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DAEC Plant Support Center
Operated by Nuclear Management Company, LLC

November 7, 2001
NG-01-1289

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station 0-P1-17
Washington, DC 20555-0001

Subject: Duane Arnold Energy Center (DAEC)
Docket No: 50-331
Op. License No: DPR-49
Core Operating Limits Report for DAEC Cycle 18 Operation for 1912 MWth
Reference: Letter, dated May 18, 2001, NG-01-0687, from K. Putnam (NMC) to NRC, "Revised Core Operating Limits Report for DAEC Cycle 18 Operation"
File: A-117, J-60a

Dear Sir/Madam:

In accordance with the requirements of Duane Arnold Energy Center Technical Specifications Section 5.6.5.d, a copy of the Core Operating Limits Report (COLR) for Cycle 18 operation for 1912 megawatts thermal (MWth) is enclosed. This COLR has been prepared using NRC-approved methods and confirms that all applicable limits of the safety analysis have been met. The previously submitted COLR for 1658 MWth (Reference 1) should be replaced in its entirety with this COLR.

No new commitments are made by this letter.

Please contact this office if you have any questions regarding this matter.

Sincerely,

Kenneth S. Putnam
Manager, Licensing

Enclosure: Core Operating Limits Report - Cycle 18 for 1912 MWth

cc: H. Tran (w/a)
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DUANE ARNOLD ENERGY CENTER

Cycle 18

CORE OPERATING LIMITS REPORT

for

1912 MW Rated Thermal Power

Rev. 0

October 2001

Prepared by: Bridget M. Hendrickson 10-3-2001

Verified by: Matt Braadt 10-3-01

Concurred by: 10/15/2001
Manager, Licensing

for JB 10-12-01
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Brad Hopkins for D. Mienke 10/15/2001
Project Manager, Nuclear Fuel Services-DAEC

10-5-01
Manager, Operations Support

Reviewed by: OC # 2001-40 10/16/01
Chairman, Operations Committee

Approved by: 11/7/01
Plant Manager, Nuclear

1.0 Core Operating Limits Report

This Core Operating Limits Report for Cycle 18 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 MW. The core operating limits have been developed using NRC-approved methodology (Ref. 1) and are documented in References 2, 3, 4, 5, and 15. The Cycle 18 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-14, June 2000

2. Supplemental Reload Licensing Report for Duane Arnold Energy Center, Reload 17, Cycle 18, Power Rerate to 1912 MWth, J11-03834SRLR1912, Rev. 1, September 2001

3. Fuel Bundle Information Report for Duane Arnold Energy Center, Reload 17, Cycle 18, J11-03834FBIR, Rev. 0, March 2001

4. Duane Arnold Energy Center GE12 Fuel Upgrade Project, NEDC-32915P, November, 1999

5. Duane Arnold Energy Center Asset Enhancement Program, Task T0304: Reactor Internal Pressure Differences, GE-NE-A22-00100-11-01, Rev. 0, August 2000

6. Average Power Range Monitor, Rod Block Monitor and Technical Specification Improvement (ARTS) Program for the Duane Arnold Energy Center, NEDC-30813, December 1984

7. GE Fuel Bundle Designs, NEDE-31152P, Rev. 7, June 2000

8. GE12 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II), NEDE-32417P, December 1994

9. GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II), NEDC-32868P, Rev. 0, December 1998

10. Letter from S. A. Richards (NRC) to J. F. Klapproth (GENE), "Review of NEDC-32992P, ODYSY Application for Stability Licensing Calculations," April 20, 2001

11. Lattice-Dependent MAPLHGR Report for Duane Arnold Energy Center Reload 15 Cycle 16, 23A5410AA, Rev. 0, March 1998

12. Lattice-Dependent MAPLHGR Report for Duane Arnold Energy Center Reload 16 Cycle 17, J11-03517MAPL, Rev. 0, October 1999

Preparer Initials: BWA
Verifier Initials: MB

13. Letter from T. Orr (GNF) to A. Hess (NMC), "Transmittal of Verified Composite MAPLHGRs for GE14 in DAEC Cycle 18", TGO:01-039, May 15, 2001

14. Duane Arnold Energy Center Asset Enhancement Program, Task T0407: ECCS-LOCA SAFER/GESTR, GE-NE-A22-00100-29-01, Rev. 0, September 2000

15. Cycle Management Report, Supplement 1 for Duane Arnold Energy Center, Cycle 18 with Power Rerate, J11-03834CMR, Supplement 1, September 2001

Preparer Initials: BWJ AH
Verifier Initials: MB

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, and 7 multiplied by the smaller of the two MAPFAC/LHGRFAC factors determined from Figures 8 and 9.

   b. During 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, and 7 multiplied by the smaller of the two MAPFAC/LHGRFAC factors determined from Figures 9 and 10.

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

The above APLHGR limits are a 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 26% of rated ($21.7\% \leq P < 26\%$), the Operating Limit MCPR is given by Figure 11. For core thermal power greater than or equal to 26% of rated ($P \geq 26\%$), the Operating Limit MCPR is the greater of either:

      i) The applicable flow-dependent MCPR determined from Figure 12, or

      ii) The appropriate RATED POWER MCPR from Figure 13 or 14 [Figure 15 for Recirculation Pump Trip Out of Service (RPTOOS); Figure 16 for both Turbine Bypass Valves Out-of-Service (TBVOOS); Figure 17 for TBVOOS and RPTOOS], multiplied by the applicable power-dependent MCPR multiplier determined from Figure 11.

   b. During SLO with core thermal power greater than or equal to 21.7% of rated, the SLO Operating Limit MCPR is determined by adding 0.02 to the Operating Limit MCPR determined above.

Preparer Initials: BWA
Verifier Initials: MB

4.0 Reload Fuel Bundles

FUEL TYPE	CYCLE LOADED	NUMBER
GE10-P8DXB341-9GZ-100T-150-T6	16	64
GE10-P8DXB342-12GZ-100T-150-T6	16	40
GE12-P10DSB371-12GZ-100T-150-T6	17	80
GE12-P10DSB370-14GZ-100T-150-T6	17	48
GE14-P10DNAB407-16GZ-100T-150-T6-3898	18	40
GE14-P10DNAB402-17GZ-100T-150-T6-3897	18	56
GE14-P10DNAB398-15GZ-100T-150-T6-3896	18	40

5.0 Thermal-Hydraulic Stability

a. Continued reactor operation within the "Exclusion Zone" on the power/flow map, as defined on Figure 18, is not permitted. (SR 3.4.1.2)

b. Continued reactor operation within the "Buffer Zone" on the power/flow map, as defined on Figure 18, is not permitted when the thermal-hydraulic stability monitor (SOLOMON) is not operational.

Preparer Initials: BMH AH
Verifier Initials: MS

TABLE 1

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

for

GE10-P8DXB341-9GZ-100T-150-T6

Planar Average Exposure (GWd/ST)	APLHGR Limit (KW/ft)
0.00	11.87
0.20	11.89
1.00	11.94
2.00	12.08
3.00	12.26
4.00	12.44
5.00	12.55
6.00	12.66
7.00	12.76
8.00	12.86
9.00	12.99
10.00	13.12
12.50	13.35
15.00	12.89
20.00	12.02
25.00	11.20
35.00	9.73
45.00	8.54
51.02	5.65

Preparer Initials: BmH AH
Verifier Initials: MB

TABLE 2

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

for

GE10-P8DXB342-12GZ-100T-150-T6

Planar Average Exposure (GWd/ST)	APLHGR Limit (KW/ft)
0.00	11.27
0.20	11.32
1.00	11.42
2.00	11.63
3.00	11.87
4.00	12.01
5.00	12.15
6.00	12.29
7.00	12.44
8.00	12.61
9.00	12.81
10.00	13.02
12.50	13.15
15.00	13.09
20.00	12.27
25.00	11.47
35.00	9.90
45.00	8.53
50.98	5.64

Preparer Initials: BWJ AH
Verifier Initials: MB

TABLE 3

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

for

GE12-P10DSB371-12GZ-100T-150-T6

Planar Average Exposure (GWd/ST)	APLHGR Limit (KW/ft)
0.00	8.99
0.20	9.04
1.00	9.13
2.00	9.26
3.00	9.40
4.00	9.54
5.00	9.69
6.00	9.84
7.00	9.98
8.00	10.11
9.00	10.17
10.00	10.23
11.00	10.30
12.00	10.30
13.00	10.29
14.00	10.28
15.00	10.19
17.00	9.99
20.00	9.69
25.00	9.21
30.00	8.73
35.00	8.26
40.00	7.81
45.00	7.29
50.00	6.79
55.00	6.29
57.84	6.01

Preparer Initials: BMJ AJ
Verifier Initials: MS

TABLE 4

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

for

GE12-P10DSB370-14GZ-100T-150-T6

Planar Average Exposure (GWd/ST)	APLHGR Limit (KW/ft)
0.00	8.92
0.20	8.95
1.00	9.01
2.00	9.13
3.00	9.27
4.00	9.41
5.00	9.56
6.00	9.72
7.00	9.88
8.00	10.01
9.00	10.13
10.00	10.23
11.00	10.31
12.00	10.31
13.00	10.31
14.00	10.30
15.00	10.21
17.00	10.00
20.00	9.69
25.00	9.20
30.00	8.72
35.00	8.25
40.00	7.79
45.00	7.27
50.00	6.77
55.00	6.27
57.68	6.00

Preparer Initials: BWA
Verifier Initials: MD

TABLE 5

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

for

GE14-P10DNAB407-16GZ-100T-150-T6-3898

Planar Average Exposure (GWd/ST)	APLHGR Limit (KW/ft)
0.00	9.92
0.20	9.99
1.00	10.08
2.00	10.19
3.00	10.31
4.00	10.44
5.00	10.57
6.00	10.71
7.00	10.80
8.00	10.89
9.00	10.97
10.00	11.06
11.00	11.15
12.00	11.18
13.00	11.17
14.00	11.16
15.00	11.14
17.00	11.08
19.13	10.95
20.00	10.89
25.00	10.50
30.00	10.00
35.00	9.38
40.00	8.80
45.00	8.26
50.00	7.75
55.00	6.29
57.61	4.99
57.90	4.85

