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TS 5.6.5.d

September 9, 2005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Peach Bottom Atomic Power Station, Unit 2
Facility Operating License No. DPR- 44
NRC Docket No. 50-277

Subject: Issuance of the Core Operating Limits Report for Reload 15, Cycle 16, Revision 3

Enclosed is a copy of the Core Operating Limits Report (COLR) for Peach Bottom Atomic Power Station (PBAPS), Unit 2, Reload 15, Cycle 16, Revision 3. Revision 3 is the result of implementation of revised thermal limits and incorporation of Oscillation Power Range Monitoring (OPRM) set points for Single Recirculation Loop Operation (SLO).

This COLR is being submitted to the NRC in accordance with PBAPS, Unit 2 Technical Specifications (TS) Section 5.6.5.d.

If you have any questions, please do not hesitate to contact Tom Loomis at (610) 765-5510.

Very truly yours,

Pamela B. Cowan
Director - Licensing and Regulatory Affairs
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Enclosure

cc: S. J. Collins, Administrator, Region I, USNRC
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CORE OPERATING LIMITS REPORT FOR

PEACH BOTTOM ATOMIC POWER STATION UNIT 2

RELOAD 15, CYCLE 16

REVISION 3

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INTRODUCTION AND SUMMARY

This report provides the following cycle-specific parameter limits for Peach Bottom Atomic Power Station Unit 2 Cycle 16 (Reload 15):

- Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
- Single Loop Operation (SLO) MAPLHGR multipliers
- Operating Limit Minimum Critical Power Ratio (OLMCPR)
- ARTS MCPR thermal limit adjustments and multipliers
- Single Loop Operation (SLO) MCPR adjustment
- Linear Heat Generation Rate (LHGR)
- ARTS LHGR thermal limit multipliers
- Single Loop Operation (SLO) LHGR multipliers
- Rod Block Monitor (RBM) Analytical Limits, Allowable Values and MCPR Limits
- Turbine Bypass Valve Parameters
- EOC Recirculation Pump Trip (EOC-RPT) Parameters
- Stability Protection - Oscillation Power Range Monitor (OPRM) Trip Setpoints
- Asymmetric Feedwater Temperature Operation (AFTO) thermal limit penalties

These values have been determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met.

This report provides the means for calculating the Operating Limit MCPR, LHGR, and MAPLHGR thermal limits for the following conditions:

- All points in the operating region of the power/flow map including Maximum Extended Load Line Limit (MELLL) down to 82.9% of rated core flow during rated thermal power (3514 MWt) operation
- Increased Core Flow (ICF), up to 110% of rated core flow
- End-of-Cycle Power Coastdown to a minimum power level of 40%
- Feedwater Heaters Out of Service (FWHOOS) to 55° F temperature reduction at any time during the cycle
- Final Feedwater Temperature Reduction (FWTR) between End-of-Rated (EOR) and End-of-Cycle (EOC) to 90° F temperature reduction maintaining $\leq$ 100% load line (Reference 1)
- Asymmetric Feedwater Temperature Operation (AFTO) – Appendix A

The Allowable Values, documented in Reference (1), for feedwater temperature as a function of thermal power for both FWHOOS and FWTR are specified in the appropriate Peach Bottom procedures.

Note that the term "EOR" refers to the cycle exposure at which operation at "rated conditions" is no longer possible (i.e., the cycle exposure at which cycle extension begins) based on the EOR point as documented in the current revision of the Cycle Management Report.

Also note that the following description of MAPLHGR, LHGR and MCPR limits pertain to **NON** - AFTO. A separate description of AFTO limits and their associated ARTS figures are located in Appendix A.

Preparation of this report was performed in accordance with Exelon Nuclear procedures. This report is submitted in accordance with Technical Specification 5.6.5 of Reference (2) and contains all thermal limit parameters related to the implementation of the ARTS Improvement Program and Maximum Extended Load Line Limit Analyses (ARTS/MELLLA) for Peach Bottom Unit 2 Cycle 16.

MAPLHGR LIMITS

The MAPLHGR limits (kW/ft) obtained from the emergency core cooling system analysis are provided in Figure 1. The MAPLHGR limits comprise a given fuel type as a function of average planar exposure. The MAPLHGR figure is used when hand calculations are required. All MAPLHGR values for each fuel type as a function of axial location and average planar exposure shall be less than or equal to the applicable MAPLHGR limits for the respective fuel and lattice types to be in compliance with Technical Specification 3.2.1. These MAPLHGR limits are specified in References (4) and (5) and the process computer databank. The SLO MAPLHGR multiplier (0.73) is applied as shown in Table 4. This value is based on the GE14 fuel product line. The SLO MAPLHGR multiplier is clamped at 0.73 for any core flow to ensure peak clad temperatures are maintained within the limits of the cycle-specific LOCA analysis for single recirculation loop operation. The MAPLHGR SLO multiplier was obtained from Reference (4). AFTO parameters are addressed in Appendix A.

LINEAR HEAT GENERATION RATES

The beginning of life (maximum) LHGR values for each fuel type for use in Technical Specification 3.2.3 are provided in Table 3. The LHGR values as a function of peak pellet exposure are provided in References (5) and (17). The bases for the LHGR values are documented in Reference (3). The ARTS-based LHGR power-dependent multipliers (LHGRFAC(P)) are provided in Figures 2 and 3. Figure 2 is valid for seven or more (of nine) Turbine Bypass Valves (TBVs) In-Service and Recirculation Pump Trip (RPT) In-Service with a maximum temperature reduction of 90° F for FWTR operation. Figure 3 is valid for three or more (of nine) TBVs Out-of-Service (OOS) or RPTOOS with a maximum FWTR of 90° F. The flow-dependent multipliers (LHGRFAC(F)) are provided in Figures 4 and 5 as a function of the number of recirculation loops in operation only. The SLO LHGR multiplier (0.73) is applied through LHGRFAC(F) as shown in Figure 5. The power- and flow-dependent LHGR multipliers were obtained from References (1), (6), (7), (9) and (21). AFTO parameters are addressed in Appendix A.

MCPR LIMITS

The Operating Limit MCPR (OLMCPR) for use in Technical Specification 3.2.2 for each fuel type is provided in Table 1. These values are determined by the cycle-specific fuel reload analyses in Reference (4). For Single Loop Operation with Turbine Bypass Valve and Recirculation Pump Trip in-service (Option B) from BOC to EOR-2300, the OLMCPR is increased to 1.38 to comply with the results of the Single Loop Operation Recirculation Pump Seizure Analysis described in Reference (13). This OLMCPR increase is necessary to prevent violating the Reference (13) SLO SLMCPR considering the appropriate ARTS multiplier for single pump flows. For all other operating domains, the OLMCPR is increased by 0.02 when operating in SLO (due to the 0.02 safety limit MCPR increase for SLO). The Safety Limit MCPRs are documented in Section 2.1.1.2 of Reference (2).

Control rod scram time verification is required as per Technical Specification 3.1.4, "Control Rod Scram Times". Tau, a measure of scram time performance to notch position 36 throughout the

cycle, is determined based on the cumulative scram time test results. The calculation of Tau shall be performed in accordance with site procedures. Linear interpolation shall be used to calculate the OLMCPR value if Tau is between 0.0 (Tau Option B) and 1.0 (Tau Option A).

Separate OLMCPR values are presented herein (Table 1) for the following domains:

- TBVs In-Service (seven or more in-service) and RPT In-Service, maximum FWTR of 90 °F
- TBVs Out-of-Service (three or more out-of-service) and RPT In-Service, maximum FWTR of 90 °F
- TBVs In-Service (seven or more in-service) and RPT Out-of-Service, maximum FWTR of 90 °F

The OLMCPR values are documented in Reference (4) for all of the fuel designs.

The ARTS-based power-dependent MCPR limits, OLMCPR(P), for use in Technical Specification 3.2.2 are provided in Figures 6 and 7. Figure 6 is valid for seven or more (of nine) Turbine Bypass Valves (TBVs) In-Service and Recirculation Pump Trip (RPT) In-Service and a maximum temperature reduction of 90 °F for FWTR operation. Figure 7 is valid for three or more (of nine) TBVs Out-of-Service (OOS) or RPTOOS with a maximum FWTR of 90 °F. The flow-dependent MCPR limits, OLMCPR(F), are provided in Figure 8. Figure 8 is valid for all operating conditions with symmetric feedwater temperature operation. OLMCPR(P, F) curves were obtained from References (1), (6), (7), (9), (16) and (21). AFTO parameters are addressed in Appendix A.

The Oscillation Power Range Monitor (OPRM) Period Based Detection Algorithm (PBDA) Trip Settings are based, in part, on the cycle specific OLMCPR and the ARTS-based power dependent MCPR limits [K(p) multiplier] (see OPRM discussion below).

OVERALL GOVERNING MCPR AND LHGR LIMITS

ARTS provides for power- and flow-dependent thermal limit adjustments and multipliers that allow for a more reliable administration of the MCPR and LHGR thermal limits. At any given power/flow (P/F) state, all four limits are to be determined: LHGRFAC(P), LHGRFAC(F), OLMCPR(P), and OLMCPR(F) from Figures 2 through 15, inclusive. The most limiting MCPR and the most limiting LHGR [maximum of OLMCPR(P) and OLMCPR(F) and minimum of LHGRFAC(P) and LHGRFAC(F)] for a given (P,F) condition will be the governing limits. The OLMCPR for each fuel type is determined by the cycle-specific fuel reload analyses in Reference (4). Rated LHGR values are obtained from the bundle-specific thermal-mechanical analysis. Supporting documentation for the ARTS-based limits is provided in References (1), (4), (7), (8), (9) and (21).

