



**Pacific Gas and
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September 14, 2007

PG&E Letter DCL-07-090

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

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Core Operating Limits Report for Units 1 and 2

Dear Commissioners and Staff:

In accordance with Diablo Canyon Power Plant Technical Specification 5.6.5.d, enclosed are the Core Operating Limits Report (COLR) for Units 1 and 2. The COLR has been revised consistent with the NRC approved License Amendment Numbers 195 and 196 for Units 1 and 2, respectively.

There are no new or revised regulatory commitments in this report.

If there are any questions regarding the COLR, please contact Mr. Steve Hamilton at (805) 545-3449.

Sincerely,

James R. Becker

ddm/2254/A0686045

Enclosures

cc: Diablo Distribution
cc/enc: Michael A. Brown, NRC Resident Inspector
Elmo E. Collins, NRC Region IV
Alan B. Wang, NRR Project Manager

A001

NRR

**CORE OPERATING LIMITS REPORT (COLR)
DIABLO CANYON POWER PLANT UNIT 1
EFFECTIVE DATE AUGUST 15, 2007**

TITLE: COLR for Diablo Canyon Unit 1 Cycle 15

1

8/15/07
EFFECTIVE DATE

PROCEDURE CLASSIFICATION: QUALITY RELATED

1. CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Diablo Canyon Unit 1 Cycle 15 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)
- 3.4.1 - RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits.
- 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.

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

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

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

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)

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

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

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

$$F_Q^{RTP} = 2.58$$

$$K(Z) = 1.0$$

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

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 15 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.

TITLE: COLR for Diablo Canyon Unit 1 Cycle 15

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

$F_Q^W(Z)$ 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.

$W(z)$ 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.

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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 = Power Factor Multiplier

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

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

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.

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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_{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.

2.11 RCS Pressure and Temperature Departure from Nucleate Boiling (DNB) Limits

2.11.1 Pressurizer pressure is greater than or equal to 2175 psig.

2.11.2 RCS average temperature is less than or equal to 581.7°F.

NOTE: The DNBR RCS Tavg limit is based on the slightly lower and bounding value associated with Unit 1 in order to have the same surveillance limits for both Unit 1 and Unit 2.

3. TABLES

3.1 Table 1, "F_Q Margin Decreases in Excess of 2% Per 31 EFPD."

3.2 Table 2A, "Load Follow W(Z) Factors at 150 and 5,000 MWD/MTU as a Function of Core Height."

3.3 Table 2B, "Load Follow W(Z) Factors at 12,000 and 22,000 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 "Diablo Canyon Unit 1 Cycle 15 Final Reload Evaluation, Revision 1," May, 2007.

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

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TABLE 1: F_Q Margin Decreases in Excess of 2% Per 31 EFPD

Cycle Burnup (MWD/MTU)	Max. % Decrease in F _Q Margin
0	2.05
150	2.05
313	2.32
475	2.56
638	2.76
801	2.88
963	2.93
1126	2.88
1289	2.75
1451	2.54
1614	2.26
1777	2.00

NOTE: All cycle burnups outside the range of this table shall use a 2% decrease in F_Q margin for compliance with SR 3.2.1.2. Linear interpolation is adequate for intermediate cycle burnups.

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TABLE 2A: Load Follow W(Z) Factors at 150 and 5000 MWD/MTU as a Function of Core Height

HEIGHT (FEET)	150 MWD/MTU W(Z)	HEIGHT (FEET)	5000 MWD/MTU W(Z)
*0.0000	1.4014	*0.0000	1.4209
*0.2000	1.3937	*0.2000	1.4182
*0.4000	1.3843	*0.4000	1.4120
*0.6000	1.3740	*0.6000	1.4037
*0.8000	1.3628	*0.8000	1.3930
1.0000	1.3496	1.0000	1.3797
1.2000	1.3340	1.2000	1.3637
1.4000	1.3168	1.4000	1.3456
1.6000	1.2986	1.6000	1.3259
1.8000	1.2795	1.8000	1.3048
2.0000	1.2597	2.0000	1.2829
2.2000	1.2396	2.2000	1.2602
2.4000	1.2190	2.4000	1.2373
2.6000	1.1983	2.6000	1.2145
2.8000	1.1827	2.8000	1.1908
3.0000	1.1747	3.0000	1.1739
3.2000	1.1713	3.2000	1.1643
3.4000	1.1672	3.4000	1.1582
3.6000	1.1620	3.6000	1.1587
3.8000	1.1592	3.8000	1.1587
4.0000	1.1582	4.0000	1.1575
4.2000	1.1571	4.2000	1.1558
4.4000	1.1551	4.4000	1.1533
4.6000	1.1524	4.6000	1.1499
4.8000	1.1489	4.8000	1.1459
5.0000	1.1451	5.0000	1.1410
5.2000	1.1396	5.2000	1.1357
5.4000	1.1347	5.4000	1.1296
5.6000	1.1412	5.6000	1.1219
5.8000	1.1530	5.8000	1.1228

