



**Pacific Gas and  
Electric Company**

**James R. Becker**  
Vice President-Diablo Canyon  
Operations and Station Director

Diablo Canyon Power Plant  
P.O. Box 56  
Avila Beach, CA 93424

805.545.3462  
Fax: 805.545.4234

December 2, 2005

PG&E Letter DCL-05-141

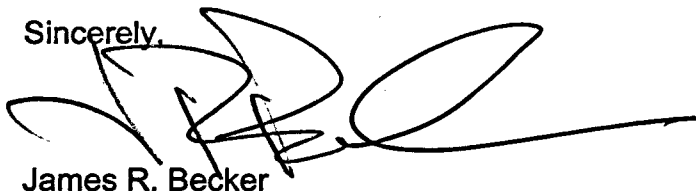
U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Docket No. 50-275, OL-DPR-80  
Diablo Canyon Unit 1  
Core Operating Limits Report Unit 1, Cycle 14

Dear Commissioners and Staff:

In accordance with Diablo Canyon Power Plant Technical Specification 5.6.5.d,  
enclosed is the Core Operating Limits Report for Unit 1, Cycle 14.

Sincerely,



James R. Becker

ddm/2254/A0606639

Enclosure

cc/enc: Edgar Bailey, DHS  
Terry W. Jackson, NRC Senior Resident Inspector  
Bruce S. Mallett, NRC Region IV  
Alan B. Wang, NRR Project Manager  
cc: Diablo Distribution

A 001

Enclosure  
PG&E Letter DCL-05-141

**CORE OPERATING LIMITS REPORT (COLR)  
DIABLO CANYON POWER PLANT  
UNIT 1, CYCLE 14, REVISION 0 (12 Pages)  
EFFECTIVE DATE NOVEMBER 16, 2005**

TITLE: COLR For Diablo Canyon Unit 1 Cycle 14

1

11/16/05

EFFECTIVE DATE

---

PROCEDURE CLASSIFICATION: QUALITY RELATED

1. CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Diablo Canyon Unit 1 Cycle 14 has been prepared in accordance with the requirements of Technical Specification (TS) 5.6.5.

The Technical Specifications affected by this report are listed below:

- 3.1.1 - Shutdown Margin (MODE 2 with  $k_{\text{eff}} < 1.0$ , MODES 3, 4, and 5)
- 3.1.3 - Moderator Temperature Coefficient
- 3.1.4 - Rod Group Alignment Limits
- 3.1.5 - Shutdown Bank Insertion Limits
- 3.1.6 - Control Bank Insertion Limits
- 3.2.1 - Heat Flux Hot Channel Factor -  $F_Q(Z)$
- 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor -  $F_{\Delta H}^N$
- 3.2.3 - Axial Flux Difference - (AFD)
- 3.9.1 - Boron Concentration

2. OPERATING LIMITS

The cycle-specific parameter limits for the TS listed in Section 1. are presented in the following subsections. These limits have been developed using the NRC-approved methodologies specified in TS 5.6.5.

2.1 Shutdown Margin (SDM) (TS 3.1.1)

The SDM limit for MODE 2 with  $k_{\text{eff}} < 1.0$ , MODES 3 and 4 is:

- 2.1.1 The shutdown margin with Safety Injection enabled shall be greater than or equal to 1.6%  $\Delta k/k$ .
- 2.1.2 In Modes 3 or 4 the shutdown margin with Safety Injection blocked shall be greater than or equal to 1.6%  $\Delta k/k$  calculated at a temperature of 200°F.

The SDM limit for MODE 5 is:

- 2.1.3 The shutdown margin shall be greater than or equal to 1.0%  $\Delta k/k$ . However, an administrative value of 1.6 %  $\Delta k/k$  will be used to address concerns of NSAL-02-014.

2.2 Shutdown Margin (SDM) (TS 3.1.4, 3.1.5, 3.1.6)

The SDM for MODE 1 and MODE 2 with  $k_{\text{eff}} \geq 1.0$  is:

- 2.2.1 The shutdown margin shall be greater than or equal to 1.6%  $\Delta k/k$ .