ROD BLOCK MONITOR SETPOINTS

The RBM power-biased Analytical Limits, Allowable Values and MCPR Limits for use in Technical Specification 3.3.2.1 are provided in Table 2 per Reference (6) with supporting documentation in References (4) and (10).

STEAM BYPASS SYSTEM OPERABILITY

The operability requirements for the steam bypass system are governed by Technical Specification 3.7.6. If the requirements cannot be met, the appropriate power dependent limits for Turbine Bypass Valves Out-of-Service (TBVOOS) must be used (Table 1 with Figures 3 and 7 or Figures 10 and 14). The minimum number of bypass valves to maintain system operability is seven as per Reference (11) and Table 5. Table 5 also includes other Turbine Bypass Valve parameters.

EOC RECIRCULATION PUMP TRIP (EOC-RPT) OPERABILITY

If the EOC-RPT is inoperable, then the OLMCPR (Table 1), LHGRFAC(P) (Figure 3), and OLMCPR(P) (Figure 7) values for EOC Recirculation Pump Trip Out-of-Service (RPTOOS), must be used. Appendix A contains LHGRFAC(P) and OLMCPR(P) for RPTOOS with AFTO conditions.

The measured EOC-RPT Response Time as referenced in Technical Specifications Section 3.3.4.2 and as defined in Technical Specifications Section 1.1 shall comply with the surveillance requirements in Reference (12) and applicable site procedures for TCV Fast Closure Trip (i.e. Generator Load Drop) and TSV Fast Closure Trip (i.e. Turbine Trip).

A total EOC-RPT system response time acceptance criterion of 0.175 seconds is assumed in the safety analysis for both trips and is defined as the time from the turbine valves (TCV or TSV) start to close until complete arc suppression of the EOC-RPT circuit breakers.

CONCURRENT TBVOOS AND RPTOOS

Cycle 16 is not licensed for TBVOOS and RPTOOS to occur concurrently. Therefore, concurrent TBVOOS and RPTOOS is an unanalyzed condition.

STABILITY PROTECTION - OSCILLATION POWER RANGE MONITOR (OPRM)

The Cycle 16 OPRM Period Based Detection Algorithm (PBDA) Trip Settings are provided in Tables 6 and 7. These values are based on the cycle specific analysis documented in References 18 and 20. The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system (Reference 19). The OPRM Growth Rate Algorithm (GRA) and Amplitude Based Algorithm (ABA) trip settings can be found in the Power Range Neutron Monitoring Configuration Control Documents (SPID's) G-080-VC-234 through 237 (Unit-2).

Table 7 provides alternate PBDA Trip Settings that may be applied during single loop operation (SLO) conditions. These trip settings are applicable when in SLO, with reactor power less than or equal to 65% of rated. The standard two loop operation OPRM Trip Settings specified in Table 6 are bounding for both two loop and SLO conditions. The standard two loop operation OPRM Trip Settings specified in Table 6 must be implemented prior to restarting the idle pump when exiting the SLO condition.

Any change to the OLMCPR values and/or the ARTS-based power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA Trip Settings.

REFERENCES

1. "Peach Bottom Atomic Power Station Evaluation for Extended Final Feedwater Temperature Reduction of 90° F", NEDC-32707P, Supplement 1, May 20, 1998
2. "Technical Specifications for Peach Bottom Atomic Power Station Unit 2", Docket No. 50-277, Appendix A to License No. DPR-44
3. "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-14, June 2000; and NEDE-24011-P-A-14-US, June 2000
4. "Supplemental Reload Licensing Report for Peach Bottom 2, Reload 15 Cycle 16", Global Nuclear Fuel Document No. 0000-0025-6977-SRLR, Rev. 0, August 2004

5. "Fuel Bundle Information Report for Peach Bottom 2, Reload 15 Cycle 16", Global Nuclear Fuel Document No. 0000-0025-6977-FBIR, Revision 0, August 2004

6. "Maximum Extended Load Line Limit and ARTS Improvement Program Analyses for Peach Bottom Atomic Power Station Unit 2 and 3", NEDC-32162P, Revision 2, March 1995

7. "ARTS Flow-Dependent Limits with TBVOOS for Peach Bottom Atomic Power Station and Limerick Generating Station", NEDC-32847P, June 1998

8. Letter, G. V. Kumar to A. M. Olson, "PECO Rerate Project, ARTS Thermal Limits", June 27, 1995

9. "Peach Bottom Atomic Power Station Units 2 & 3 Plant and Cycle-Independent ARTS Thermal Limits Analyses", NEDC-32162P, Supplement 1, Revision 0, August 2001

10. PECO Energy Calculation PE-0251, "Power Range Neutron Monitoring System Setpoint Calculations Peach Bottom Atomic Power Station Units 2 & 3," Revision 1

11. Peach Bottom 2 Cycle 16 OPL-3, Global Nuclear Fuels eDRF #0000-0024-7901, Suresh Gupta, August 12, 2004

12. PECO Calculation PE-0173, "Determination of Total Time Required to Initiate the Trip Signal to the EOC-RPT Circuit Breaker"

13. "GE14 Fuel Design Cycle-Independent Analyses for Peach Bottom Atomic Power Station Units 2 & 3," GENE L12-00880-00-01P, September 2000

14. "Safety Review for Peach Bottom Atomic Power Station Units 2 and 3 Asymmetric Feedwater Temperature Operation", NEDC – 32691P, Revision 0, May 1997

15. ECR 02-00478, "Asymmetric Feedwater Operation Implementation"

16. Letter, F. T. Bolger to C. P. Collins, "Removal of MCPR(F) Low Flow Correction in NEDC-32847P," February 4, 2002.

17. Letter, Michael P. Gallagher to U. S. Nuclear Regulatory Commission, "Peach Bottom Atomic Power Station Units 2 & 3, Facility Operating License Nos. DPR-44 and DPR-56, NRC Docket Nos 50-277 and 50-278, License Amendment Request 01-01190 "Power Uprate Request for Appendix K Measurement Uncertainty Recapture," May 24, 2002

18. "Peach Bottom 2 Cycle 16 Option III Stability Analysis," GENE-0000-0031-5879-R0, January 2005

19. "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications", NEDO-32465-A, August 1996.

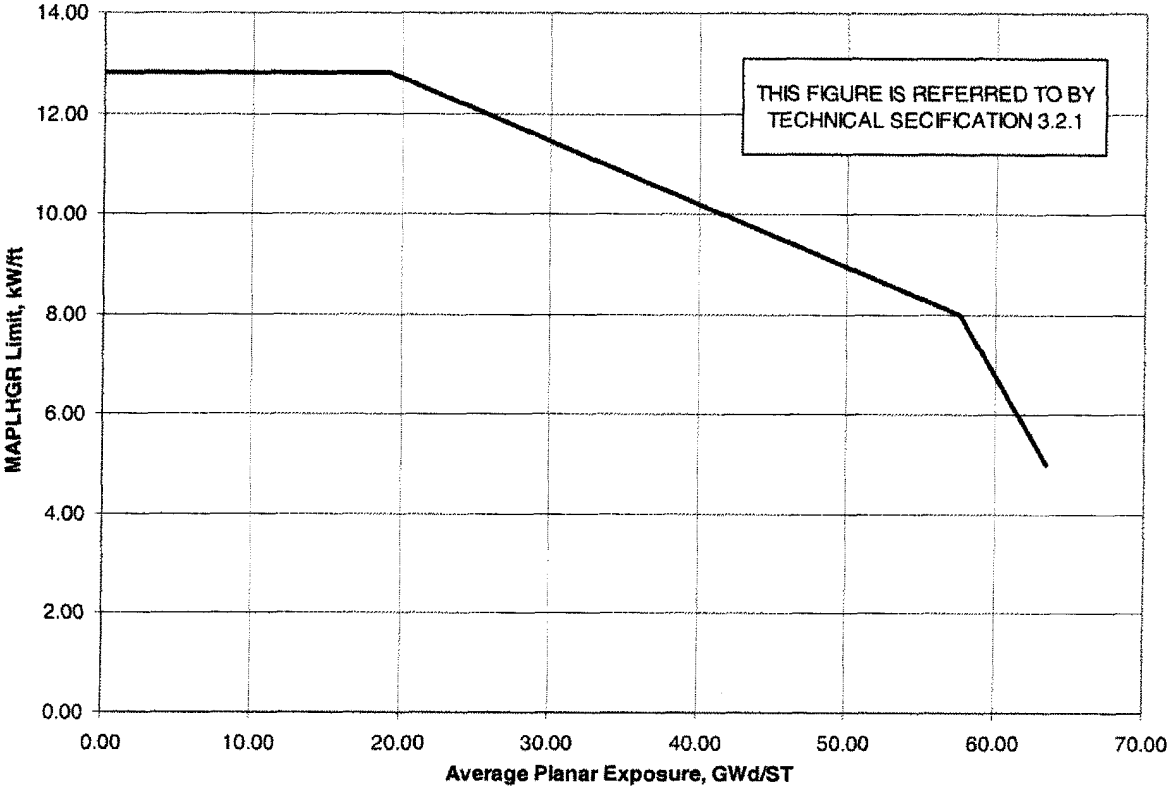
20. EC 356623, "Evaluation of PBAPS SLO OPRM Trip Setpoints for Peach Bottom 2 Cycle 16 and Unit 3 Cycle 15 AT 244909-10", July 29, 2005.

21. "Peach Bottom 2 and 3 Off-Rated Analyses Below the PLU Power Level," GE-NE-0000-0041-8205-R0, Revision 0, August 2005.

