Pacific Gas and
Electric Company®

James R. Becker
Site Vice President and
Station Director

Diablo Canyon Power Plant
Mail Code 104/5/502
P. O. Box 56
Avila Beach, CA 93424

805.545.3462
Internal: 691.3462
Fax: 805.545.4234

March 26, 2008

PG&E Letter DCL-08-029

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

Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Core Operating Limits Report for Unit 2

Dear Commissioners and Staff:

In accordance with Diablo Canyon Power Plant Technical Specification 5.6.5.d, enclosed is the Core Operating Limits Report (COLR) for Unit 2. The COLR has been revised for Unit 2 Cycle 15, consistent with the NRC approved License Amendment Number 196.

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/A0710976
Enclosure
cc: Diablo Distribution
cc/enc: Elmo E. Collins, NRC Region IV
Michael S. Peck, NRC Senior Resident Inspector
Alan B. Wang, NRR Project Manager

A001
NRR

CORE OPERATING LIMITS REPORT (COLR)
DIABLO CANYON POWER PLANT UNIT 2 CYCLE 15
EFFECTIVE DATE MARCH 22, 2008

TITLE: COLR for Diablo Canyon Unit 2 Cycle 15

2

03/22/08
EFFECTIVE DATE

PROCEDURE CLASSIFICATION: QUALITY RELATED

1. CORE OPERATING LIMITS REPORT

1.1 This Core Operating Limits Report (COLR) for Diablo Canyon Unit 2 Cycle 15 has been prepared in accordance with the requirements of Technical Specification (TS) 5.6.5.

1.2 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 - $F^N_{\Delta H}$
- 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% Δk/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% Δk/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% Δk/k. However, an administrative value of 1.6 % Δk/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 $k_{eff} \geq 1.0$ is:

2.2.1 The shutdown margin shall be greater than or equal to 1.6% Δk/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 -3.9×10^{-4} Δk/k/°F for all rods withdrawn, end of cycle life (EOL), RATED THERMAL POWER condition.

2.3.2 The MTC 300 ppm surveillance limit is -3.0×10^{-4} Δk/k/°F (all rods withdrawn, RATED THERMAL POWER condition).

2.3.3 The MTC 60 ppm surveillance limit is -3.72×10^{-4} Δk/k/°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: $$P = \frac{THERMAL\ POWER}{RATED\ THERMAL\ POWER}$$

$F_Q^{RTP} = 2.58$

$K(Z) = 1.0$

NOTE: The W(Z) data is appropriate for use only if the predicted axial offset is within ±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.

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.

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

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

where:

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

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

$F^{RTP}_{\Delta H}$ = 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, $F^{N}_{\Delta H}$, 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 $F^{RTP}_{\Delta H}$ = 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, $F^{N}_{\Delta H}$, 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.

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) Limit (TS 3.4.1)

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 T_{AVG} 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 4,000 MWD/MTU as a Function of Core Height"

3.3 Table 2B, "Load Follow W(Z) Factors at 12,000 and 20,000 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-08-26, "Diablo Canyon Unit 2 Cycle 15 Reload Evaluation and COLR, Revision 1," March, 2008

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

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

Cycle Burnup (MWD/MTU)	Max. % Decrease in F_Q Margin
150	2.00
313	2.40
475	2.90
638	3.29
800	3.56
963	3.70
1125	3.71
1288	3.60
1450	3.39
1613	3.10
1775	2.77
1938	2.42
2100	2.10
2263	2.00

5675	2.00
5838	2.25
6000	2.90
6163	3.48
6325	3.29
6488	3.09
6650	2.88
6813	2.66
6975	2.43
7138	2.13
7300	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.

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

HEIGHT (FEET)	150 MWD/MTU W(Z)	HEIGHT (FEET)	4000 MWD/MTU W(Z)
* 0.0000	1.5321	* 0.0000	1.5088
* 0.2000	1.5270	* 0.2000	1.5046
* 0.4000	1.5183	* 0.4000	1.4966
* 0.6000	1.5074	* 0.6000	1.4861
* 0.8000	1.4943	* 0.8000	1.4731
1.0000	1.4784	1.0000	1.4571
1.2000	1.4599	1.2000	1.4383
1.4000	1.4395	1.4000	1.4172
1.6000	1.4176	1.6000	1.3943
1.8000	1.3945	1.8000	1.3698
2.0000	1.3703	2.0000	1.3441
2.2000	1.3454	2.2000	1.3177
2.4000	1.3197	2.4000	1.2906
2.6000	1.2936	2.6000	1.2631
2.8000	1.2680	2.8000	1.2404
3.0000	1.2390	3.0000	1.2238
3.2000	1.2187	3.2000	1.2121
3.4000	1.2169	3.4000	1.2029
3.6000	1.2149	3.6000	1.1938
3.8000	1.2119	3.8000	1.1889
4.0000	1.2084	4.0000	1.1859
4.2000	1.2036	4.2000	1.1818
4.4000	1.1978	4.4000	1.1769
4.6000	1.1910	4.6000	1.1709
4.8000	1.1833	4.8000	1.1642
5.0000	1.1749	5.0000	1.1565
5.2000	1.1654	5.2000	1.1485
5.4000	1.1556	5.4000	1.1395
5.6000	1.1533	5.6000	1.1279
5.8000	1.1610	5.8000	1.1329