TITLE: COLR For Diablo Canyon Unit 1 Cycle 14

2.3 Moderator Temperature Coefficient (MTC) (TS 3.1.3)

The MTC limit for MODES 1, 2, and 3 is:

- 2.3.1 The MTC shall be less negative than  $-3.9 \times 10^{-4} \Delta k/k/^{\circ}F$  for all rods withdrawn, end of cycle life (EOL), RATED THERMAL POWER condition.
- 2.3.2 The MTC 300 ppm surveillance limit is  $-3.0 \times 10^{-4} \Delta k/k/^{\circ}F$  (all rods withdrawn, RATED THERMAL POWER condition).
- 2.3.3 The MTC 60 ppm surveillance limit is  $-3.72 \times 10^{-4} \Delta k/k/^{\circ}F$  (all rods withdrawn, RATED THERMAL POWER condition).

2.4 Shutdown Bank Insertion Limits (TS 3.1.5)

- 2.4.1 Each shutdown bank shall be withdrawn to at least 225 steps.

2.5 Control Bank Insertion Limits (TS 3.1.6)

- 2.5.1 The control banks shall be limited in physical insertion as shown in Figure 1.

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

2.6.1 
$$F_Q(Z) < \frac{F_Q^{RTP}}{P} * K(Z) \quad \text{for } P > 0.5$$

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

where: 
$$P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

$$F_Q^{RTP} = 2.58$$

$$K(Z) = 1.0$$

- 2.6.2 The  $W(Z)$  data for Relaxed Axial Offset Control (RAOC) operation, provided in Tables 2A and 2B are sufficient to determine the RAOC  $W(Z)$  versus core height for Cycle 14 burnups through the end of full power reactivity plus a power coast down of up to 1000 MWD/MTU.

Table 1 shows  $F_Q$  margin decreases that are greater than 2% per 31 Effective Full Power Days (EFPD). These values shall be used to increase  $F_Q^W(Z)$  per SR 3.2.1.2. A 2% penalty factor shall be used at all cycle burnups that are outside the range of Table 1.

**NOTE:** The  $W(Z)$  data is appropriate for use only if the predicted axial offset is within  $\pm 3\%$  of the measured value.

TITLE: COLR For Diablo Canyon Unit 1 Cycle 14

2.6.3  $F_Q(Z)$  shall be evaluated to determine if it is within its limits by verifying that  $F_Q^C(Z)$  and  $F_Q^W(Z)$  satisfy the following:

- Using the moveable incore detectors to obtain a power distribution map in MODE 1.
- Increasing the measured  $F_Q(Z)$  component of the power distribution map by 3% to account for manufacturing tolerances and further increasing the value by 5% to account for measurement uncertainties.
- Satisfying the following relationship:

$$F_Q^C(Z) < \frac{F_Q^{RTP} * K(Z)}{P} \quad \text{for } P > 0.5$$

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

$$F_Q^W(Z) < \frac{F_Q^{RTP}}{p} * K(Z) \quad \text{for } P > 0.5$$

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

where:

$F_Q^C(Z)$  is the measured  $F_Q(Z)$  increased by the allowances for manufacturing tolerances and measurement uncertainty.

$F_Q^{RTP}$  is the  $F_Q$  limit

$K(Z)$  is the normalized  $F_Q(Z)$  as a function of core height

$P$  is the relative THERMAL POWER, and

$W(z)$  is the cycle dependent function that accounts for power distribution transients encountered during normal operation.

$F_Q^{RTP}$  and  $K(Z)$  are specified in 2.6.1 and  $W(Z)$  is specified in 2.6.2.

$F_Q^W(Z)$  is the total peaking factor,  $F_Q^C(Z)$ , multiplied by  $W(Z)$  which gives the maximum  $F_Q(Z)$  calculated to occur in normal operation.

TITLE: COLR For Diablo Canyon Unit 1 Cycle 14

2.7 Nuclear Enthalpy Rise Hot Channel Factor -  $F_{\Delta H}^N$  (TS 3.2.2)

$$F_{\Delta H}^N \leq F_{\Delta H}^{RTP} * [1 + PF_{\Delta H} * (1-P)]$$

where:

$$P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

$F_{\Delta H}^N$  = Measured values of  $F_{\Delta H}^N$  obtained by using the moveable incore detectors to obtain a power distribution map.