* Top and Bottom 8% Excluded

TITLE: COLR for Diablo Canyon Unit 1 Cycle 15

TABLE 2A: Load Follow W(Z) Factors at 150 and 5000 MWD/MTU as a Function of Core Height (Continued)

HEIGHT (FEET)	150 MWD/MTU W(Z)	HEIGHT (FEET)	5000 MWD/MTU W(Z)
6.0000	1.1670	6.0000	1.1343
6.2000	1.1824	6.2000	1.1507
6.4000	1.1964	6.4000	1.1664
6.6000	1.2091	6.6000	1.1810
6.8000	1.2205	6.8000	1.1945
7.0000	1.2302	7.0000	1.2064
7.2000	1.2382	7.2000	1.2169
7.4000	1.2446	7.4000	1.2259
7.6000	1.2488	7.6000	1.2329
7.8000	1.2505	7.8000	1.2376
8.0000	1.2493	8.0000	1.2399
8.2000	1.2454	8.2000	1.2395
8.4000	1.2384	8.4000	1.2362
8.6000	1.2275	8.6000	1.2294
8.8000	1.2184	8.8000	1.2252
9.0000	1.2205	9.0000	1.2274
9.2000	1.2350	9.2000	1.2455
9.4000	1.2513	9.4000	1.2662
9.6000	1.2677	9.6000	1.2865
9.8000	1.2846	9.8000	1.3058
10.0000	1.3001	10.0000	1.3230
10.2000	1.3103	10.2000	1.3360
10.4000	1.3150	10.4000	1.3439
10.6000	1.3250	10.6000	1.3513
10.8000	1.3434	10.8000	1.3606
11.0000	1.3594	11.0000	1.3640
*11.2000	1.3649	*11.2000	1.3611
*11.4000	1.3685	*11.4000	1.3690
*11.6000	1.3611	*11.6000	1.3686
*11.8000	1.3412	*11.8000	1.3562
*12.0000	1.3243	*12.0000	1.3468

* Top and Bottom 8% Excluded

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TABLE 2B: Load Follow W(Z) Factors at 12000 and 22000 MWD/MTU as a Function of Core Height

HEIGHT (FEET)	12000 MWD/MTU W(Z)	HEIGHT (FEET)	22000 MWD/MTU W(Z)
*0.0000	1.3147	*0.0000	1.3623
*0.2000	1.3129	*0.2000	1.3513
*0.4000	1.3112	*0.4000	1.3404
*0.6000	1.3095	*0.6000	1.3303
*0.8000	1.3047	*0.8000	1.3214
1.0000	1.2972	1.0000	1.3104
1.2000	1.2877	1.2000	1.2970
1.4000	1.2771	1.4000	1.2828
1.6000	1.2658	1.6000	1.2683
1.8000	1.2538	1.8000	1.2535
2.0000	1.2413	2.0000	1.2383
2.2000	1.2284	2.2000	1.2229
2.4000	1.2151	2.4000	1.2071
2.6000	1.2018	2.6000	1.1911
2.8000	1.1869	2.8000	1.1740
3.0000	1.1799	3.0000	1.1599
3.2000	1.1789	3.2000	1.1591
3.4000	1.1761	3.4000	1.1738
3.6000	1.1770	3.6000	1.1882
3.8000	1.1785	3.8000	1.2013
4.0000	1.1796	4.0000	1.2130
4.2000	1.1797	4.2000	1.2229
4.4000	1.1789	4.4000	1.2308
4.6000	1.1771	4.6000	1.2367
4.8000	1.1742	4.8000	1.2412
5.0000	1.1708	5.0000	1.2432
5.2000	1.1651	5.2000	1.2482
5.4000	1.1614	5.4000	1.2716
5.6000	1.1751	5.6000	1.2930
5.8000	1.1907	5.8000	1.3114

* Top and Bottom 8% Excluded

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TITLE: COLR for Diablo Canyon Unit 1 Cycle 15

TABLE 2B: Load Follow W(Z) Factors at 12000 and 22000 MWD/MTU as a Function of
Core Height (Continued)