Preparer Initials: BWH AJ
Verifier Initials: MB

TABLE 6

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

for

GE14-P10DNAB402-17GZ-100T-150-T6-3897

Planar Average Exposure (GWd/ST)	APLHGR Limit (KW/ft)
0.00	9.91
0.20	9.95
1.00	10.03
2.00	10.13
3.00	10.23
4.00	10.34
5.00	10.44
6.00	10.55
7.00	10.66
8.00	10.77
9.00	10.89
10.00	11.01
11.00	11.13
12.00	11.18
13.00	11.15
14.00	11.12
15.00	11.08
17.00	11.00
19.13	10.87
20.00	10.82
25.00	10.28
30.00	9.74
35.00	9.13
40.00	8.55
45.00	8.01
50.00	7.51
55.00	6.16
57.61	4.86
57.67	4.83

Preparer Initials: BMH AH
Verifier Initials: MB

TABLE 7

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

Preparer Initials: BMH AH
Verifier Initials: MS

APLHGR vs PAE

GE10-P8DXB341-9GZ-100T-150-T6

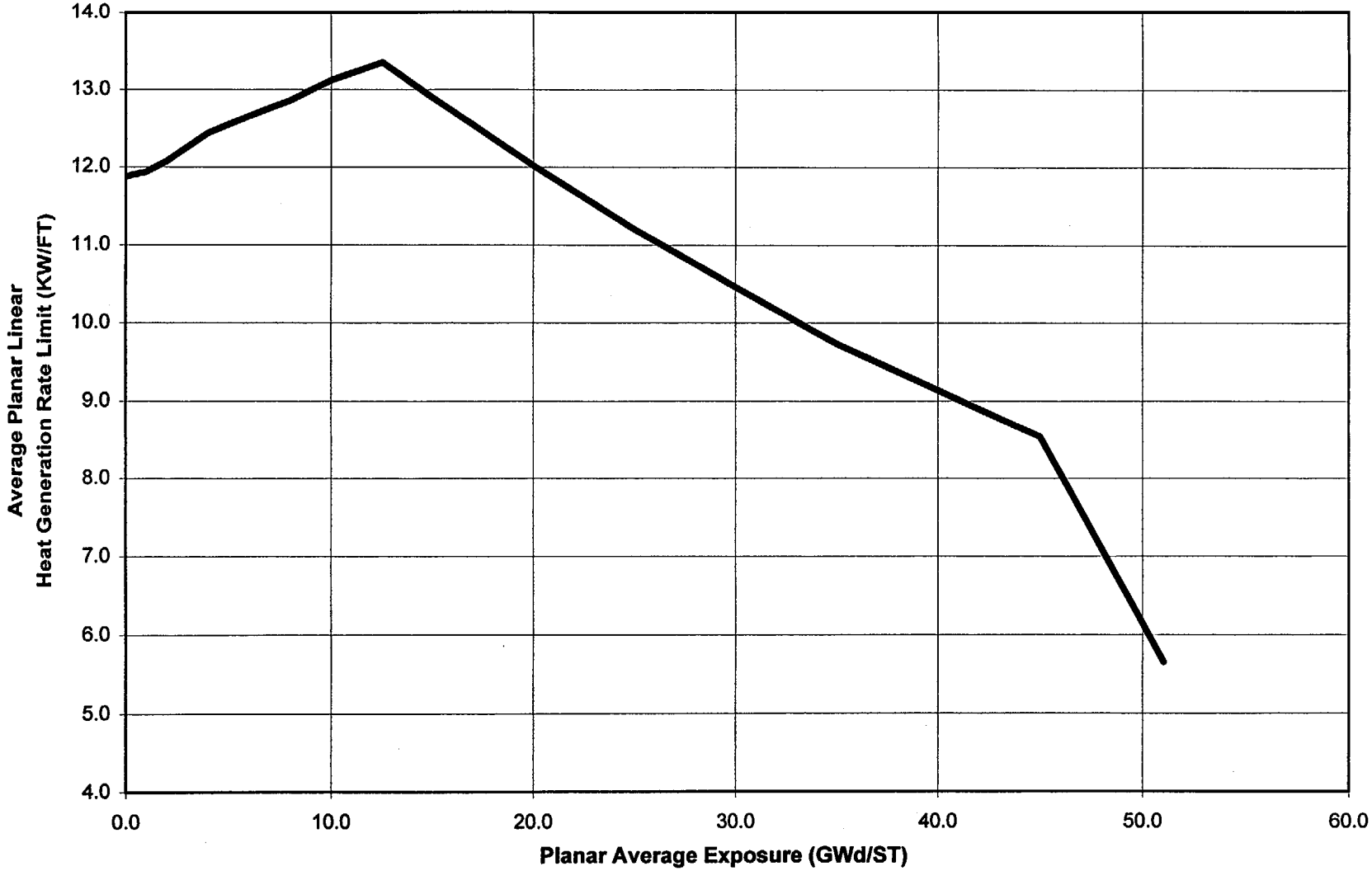

Figure 1

Preparer Initials BM/AH
Verifier Initials MS

APLHGR vs PAE

GE10-P8DXB342-12GZ-100T-150-T6

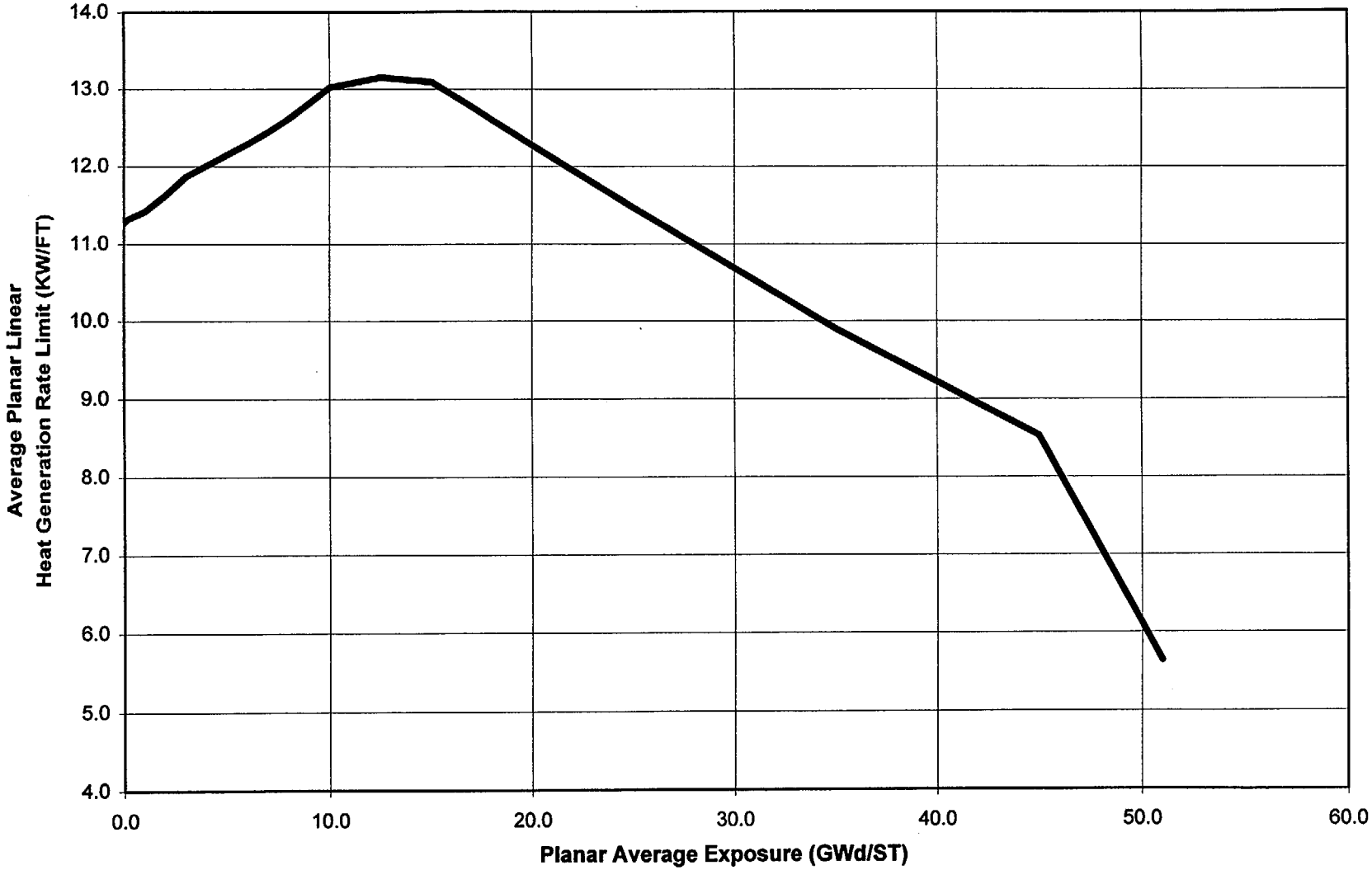

