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FPL Energy.
Duane Arnold Energy Center

March 14, 2007

NG-07-0253
TS 5.6.5.d

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

Duane Arnold Energy Center
Docket 50-331
License No. DPR-49

Core Operating Limits Report for DAEC Cycle 21 Operation

In accordance with the requirements of Duane Arnold Energy Center (DAEC) Technical Specifications Section 5.6.5.d, a copy of the Core Operating Limits Report (COLR) for Cycle 21 operation of the DAEC is enclosed.

This letter contains no new commitments and no revisions to existing commitments.

Gary Van Middlesworth
Site Vice President, Duane Arnold Energy Center
FPL Energy Duane Arnold, LLC

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Duane Arnold Energy Center, USNRC
Resident Inspector, Duane Arnold Energy Center, USNRC

A001

Enclosure to
NG-07-0253

DUANE ARNOLD ENERGY CENTER

CYCLE 21

CORE OPERATING LIMITS REPORT

REVISION 1

32 pages follow

Revision 1
March 2007

Duane Arnold Energy Center
Cycle 21
Core Operating Limits Report

FPL Energy

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DUANE ARNOLD ENERGY CENTER
CYCLE 21
CORE OPERATING LIMITS REPORT

Revision 1
March 2007

Prepared by: _____ Date: 3/7/07
JB Nuclear Fuels

Verified by: Matt Brandt Date: 3-7-2007
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Concurred by: _____ Date: 3/8/07
Manager, Licensing

Concurred by: _____ Date: 3-8-07
Manager, Systems Engineering

Concurred by: _____ Date: 3-8-07
Director, Engineering

Reviewed by: _____ Date: 3-9-2007 PORC # 2007-17
Chairman, PORC

Approved by: _____ Date: 3/9/07
Plant Manager, Nuclear

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1.0 Core Operating Limits Report

This Core Operating Limits Report for Cycle 21 has been prepared in accordance with the requirements of Technical Specification 5.6.5 and is applicable to operation for which rated thermal power is 1912 MWt. The core operating limits have been developed using NRC-approved methodology (References 1, 6 and 7) and are established such that all applicable limits of the plant safety analysis are met. The Cycle 21 values for the core operating limits are provided in Section 3.0 of this report.

2.0 References

1. General Electric Standard Application for Reactor Fuel (GESTAR-II), NEDE-24011-P-A-15, September 2005.
2. Supplemental Reload Licensing Report for Duane Arnold Energy Center, Reload 20 Cycle 21, 0000-0051-8481-SRLR Rev. 0, December 2006.
3. Letter from F.R. Lindquist (GNF) to R. Rodriguez (FPL), "Composite MAPLHGRs for New Fuel Designs in DAEC Cycle 21," December 7, 2006.
4. Duane Arnold Energy Center Cycle 20 Core Operating Limits Report, Revision 0, February 2005.
5. Duane Arnold Energy Center Asset Enhancement Program, Task T0201: Power/Flow Map, GE-NE-A22-00100-04-01, Revision 0, February 2000.
6. General Electric Licensing Topical Report ODYSY Application for Stability Licensing Calculations, NEDC-32992-P-A, DRF AI3-00426-00, July 2001.
7. General Electric Report, Plant-Specific Core-Wide Mode DIVOM Procedure Guideline, GE-NE-0000-0031-6498-R0, June 6, 2005.

3.0 Core Operating Limits

1. Average Planar Linear Heat Generation Rate (APLHGR) – TS 3.2.1

   a. The APLHGR for each fuel type as a function of Planar Average Exposure (PAE) shall not exceed the limiting value shown in Figures 1, 2, 3, 4, 5, 6, 7, and 8 multiplied by the smaller of the two MAPFAC/LHGRFAC factors determined from Figures 9 and 10.

   b. During Single Loop Operation (SLO), the actual APLHGR for each type of fuel as a function of planar average exposure shall not exceed the limiting value shown in Figures 1, 2, 3, 4, 5, 6, 7, and 8 multiplied by the smaller of the two MAPFAC/LHGRFAC factors determined from Figures 10 and 11.

   c. Tables 1, 2, 3, 4, 5, 6, 7, and 8 provide APLHGR limit values (KW/ft) corresponding to Figures 1, 2, 3, 4, 5, 6, 7, and 8, respectively.

The above APLHGR limits are bounding composite of the actual fuel thermal limits for Maximum Average Planar Linear Heat Generation (MAPLHGR), derived from the Emergency Core Cooling requirements of the Loss-of-Coolant Accident (LOCA) analyses, and the Maximum Linear Heat Generation Rate (MLHGR), derived from the fuel thermal-mechanical performance limits. The individual MAPLHGR and MLHGR limits, as discussed in the BASES for TS 3.2.1, are modeled in the process computer. The above composite can be used to determine the TS APLHGR limit in the event the process computer is not available.

2. Minimum Critical Power Ratio (MCPR) – TS 3.2.2

   a. The MCPR shall be equal to or greater than the Operating Limit MCPR, which is a function of Core Thermal Power, Core Flow, Fuel Type, and Scram Time (Tau). For Core Thermal Power greater than or equal to 21.7% of rated and less than 40% of rated ($21.7\% \leq P < 40\%$), the Operating Limit MCPR is given by Figure 12. For Core Thermal Power greater than or equal to 40% of rated ($P \geq 40\%$), the Operating Limit MCPR is the greater of either:

      i) The applicable flow-dependent MCPR determined from Figure 13, or

      ii) The appropriate Rated Power MCPR from Figure 14 or 15 [Figure 16 for Recirculation Pump Trip Out-of-Service (RPTOOS); Figure 17 for Turbine Bypass Valves Out-of-Service (TBVOOS); Figure 18 for TBVOOS and RPTOOS], multiplied by the applicable power-dependent MCPR multiplier determined from Figure 12.

   b. During SLO with Core Thermal Power greater than or equal to 21.7% of rated, the SLO Operating Limit MCPR is the greater of either:

      i) adding 0.02 to the Operating Limit MCPR determined above, or

      ii) 1.38.

4.0 Reload Fuel Bundles

FUEL TYPE	CYCLE LOADED	NUMBER
GE14-P10DNAB398-15GZ-100T-150-T6-3896	19	16
GE14-P10DNAB438-12G6.0-100T-150-T6-2541	19	32
GE14-P10DNAB440-14G6.0-100T-150-T6-2561	19	16
GE14-P10DNAB420-16GZ-100T-150-T6-2814	20	80
GE14-P10DNAB438-14G6.0-100T-150-T6-2815	20	40
GE14-P10DNAB420-16GZ-100T-150-T6-2816	20	32
GE14-P10DNAB438-12G6.0-100T-150-T6-2541	21	40
GE14-P10DNAB410-16GZ-100T-150-T6-2919	21	88
GE14-P10DNAB407-18GZ-100T-150-T6-2920	21	24

Note that the bundle GE14-P10DNAB438-12G6.0-100T-150-T6-2541 loaded in Cycle 21 is identical to the assembly of the same name that was loaded in Cycle 19.

5.0 Thermal-Hydraulic Stability

a. Continued reactor operation within the "Exclusion Zone" on the power/flow map, as defined on Figure 19, is not permitted. (Surveillance Requirement 3.4.1.2)

b. Continued reactor operation within the "Buffer Zone" on the power/flow map, as defined in Figure 19, is not permitted when the thermal-hydraulic stability monitor (SOLOMON) is not operational.

Please see References 6 and 7 for more information on Thermal-Hydraulic Stability.

TABLE 1

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB398-15GZ-100T-150-T6-3896

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	10.15
0.20	10.19
1.00	10.27
2.00	10.37
3.00	10.47
4.00	10.58
5.00	10.69
6.00	10.80
7.00	10.91
8.00	11.03
9.00	11.09
10.00	11.10
11.00	11.11
12.00	11.14
13.00	11.07
14.00	11.03
15.00	11.00
17.00	10.93
19.13	10.81
20.00	10.75
25.00	10.18
30.00	9.65
35.00	9.17
40.00	8.72
45.00	8.19
50.00	7.67
55.00	6.10
57.56	4.83

TABLE 2

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB438-12G6.0-100T-150-T6-2541

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.76
0.20	9.83
1.00	9.94
2.00	10.08
3.00	10.14
4.00	10.20
5.00	10.27
6.00	10.33
7.00	10.40
8.00	10.47
9.00	10.54
10.00	10.61
11.00	10.68
12.00	10.64
13.00	10.60
14.00	10.56
15.00	10.53
17.00	10.45
19.13	10.32
20.00	10.26
25.00	9.89
30.00	9.50
35.00	9.11
40.00	8.68
45.00	8.21
50.00	7.53
55.00	5.05
55.40	4.85

TABLE 3

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB440-14G6.0-100T-150-T6-2561

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.52
0.20	9.59
1.00	9.68
2.00	9.79
3.00	9.91
4.00	10.03
5.00	10.12
6.00	10.19
7.00	10.27
8.00	10.34
9.00	10.42
10.00	10.50
11.00	10.57
12.00	10.53
13.00	10.50
14.00	10.48
15.00	10.46
17.00	10.41
19.13	10.30
20.00	10.25
25.00	9.89
30.00	9.51
35.00	9.12
40.00	8.69
45.00	8.21
50.00	7.50
55.00	5.02
55.33	4.86

TABLE 4

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB420-16GZ-100T-150-T6-2814

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.70
0.20	9.74
1.00	9.82
2.00	9.92
3.00	10.03
4.00	10.15
5.00	10.26
6.00	10.39
7.00	10.51
8.00	10.64
9.00	10.77
10.00	10.90
11.00	11.02
12.00	11.02
13.00	11.00
14.00	10.97
15.00	10.94
17.00	10.87
19.13	10.75
20.00	10.71
25.00	10.26
30.00	9.80
35.00	9.34
40.00	8.78
45.00	8.23
50.00	7.69
55.00	5.74
56.75	4.86

TABLE 5

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB438-14G6.0-100T-150-T6-2815

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.37
0.20	9.46
1.00	9.57
2.00	9.72
3.00	9.84
4.00	9.96
5.00	10.08
6.00	10.21
7.00	10.33
8.00	10.40
9.00	10.47
10.00	10.53
11.00	10.60
12.00	10.55
13.00	10.51
14.00	10.47
15.00	10.44
17.00	10.38
19.13	10.28
20.00	10.23
25.00	9.88
30.00	9.50
35.00	9.10
40.00	8.67
45.00	8.20
50.00	7.51
55.00	5.03
55.36	4.85

TABLE 6

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB420-16GZ-100T-150-T6-2816

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.69
0.20	9.73
1.00	9.81
2.00	9.91
3.00	10.02
4.00	10.14
5.00	10.25
6.00	10.37
7.00	10.50
8.00	10.62
9.00	10.75
10.00	10.88
11.00	11.00
12.00	11.00
13.00	10.97
14.00	10.94
15.00	10.91
17.00	10.84
19.13	10.73
20.00	10.69
25.00	10.26
30.00	9.80
35.00	9.34
40.00	8.78
45.00	8.22
50.00	7.69
55.00	5.73
56.73	4.87