FIGURE 1

MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE

FOR ALL FUEL TYPES



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	12.82
14.51	12.82
19.13	12.82
57.61	8.00
63.50	5.00

FIGURE 2

POWER-DEPENDENT LHGR MULTIPLIER, LHGRFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3

VALID FOR 7 OR MORE TBVs IN-SERVICE, RPT IN-SERVICE AND MAX 90^{O} F FWTR

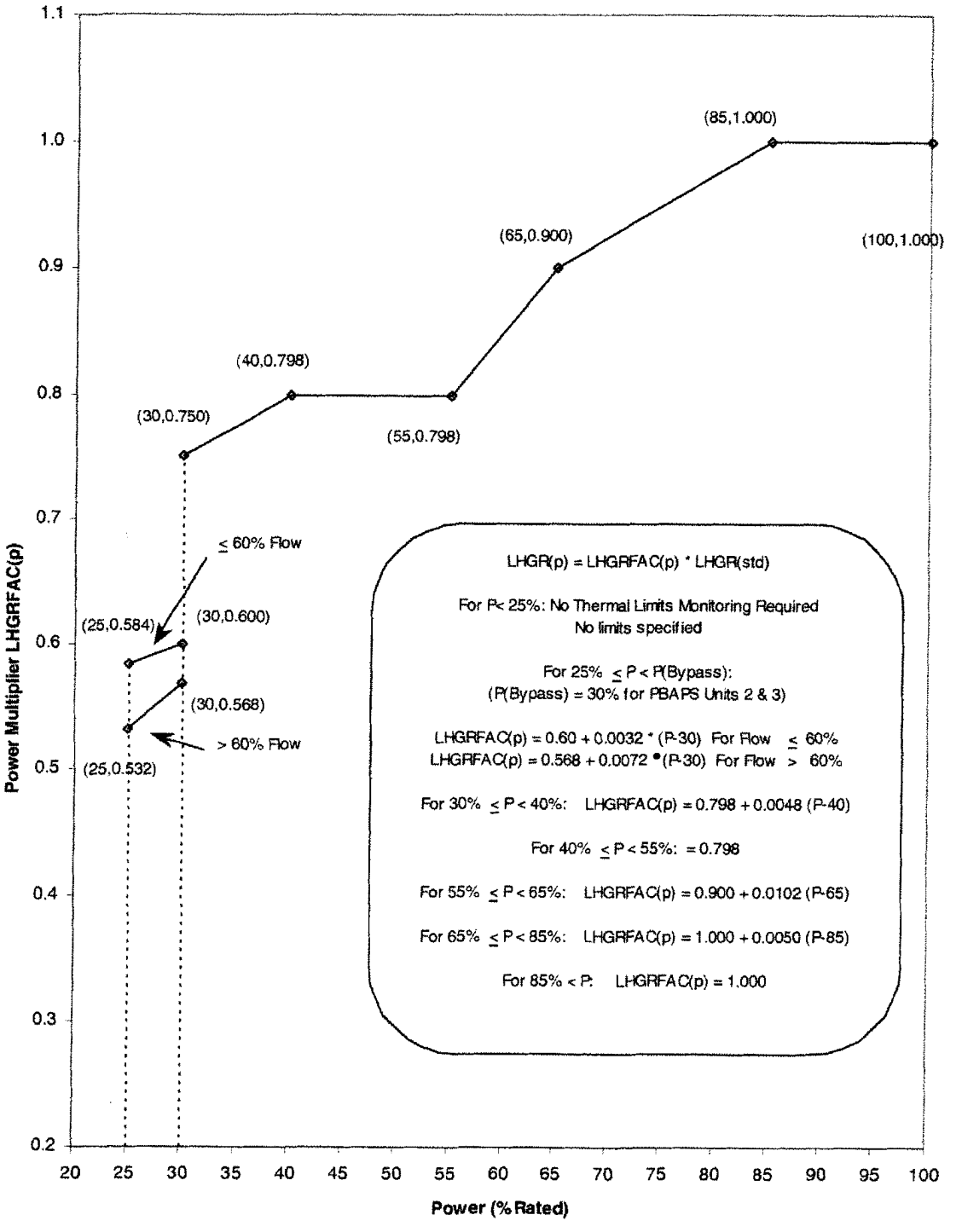


FIGURE 3

POWER-DEPENDENT LHGR MULTIPLIER, LHGRFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3, 3.3.4.2 and 3.7.6

VALID FOR 3 OR MORE TBVOOS OR RPTOOS AND MAX 90 °F FWTR

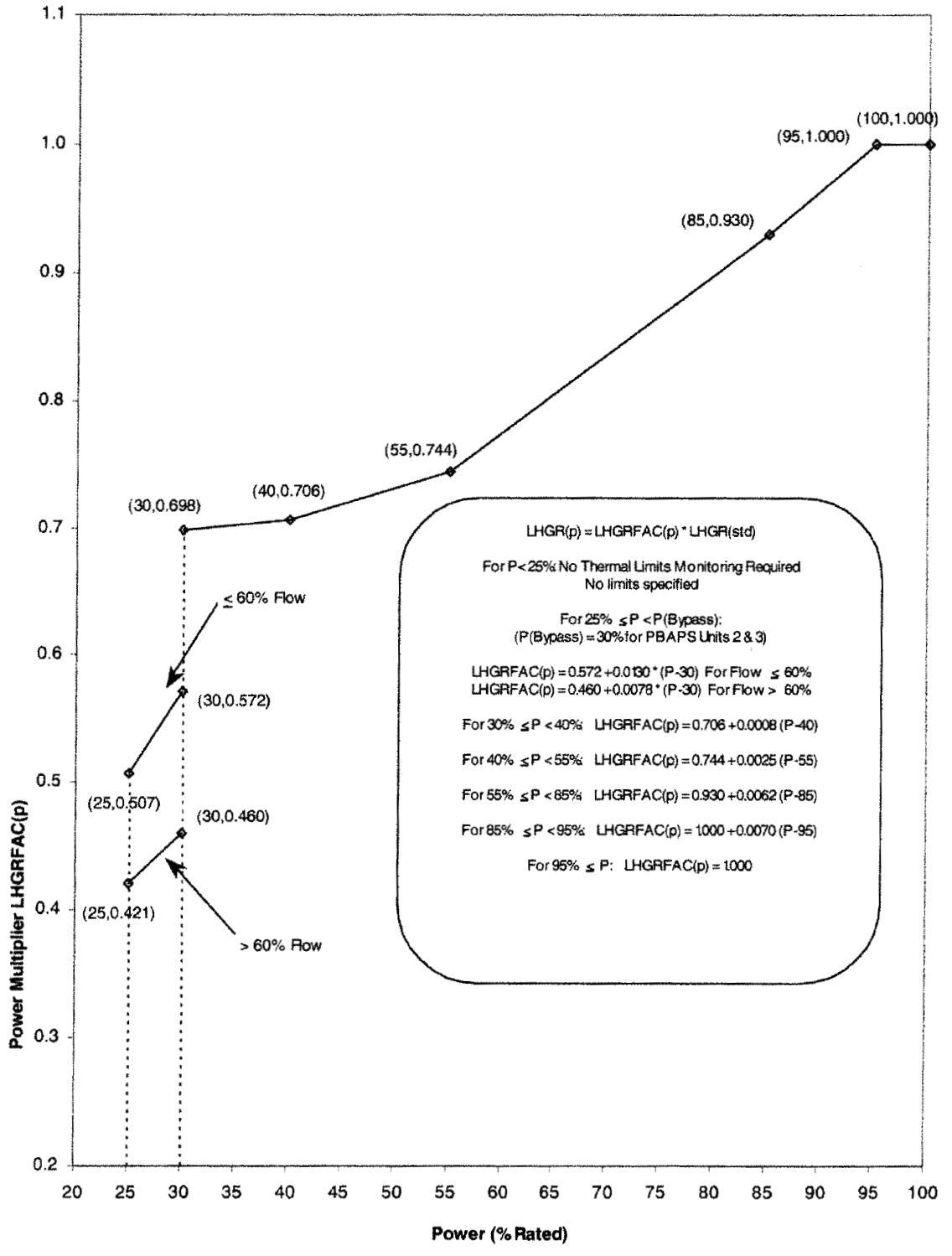


FIGURE 4

FLOW-DEPENDENT LHGR MULTIPLIER, LHGRFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3