HEIGHT (FEET)	12000 MWD/MTU W(Z)	HEIGHT (FEET)	22000 MWD/MTU W(Z)
6.0000	1.2028	6.0000	1.3277
6.2000	1.2143	6.2000	1.3411
6.4000	1.2239	6.4000	1.3518
6.6000	1.2317	6.6000	1.3596
6.8000	1.2375	6.8000	1.3641
7.0000	1.2414	7.0000	1.3657
7.2000	1.2436	7.2000	1.3643
7.4000	1.2434	7.4000	1.3593
7.6000	1.2407	7.6000	1.3506
7.8000	1.2354	7.8000	1.3379
8.0000	1.2274	8.0000	1.3213
8.2000	1.2166	8.2000	1.3008
8.4000	1.2041	8.4000	1.2765
8.6000	1.1939	8.6000	1.2513
8.8000	1.1857	8.8000	1.2399
9.0000	1.1868	9.0000	1.2364
9.2000	1.2042	9.2000	1.2294
9.4000	1.2312	9.4000	1.2278
9.6000	1.2563	9.6000	1.2375
9.8000	1.2788	9.8000	1.2581
10.0000	1.3003	10.0000	1.2807
10.2000	1.3201	10.2000	1.3012
10.4000	1.3377	10.4000	1.3205
10.6000	1.3525	10.6000	1.3382
10.8000	1.3660	10.8000	1.3553
11.0000	1.3737	11.0000	1.3676
*11.2000	1.3729	*11.2000	1.3723
*11.4000	1.3699	*11.4000	1.3746
*11.6000	1.3559	*11.6000	1.3642
*11.8000	1.3296	*11.8000	1.3399
*12.0000	1.3062	*12.0000	1.3188