TABLE 7

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB410-16GZ-100T-150-T6-2919

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.44
0.20	9.49
1.00	9.59
2.00	9.73
3.00	9.87
4.00	10.01
5.00	10.16
6.00	10.32
7.00	10.48
8.00	10.63
9.00	10.77
10.00	10.91
11.00	11.02
12.00	11.04
13.00	11.02
14.00	11.01
15.00	11.01
17.00	10.97
19.13	10.87
20.00	10.83
25.00	10.38
30.00	9.85
35.00	9.23
40.00	8.64
45.00	8.10
50.00	7.59
55.00	6.09
57.37	4.89

TABLE 8

Average Planar Linear Heat Generation Rate (APLHGR) Limit
as a Function of Planar Average Exposure

for

GE14-P10DNAB407-18GZ-100T-150-T6-2920

Planar Average Exposure (GWd/ST)	APLHGR Limit (kW/ft)
0.00	9.38
0.20	9.43
1.00	9.53
2.00	9.66
3.00	9.80
4.00	9.95
5.00	10.10
6.00	10.26
7.00	10.42
8.00	10.57
9.00	10.71
10.00	10.82
11.00	10.93
12.00	10.93
13.00	10.91
14.00	10.84
15.00	10.78
17.00	10.65
19.13	10.52
20.00	10.46
25.00	10.05
30.00	9.60
35.00	9.15
40.00	8.60
45.00	8.06
50.00	7.55
55.00	5.30
55.93	4.83

APLHGR vs Planar Average Exposure

GE14-P10DNAB398-15GZ-100T-150-T6-3896

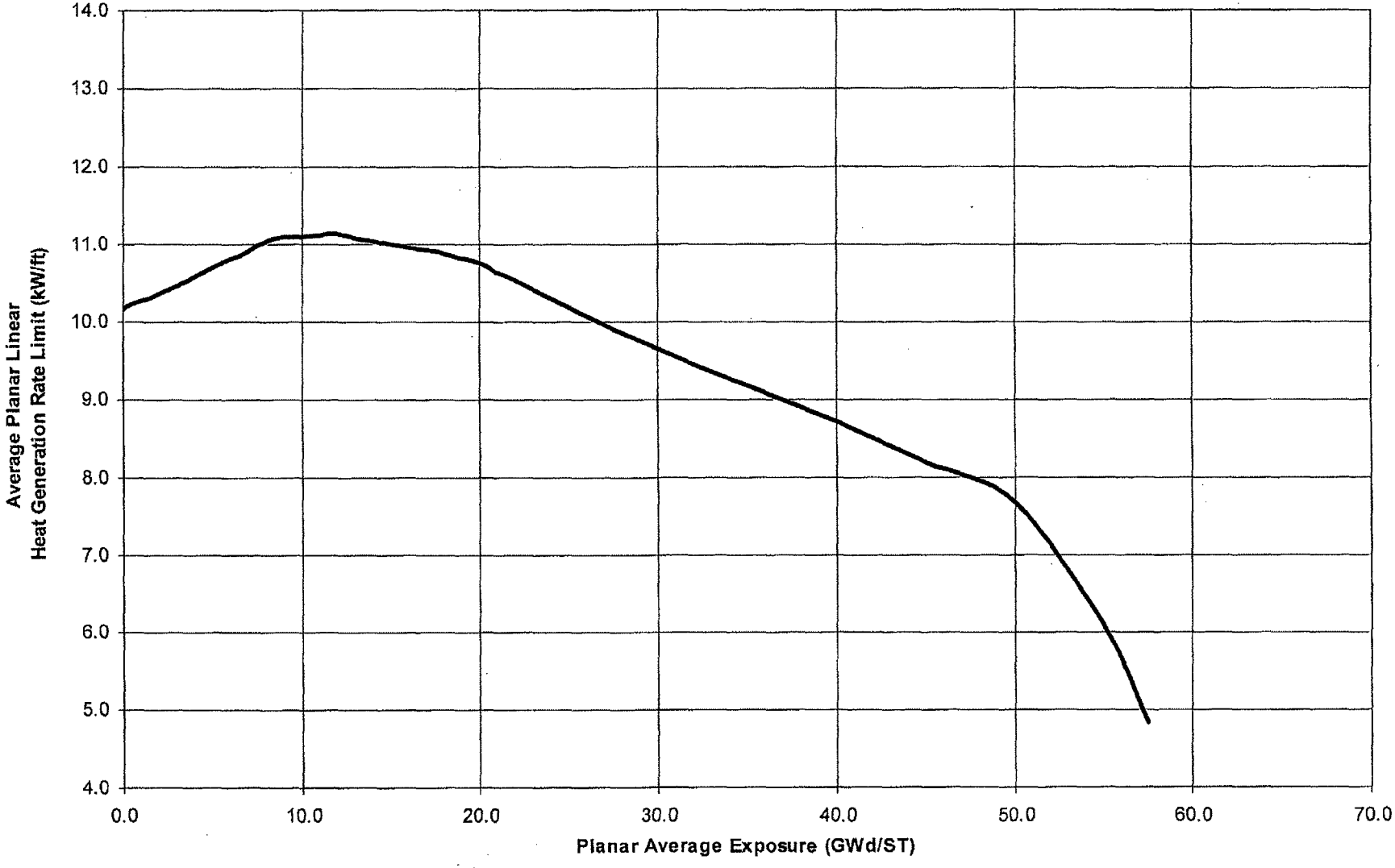

Figure 1

APLHGR vs Planar Average Exposure

GE14-P10DNAB438-12G6.0-100T-150-T6-2541

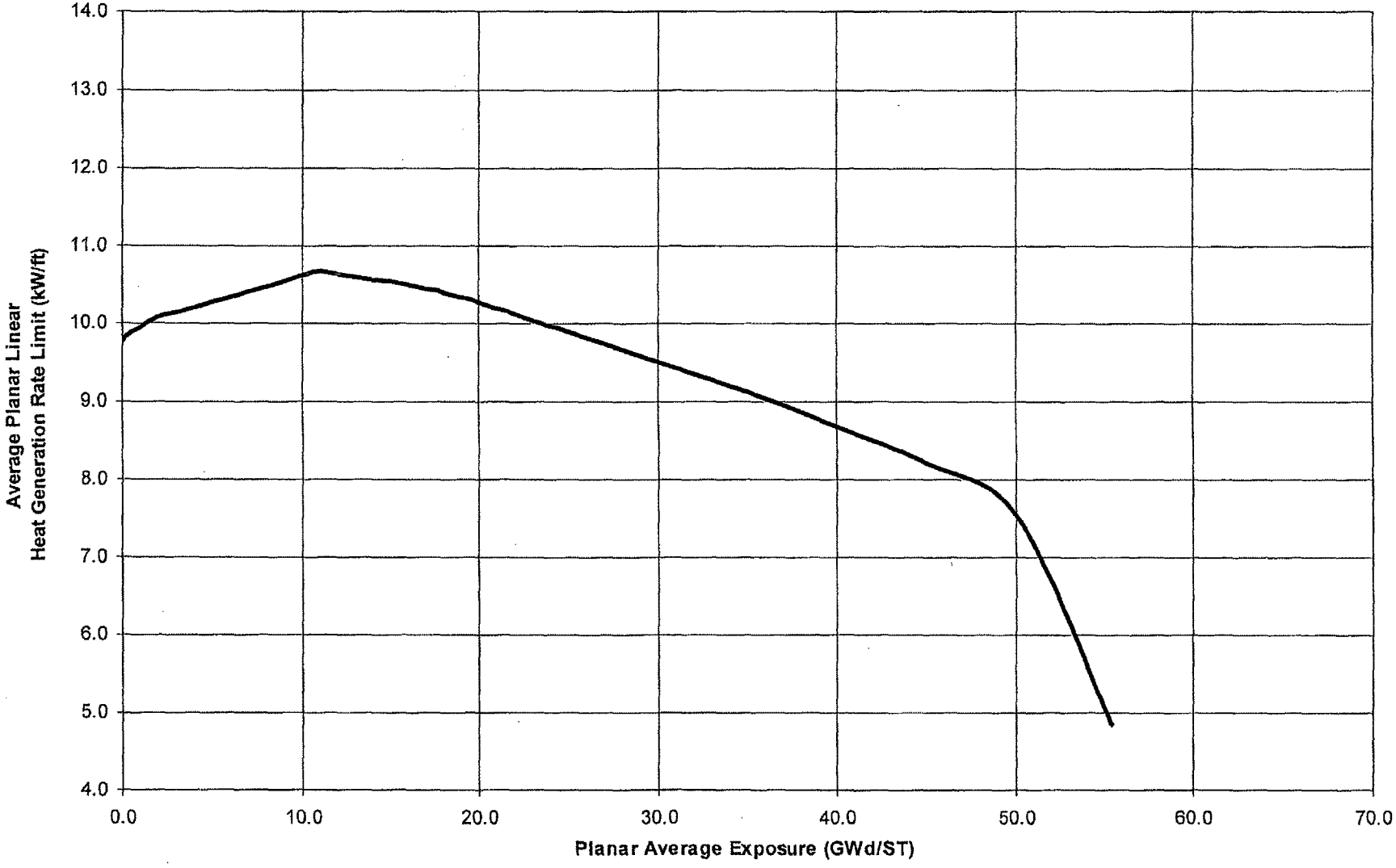

Figure 2

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APLHGR vs Planar Average Exposure