VALID FOR TWO LOOP RECIRC FLOW

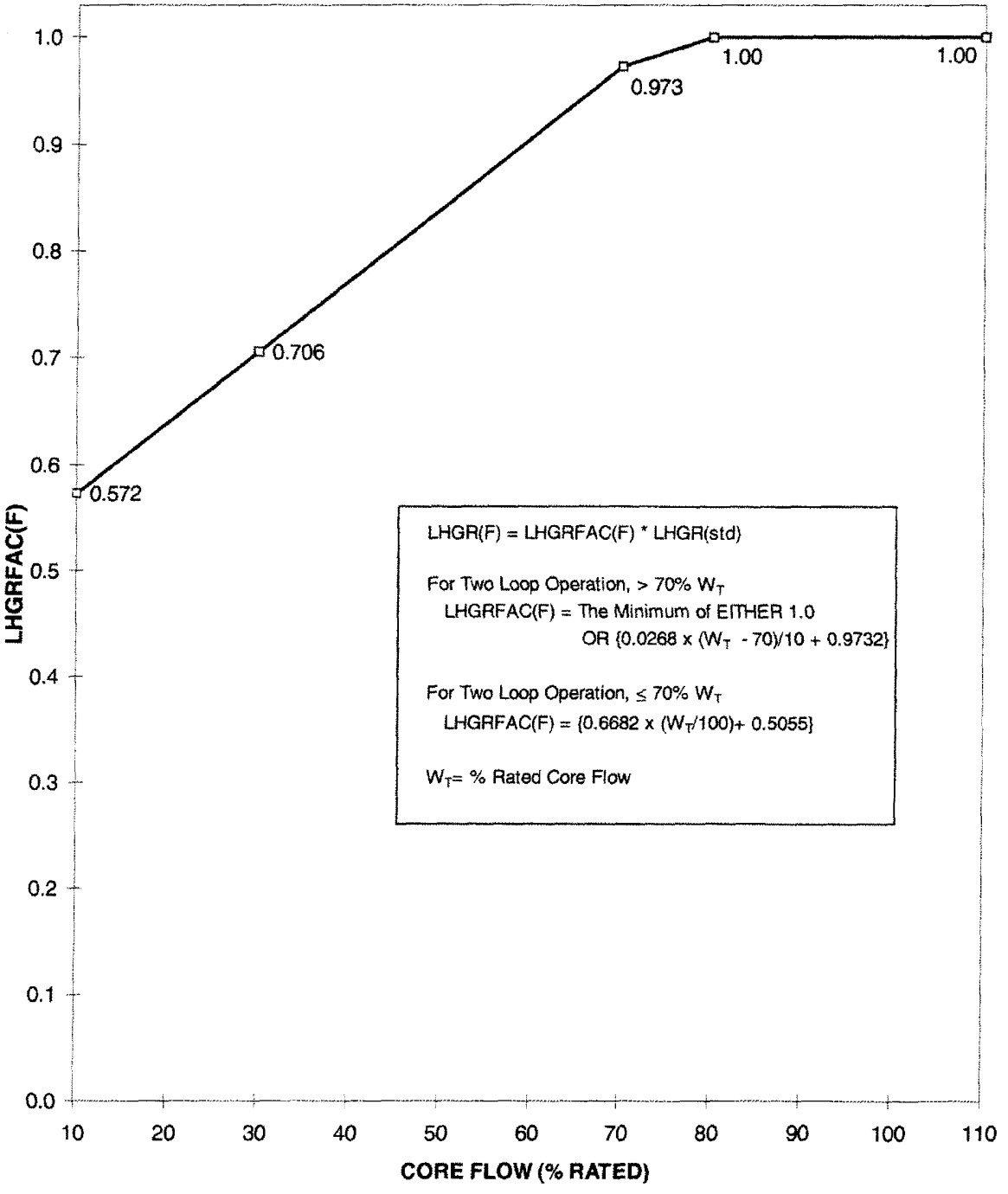


FIGURE 5

FLOW-DEPENDENT LHGR MULTIPLIER, LHGRFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3 AND 3.4.1

VALID FOR SINGLE LOOP RECIRC FLOW

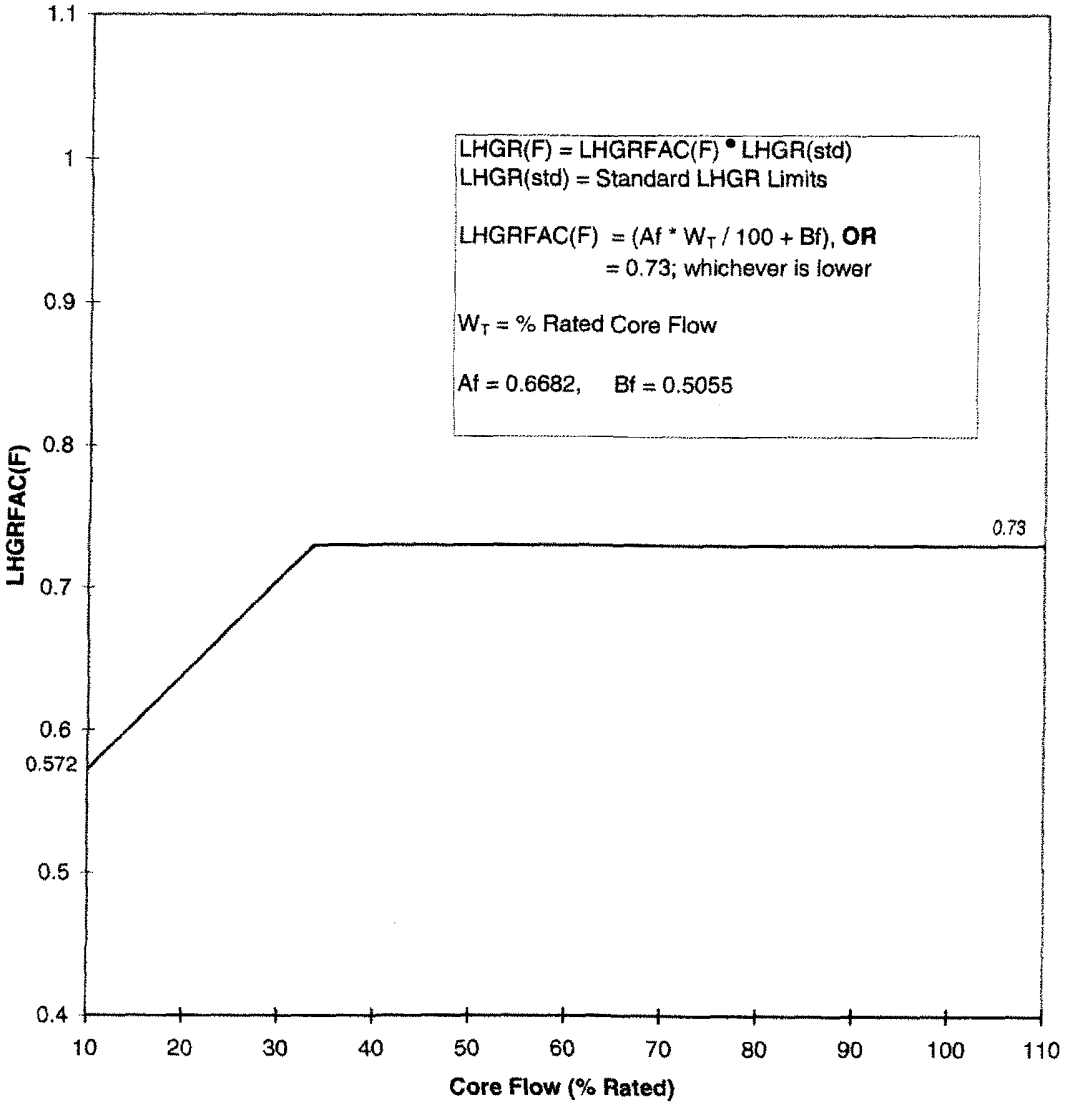


TABLE 1

OPERATING LIMIT MINIMUM CRITICAL POWER RATIO (OLMCPR)

Applicable to all fuel types

Use in conjunction with Figures 6, 7, and 8

For OLMCPR when in Single Loop Operation, See Note (2).

These Tables are referred to by Technical Specification 3.2.2, 3.4.1 and 3.7.6

		TBV in Service and RPT in Service		TBV out of Service (3 or more TBVOOS)		RPT OOS	
		Option B $\tau = 0$	Option A $\tau = 1$	Option B $\tau = 0$	Option A $\tau = 1$	Option B $\tau = 0$	Option A $\tau = 1$
Two Loop Operation	**BOC to EOR –2300 MWd/ST**	1.33	1.36	1.38	1.41	1.38	1.49
	EOR - 2300 MWd/ST to EOC	1.38	1.41	1.44	1.47	1.45	1.62
Single Loop Operation	**BOC to EOR -2300 MWd/ST**	1.38[3]	1.38	1.40	1.43	1.40	1.51
	EOR - 2300 MWd/ST to EOC	1.40	1.43	1.46	1.49	1.47	1.64

NOTES:

1) When Tau does not equal 0 or 1, use linear interpolation.

2) For single-loop operation, the MCPR operating limit is 0.02 greater than the two loop value except when the Two Loop Operation MCPR operating limit is less than 1.36 (consistent with Reference 13).

3) OLMCPR limit set by the Single Loop Operation (SLO) - Recirculation Pump Seizure Analysis. (Reference 13)