* Top and Bottom 8% excluded

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

HEIGHT (FEET)	150 MWD/MTU W(Z)	HEIGHT (FEET)	4000 MWD/MTU W(Z)
6.0000	1.1754	6.0000	1.1470
6.2000	1.1867	6.2000	1.1584
6.4000	1.1974	6.4000	1.1693
6.6000	1.2067	6.6000	1.1791
6.8000	1.2147	6.8000	1.1876
7.0000	1.2210	7.0000	1.1948
7.2000	1.2256	7.2000	1.2004
7.4000	1.2282	7.4000	1.2044
7.6000	1.2286	7.6000	1.2072
7.8000	1.2266	7.8000	1.2083
8.0000	1.2222	8.0000	1.2073
8.2000	1.2152	8.2000	1.2041
8.4000	1.2054	8.4000	1.1987
8.6000	1.1927	8.6000	1.1900
8.8000	1.1785	8.8000	1.1866
9.0000	1.1615	9.0000	1.1887
9.2000	1.1462	9.2000	1.1976
9.4000	1.1432	9.4000	1.2027
9.6000	1.1426	9.6000	1.2100
9.8000	1.1416	9.8000	1.2158
10.0000	1.1420	10.0000	1.2183
10.2000	1.1449	10.2000	1.2188
10.4000	1.1502	10.4000	1.2184
10.6000	1.1563	10.6000	1.2231
10.8000	1.1621	10.8000	1.2299
11.0000	1.1668	11.0000	1.2379
* 11.2000	1.1729	* 11.2000	1.2481
* 11.4000	1.1824	* 11.4000	1.2524
* 11.6000	1.1834	* 11.6000	1.2504
* 11.8000	1.1771	* 11.8000	1.2438
* 12.0000	1.1709	* 12.0000	1.2372

* Top and Bottom 8% excluded

Table 2B: Load Follow W(Z) Factors at 12000 and 20000 MWD/MTU
as a Function of Core Height

HEIGHT (FEET)	12000 MWD/MTU W(Z)	HEIGHT (FEET)	20000 MWD/MTU W(Z)
* 0.0000	1.2489	* 0.0000	1.3031
* 0.2000	1.2516	* 0.2000	1.3036
* 0.4000	1.2510	* 0.4000	1.3002
* 0.6000	1.2481	* 0.6000	1.2943
* 0.8000	1.2429	* 0.8000	1.2857
1.0000	1.2355	1.0000	1.2744
1.2000	1.2264	1.2000	1.2614
1.4000	1.2167	1.4000	1.2477
1.6000	1.2066	1.6000	1.2338
1.8000	1.1962	1.8000	1.2199
2.0000	1.1857	2.0000	1.2058
2.2000	1.1752	2.2000	1.1918
2.4000	1.1643	2.4000	1.1773
2.6000	1.1530	2.6000	1.1621
2.8000	1.1477	2.8000	1.1558
3.0000	1.1452	3.0000	1.1568
3.2000	1.1439	3.2000	1.1620
3.4000	1.1445	3.4000	1.1700
3.6000	1.1480	3.6000	1.1775
3.8000	1.1510	3.8000	1.1863
4.0000	1.1524	4.0000	1.1968
4.2000	1.1539	4.2000	1.2069
4.4000	1.1573	4.4000	1.2148
4.6000	1.1599	4.6000	1.2209
4.8000	1.1612	4.8000	1.2250
5.0000	1.1619	5.0000	1.2275
5.2000	1.1606	5.2000	1.2276
5.4000	1.1593	5.4000	1.2266
5.6000	1.1690	5.6000	1.2316
5.8000	1.1867	5.8000	1.2423

* Top and Bottom 8% excluded

Table 2B: Load Follow W(Z) Factors at 12000 and 20000 MWD/MTU as a Function of Core Height (Continued)