GE14-P10DNAB440-14G6.0-100T-150-T6-2561

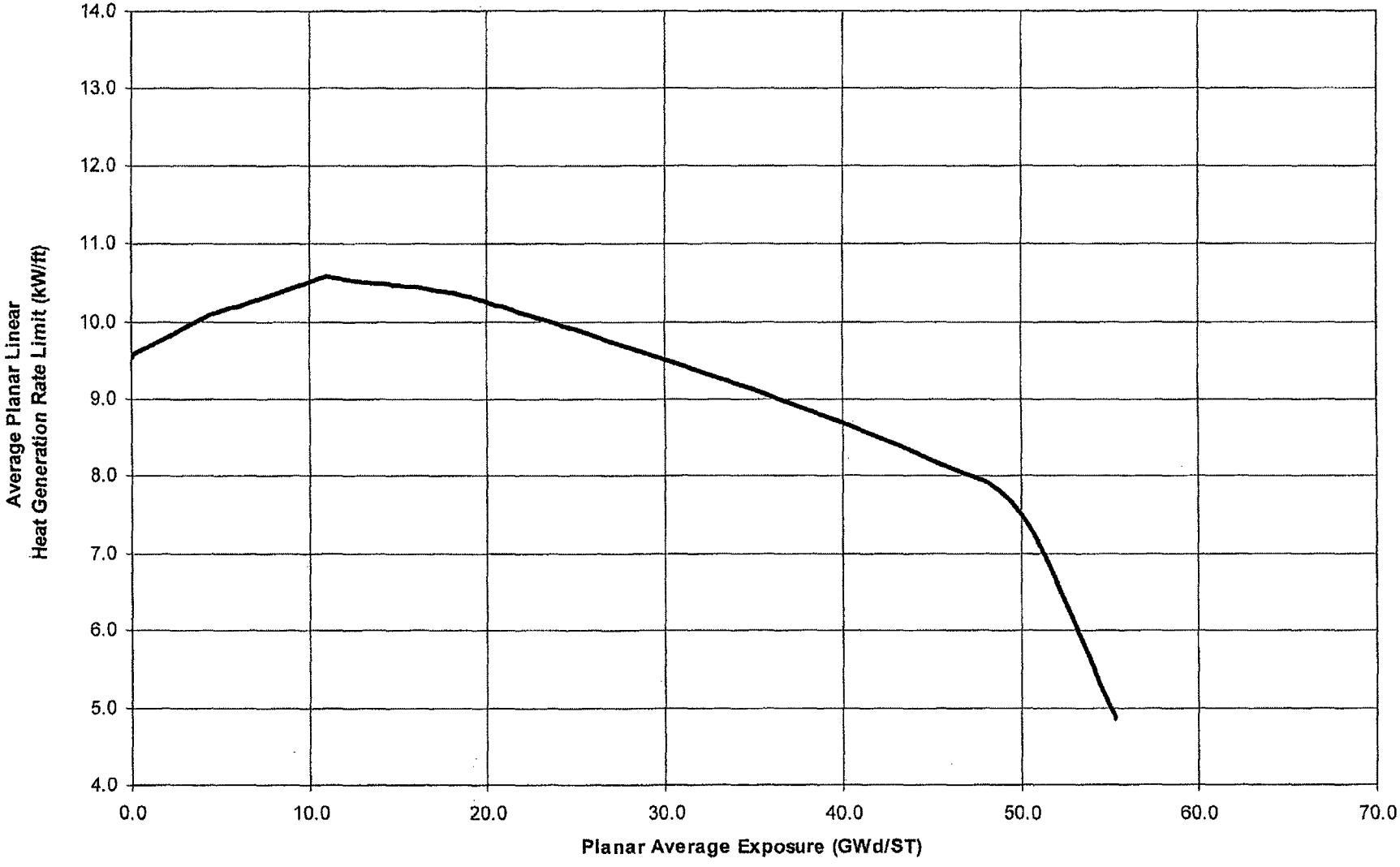

Figure 3

APLHGR vs Planar Average Exposure

GE14-P10DNAB420-16GZ-100T-150-T6-2814

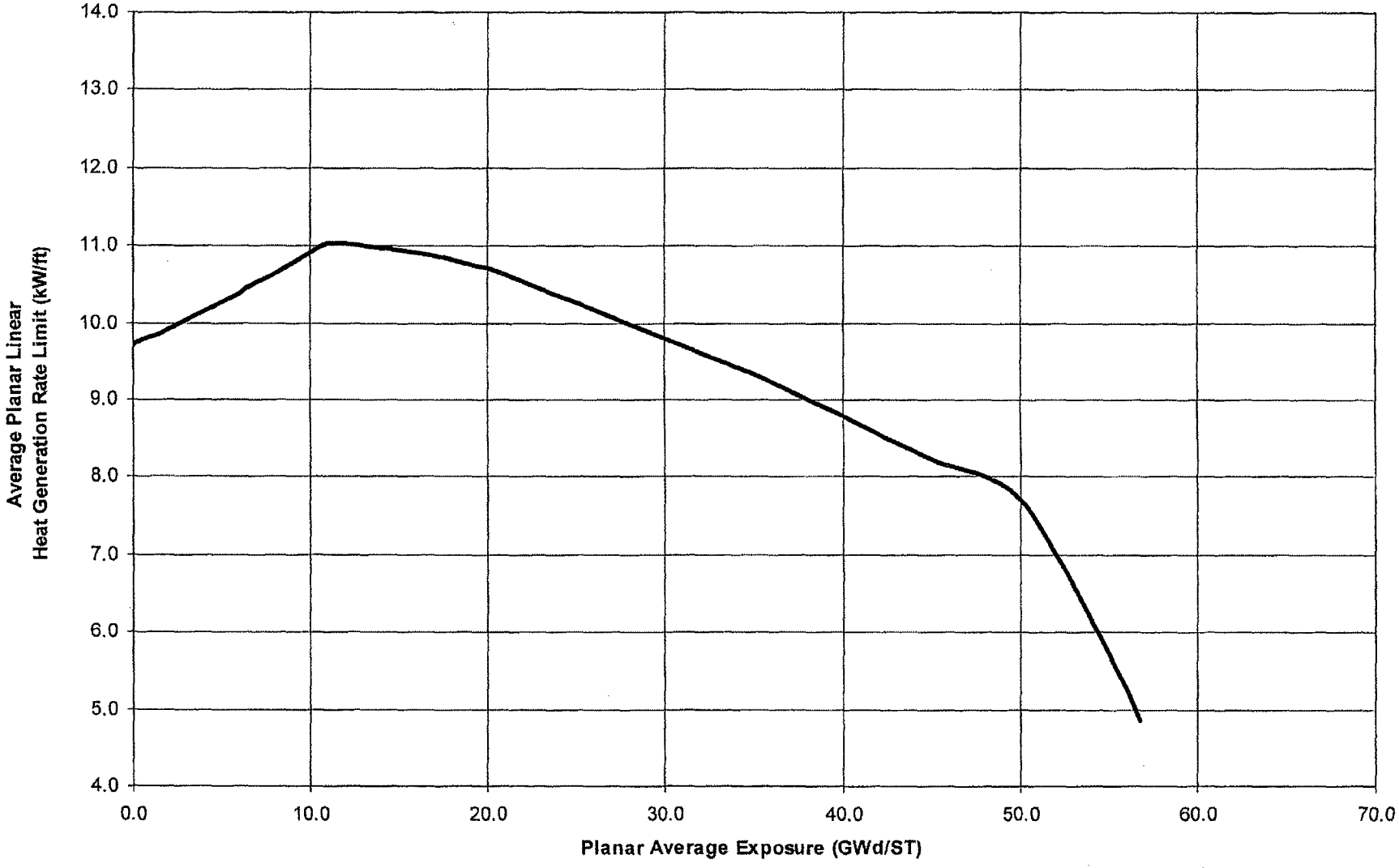

Figure 4

APLHGR vs Planar Average Exposure

GE14-P10DNAB438-14G6.0-100T-150-T6-2815

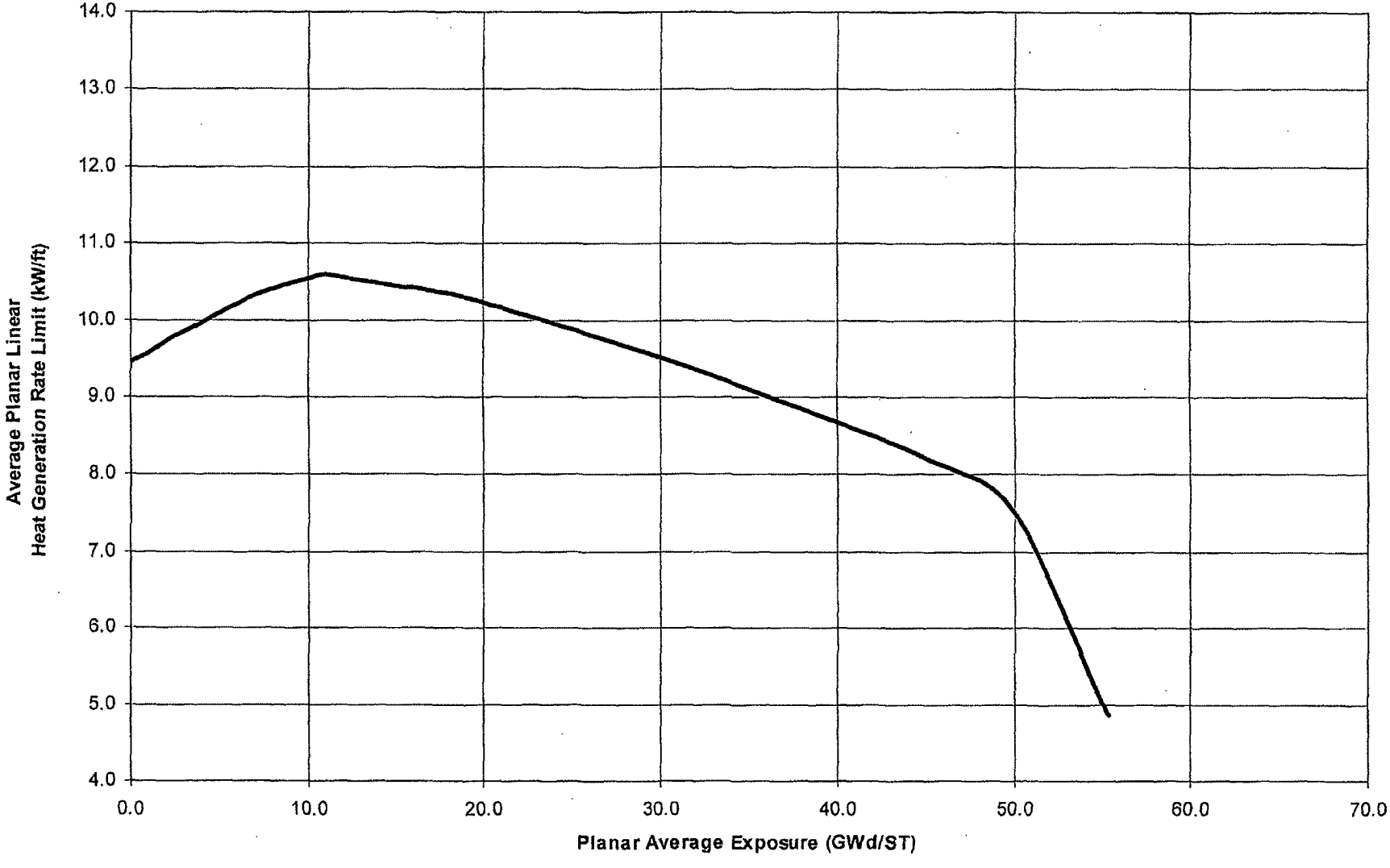

Figure 5

APLHGR vs Planar Average Exposure