FIGURE 6

POWER-DEPENDENT MCPR LIMIT, OLMCPR(P), AND MULTIPLIERS
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2

VALID FOR 7 OR MORE TBVs IN-SERVICE, RPT IN-SERVICE AND MAX 90 °F FWTR
VALID FOR TWO OR SINGLE LOOP RECIRC FLOW

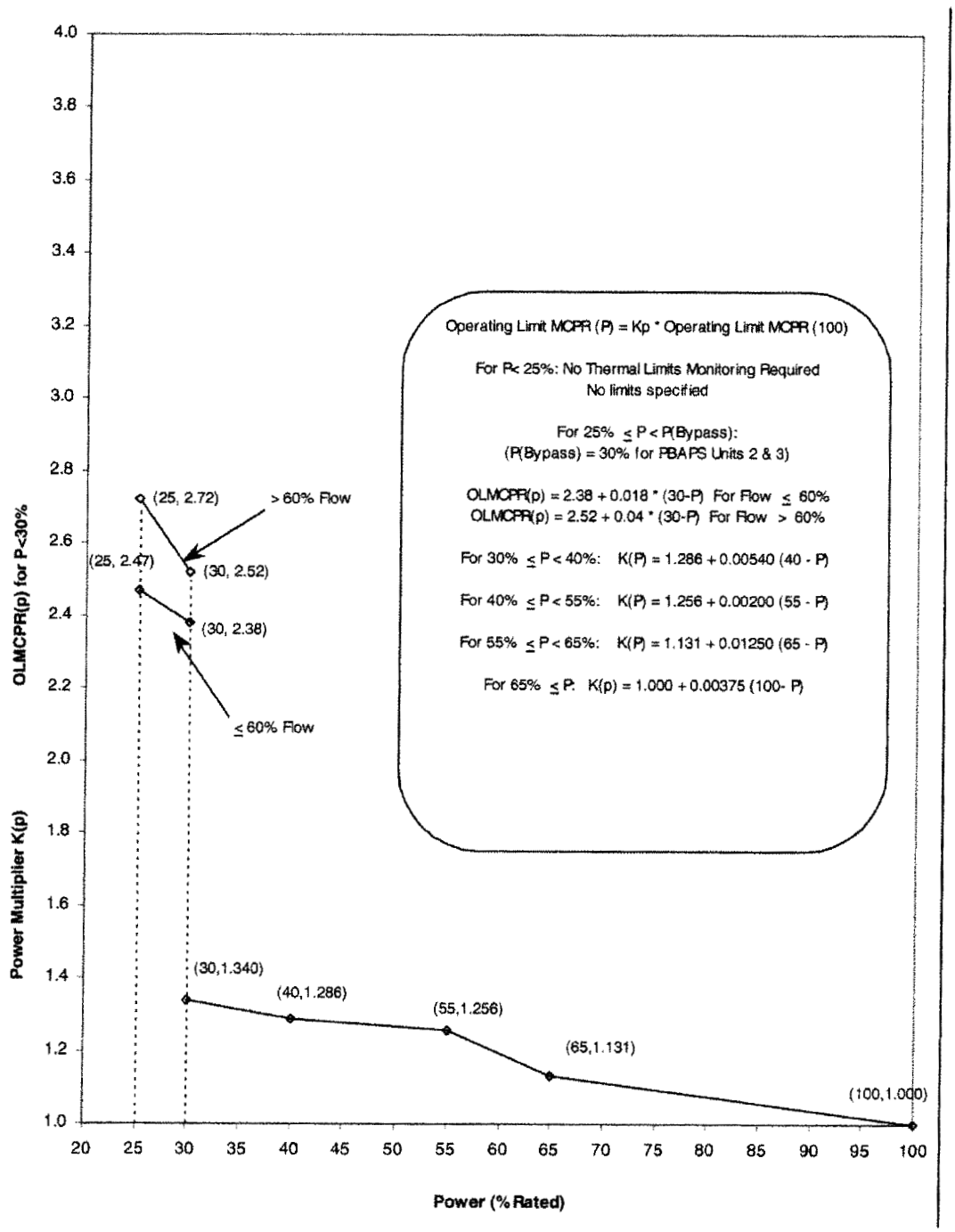


FIGURE 7

POWER-DEPENDENT MCPR LIMIT, OLMCPR(P), AND MULTIPLIERS
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2, 3.3.4.2 and 3.7.6

VALID FOR 3 OR MORE TBVOOS OR RPTOOS AND MAX 90 °F FWTR
VALID FOR TWO OR SINGLE LOOP RECIRC FLOW

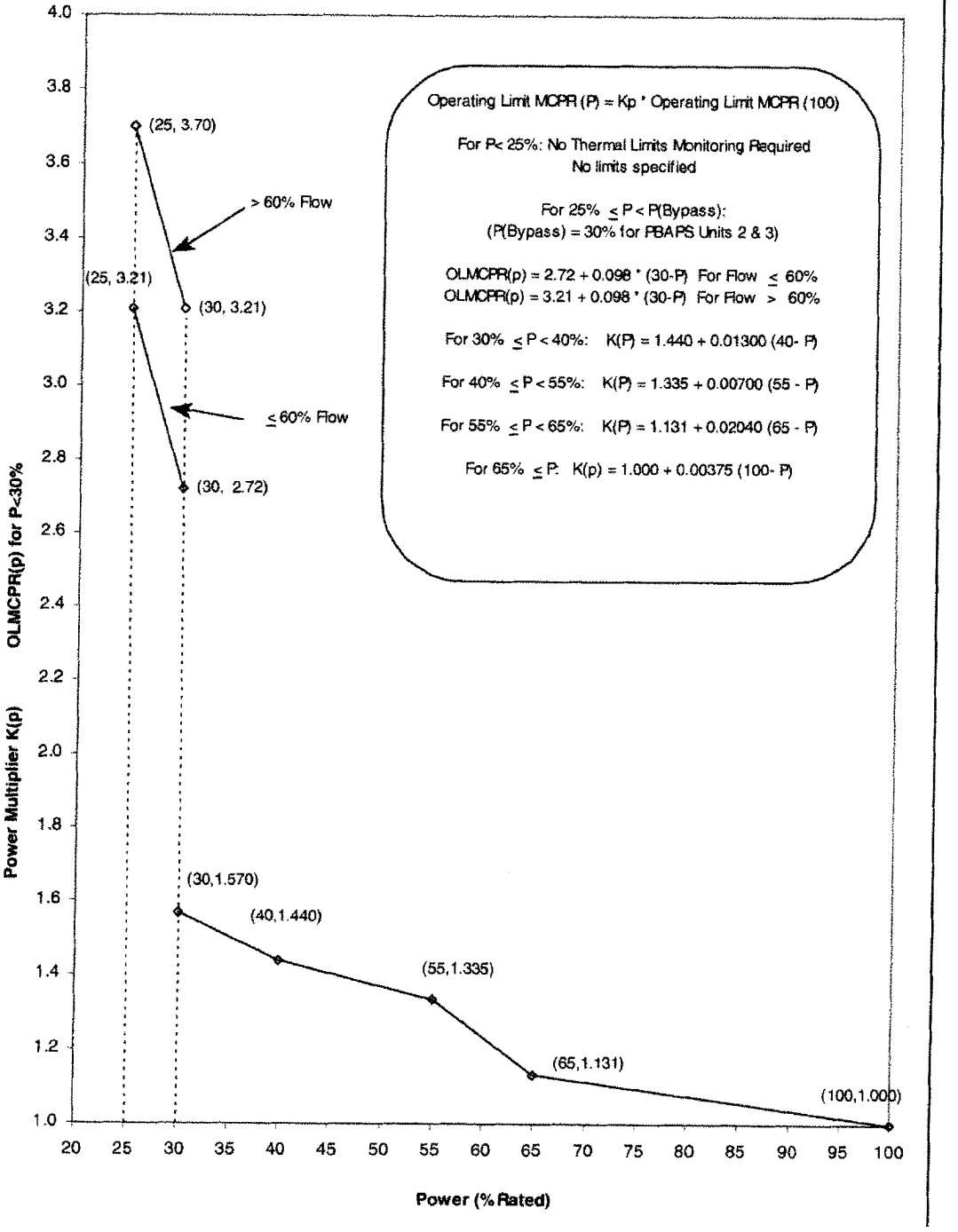


FIGURE 8

FLOW-DEPENDENT MCPR LIMITS, OLMCPR(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2

VALID FOR ALL CONDITIONS

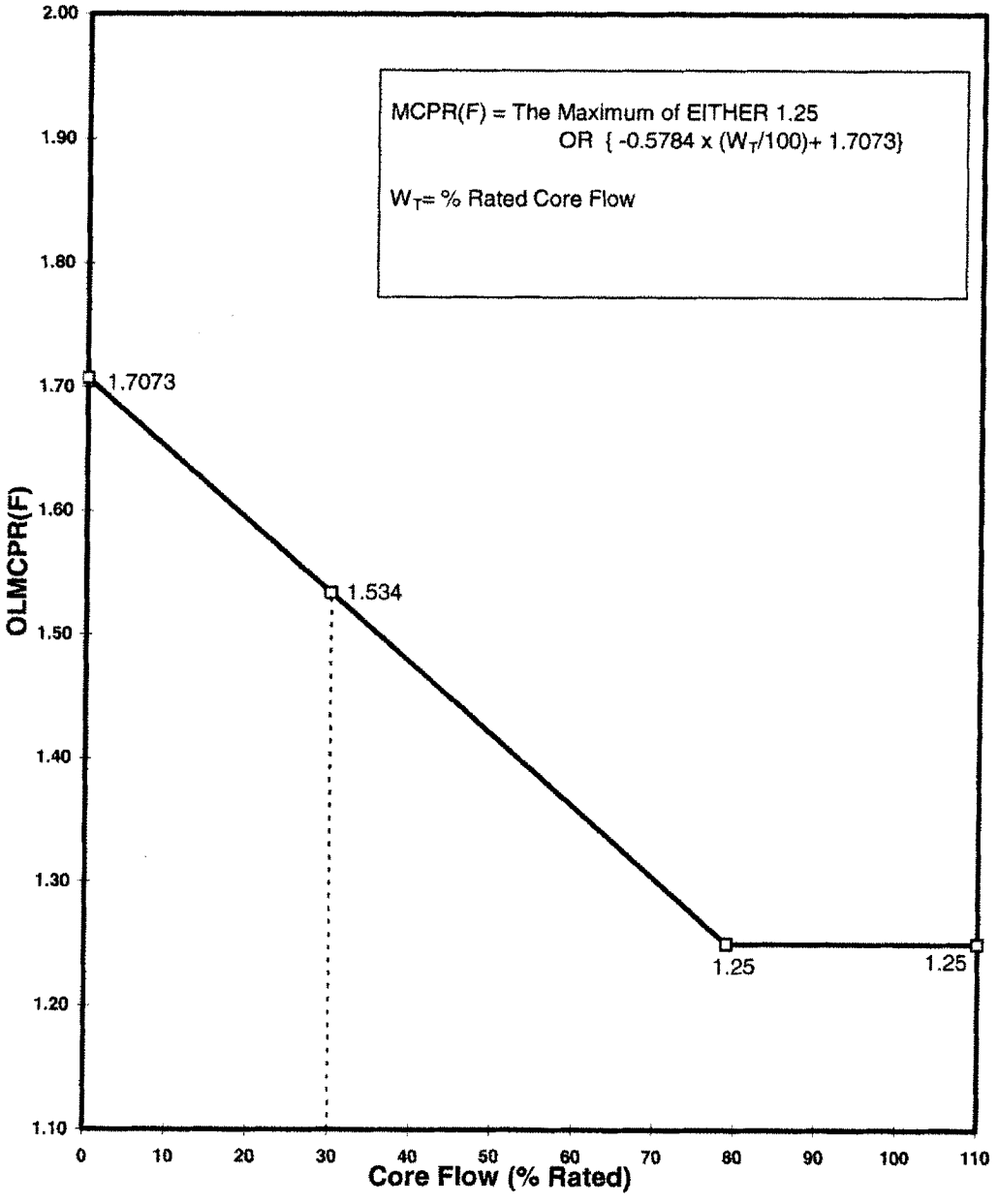


TABLE 2

ROD BLOCK MONITOR ANALYTICAL LIMITS, ALLOWABLE VALUES, AND MCPR LIMITS THIS TABLE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.3.2.1