HEIGHT (FEET)	12000 MWD/MTU W(Z)	HEIGHT (FEET)	20000 MWD/MTU W(Z)
6.0000	1.2052	6.0000	1.2533
6.2000	1.2216	6.2000	1.2618
6.4000	1.2366	6.4000	1.2686
6.6000	1.2500	6.6000	1.2734
6.8000	1.2614	6.8000	1.2761
7.0000	1.2708	7.0000	1.2764
7.2000	1.2780	7.2000	1.2756
7.4000	1.2835	7.4000	1.2766
7.6000	1.2868	7.6000	1.2767
7.8000	1.2876	7.8000	1.2746
8.0000	1.2854	8.0000	1.2698
8.2000	1.2805	8.2000	1.2625
8.4000	1.2728	8.4000	1.2527
8.6000	1.2616	8.6000	1.2406
8.8000	1.2515	8.8000	1.2262
9.0000	1.2429	9.0000	1.2108
9.2000	1.2357	9.2000	1.2023
9.4000	1.2334	9.4000	1.2064
9.6000	1.2298	9.6000	1.2094
9.8000	1.2257	9.8000	1.2126
10.0000	1.2271	10.0000	1.2190
10.2000	1.2354	10.2000	1.2265
10.4000	1.2471	10.4000	1.2328
10.6000	1.2685	10.6000	1.2463
10.8000	1.2881	10.8000	1.2658
11.0000	1.3011	11.0000	1.2864
* 11.2000	1.3102	* 11.2000	1.3045
* 11.4000	1.3123	* 11.4000	1.3162
* 11.6000	1.3066	* 11.6000	1.3160
* 11.8000	1.2867	* 11.8000	1.3016
* 12.0000	1.2667	* 12.0000	1.2872