Figure 2

Preparer Initials EMJ AH
Verifier Initials MB

APLHGR vs PAE

GE12-P10DSB371-12GZ-100T-150-T6

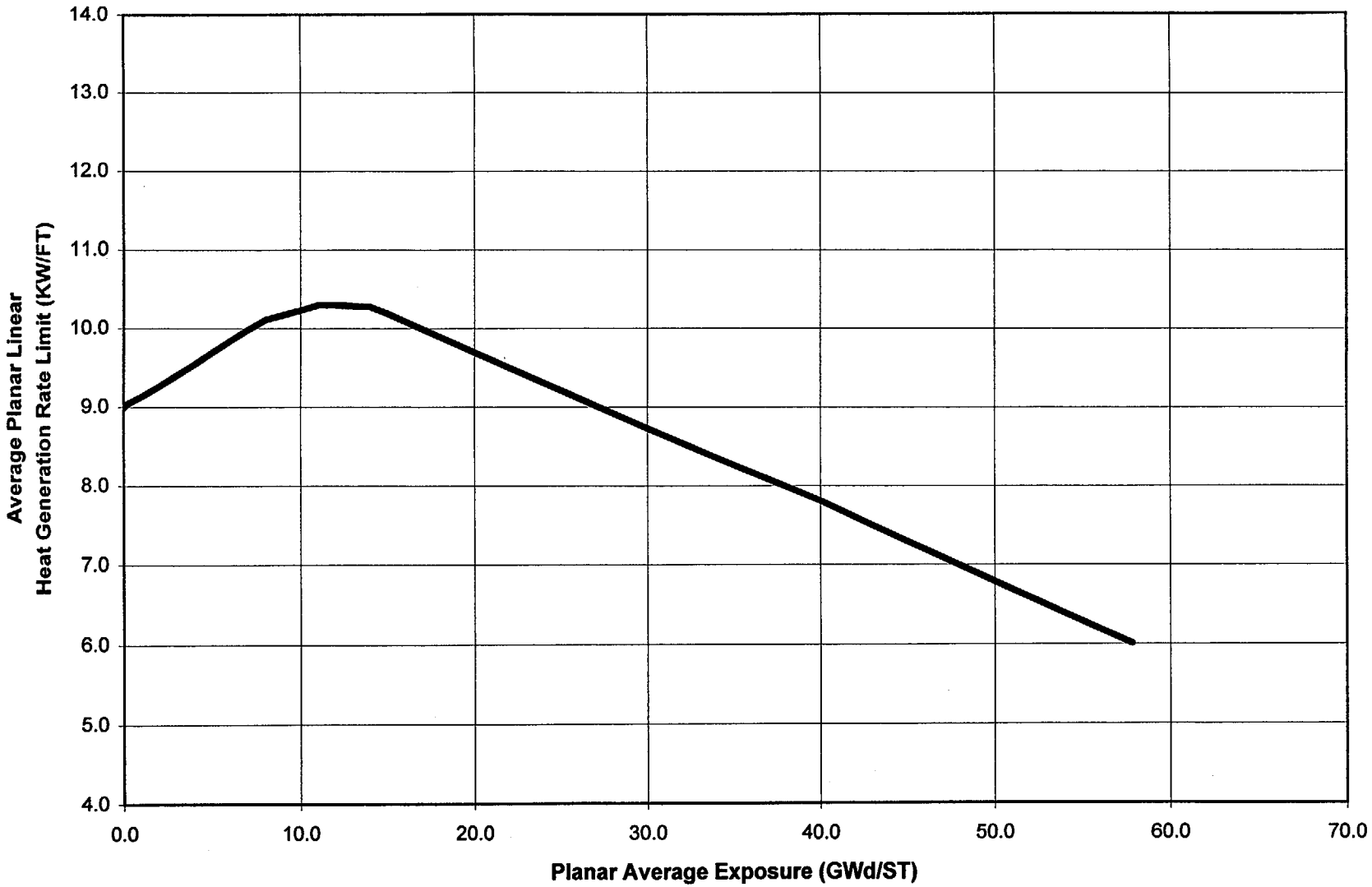

Figure 3

Preparer Initials BWL AH
Verifier Initials MB

APLHGR vs PAE

GE12-P10DSB370-14GZ-100T-150-T6

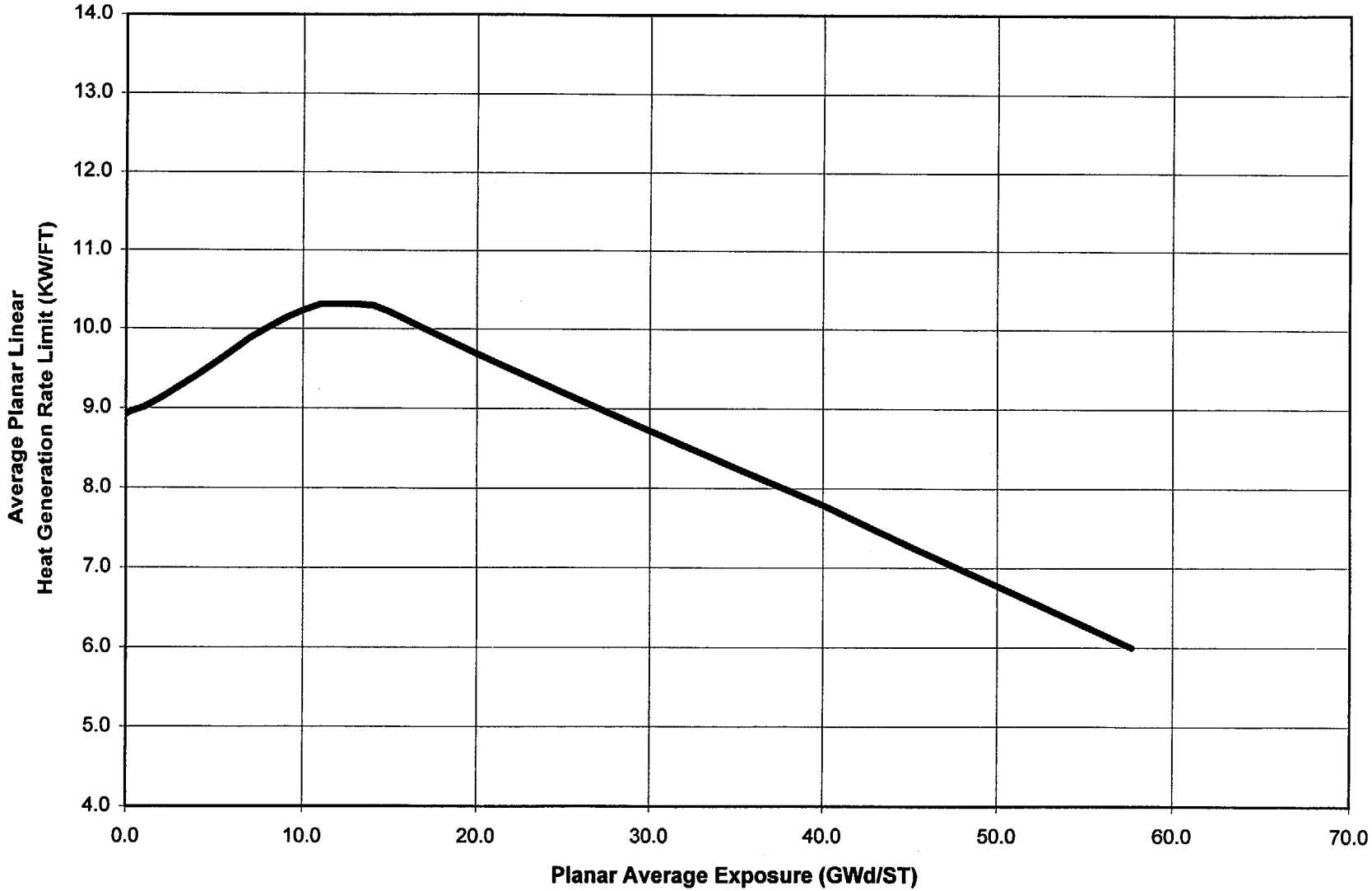

Figure 4

Preparer Initials GWL/AH
Verifier Initials MB

APLHGR VS PAE

GE14-P10DNAB407-16GZ-100T-150-T6-3898

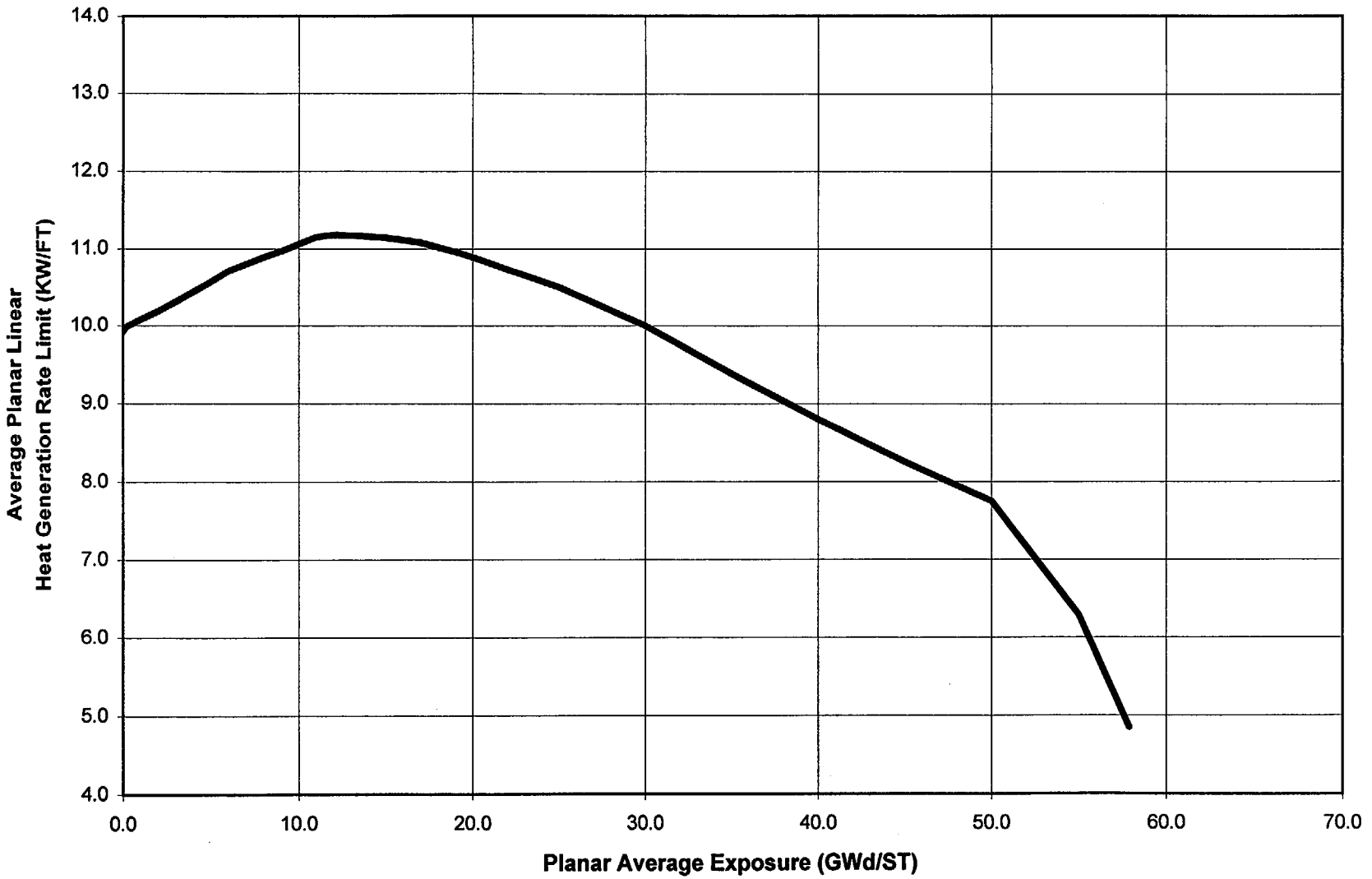