GE14-P10DNAB420-16GZ-100T-150-T6-2816

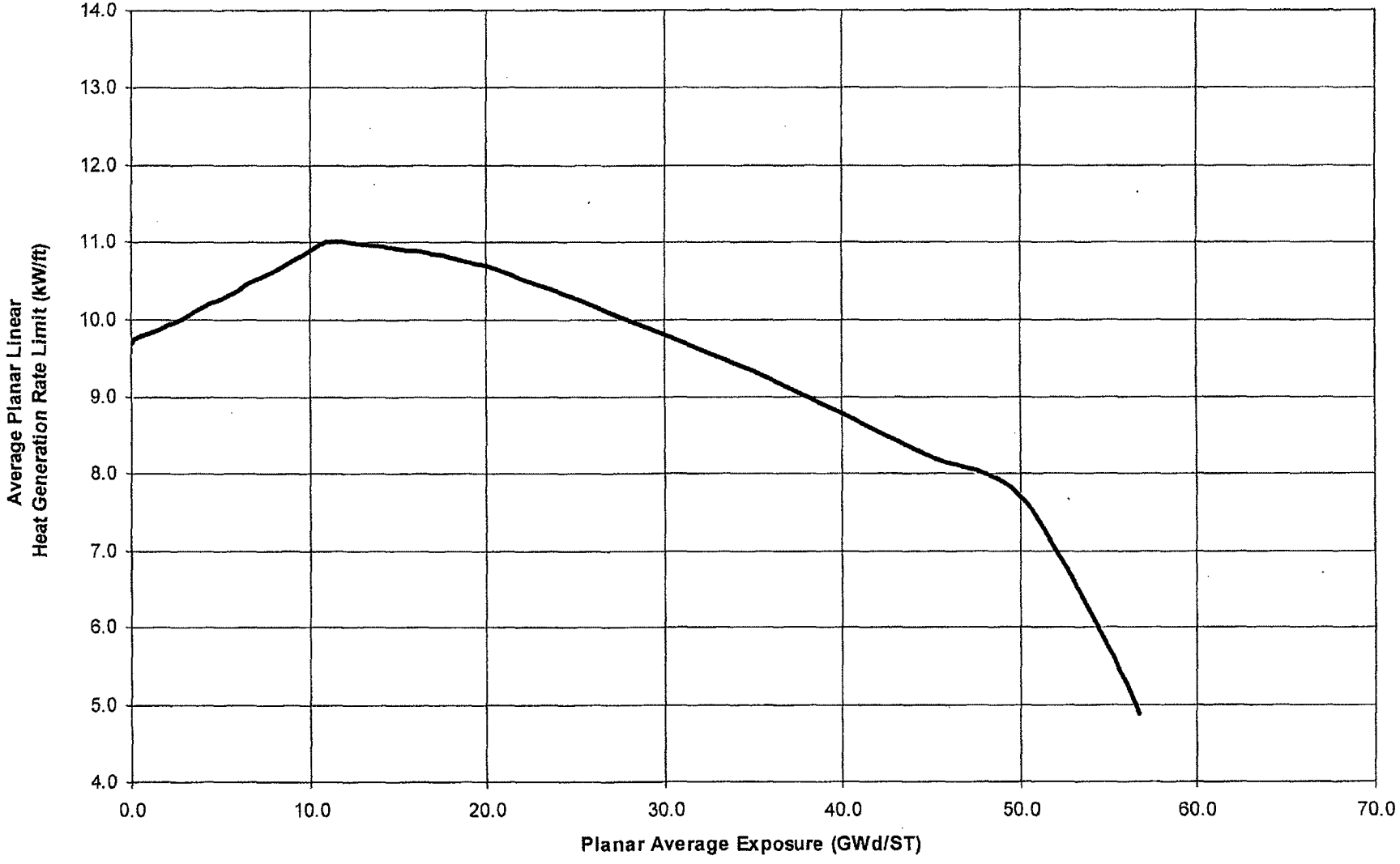

Figure 6

CONTROLLED COPY

APLHGR vs Planar Average Exposure

GE14-P10DNAB410-16GZ-100T-150-T6-2919

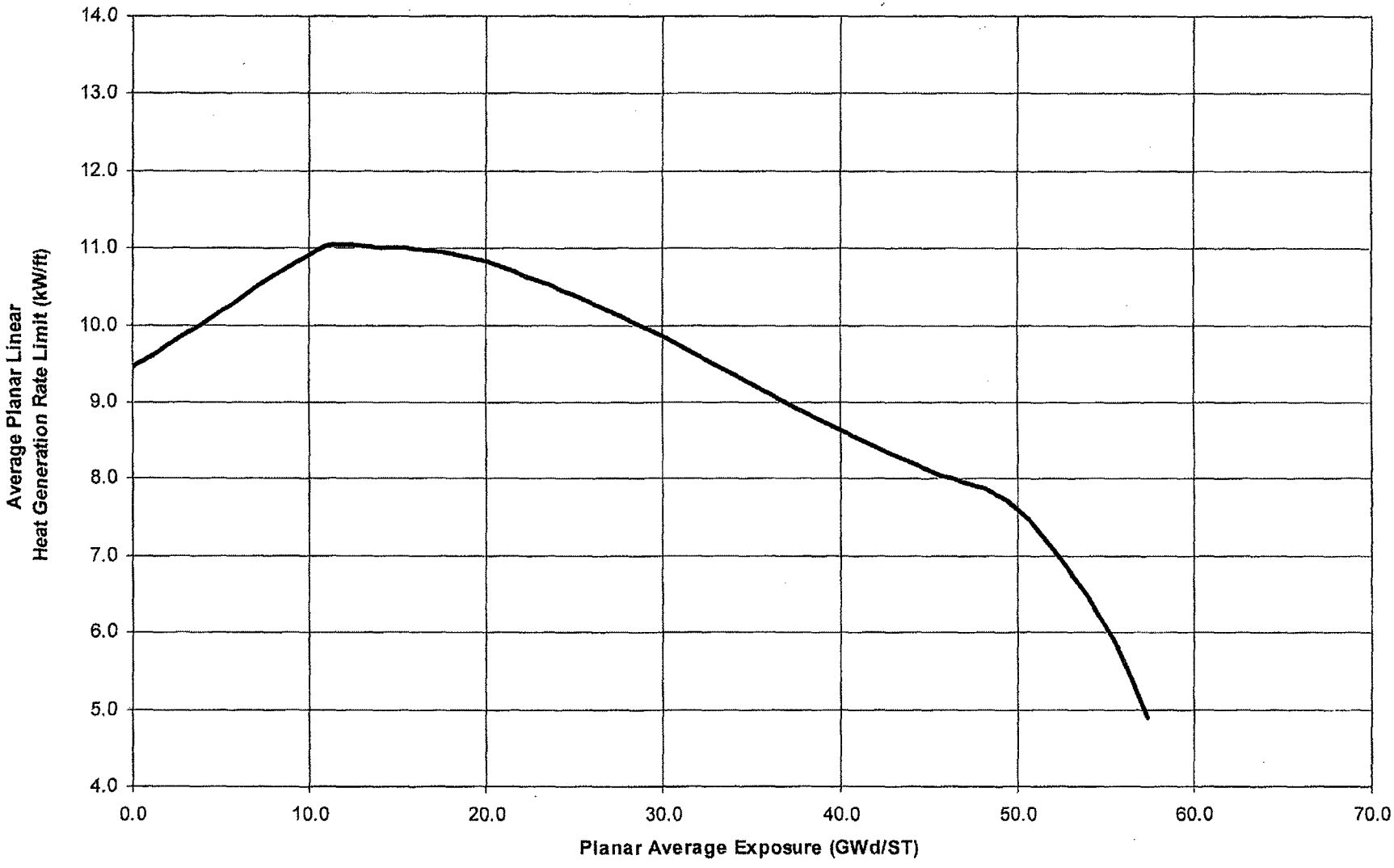

Figure 7

APLHGR vs Planar Average Exposure

GE14-P10DNAB407-18GZ-100T-150-T6-2920

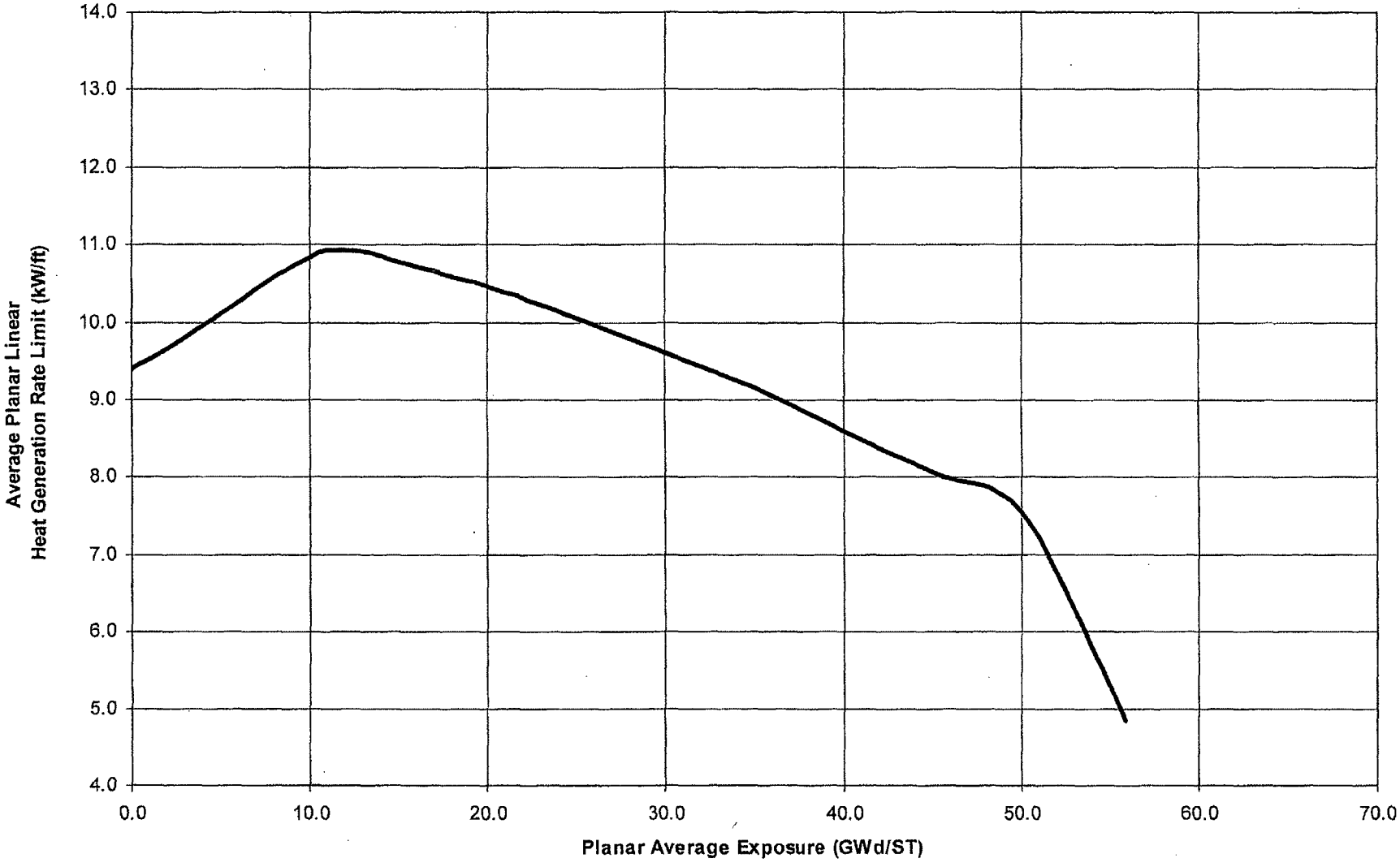