* Top and Bottom 8% excluded

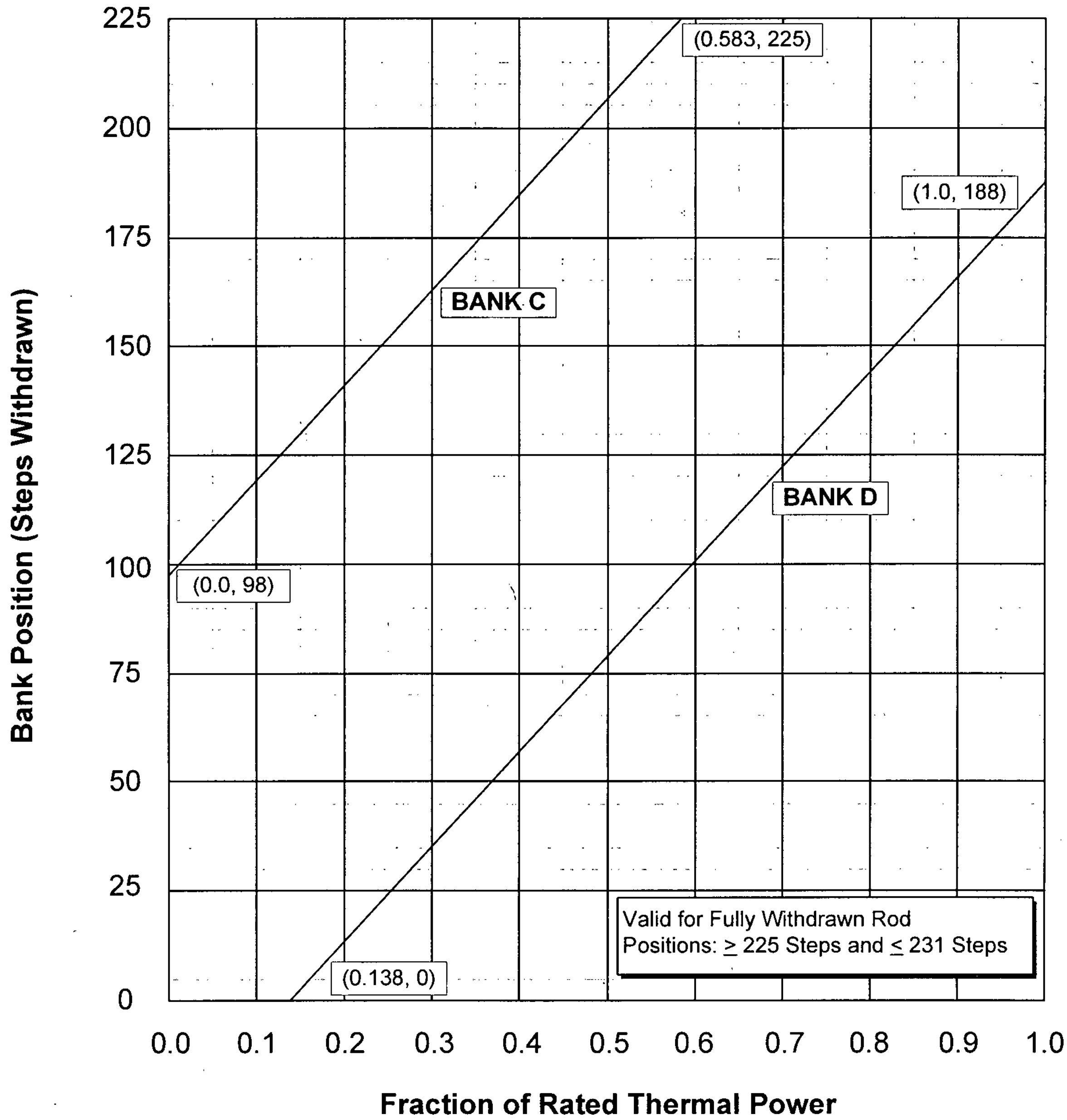

Figure 1: Control Bank Insertion Limits Versus Rated Thermal Power

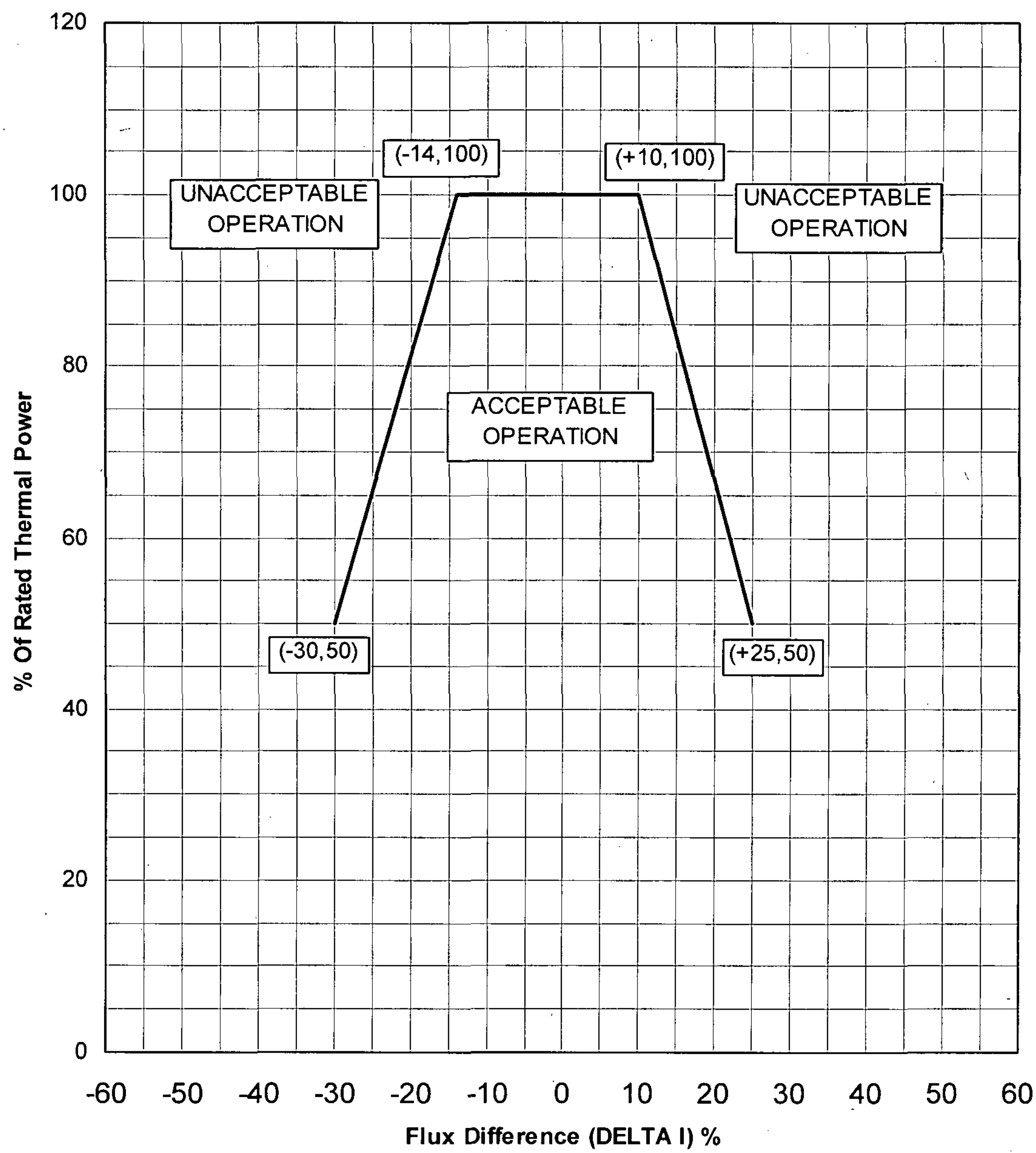

Figure 2: AFD Limits as a Function of Rated Thermal Power