* Top and Bottom 8% Excluded

TITLE: COLR for Diablo Canyon Unit 1 Cycle 15

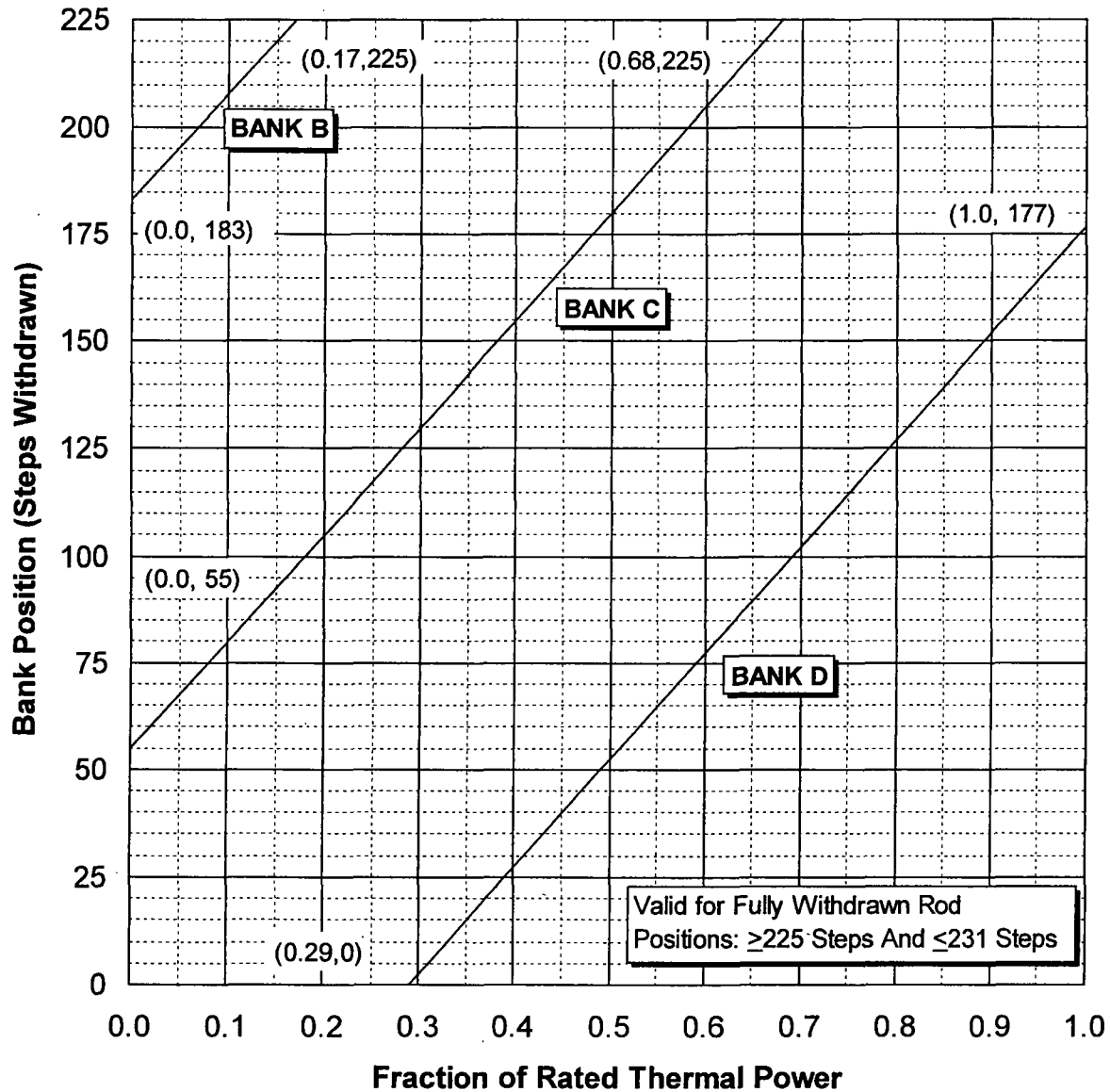


FIGURE 1: Control Bank Insertion Limits Versus Rated Thermal Power

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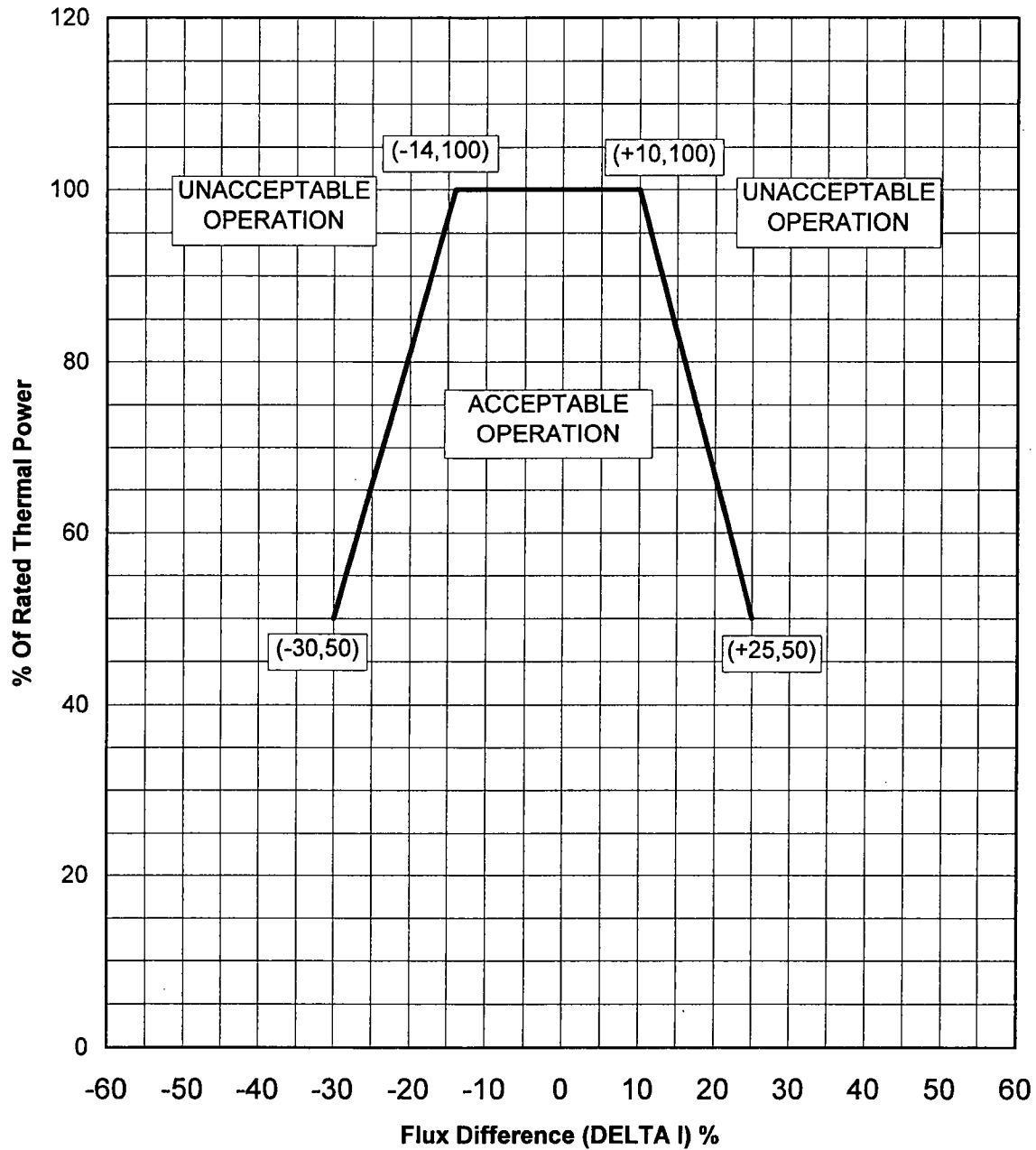