Figure 8

Flow Dependent LHGR and MAPLHGR Multipliers

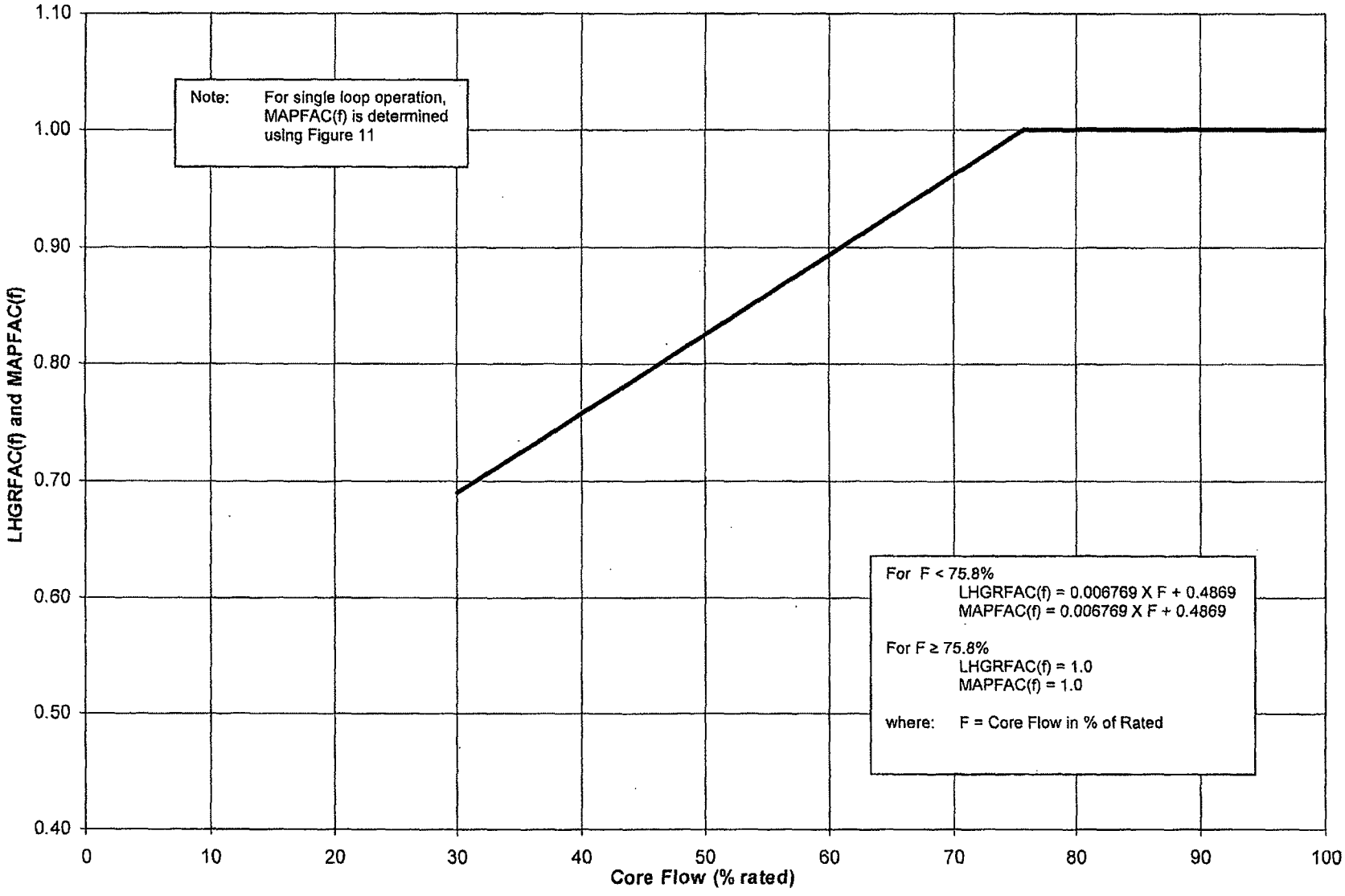

Figure 9

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Power Dependent LHGR and MAPLHGR Multipliers

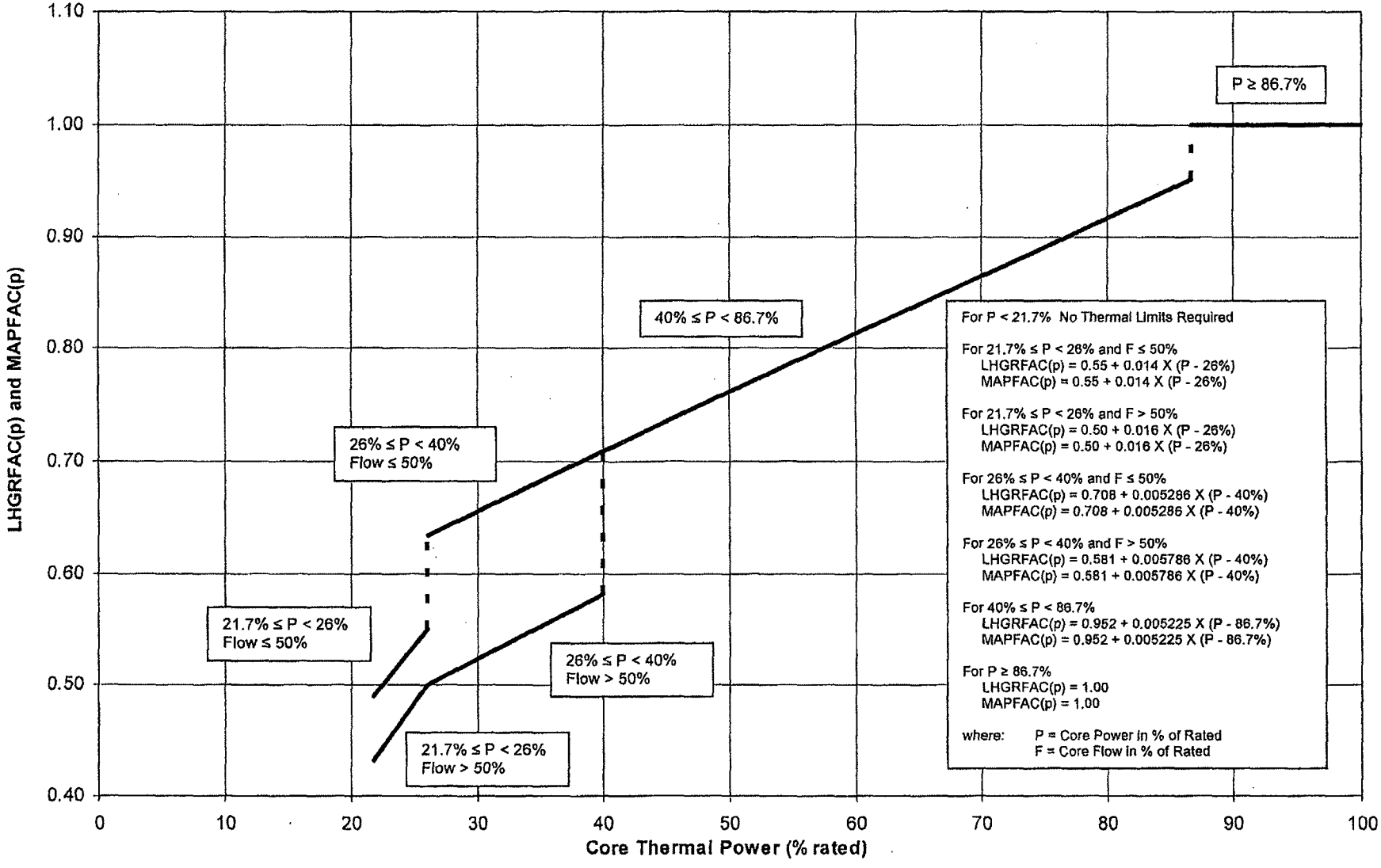

Figure 10

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Flow Dependent MAPLHGR Multipliers
Single Loop Operation