$F_{\Delta H}^{RTP}$  = 1.59 (includes the 4% measurement uncertainty)

$PF_{\Delta H}$  = 0.3

2.8 Power Distribution Measurement Uncertainty (TS 3.2.1. and TS 3.2.2):

If the Power Distribution Monitoring System (PDMS) is OPERABLE, the uncertainty,  $U_{FAH}$ , to be applied to the Nuclear Enthalpy Rise Hot Channel Factor  $F_{\Delta H}^N$  shall be calculated by the following formula:

$$U_{FAH} = 1.0 + \frac{U_{\Delta H}}{100.0}$$

where:  $U_{\Delta H}$  = Uncertainty for enthalpy rise as defined in equation (5-19) in Reference 6.2 and  $F_{\Delta H}^{RTP}$  = 1.65 for PDMS (in the above Section 2.7 equation).

If the PDMS is OPERABLE, the uncertainty,  $U_{FQ}$ , to be applied to the Heat Flux Hot Channel Factor  $F_Q(z)$  shall be calculated by the following formula:

$$U_{FQ} = \left( 1.0 + \frac{U_Q}{100.0} \right) * U_e$$

where:  $U_Q$  = Uncertainty for power peaking factor as defined in equation (5-19) in Reference 6.2.

$U_e$  = Engineering uncertainty factor  
= 1.03

If the PDMS is inoperable, the Nuclear Enthalpy Rise Hot Channel Factor  $F_{\Delta H}^N$  shall be calculated as specified in Section 2.7.

If the PDMS is inoperable, the Heat Flux Hot Channel Factor  $F_Q(Z)$  shall be calculated as specified in Section 2.6.

**TITLE: COLR For Diablo Canyon Unit 1 Cycle 14**

---

2.9 Axial Flux Difference (TS 3.2.3)

2.9.1 The Axial Flux Difference (AFD) Limits are provided in Figure 2.

2.10 Boron Concentration (TS 3.9.1)

The refueling boron concentration of the Reactor Coolant System, the refueling canal, and the refueling cavity shall be maintained within the more restrictive of the following limits:

2.10.1 A  $k_{\text{eff}}$  of 0.95 or less, with the most reactive control rod assembly completely withdrawn, or

2.10.2 A boron concentration of greater than or equal to 2000 ppm.

3. TABLES

3.1 Table 1, "F<sub>Q</sub> Margin Decreases in Excess of 2% Per 31 EFPD."

3.2 Table 2A, "Load Follow W(Z) Factors at 150 and 4,000 MWD/MTU as a Function of Core Height."

3.3 Table 2B, "Load Follow W(Z) Factors at 10,000 and 17,800 MWD/MTU as a Function of Core Height."

4. FIGURES

4.1 Figure 1, "Control Bank Insertion Limits Versus Rated Thermal Power."

4.2 Figure 2, "AFD Limits as a Function of Rated Thermal Power."

5. RECORDS

None

6. REFERENCES

6.1 PCT-05-52, "Diablo Canyon Unit 1 Cycle 14 Final Reload Evaluation," July 25, 2005.

6.2 WCAP-12473-A (Non-Proprietary), "BEACON Core Monitoring and Operations Support System," August, 1994.

**PACIFIC GAS AND ELECTRIC COMPANY  
DIABLO CANYON POWER PLANT**

**NUMBER COLR 1-14  
REVISION 0  
PAGE 6 OF 12  
UNIT 1**

**TITLE: COLR For Diablo Canyon Unit 1 Cycle 14**

---

**TABLE 1: F<sub>Q</sub> Margin Decreases in Excess of 2% Per 31 EFPD**

Cycle Burnup (MWD/MTU)	Max. % Decrease in F <sub>Q</sub> Margin
476	2.00
638	2.06
801	2.35
964	2.59
1127	2.80
1289	2.97
1452	3.09
1615	3.17
1778	3.16
1940	3.09
2103	2.97
2266	2.80
2429	2.58
2591	2.33
2754	2.06
2917	2.00

**NOTE:** All cycle burnups outside the range of this table shall use a 2% decrease in F<sub>Q</sub> margin for compliance with SR 3.2.1.2. Linear interpolation is adequate for intermediate cycle burnups.