Applicability: BOC to EOC

FUNCTION	ANALYTICAL LIMIT[1]	ALLOWABLE VALUE[1]	MCPR LIMIT
Low Power Range - Upscale (Low Trip Setpoint)	≤ 123.0%	≤ 121.2%	< 1.70 [2] < 1.40 [3]
Intermediate Power Range - Upscale (Intermediate Trip Setpoint)	≤ 118.0%	≤ 116.2%	< 1.70 [2] < 1.40 [3]
High Power Range - Upscale (High Trip Setpoint)	≤ 113.2%	≤ 111.4%	< 1.70 [2] < 1.40 [3]
Inop	N/A	N/A	< 1.70 [2] < 1.40 [3]

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(1) These Trip Level Settings (with RBM filter time constant between 0.1 and 0.55 seconds) are based on a cycle-specific rated RWE MCPR limit of 1.30 which is less than the minimum cycle OLMCPR (References (4), (6) and (10))

(2) This is the MCPR limit (given THERMAL POWER ≥ 28.4% and < 90% RTP) below which the RBM is required to be OPERABLE (References (4) and (6) and TS Table 3.3.2.1-1).

(3) This is the MCPR limit (given THERMAL POWER ≥ 90% RTP) below which the RBM is required to be OPERABLE (References (4) and (6) and TS Table 3.3.2.1-1).

TABLE 3

DESIGN LINEAR HEAT GENERATION RATE (LHGR) LIMITS[1]

FUEL TYPE	LHGR LIMIT
GE14	13.4 kW/ft

TABLE 4

SINGLE LOOP MAPLHGR MULTIPLIER

FUEL TYPE	MULTIPLIER
GE14	0.73

[1] The LHGR limits provided above are the beginning of life (maximum) values. The LHGR limits as a function of peak pellet exposure are provided in References (5) and (17).

TABLE 5

TURBINE BYPASS VALVE PARAMETERS

TURBINE BYPASS SYSTEM RESPONSE TIMES

Maximum delay time before start of bypass valve opening following generation of the turbine bypass valve flow signal	0.10 sec
Maximum time after generation of a turbine bypass valve flow signal for bypass valve position to reach 80% of full flow (includes the above delay time)	0.30 sec.
Minimum required number of bypass valves to maintain system operability	7

TABLE 6

Oscillation Power Range Monitor (OPRM)

Period Based Detection Algorithm (PBDA) Trip Settings*
Valid For All Conditions

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
1.13	15

TABLE 7

Oscillation Power Range Monitor (OPRM) – SLO**

Period Based Detection Algorithm (PBDA) Trip Settings*
Valid For SLO Conditions Only
With Reactor Power ≤ 65%

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
1.16	17

*The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system. The OPRM Growth Rate Algorithm (GRA) and Amplitude Based Algorithm (ABA) trip settings can be found in the Power Range Neutron Monitoring Configuration Control Documents (SPID's) G-080-VC-234 through 237 (Unit-2).

** The standard two loop operation OPRM Trip Settings specified in Table 6 must be implemented prior to restarting the idle pump when exiting the SLO condition.

APPENDIX A

ASYMMETRIC FEEDWATER TEMPERATURE OPERATION

Asymmetric feedwater heating (resulting from removing a heater string, or individual feedwater heaters, from operation) is the result of the specific configuration of the feedwater lines at Peach Bottom. A reduction in heating either the 'A' or the 'C' heater strings will result in a temperature mismatch between the feedwater flows entering the opposite sides of the reactor vessel. Asymmetric feedwater temperature operation (AFTO) is defined as operation in a feedwater heater/string configuration which results in a specified threshold temperature difference. This threshold is a function of power and flow. The curve of the threshold values is incorporated in the station procedures that govern AFTO (Reference 15).

As a result of analyses documented in Reference (14), a 4% penalty has been applied to the MCPR ARTS curves and a 7% penalty has been applied to the LHGR ARTS curves and MAPLHGR to ensure that sufficient thermal margin exists during anticipated operational occurrences while in AFTO.

LHGR LIMITS

The ARTS-based LHGR power-dependent multipliers (LHGRFAC(P)) for asymmetric feedwater temperature operation are provided in Appendix A, Figures 9 and 10. Figure 9 is valid for seven or more (of nine) Turbine Bypass Valves (TBVs) In-Service and Recirculation Pump Trip (RPT) In-Service, maximum 90 °F FWTR, with a maximum temperature differential of 55° F between the two feedwater sparger lines. Figure 10 is valid for three or more (of nine) TBVs Out-of-Service (OOS) or RPTOOS, maximum 90 °F FWTR, with a maximum temperature differential of 55° F between the two feedwater sparger lines. The flow-dependent multipliers (LHGRFAC(F)) for AFTO are provided in Appendix A, Figures 11 and 12 as a function of the number of recirculation loops in operation only. The SLO LHGR multiplier (0.73) is applied, with a 7% penalty, through LHGRFAC(F) as shown in Figure 12. LHGRFAC(F) is clamped at 0.679 starting at 33.6% of rated core flow for single recirculation loop and asymmetric feedwater temperature operation. The power- and flow-dependent LHGR multipliers were obtained from References (1), (4), (6), (7), (9) and (21) and were adjusted with a 7% penalty as per Reference (14).

MCPR LIMITS

The ARTS-based power-dependent MCPR limits, OLMCPR(P), for use in Technical Specification 3.2.2 during asymmetric feedwater temperature operation are provided in Appendix A, Figures 13 and 14. Figure 13 is valid for seven or more (of nine) Turbine Bypass Valves (TBVs) In-Service and Recirculation Pump Trip (RPT) In-Service, maximum 90 °F FWTR, with a maximum temperature differential of 55° F between the two feedwater sparger lines. Figure 14 is valid for three or more (of nine) TBVs Out-of-Service (OOS) or RPTOOS, maximum 90 °F FWTR, with a maximum temperature differential of 55° F between the two feedwater sparger lines. The flow-dependent MCPR limits, OLMCPR(F), for AFTO are provided in Appendix A, Figure 15. Figure 15 is valid for all operating conditions with AFTO. The power- and flow-dependent OLMCPR curves were obtained from References (1), (4), (6), (7), (9), (16) and (21) and were adjusted with a 4% penalty as per Reference (14).

MAPLHGR LIMITS

A 7% penalty is applied to all MAPLHGR limits for all conditions under asymmetric feedwater temperature operation (AFTO) as per Reference (14). The penalty is being applied as a 0.930 multiplier for all conditions, except single-loop operation (SLO), in Table 8. For single-loop operation, the AFTO multiplier is also applied to the MAPLHGR limits. The SLO multiplier (0.73) from Reference (4) is multiplied by the AFTO multiplier (0.93) in Table 8. Therefore, the SLO MAPLHGR multiplier is clamped at 0.679 as shown in Table 9 to ensure peak clad temperatures are maintained within the limits of the cycle-specific LOCA analysis for single recirculation loop and asymmetric feedwater temperature operation.

TABLE 8

AFTO MAPLHGR MULTIPLIER
(EXCEPT SINGLE LOOP OPERATION)

FUEL TYPE	MULTIPLIER
GE14	0.93

TABLE 9

AFTO SINGLE LOOP MAPLHGR MULTIPLIER

FUEL TYPE	MULTIPLIER
GE14	0.679

FIGURE 9

POWER-DEPENDENT LHGR MULTIPLIER, LHGRFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3

VALID FOR 7 OR MORE TBVs IN-SERVICE, RPT IN-SERVICE, MAX 90 °F FWTR, WITH MAX 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO)

