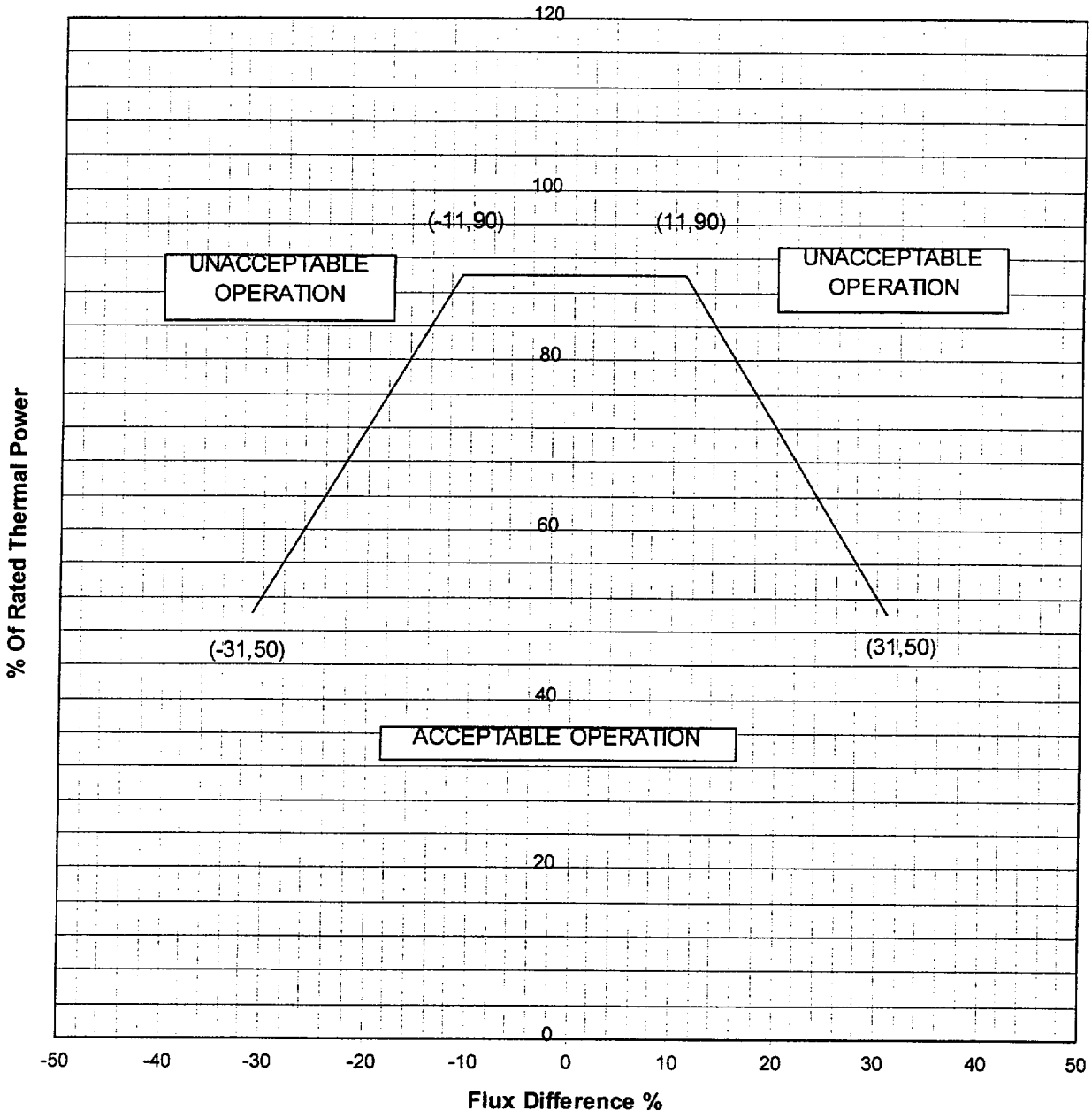
where: P = the ratio of THERMAL POWER to RATED THERMAL POWER
$F^{RTP}_{\Delta H} = 1.70$
$PF_{\Delta H} = 0.3$

2.8 Axial Flux Difference (AFD) (LCO 3.2.3)

2.8.1 The AXIAL FLUX DIFFERENCE (AFD) target band is +3, -12% of the target flux difference.

2.8.2 The AFD Acceptable Operation Limits are provided in Figure 2.8.1.

## FIGURE 2.8.1: Axial Flux Difference Limits As A Function of Rated Thermal Power



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

2.9 Reactor Trip System Overtemperature $\Delta T$ Setpoint Parameter Values (LCO 3.3.1)

2.9.1 The Overtemperature $\Delta T$ reactor trip setpoint $K_1$ shall be equal to 1.325.

2.9.2 The Overtemperature $\Delta T$ reactor trip setpoint $T_{avg}$ coefficient $K_2$ shall be equal to 0.0297 / °F.

2.9.3 The Overtemperature $\Delta T$ reactor trip setpoint pressure coefficient $K_3$ shall be equal to 0.00181 / psig.

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

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

2.9.6 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_1$ shall be equal to 8 sec.

2.9.7 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_2$ shall be equal to 3 sec.

2.9.8 The measured reactor vessel $\Delta T$ lag time constant $\tau_3$ shall be less than or equal to 2 sec.

2.9.9 The measured reactor vessel average temperature lead/lag time constant $\tau_4$ shall be equal to 33 sec.

2.9.10 The measured reactor vessel average temperature lead/lag time constant $\tau_5$ shall be equal to 4 sec.

2.9.11 The measured reactor vessel average temperature lag time constant $\tau_6$ shall be less than or equal to 2 sec.

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

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

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

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

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

2.10 Reactor Trip System Overpower $\Delta T$ Setpoint Parameter Values (LCO 3.3.1)

2.10.1 The Overpower $\Delta T$ reactor trip setpoint $K_4$ shall be equal to 1.072.

2.10.2 The Overpower $\Delta T$ reactor trip setpoint $T_{avg}$ rate/lag coefficient $K_5$ shall be equal to 0.02 / °F for increasing $T_{avg}$.

2.10.3 The Overpower $\Delta T$ reactor trip setpoint $T_{avg}$ rate/lag coefficient $K_5$ shall be equal to 0 / °F for decreasing $T_{avg}$.

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

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

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

2.10.7 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_1$ shall be equal to 8 sec.

2.10.8 The measured reactor vessel $\Delta T$ lead/lag time constant $\tau_2$ shall be equal to 3 sec.

2.10.9 The measured reactor vessel $\Delta T$ lag time constant $\tau_3$ shall be less than or equal to 2 sec.

2.10.10 The measured reactor vessel average temperature lag time constant $\tau_6$ shall be less than or equal to 2 sec.

2.10.11 The measured reactor vessel average temperature rate/lag time constant $\tau_7$ shall be equal to 10 sec.

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

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

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

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

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

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

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

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

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

2.12 Boron Concentration

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

2.12.2 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)