**PACIFIC GAS AND ELECTRIC COMPANY  
DIABLO CANYON POWER PLANT**

**NUMBER COLR 1-14  
REVISION 0  
PAGE 7 OF 12  
UNIT 1**

**TITLE: COLR For Diablo Canyon Unit 1 Cycle 14**

**TABLE 2A: Load Follow W(Z) Factors at 150 and 4000 MWD/MTU as a Function of Core Height**

<b>HEIGHT (FEET)</b>	<b>150 MWD/MTU W(Z)</b>	<b>HEIGHT (FEET)</b>	<b>4000 MWD/MTU W(Z)</b>
*0.0000	1.0000	*0.0000	1.0000
*0.2000	1.0000	*0.2000	1.0000
*0.4000	1.0000	*0.4000	1.0000
*0.6000	1.0000	*0.6000	1.0000
*0.8000	1.0000	*0.8000	1.0000
*1.0000	1.0000	*1.0000	1.0000
*1.2000	1.0000	*1.2000	1.0000
*1.4000	1.0000	*1.4000	1.0000
*1.6000	1.0000	*1.6000	1.0000
*1.8000	1.0000	*1.8000	1.0000
2.0000	1.2902	2.0000	1.3067
2.2000	1.2681	2.2000	1.2813
2.4000	1.2458	2.4000	1.2568
2.6000	1.2235	2.6000	1.2371
2.8000	1.1993	2.8000	1.2176
3.0000	1.1835	3.0000	1.1978
3.2000	1.1757	3.2000	1.1836
3.4000	1.1695	3.4000	1.1774
3.6000	1.1696	3.6000	1.1709
3.8000	1.1694	3.8000	1.1693
4.0000	1.1681	4.0000	1.1685
4.2000	1.1662	4.2000	1.1662
4.4000	1.1633	4.4000	1.1632
4.6000	1.1596	4.6000	1.1594
4.8000	1.1550	4.8000	1.1547
5.0000	1.1503	5.0000	1.1492
5.2000	1.1435	5.2000	1.1432
5.4000	1.1377	5.4000	1.1363
5.6000	1.1477	5.6000	1.1295
5.8000	1.1627	5.8000	1.1345

**\* Top and Bottom 15% Excluded**

**PACIFIC GAS AND ELECTRIC COMPANY  
DIABLO CANYON POWER PLANT**

**NUMBER COLR 1-14  
REVISION 0  
PAGE 8 OF 12  
UNIT 1**

**TITLE: COLR For Diablo Canyon Unit 1 Cycle 14**

**TABLE 2A: Load Follow W(Z) Factors at 150 and 4000 MWD/MTU as a Function of  
Core Height (Continued)**

<b>HEIGHT (FEET)</b>	<b>150 MWD/MTU W(Z)</b>	<b>HEIGHT (FEET)</b>	<b>4000 MWD/MTU W(Z)</b>
6.0000	1.1764	6.0000	1.1482
6.2000	1.1893	6.2000	1.1627
6.4000	1.2010	6.4000	1.1765
6.6000	1.2114	6.6000	1.1891
6.8000	1.2203	6.8000	1.2005
7.0000	1.2274	7.0000	1.2102
7.2000	1.2329	7.2000	1.2183
7.4000	1.2366	7.4000	1.2250
7.6000	1.2380	7.6000	1.2295
7.8000	1.2369	7.8000	1.2316
8.0000	1.2331	8.0000	1.2312
8.2000	1.2263	8.2000	1.2281
8.4000	1.2165	8.4000	1.2221
8.6000	1.2056	8.6000	1.2119
8.8000	1.2011	8.8000	1.2091
9.0000	1.2019	9.0000	1.2141
9.2000	1.2088	9.2000	1.2333
9.4000	1.2122	9.4000	1.2554
9.6000	1.2202	9.6000	1.2773
9.8000	1.2403	9.8000	1.2981
10.0000	1.2660	10.0000	1.3165
*10.2000	1.0000	*10.2000	1.0000
*10.4000	1.0000	*10.4000	1.0000
*10.6000	1.0000	*10.6000	1.0000
*10.8000	1.0000	*10.8000	1.0000
*11.0000	1.0000	*11.0000	1.0000
*11.2000	1.0000	*11.2000	1.0000
*11.4000	1.0000	*11.4000	1.0000
*11.6000	1.0000	*11.6000	1.0000
*11.8000	1.0000	*11.8000	1.0000
*12.0000	1.0000	*12.0000	1.0000