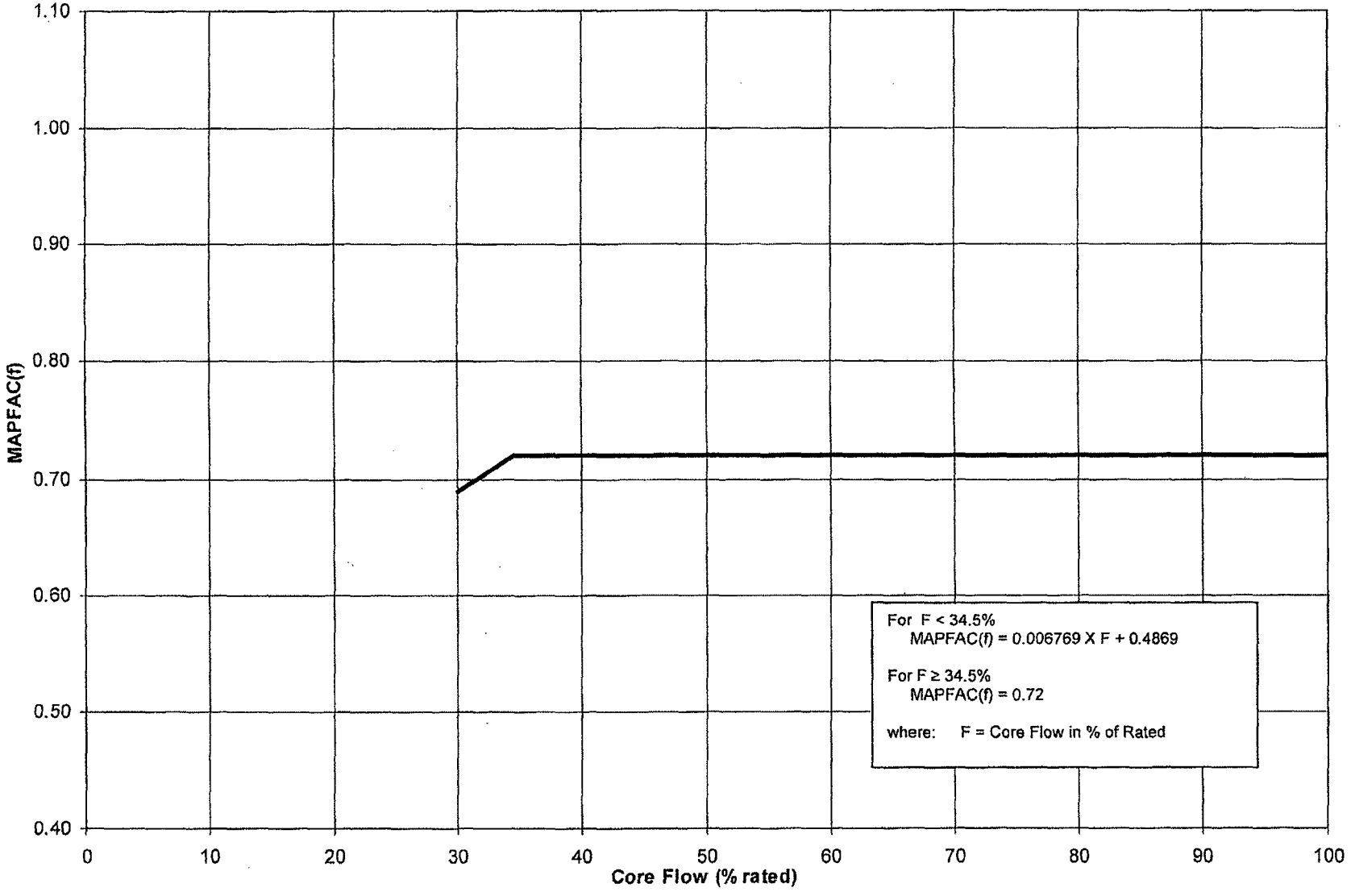

Figure 11

Power Dependent MCPR Limits

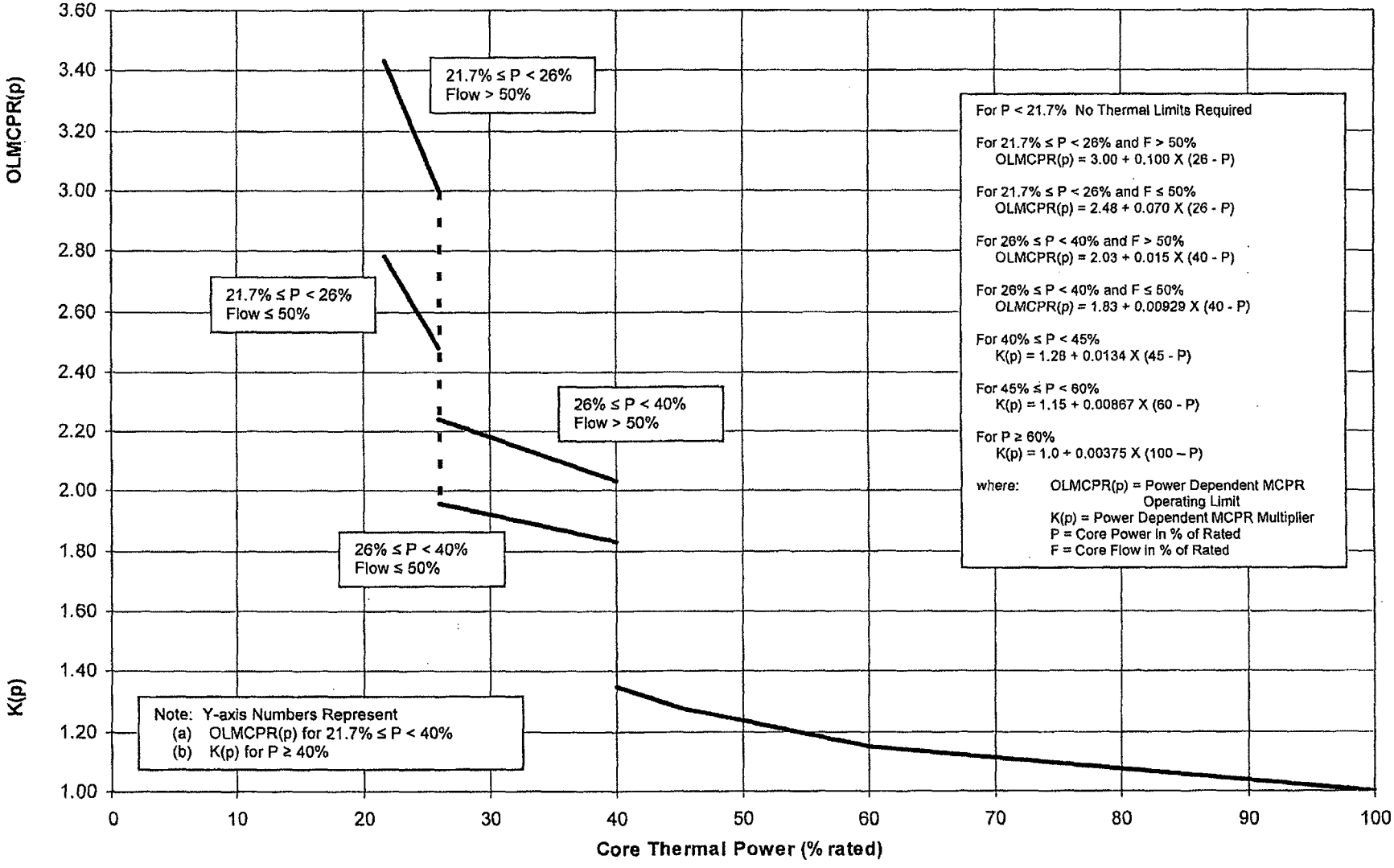

Figure 12

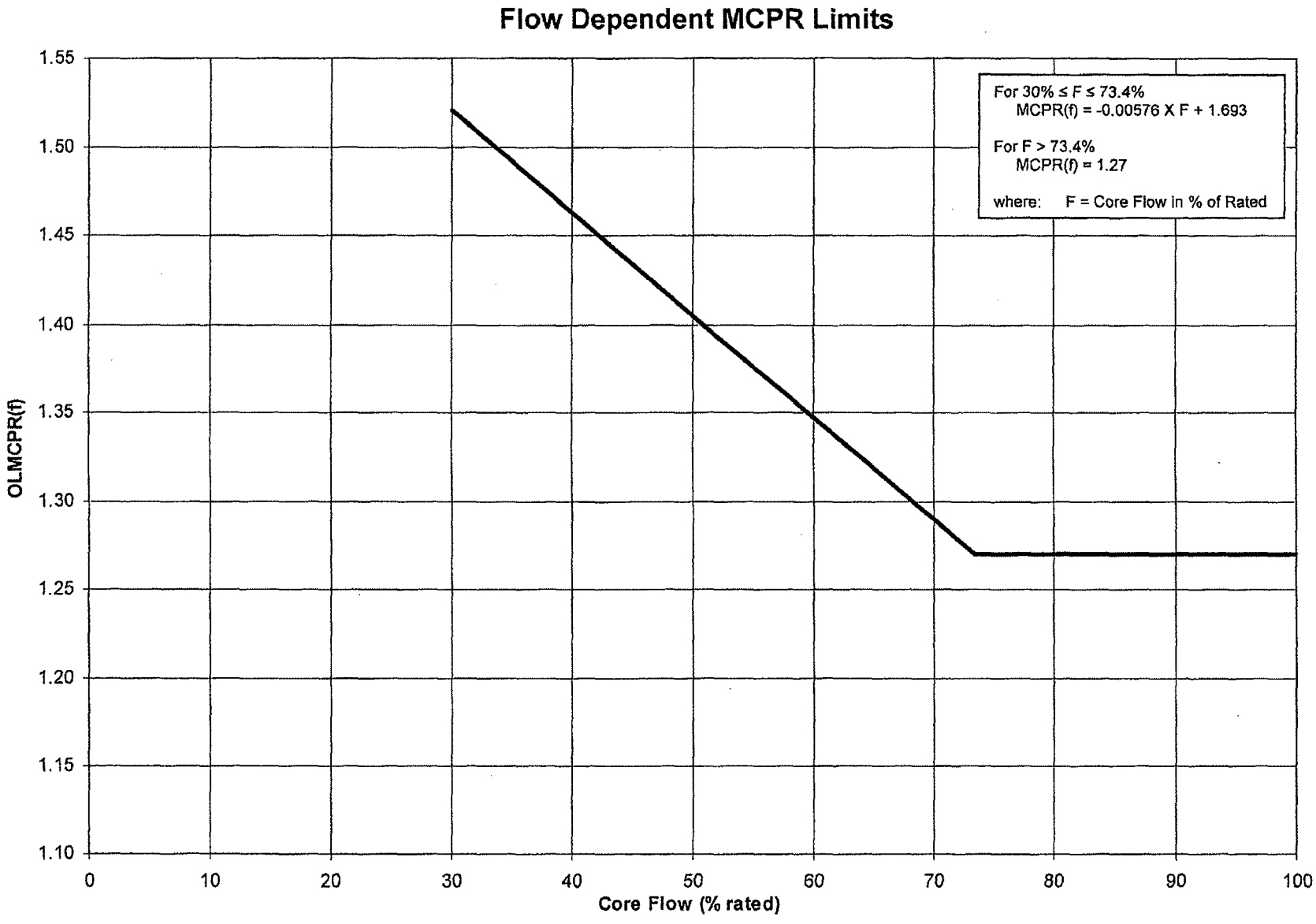

Figure 13