Figure 5

Preparer Initials BWL AH
Verifier Initials MB

APLHGR VS PAE

GE14-P10DNAB402-17GZ-100T-150-T6-3897

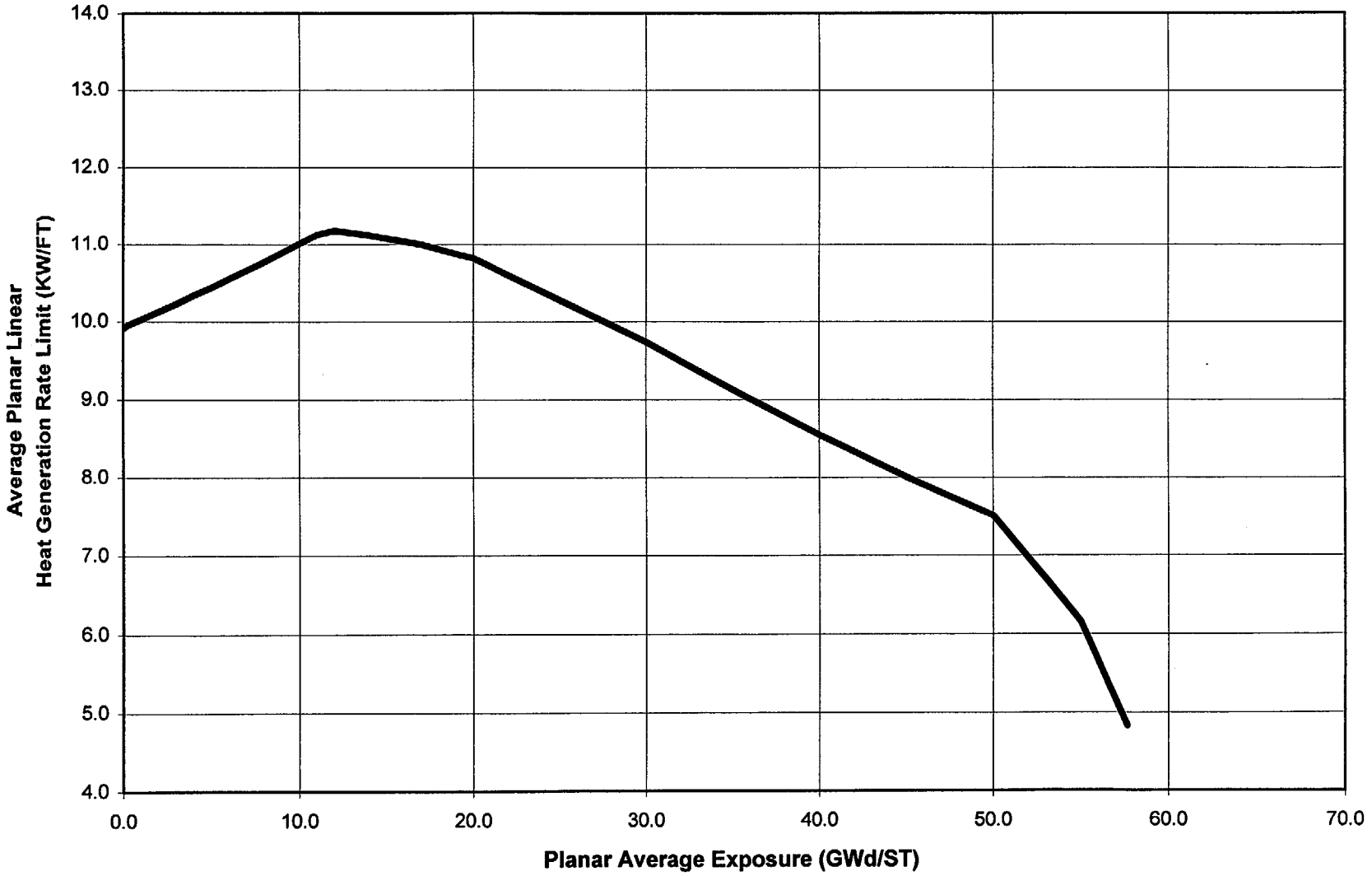

Figure 6

Preparer Initials BMJ AH
Verifier Initials MB

APLHGR VS PAE

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

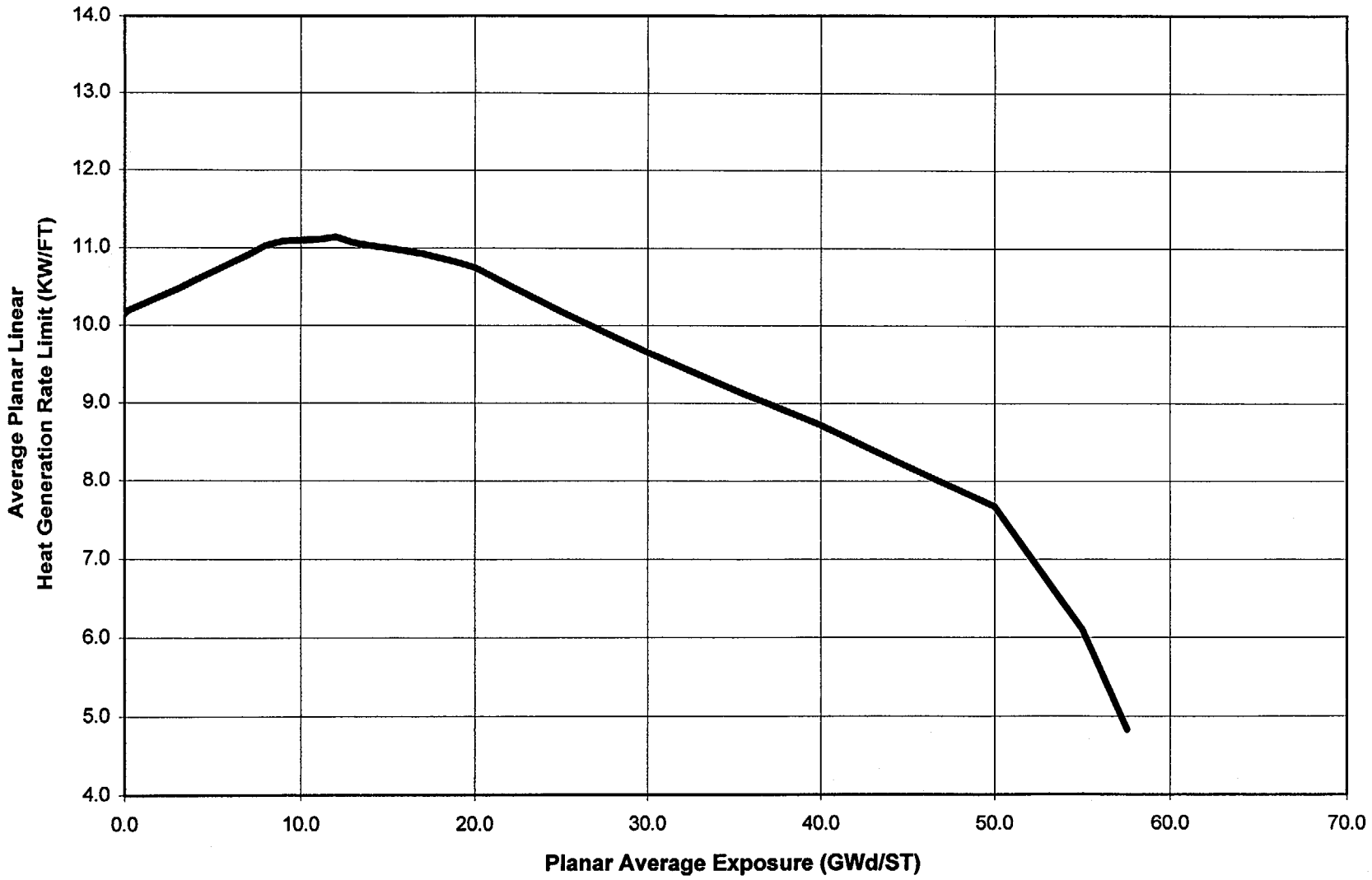

Figure 7

Preparer Initials BMJ AH

Verifier Initials

Flow Dependent LHGR and MAPLHGR Multiplier

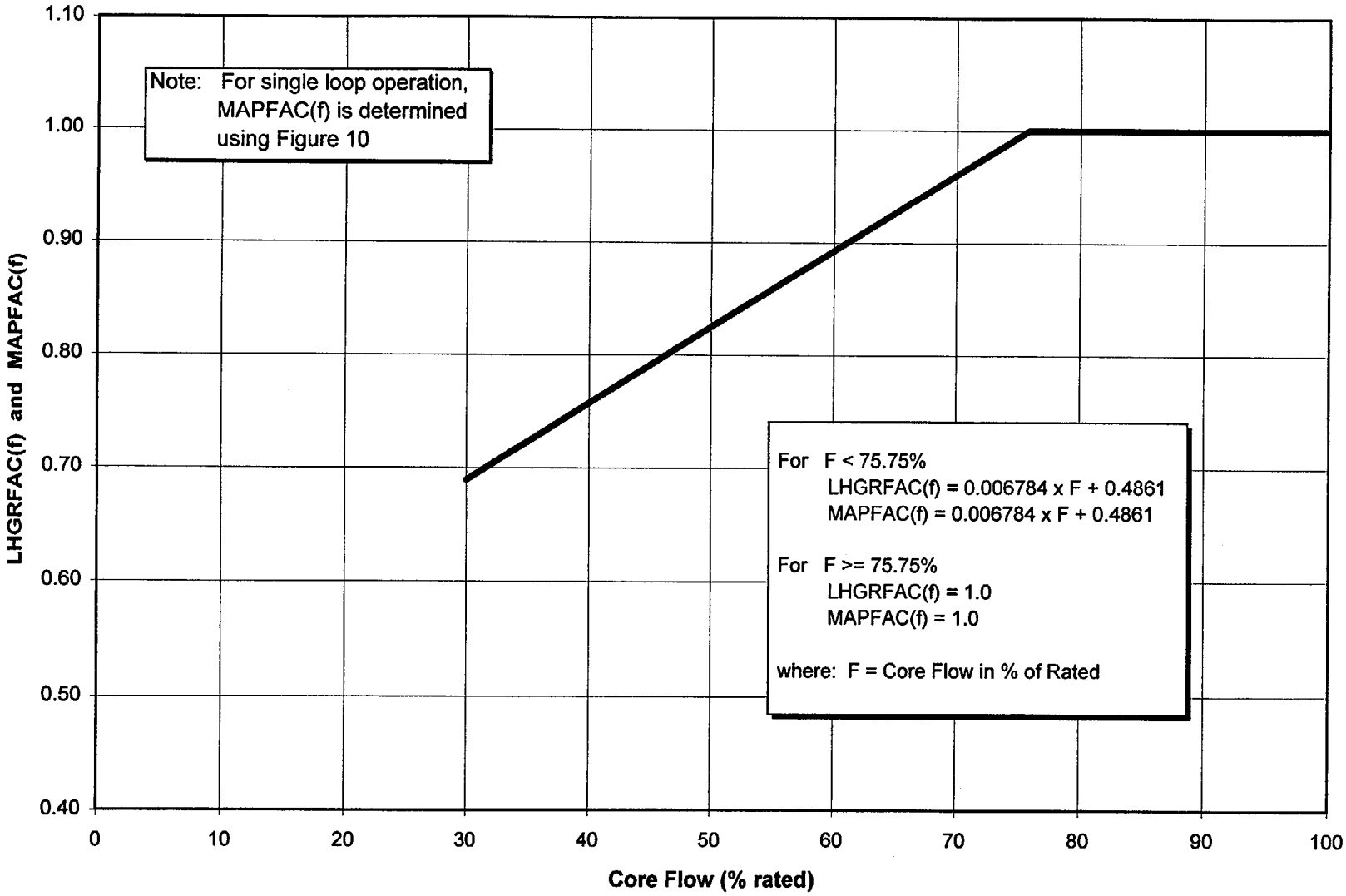