FIGURE 2: AFD Limits as a Function of Rated Thermal Power

**CORE OPERATING LIMITS REPORT (COLR)
DIABLO CANYON POWER PLANT UNIT 2
EFFECTIVE DATE AUGUST 15, 2007**

TITLE: COLR for Diablo Canyon Unit 2 Cycle 14

2

8/15/07

EFFECTIVE DATE

PROCEDURE CLASSIFICATION: QUALITY RELATED

1. CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Diablo Canyon Unit 2 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 $k_{eff} < 1.0$, 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)
- 3.4.1 - RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits
- 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 $k_{eff} < 1.0$, 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.

TITLE: COLR for Diablo Canyon Unit 2 Cycle 14

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

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

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

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)

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

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

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

$$F_Q^{RTP} = 2.58$$

$$K(Z) = 1.0$$

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

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.

TITLE: COLR for Diablo Canyon Unit 2 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:

- a. Using the moveable incore detectors to obtain a power distribution map in MODE 1.
- b. 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.
- c. 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

$F_Q^W(Z)$ 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.

$W(z)$ 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.

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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 = Power Factor Multiplier

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

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

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_{F_Q} , to be applied to the Heat Flux Hot Channel Factor, $F_Q(z)$, shall be calculated by the following formula:

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

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.

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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_{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.

2.11 RCS Pressure and Temperature Departure from Nucleate Boiling (DNB) Limits

2.11.1 Pressurizer pressure is greater than or equal to 2175 psig.

2.11.2 RCS average temperature is less than or equal to 581.7°F.

NOTE: The DNBR RCS Tavg limit is based on the slightly lower and bounding value associated with Unit 1 in order to have the same surveillance limits for both Unit 1 and Unit 2.

3. TABLES

3.1 Table 1, "F_Q Margin Decreases in Excess of 2% Per 31 EFPD."

3.2 Table 2A, "Load Follow W(Z) Factors at 150 and 5,000 MWD/MTU as a Function of Core Height."

3.3 Table 2B, "Load Follow W(Z) Factors at 12,000 and 22,000 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 NF-PGE-06-9, "Diablo Canyon Unit 2 Cycle 14 Final Reload Evaluation, Revision 1," March, 2006.

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

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TABLE 1: F_Q Margin Decreases in Excess of 2% Per 31 EFPD

Cycle Burnup (MWD/MTU)	Max. % Decrease in F _Q Margin
0	2.34
150	2.34
313	2.61
475	2.86
638	3.04
800	3.16
963	3.21
1126	3.18
1288	3.07
1451	2.89
1614	2.64
1776	2.32
1939	2.00

NOTE: All cycle burnups outside the range of this table shall use a 2% decrease in F_Q margin for compliance with SR 3.2.1.2. Linear interpolation is adequate for intermediate cycle burnups.

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TABLE 2A: Load Follow W(Z) Factors at 150 and 5000 MWD/MTU as a Function of Core Height

HEIGHT (FEET)	150 MWD/MTU W(Z)	HEIGHT (FEET)	5000 MWD/MTU W(Z)
* 0.0000	1.4943	* 0.0000	1.4635
* 0.2000	1.4891	* 0.2000	1.4591
* 0.4000	1.4809	* 0.4000	1.4512
* 0.6000	1.4708	* 0.6000	1.4412
* 0.8000	1.4588	* 0.8000	1.4291
1.0000	1.4444	1.0000	1.4142
1.2000	1.4277	1.2000	1.3965
1.4000	1.4092	1.4000	1.3766
1.6000	1.3894	1.6000	1.3548
1.8000	1.3685	1.8000	1.3316
2.0000	1.3466	2.0000	1.3073
2.2000	1.3239	2.2000	1.2822
2.4000	1.3006	2.4000	1.2567
2.6000	1.2768	2.6000	1.2310
2.8000	1.2528	2.8000	1.2057
3.0000	1.2286	3.0000	1.1851
3.2000	1.2107	3.2000	1.1718
3.4000	1.2047	3.4000	1.1646
3.6000	1.2036	3.6000	1.1623
3.8000	1.2018	3.8000	1.1612
4.0000	1.1988	4.0000	1.1595
4.2000	1.1948	4.2000	1.1570
4.4000	1.1897	4.4000	1.1537
4.6000	1.1837	4.6000	1.1496
4.8000	1.1768	4.8000	1.1448
5.0000	1.1693	5.0000	1.1391
5.2000	1.1603	5.2000	1.1332
5.4000	1.1514	5.4000	1.1264
5.6000	1.1527	5.6000	1.1171
5.8000	1.1611	5.8000	1.1237

* Top and Bottom 8% excluded.