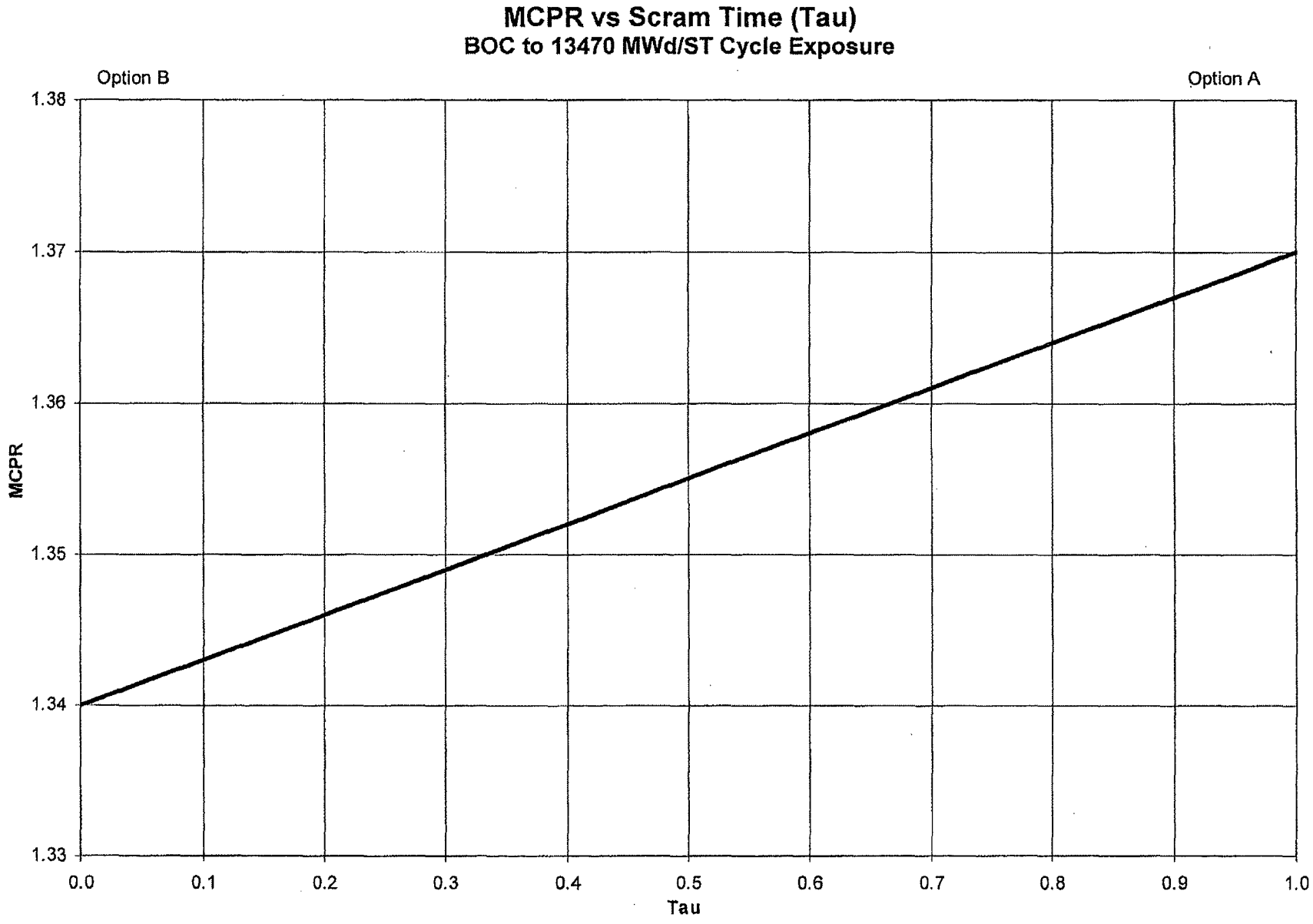

Figure 14

MCPR vs Scram Time (Tau)
13470 MWd/ST to EOC Cycle Exposure

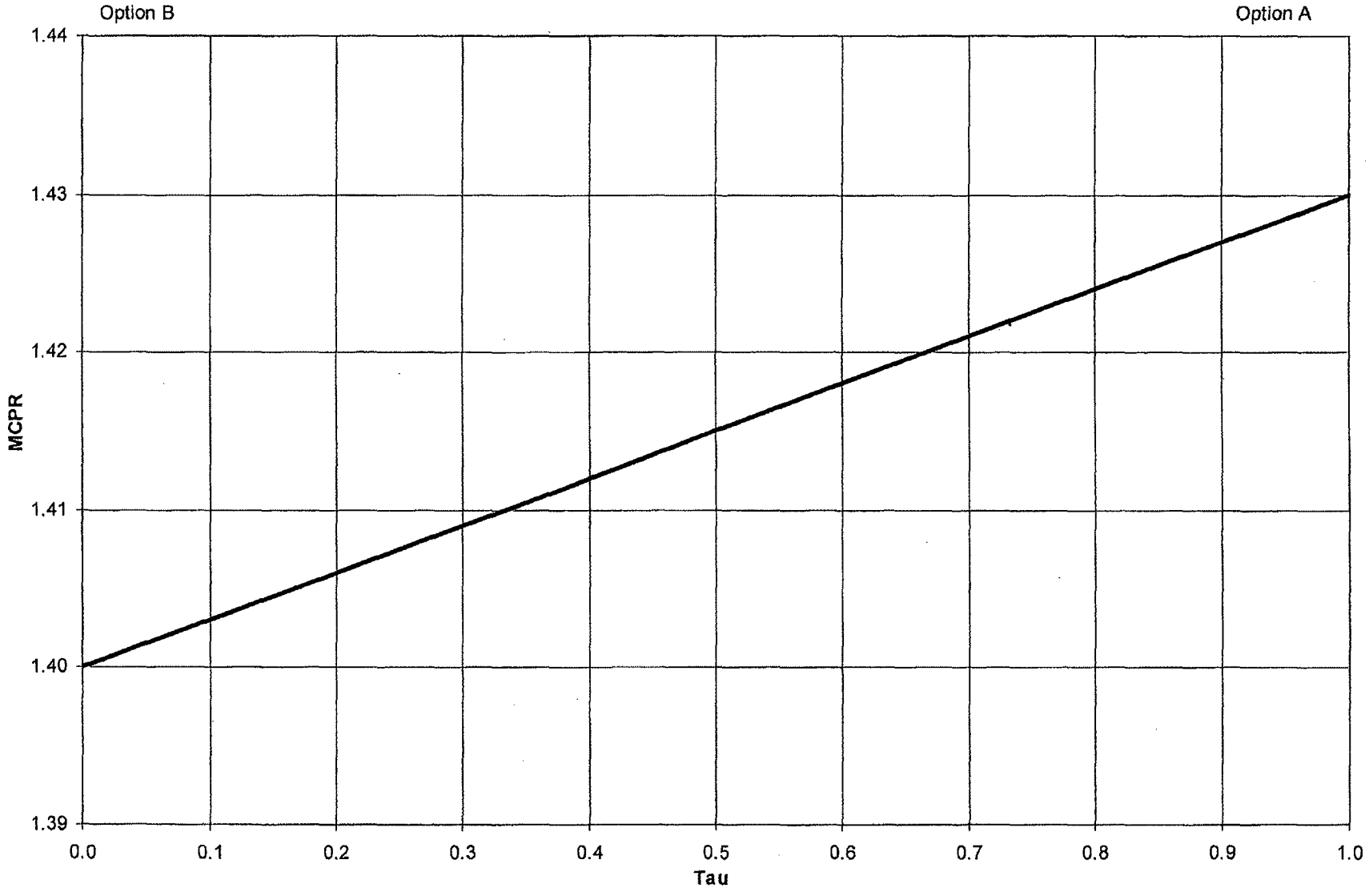

Figure 15

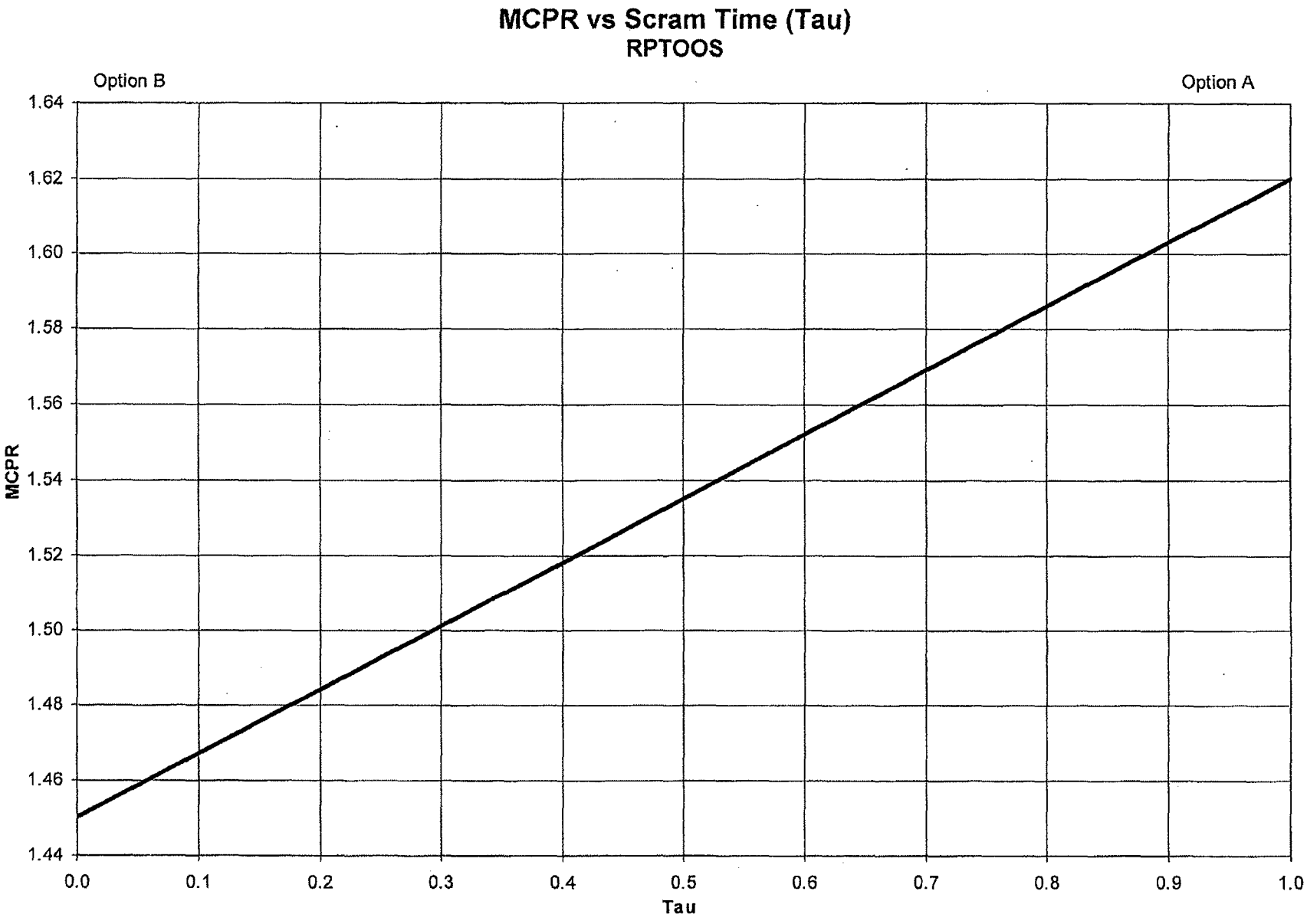

Figure 16