Figure 8

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Verifier Initials

Power Dependent LHGR and MAPLHGR MULTIPLIER

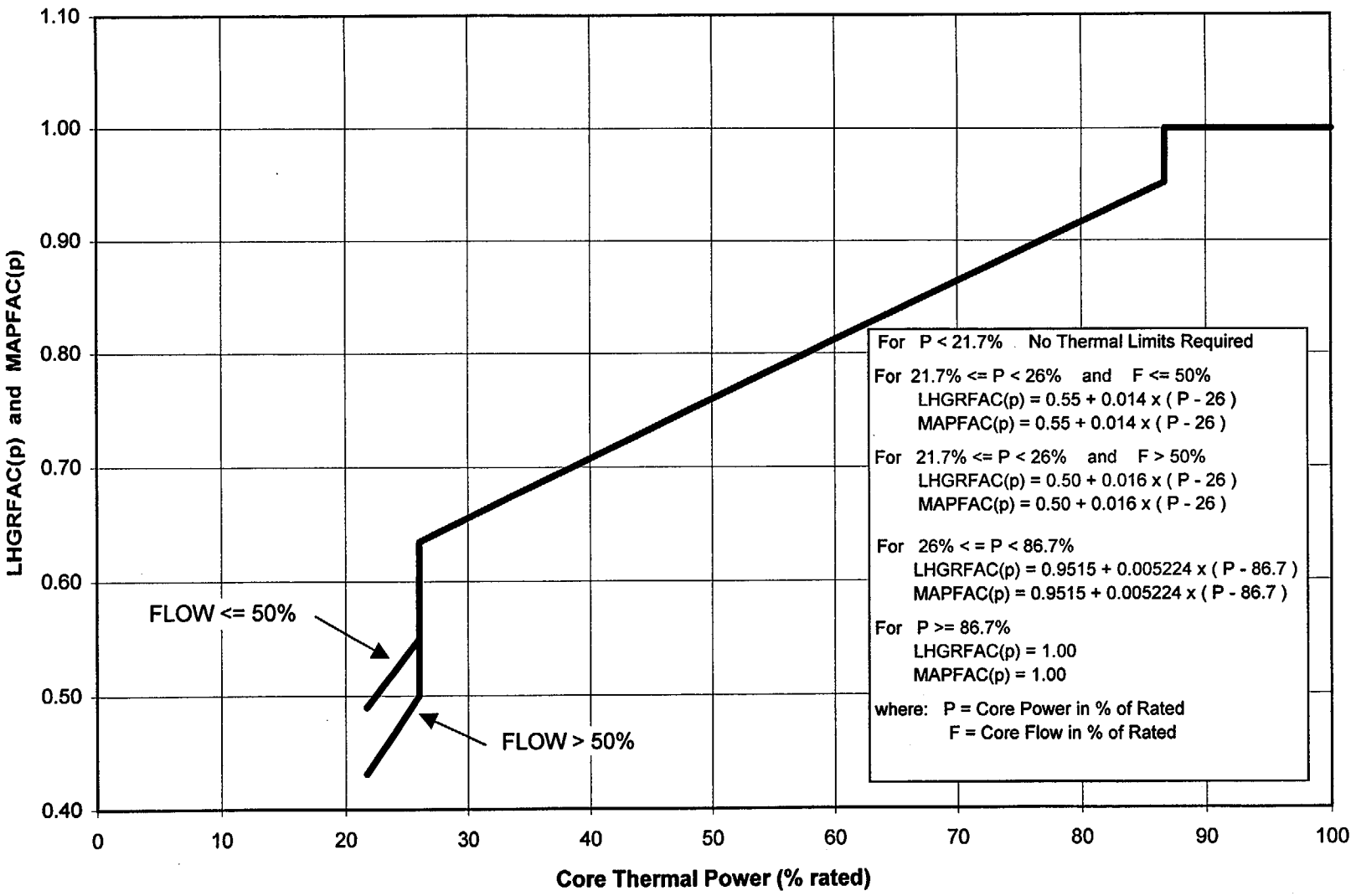

Figure 9

Preparer Initials
Verifier Initials

Flow Dependent MAPLHGR Multiplier

Single Loop Operation

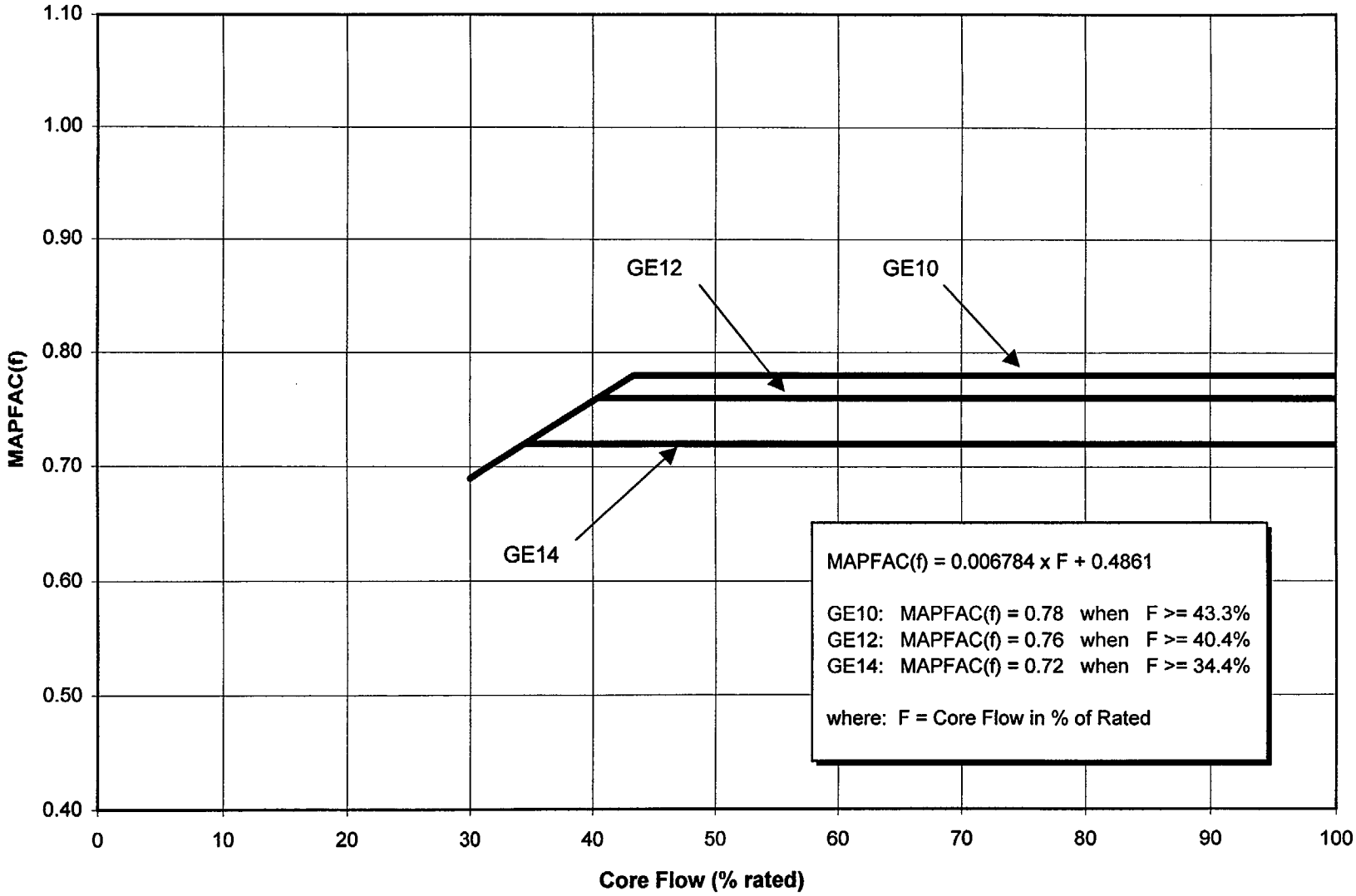

Figure 10

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Verifier Initials

Power Dependent MCPR Limits

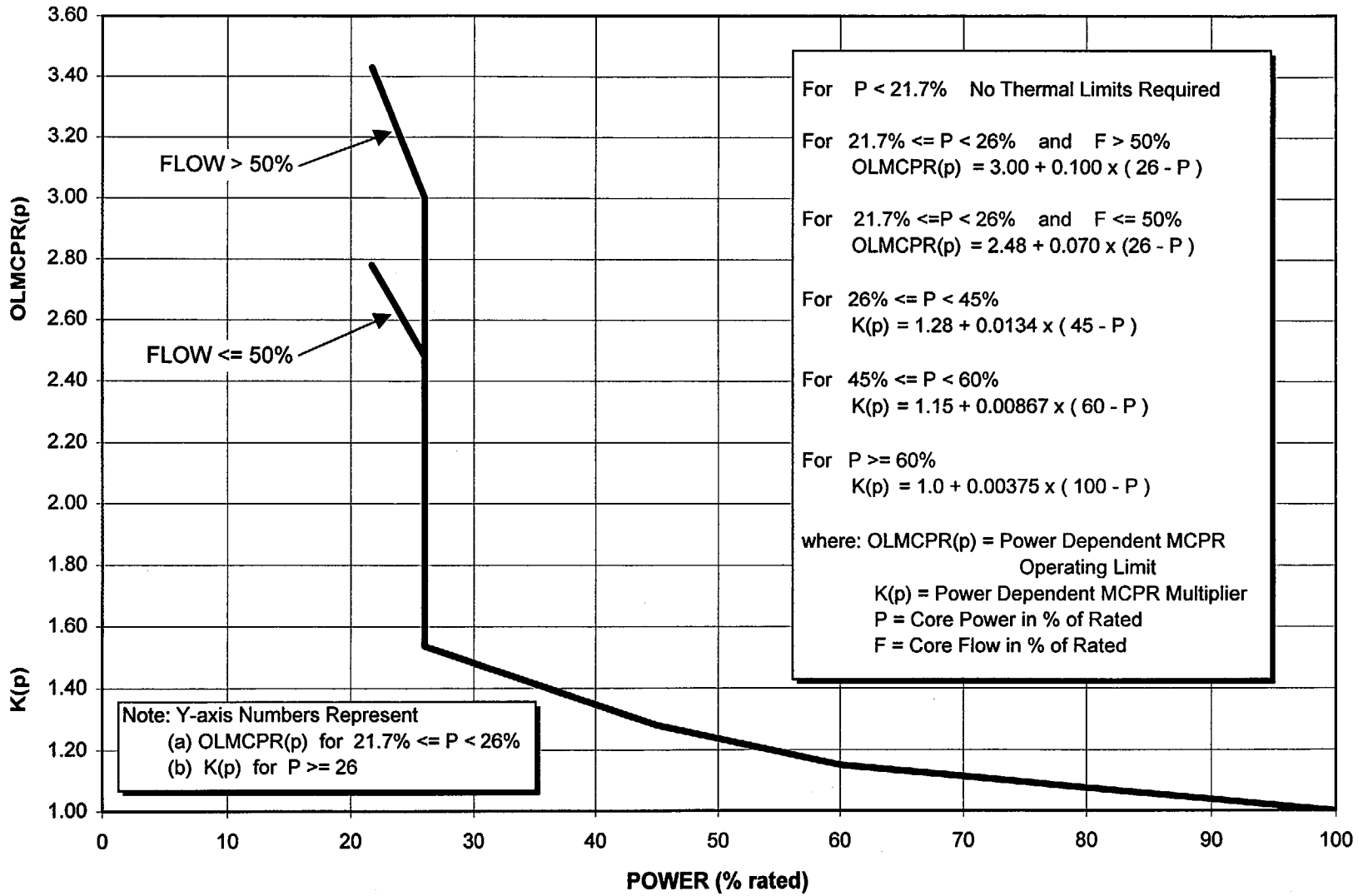