TITLE: COLR for Diablo Canyon Unit 2 Cycle 14

TABLE 2A: Load Follow W(Z) Factors at 150 and 5000 MWD/MTU as a Function of Core Height (Continued)

HEIGHT (FEET)	150 MWD/MTU W(Z)	HEIGHT (FEET)	5000 MWD/MTU W(Z)
6.0000	1.1710	6.0000	1.1406
6.2000	1.1798	6.2000	1.1566
6.4000	1.1875	6.4000	1.1718
6.6000	1.1940	6.6000	1.1860
6.8000	1.1998	6.8000	1.1990
7.0000	1.2058	7.0000	1.2106
7.2000	1.2117	7.2000	1.2206
7.4000	1.2156	7.4000	1.2289
7.6000	1.2175	7.6000	1.2352
7.8000	1.2174	7.8000	1.2394
8.0000	1.2149	8.0000	1.2412
8.2000	1.2100	8.2000	1.2406
8.4000	1.2027	8.4000	1.2374
8.6000	1.1927	8.6000	1.2305
8.8000	1.1806	8.8000	1.2266
9.0000	1.1687	9.0000	1.2270
9.2000	1.1616	9.2000	1.2296
9.4000	1.1614	9.4000	1.2413
9.6000	1.1633	9.6000	1.2527
9.8000	1.1644	9.8000	1.2596
10.0000	1.1609	10.0000	1.2696
10.2000	1.1560	10.2000	1.2871
10.4000	1.1610	10.4000	1.3024
10.6000	1.1747	10.6000	1.3161
10.8000	1.1916	10.8000	1.3292
11.0000	1.2045	11.0000	1.3385
* 11.2000	1.2148	* 11.2000	1.3436
* 11.4000	1.2245	* 11.4000	1.3489
* 11.6000	1.2258	* 11.6000	1.3469
* 11.8000	1.2189	* 11.8000	1.3414
* 12.0000	1.2119	* 12.0000	1.3358

* Top and Bottom 8% excluded.

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TABLE 2B: Load Follow W(Z) Factors at 12000 and 22000 MWD/MTU as a Function of Core Height

HEIGHT (FEET)	12000 MWD/MTU W(Z)	HEIGHT (FEET)	22000 MWD/MTU W(Z)
* 0.0000	1.2534	* 0.0000	1.3253
* 0.2000	1.2518	* 0.2000	1.3259
* 0.4000	1.2501	* 0.4000	1.3224
* 0.6000	1.2484	* 0.6000	1.3164
* 0.8000	1.2441	* 0.8000	1.3077
1.0000	1.2374	1.0000	1.2963
1.2000	1.2290	1.2000	1.2831
1.4000	1.2198	1.4000	1.2691
1.6000	1.2100	1.6000	1.2550
1.8000	1.1999	1.8000	1.2407
2.0000	1.1892	2.0000	1.2261
2.2000	1.1792	2.2000	1.2118
2.4000	1.1715	2.4000	1.1989
2.6000	1.1654	2.6000	1.1869
2.8000	1.1596	2.8000	1.1750
3.0000	1.1526	3.0000	1.1615
3.2000	1.1483	3.2000	1.1559
3.4000	1.1477	3.4000	1.1648
3.6000	1.1495	3.6000	1.1743
3.8000	1.1506	3.8000	1.1860
4.0000	1.1529	4.0000	1.1986
4.2000	1.1560	4.2000	1.2098
4.4000	1.1579	4.4000	1.2192
4.6000	1.1588	4.6000	1.2266
4.8000	1.1589	4.8000	1.2322
5.0000	1.1576	5.0000	1.2355
5.2000	1.1570	5.2000	1.2376
5.4000	1.1596	5.4000	1.2450
5.6000	1.1710	5.6000	1.2671
5.8000	1.1853	5.8000	1.2894

* Top and Bottom 8% excluded.

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TABLE 2B: Load Follow W(Z) Factors at 12000 and 22000 MWD/MTU as a Function of Core Height (Continued)