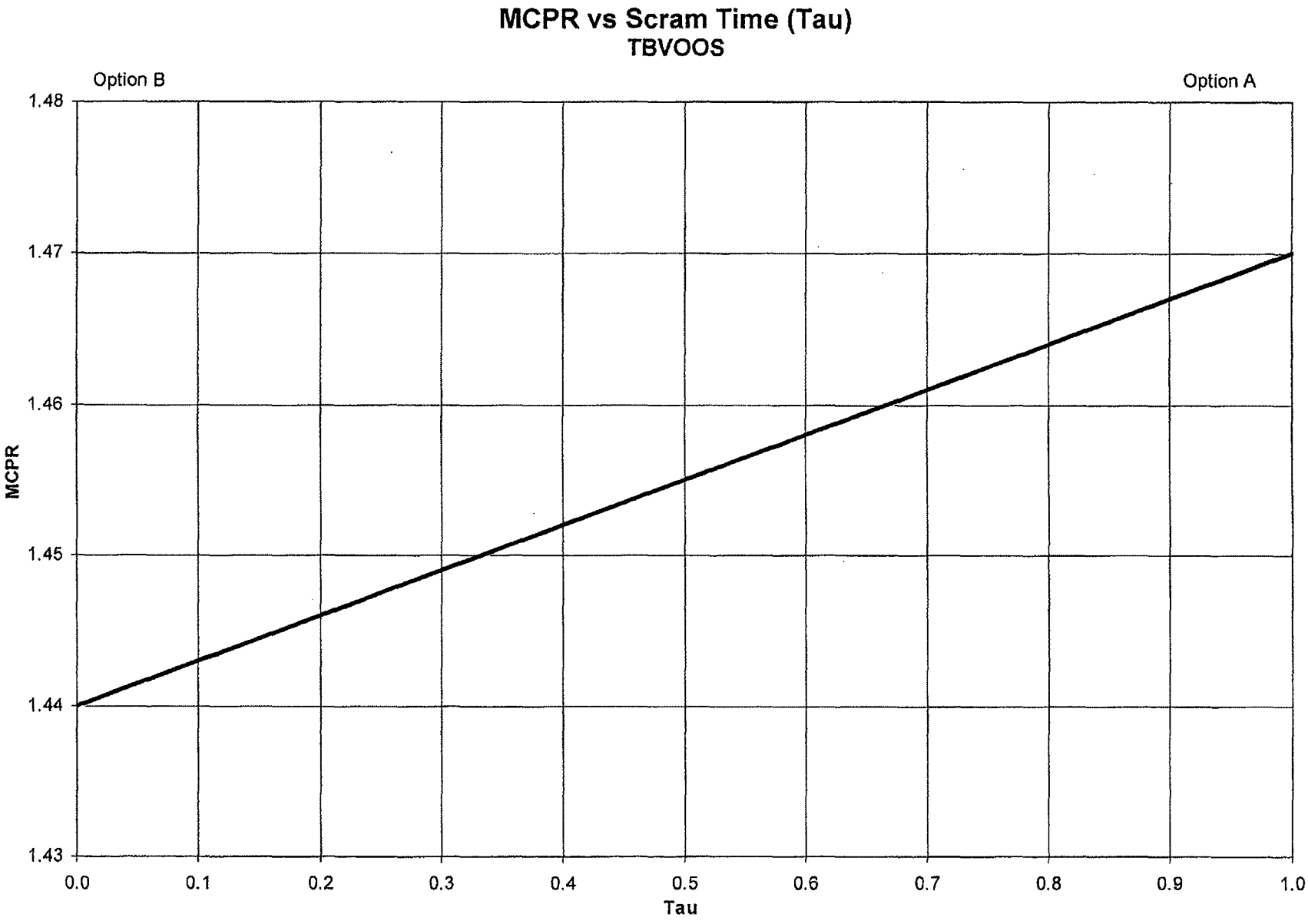

Figure 17

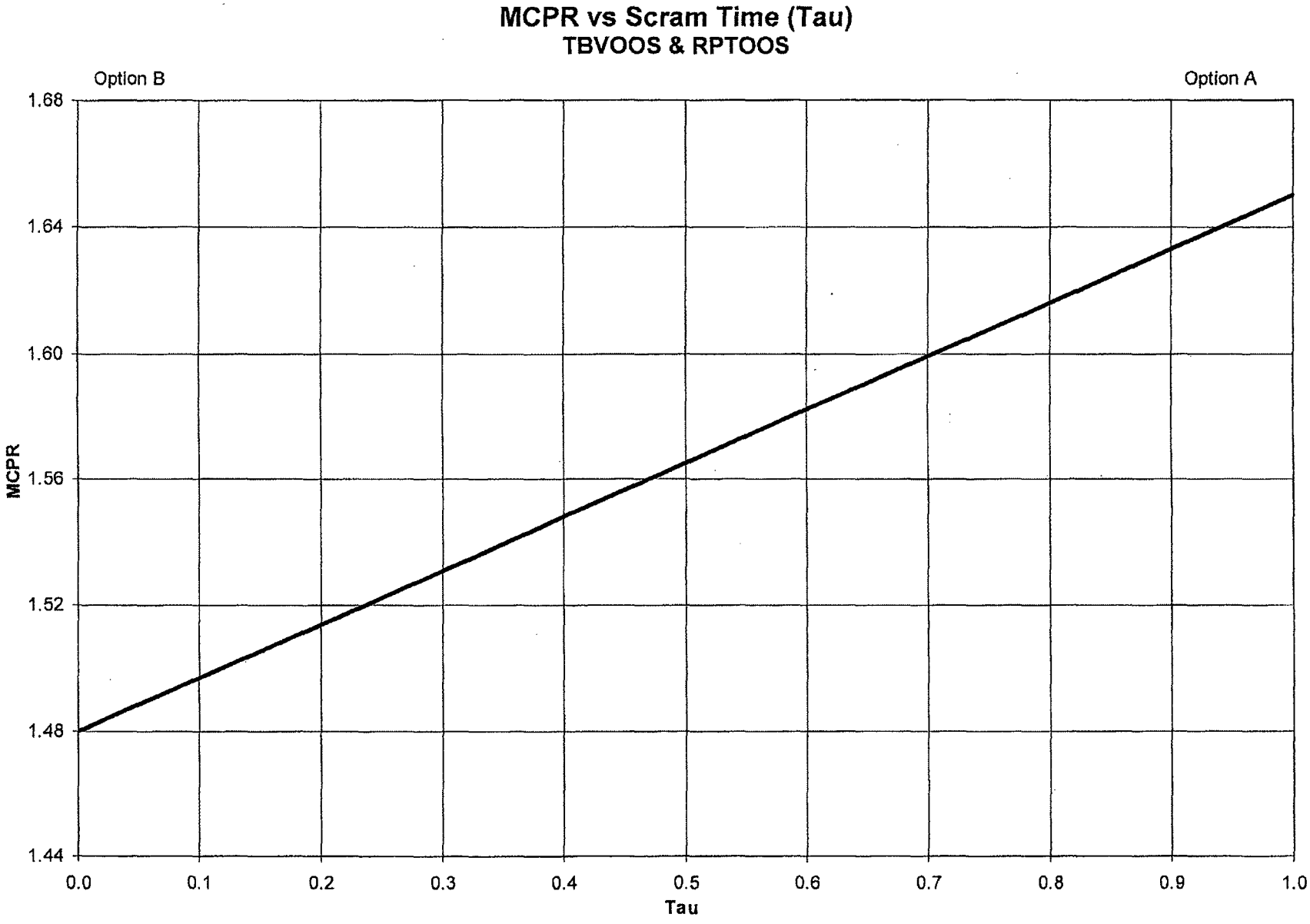

Figure 18

DAEC Stability Power/Flow Map
Cycle 21 - 1912 MWth

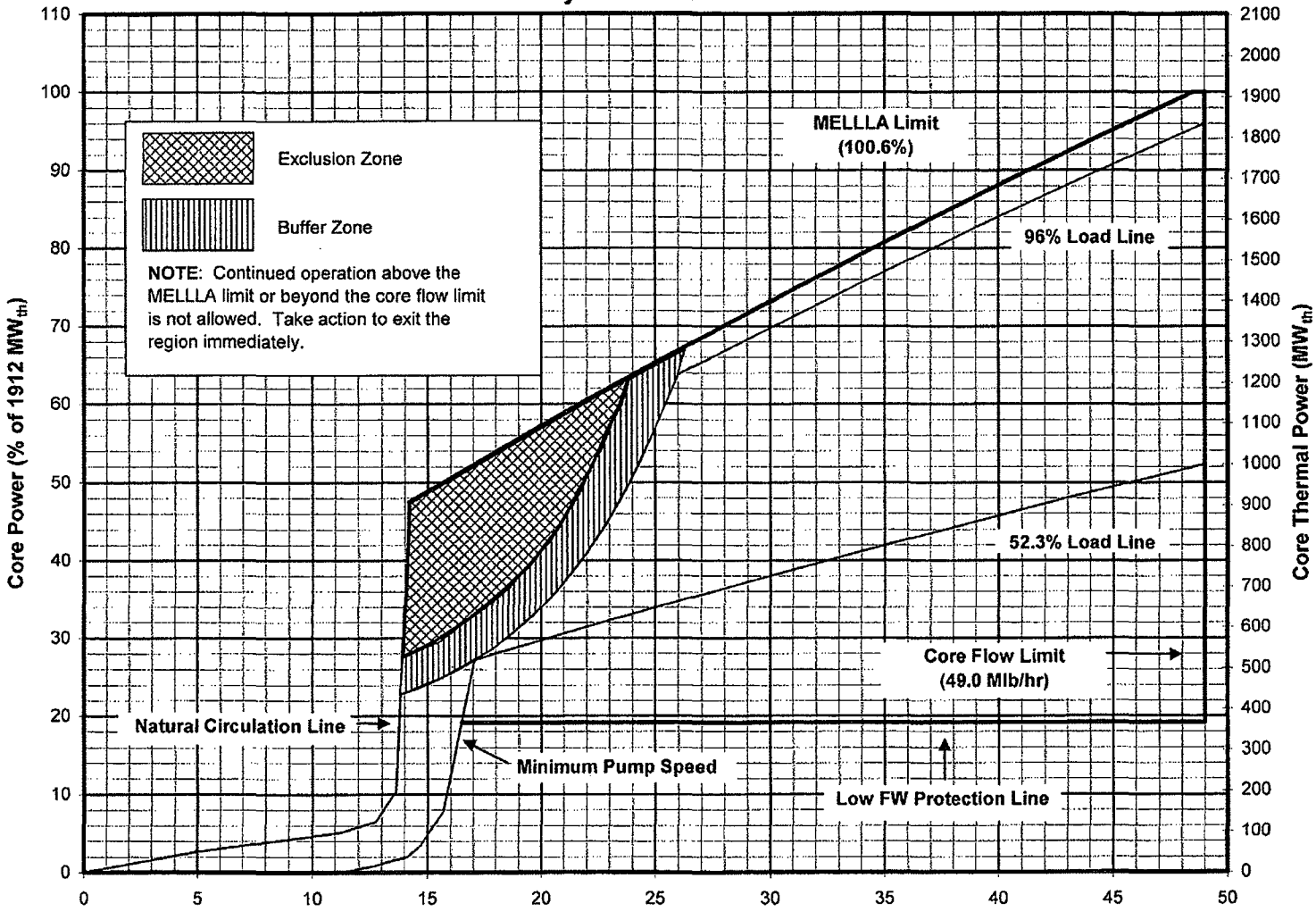

Figure 19