Figure 11

Preparer Initials BMJ AJ
Verifier Initials MB

Flow Dependent MCPR Limits

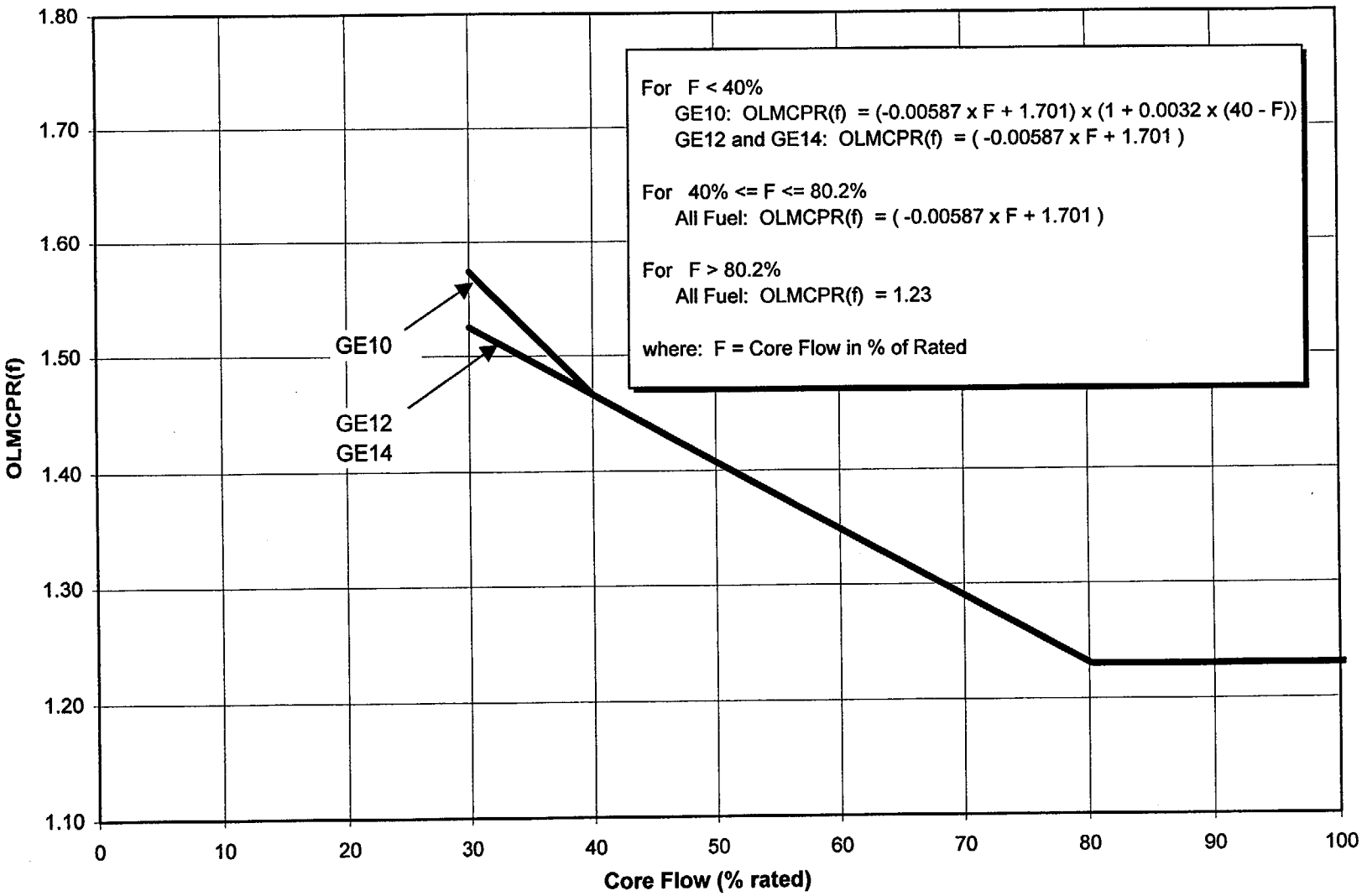

Figure 12

Preparer Initials BMH AH
Verifier Initials MB

MCPR vs TAU

Beginning-of-Cycle to 11978 MWd/ST Cycle Exposure

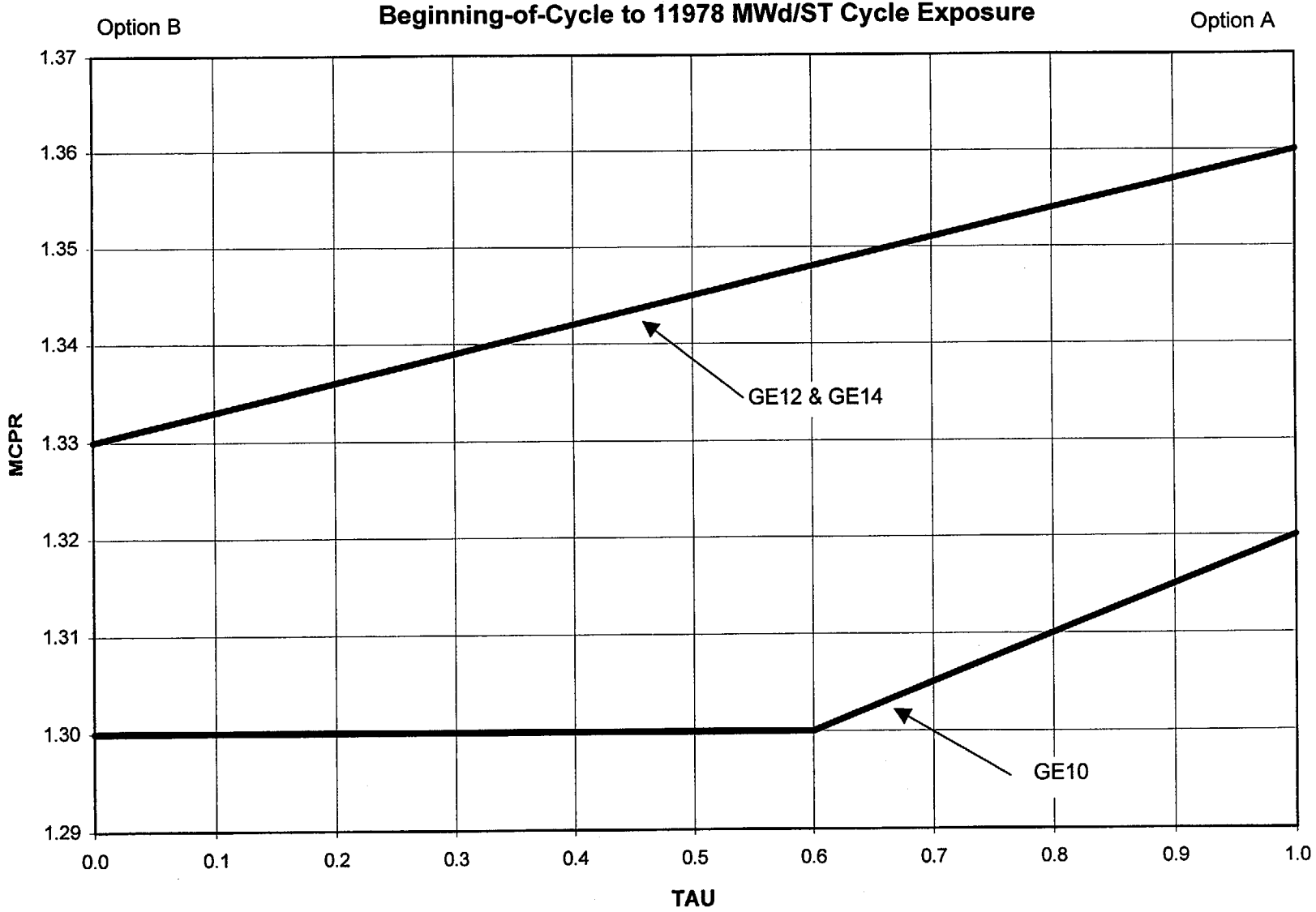

Figure 13

Preparer Initials GWA
Verifier Initials MB

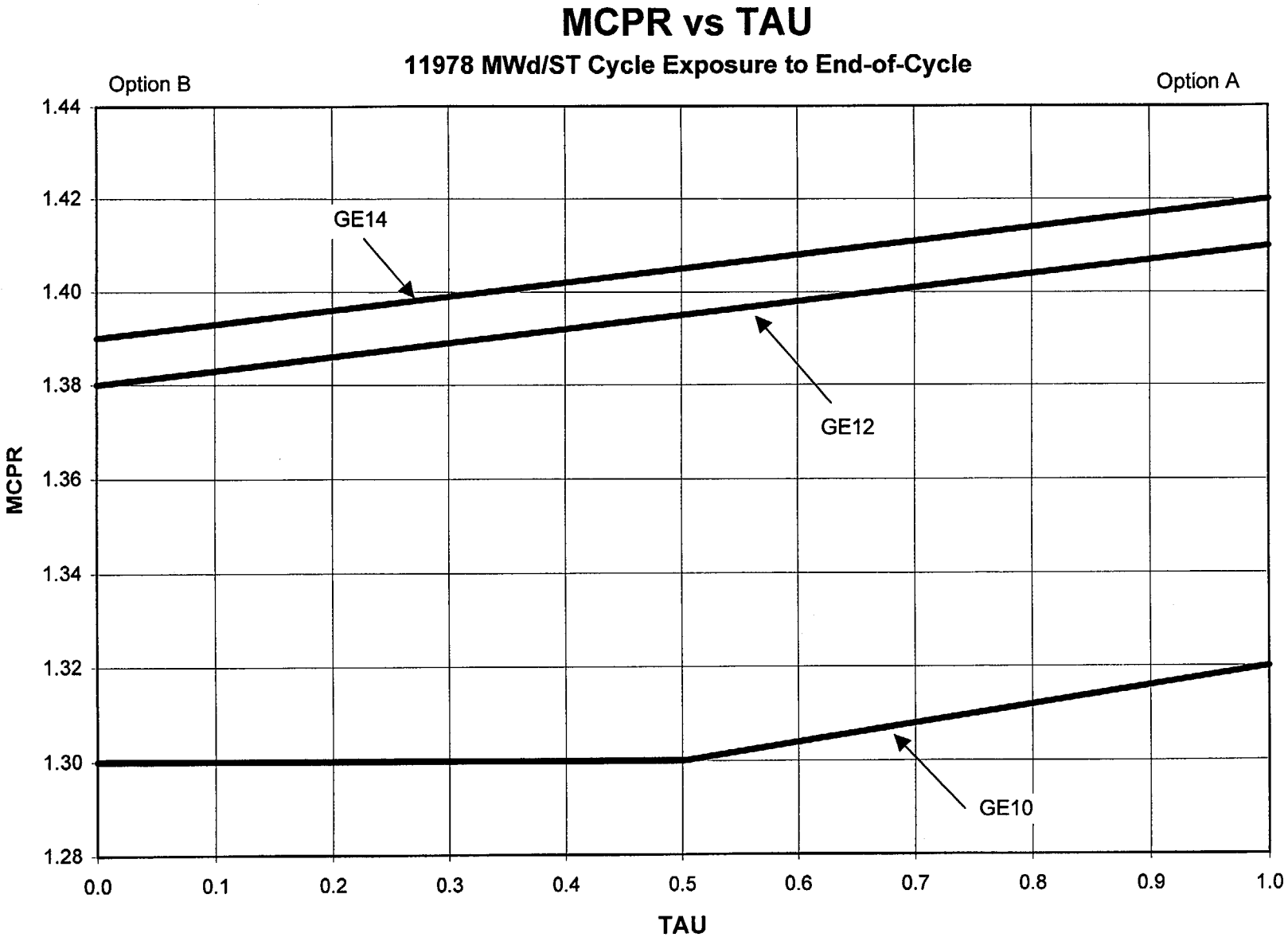

Figure 14

Preparer Initials GAH AH
Verifier Initials MB