HEIGHT (FEET)	12000 MWD/MTU W(Z)	HEIGHT (FEET)	22000 MWD/MTU W(Z)
6.0000	1.2002	6.0000	1.3078
6.2000	1.2154	6.2000	1.3243
6.4000	1.2287	6.4000	1.3381
6.6000	1.2402	6.6000	1.3492
6.8000	1.2500	6.8000	1.3574
7.0000	1.2576	7.0000	1.3626
7.2000	1.2632	7.2000	1.3645
7.4000	1.2673	7.4000	1.3630
7.6000	1.2692	7.6000	1.3580
7.8000	1.2686	7.8000	1.3492
8.0000	1.2654	8.0000	1.3367
8.2000	1.2596	8.2000	1.3206
8.4000	1.2510	8.4000	1.3008
8.6000	1.2398	8.6000	1.2778
8.8000	1.2260	8.8000	1.2506
9.0000	1.2175	9.0000	1.2240
9.2000	1.2167	9.2000	1.2078
9.4000	1.2151	9.4000	1.2050
9.6000	1.2204	9.6000	1.2006
9.8000	1.2280	9.8000	1.1970
10.0000	1.2332	10.0000	1.2024
10.2000	1.2374	10.2000	1.2326
10.4000	1.2400	10.4000	1.2636
10.6000	1.2431	10.6000	1.2921
10.8000	1.2471	10.8000	1.3116
11.0000	1.2489	11.0000	1.3227
* 11.2000	1.2483	* 11.2000	1.3324
* 11.4000	1.2472	* 11.4000	1.3396
* 11.6000	1.2379	* 11.6000	1.3329
* 11.8000	1.2293	* 11.8000	1.3101
* 12.0000	1.2206	* 12.0000	1.2872

* Top and Bottom 8% excluded.