**\* Top and Bottom 15% Excluded**

**PACIFIC GAS AND ELECTRIC COMPANY  
DIABLO CANYON POWER PLANT**

**NUMBER COLR 1-14  
REVISION 0  
PAGE 9 OF 12  
UNIT 1**

**TITLE: COLR For Diablo Canyon Unit 1 Cycle 14**

**TABLE 2B: Load Follow W(Z) Factors at 10000 and 17800 MWD/MTU as a Function of Core Height**

<b>HEIGHT (FEET)</b>	<b>10000 MWD/MTU W(Z)</b>	<b>HEIGHT (FEET)</b>	<b>17800 MWD/MTU W(Z)</b>
*0.0000	1.0000	*0.0000	1.0000
*0.2000	1.0000	*0.2000	1.0000
*0.4000	1.0000	*0.4000	1.0000
*0.6000	1.0000	*0.6000	1.0000
*0.8000	1.0000	*0.8000	1.0000
*1.0000	1.0000	*1.0000	1.0000
*1.2000	1.0000	*1.2000	1.0000
*1.4000	1.0000	*1.4000	1.0000
*1.6000	1.0000	*1.6000	1.0000
*1.8000	1.0000	*1.8000	1.0000
2.0000	1.2490	2.0000	1.2311
2.2000	1.2336	2.2000	1.2163
2.4000	1.2180	2.4000	1.2013
2.6000	1.2021	2.6000	1.1861
2.8000	1.1850	2.8000	1.1698
3.0000	1.1726	3.0000	1.1563
3.2000	1.1678	3.2000	1.1544
3.4000	1.1666	3.4000	1.1672
3.6000	1.1661	3.6000	1.1828
3.8000	1.1672	3.8000	1.1974
4.0000	1.1685	4.0000	1.2105
4.2000	1.1682	4.2000	1.2219
4.4000	1.1670	4.4000	1.2315
4.6000	1.1668	4.6000	1.2389
4.8000	1.1669	4.8000	1.2447
5.0000	1.1673	5.0000	1.2470
5.2000	1.1658	5.2000	1.2508
5.4000	1.1651	5.4000	1.2654
5.6000	1.1832	5.6000	1.2884
5.8000	1.2032	5.8000	1.3102

\* Top and Bottom 15% Excluded

**PACIFIC GAS AND ELECTRIC COMPANY  
DIABLO CANYON POWER PLANT**

**NUMBER COLR 1-14  
REVISION 0  
PAGE 10 OF 12  
UNIT 1**

**TITLE: COLR For Diablo Canyon Unit 1 Cycle 14**

**TABLE 2B: Load Follow W(Z) Factors at 10000 and 17800 MWD/MTU as a Function of  
Core Height (Continued)**

<b>HEIGHT (FEET)</b>	<b>10000 MWD/MTU W(Z)</b>	<b>HEIGHT (FEET)</b>	<b>17800 MWD/MTU W(Z)</b>
6.0000	1.2197	6.0000	1.3284
6.2000	1.2354	6.2000	1.3443
6.4000	1.2491	6.4000	1.3571
6.6000	1.2608	6.6000	1.3669
6.8000	1.2703	6.8000	1.3734
7.0000	1.2777	7.0000	1.3767
7.2000	1.2827	7.2000	1.3768
7.4000	1.2854	7.4000	1.3733
7.6000	1.2851	7.6000	1.3658
7.8000	1.2818	7.8000	1.3543
8.0000	1.2753	8.0000	1.3387
8.2000	1.2656	8.2000	1.3192
8.4000	1.2527	8.4000	1.2958
8.6000	1.2352	8.6000	1.2674
8.8000	1.2232	8.8000	1.2433
9.0000	1.2226	9.0000	1.2281
9.2000	1.2301	9.2000	1.2271
9.4000	1.2424	9.4000	1.2477
9.6000	1.2663	9.6000	1.2734
9.8000	1.2919	9.8000	1.2981
10.0000	1.3140	10.0000	1.3215
*10.2000	1.0000	*10.2000	1.0000
*10.4000	1.0000	*10.4000	1.0000
*10.6000	1.0000	*10.6000	1.0000
*10.8000	1.0000	*10.8000	1.0000
*11.0000	1.0000	*11.0000	1.0000
*11.2000	1.0000	*11.2000	1.0000
*11.4000	1.0000	*11.4000	1.0000
*11.6000	1.0000	*11.6000	1.0000
*11.8000	1.0000	*11.8000	1.0000
*12.0000	1.0000	*12.0000	1.0000