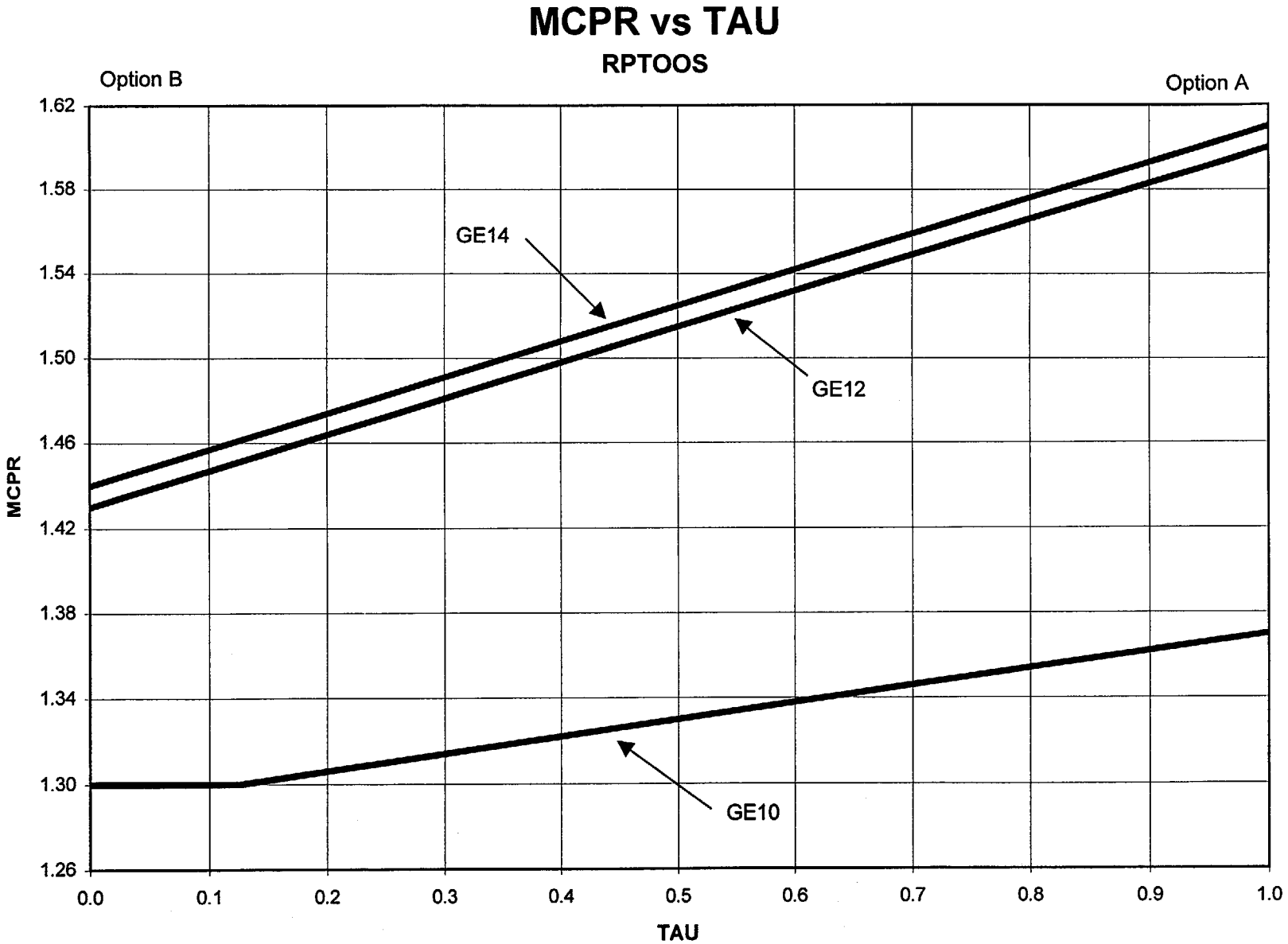

Figure 15

Preparer Initials
Verifier Initials

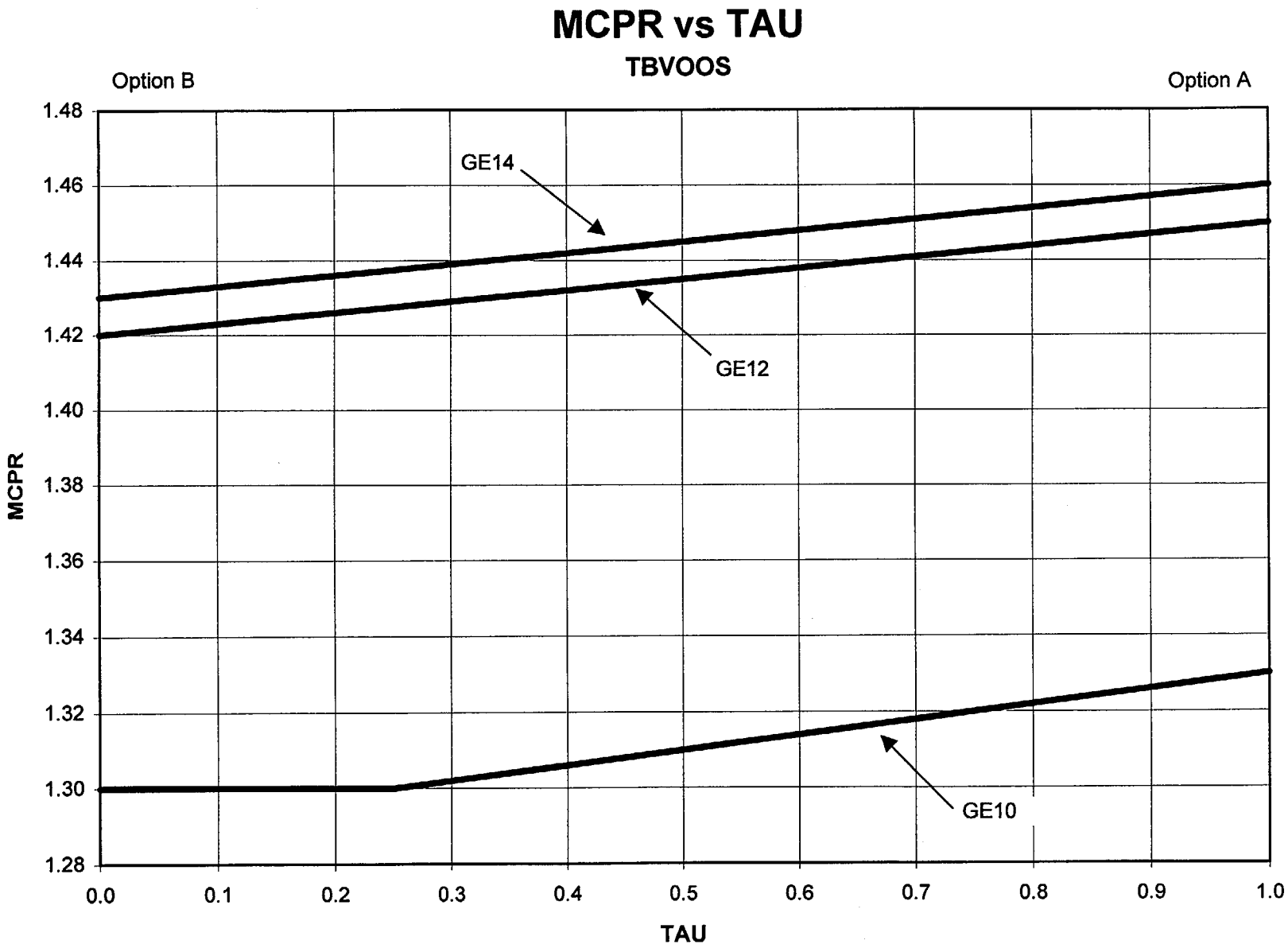

Figure 16

Preparer Initials BMA
Verifier Initials

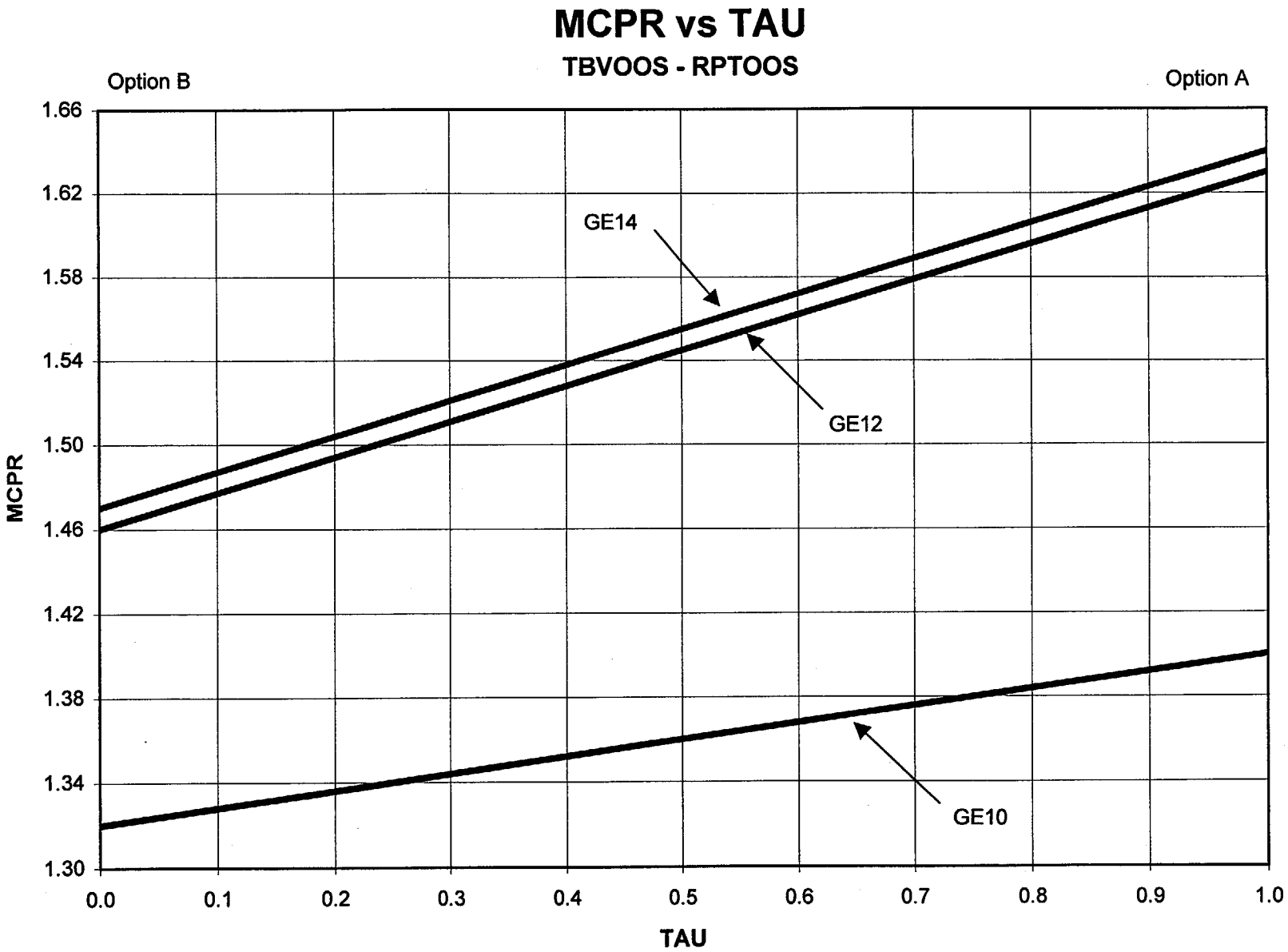

Figure 17

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Verifier Initials

DAEC Stability Power/Flow Map

Cycle 18 - 1912 MW_{th}

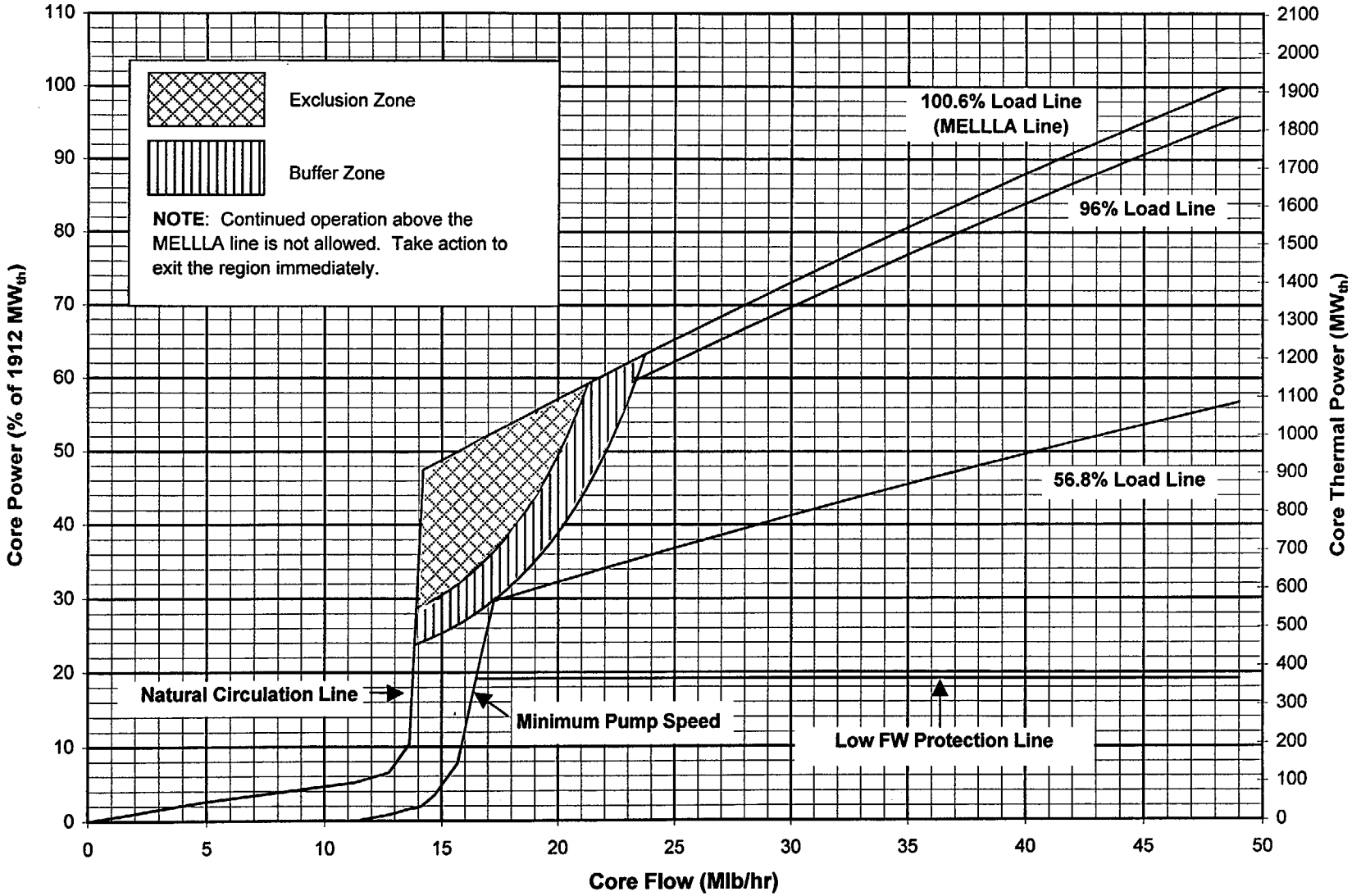

Figure 18

Preparer Initials BWA
Verifier Initials MB