TITLE: COLR for Diablo Canyon Unit 2 Cycle 14

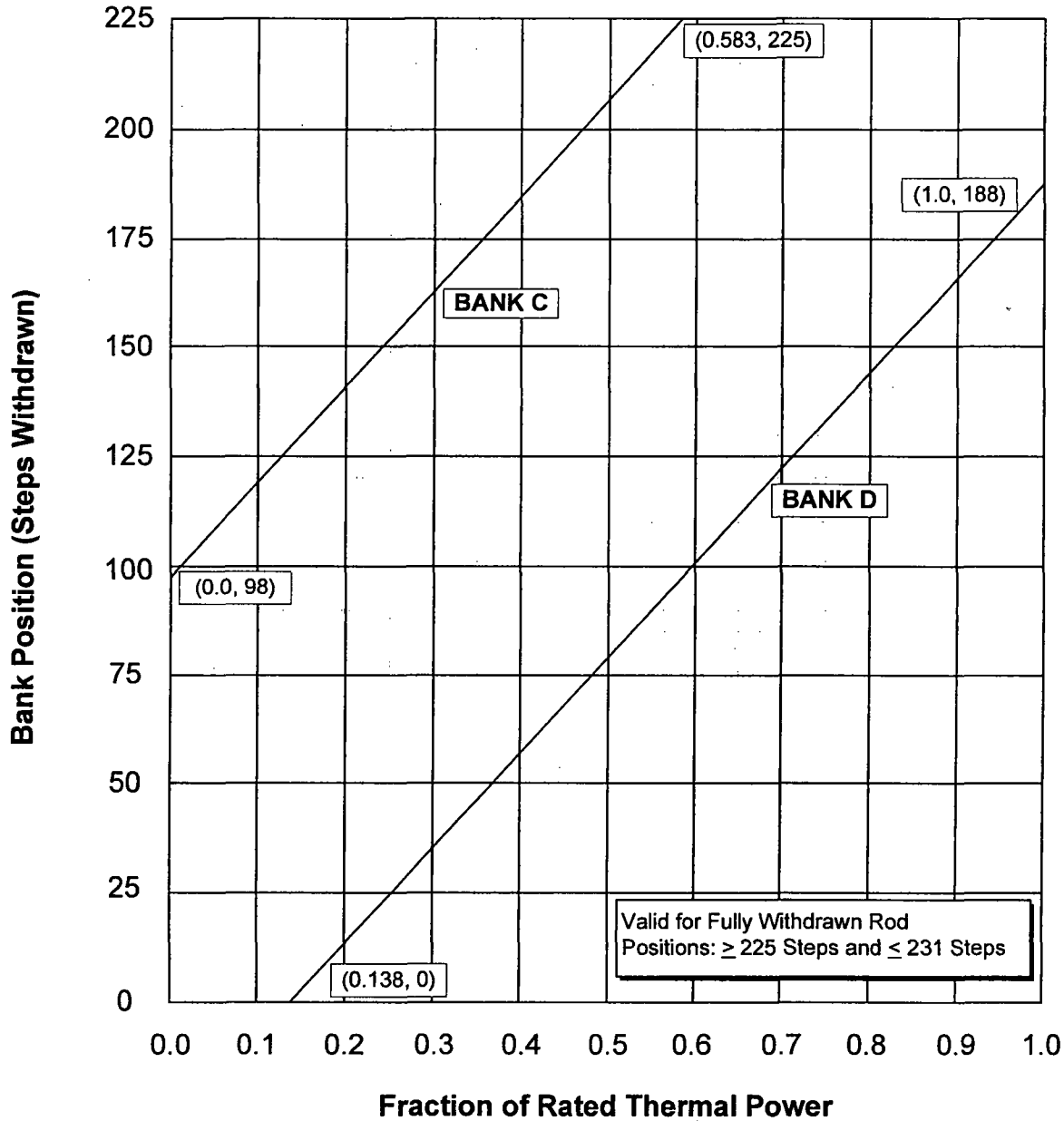


FIGURE 1: Control Bank Insertion Limits Versus Rated Thermal Power

TITLE: COLR for Diablo Canyon Unit 2 Cycle 14

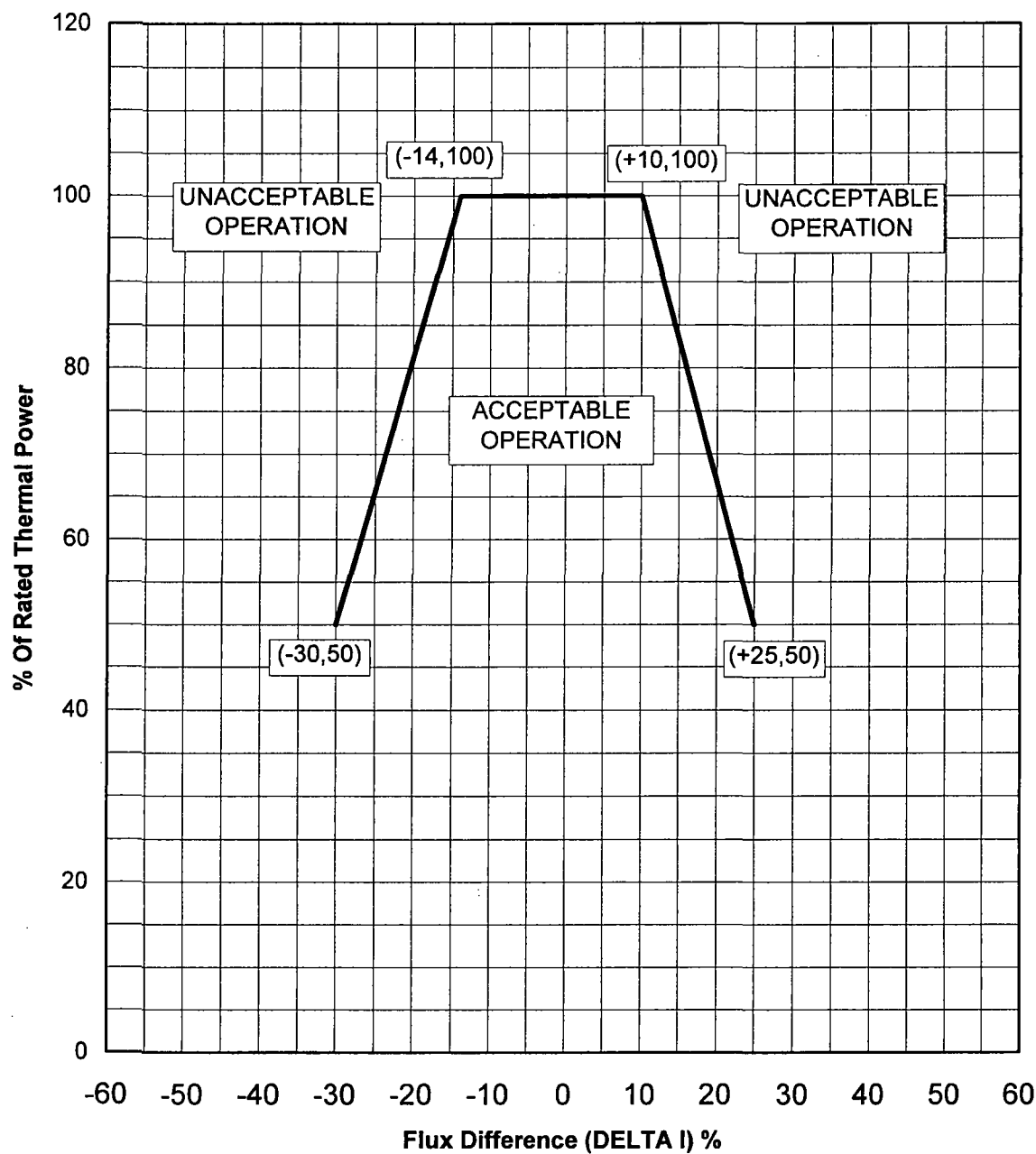


FIGURE 2: AFD Limits as a Function of Rated Thermal Power