**\* Top and Bottom 15% Excluded**

TITLE: COLR For Diablo Canyon Unit 1 Cycle 14

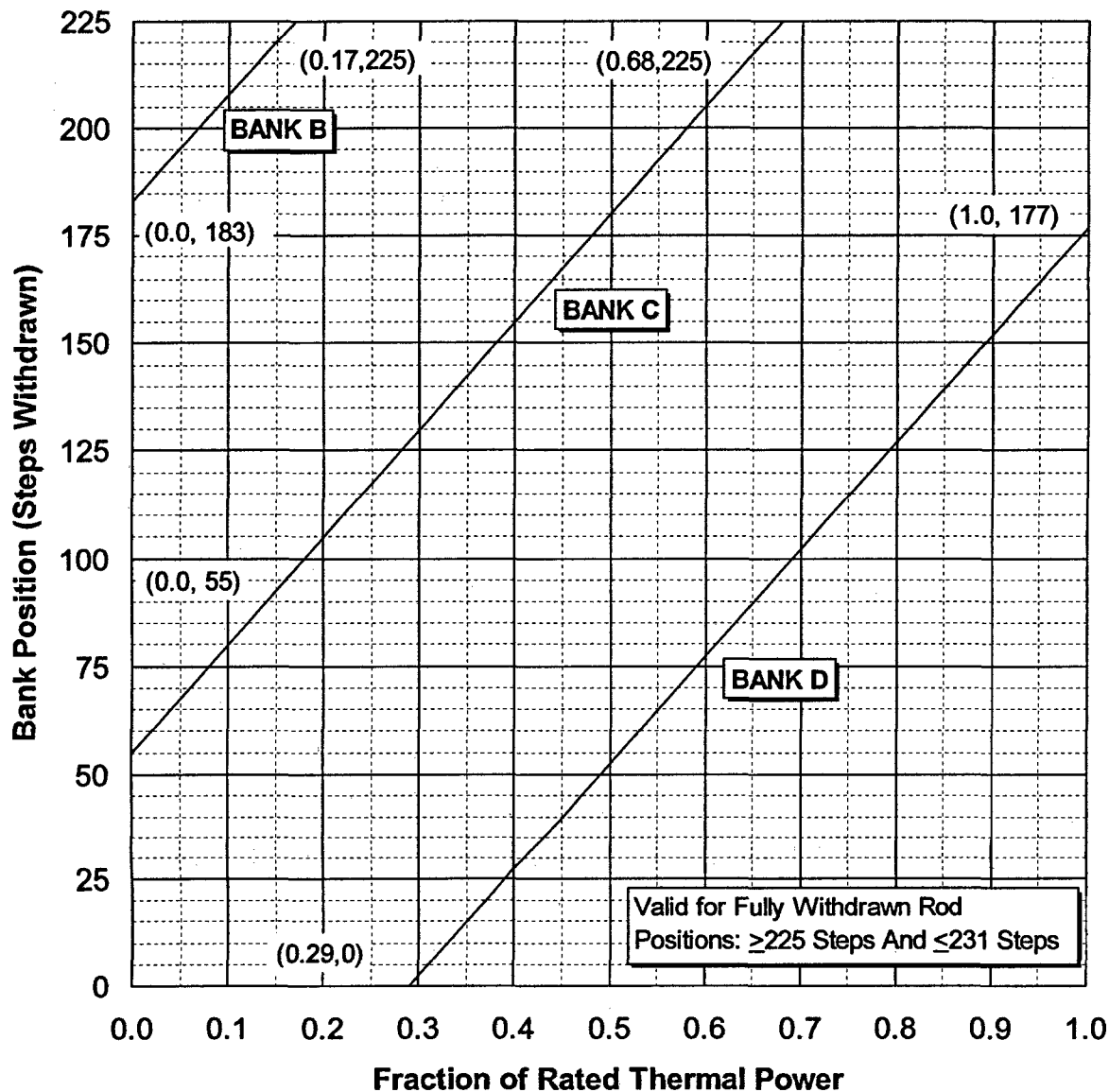


FIGURE 1: Control Bank Insertion Limits Versus Rated Thermal Power