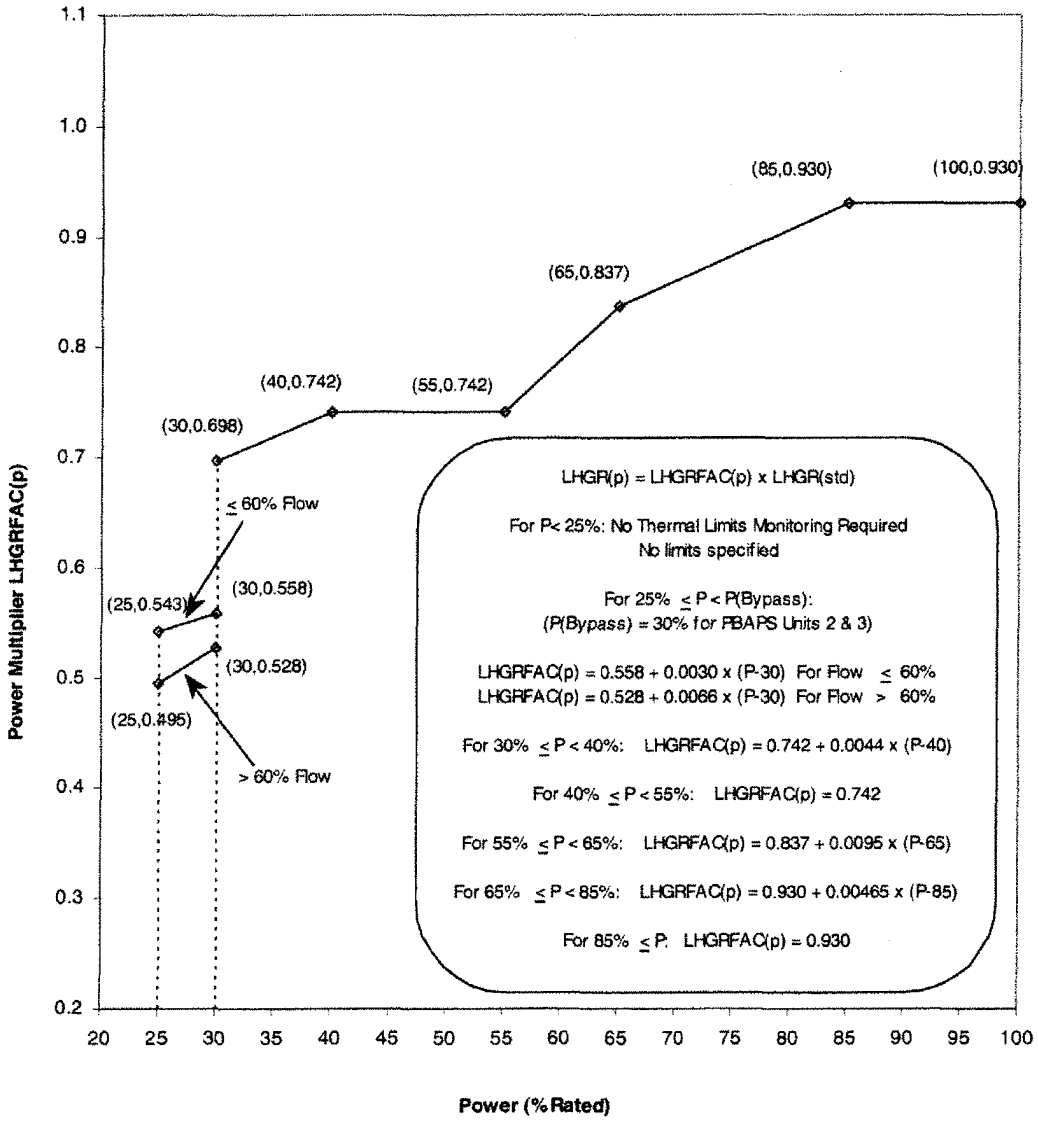


FIGURE 10

POWER-DEPENDENT LHGR MULTIPLIER, LHGRFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3, 3.3.4.2, and 3.7.6

VALID FOR 3 OR MORE TBVOOS OR RPTOOS, MAX 90 °F FWTR, WITH MAX 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO)

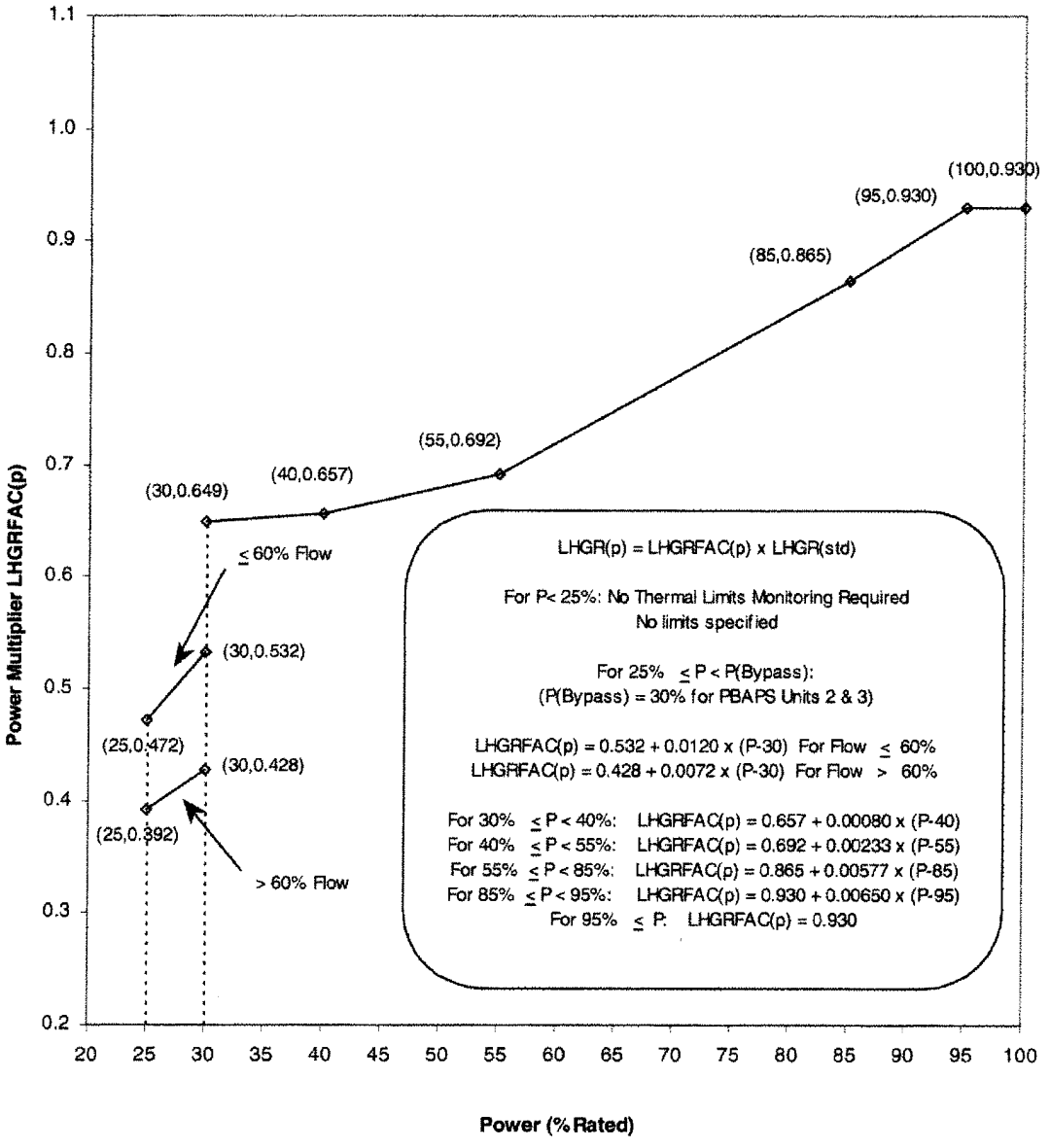


FIGURE 11

FLOW-DEPENDENT LHGR MULTIPLIER, LHGRFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3

VALID FOR 2 LOOP RECIRC FLOW WITH MAX 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO)

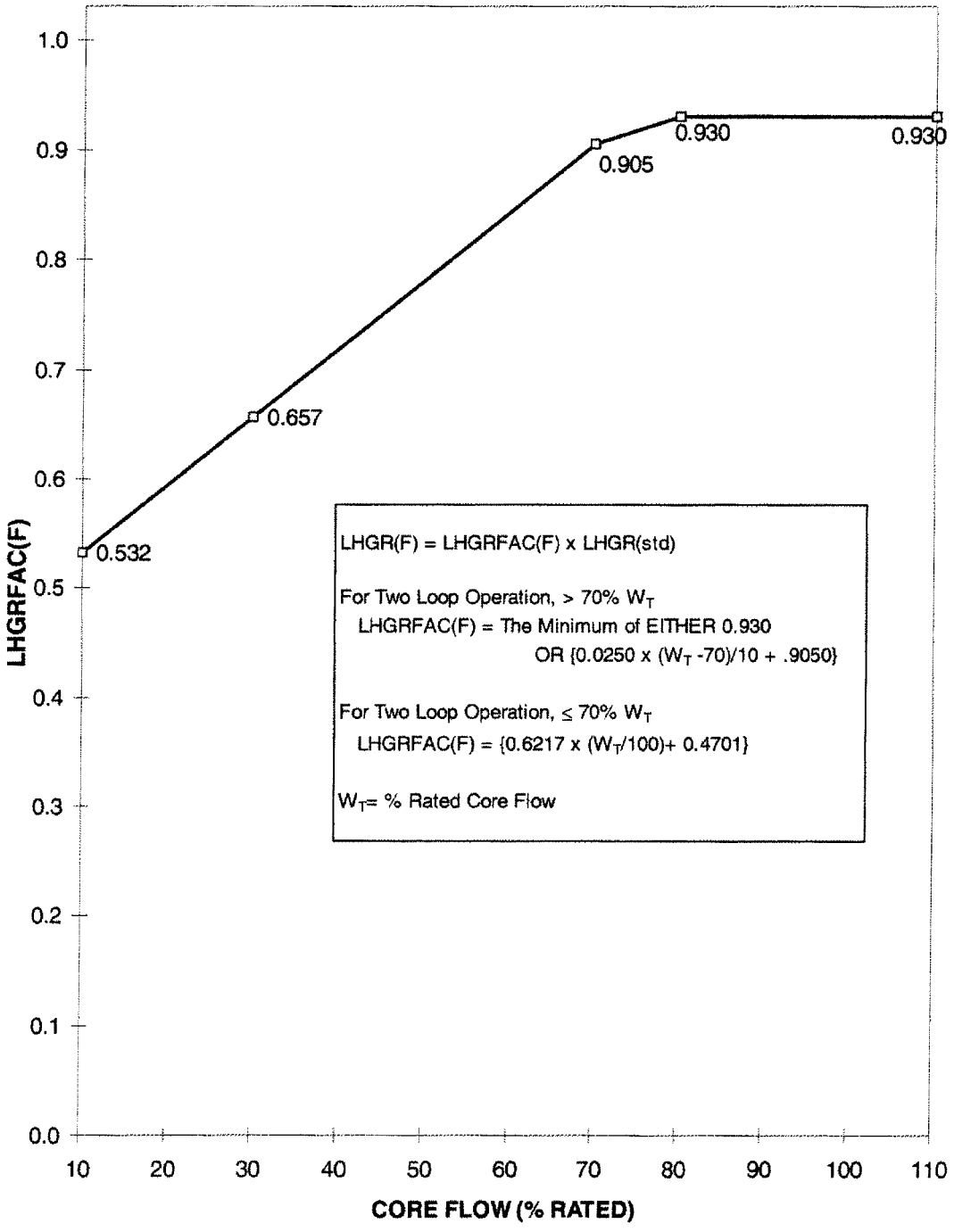


FIGURE 12

FLOW-DEPENDENT LHGR MULTIPLIER, LHGRFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3 AND 3.4.1