TITLE: COLR For Diablo Canyon Unit 1 Cycle 14

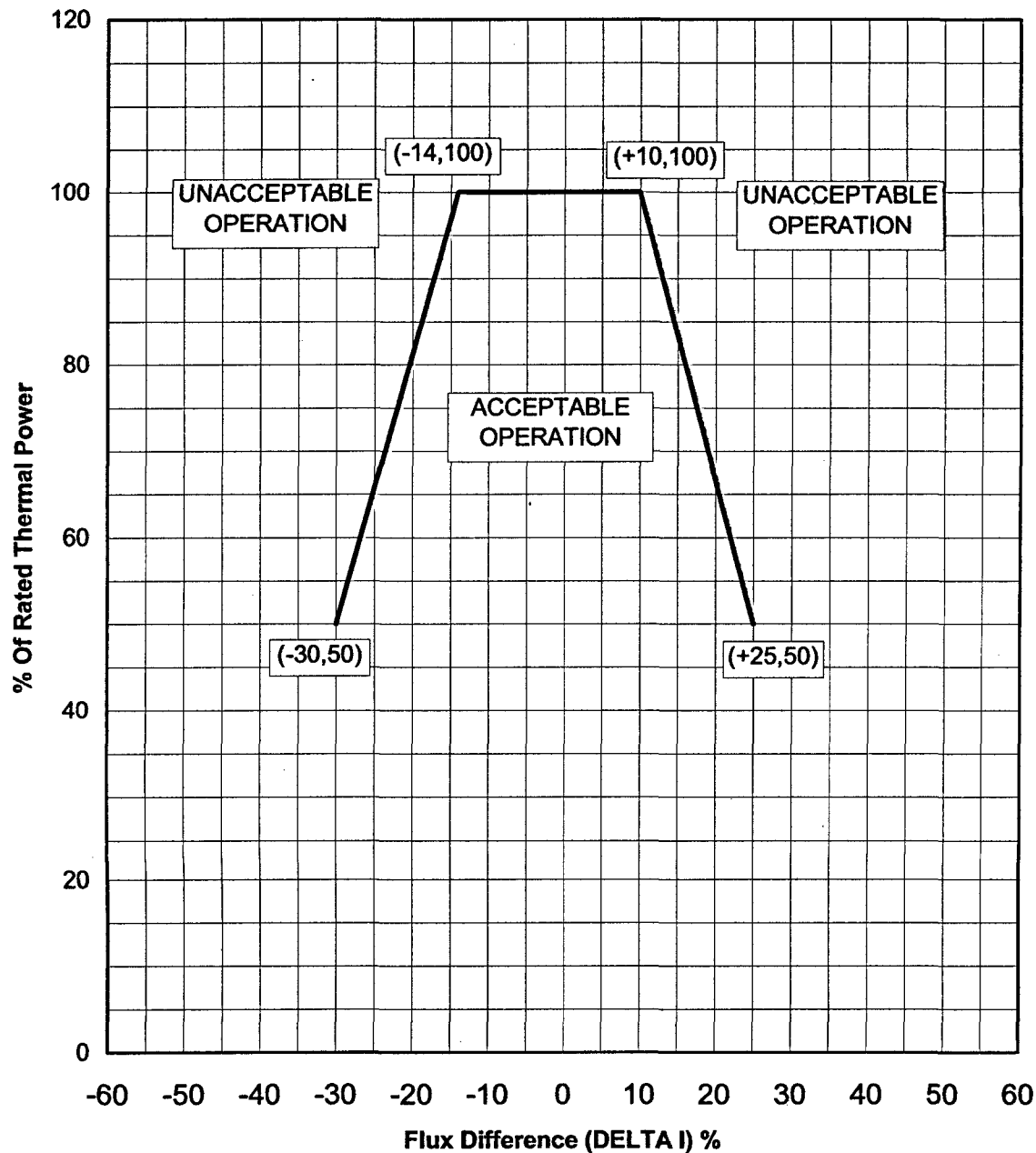


FIGURE 2: AFD Limits as a Function of Rated Thermal Power