VALID FOR SINGLE LOOP RECIRC FLOW WITH MAX 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO)

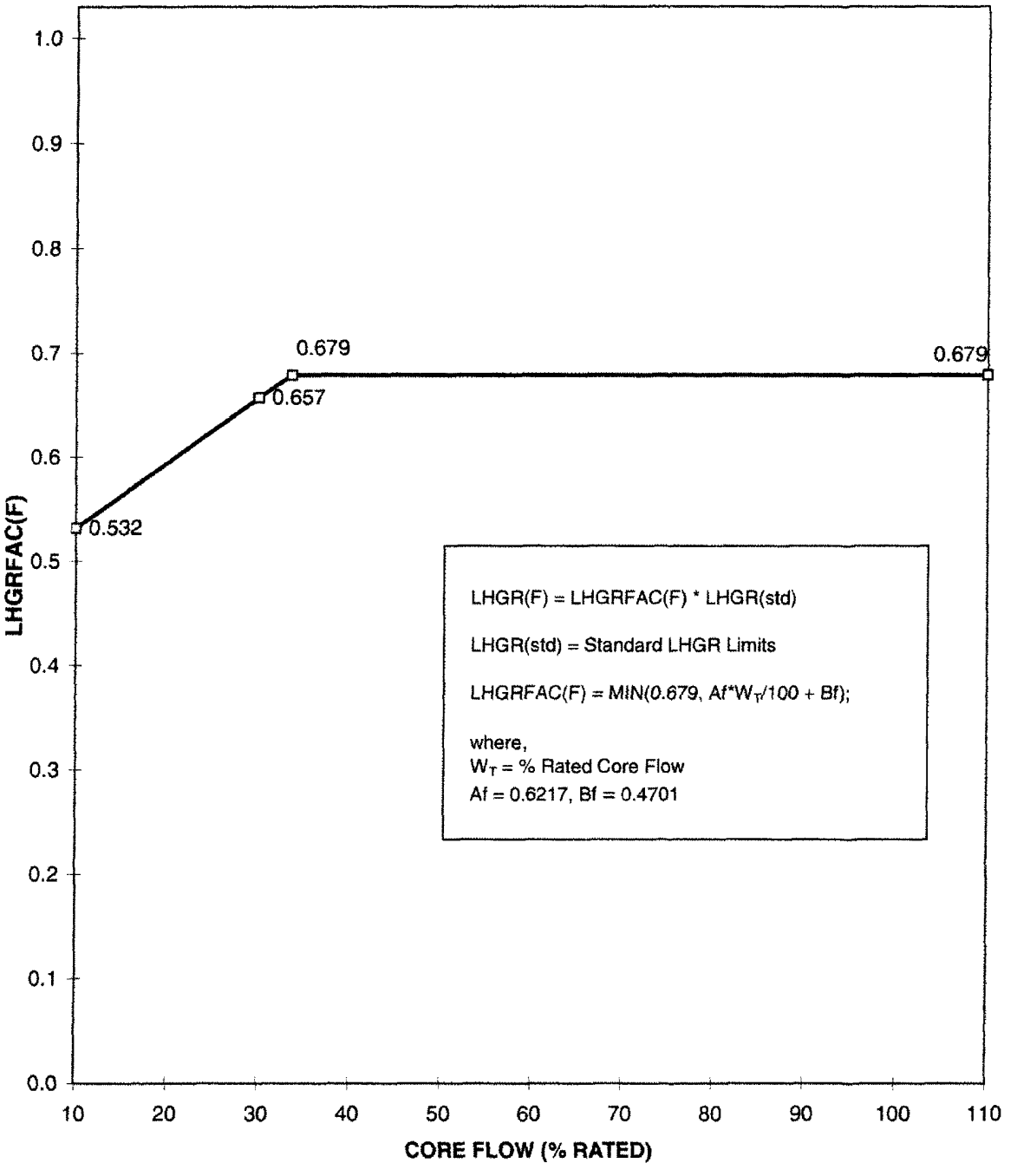


FIGURE 13

POWER-DEPENDENT MCPR LIMIT, OLMCPR(P), AND MULTIPLIERS
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2

VALID FOR 7 OR MORE TBVs IN-SERVICE, RPT IN-SERVICE, MAX 90 °F FWTR, WITH MAX 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO)
VALID FOR TWO OR SINGLE LOOP RECIRC FLOW

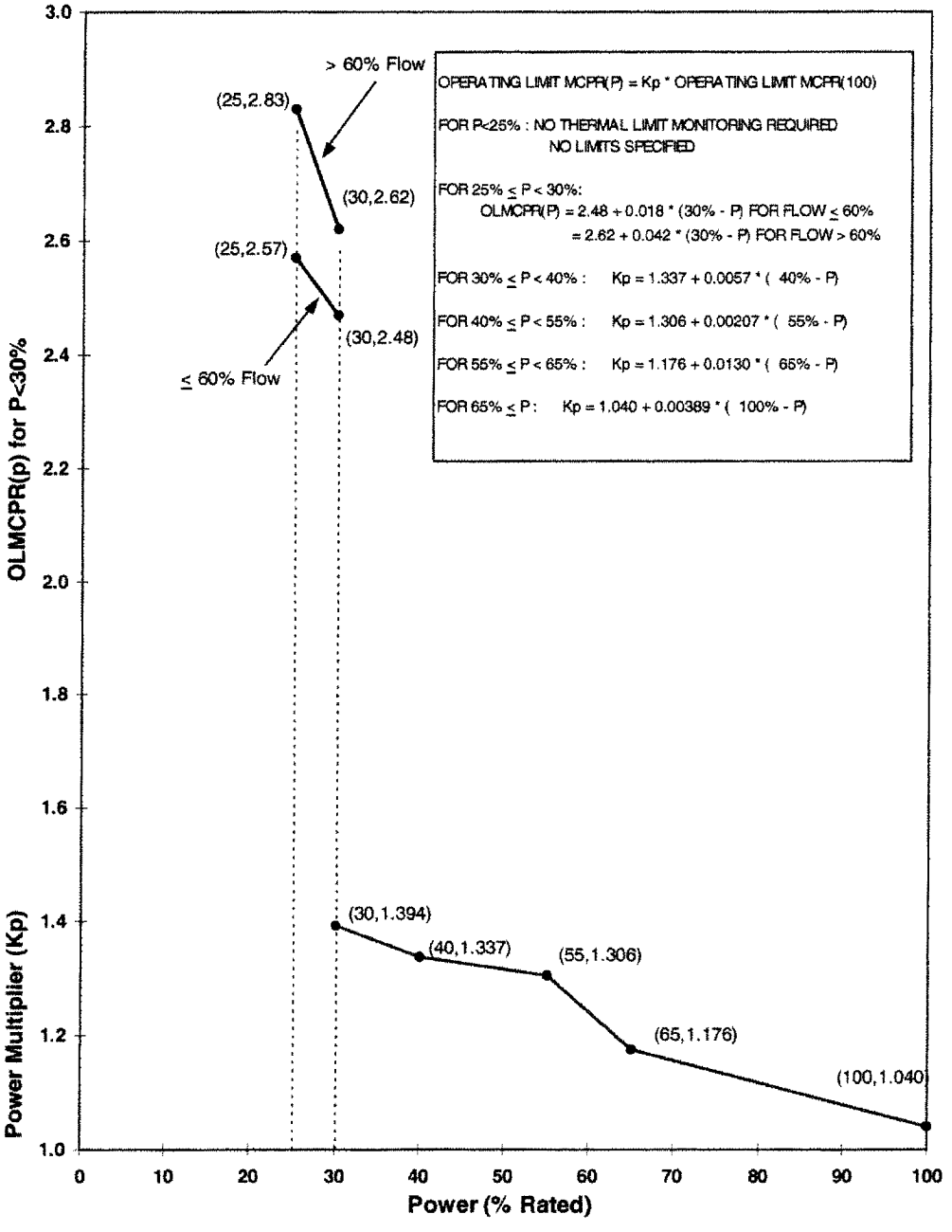


FIGURE 14

POWER-DEPENDENT MCPR LIMIT, OLMCPR(P), AND MULTIPLIERS
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2, 3.3.4.2, and 3.7.6

VALID FOR 3 OR MORE TBVOOS OR RPTOOS, MAX 90 °F FWTR, WITH MAXIMUM 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO) VALID FOR TWO OR SINGLE LOOP RECIRC FLOW

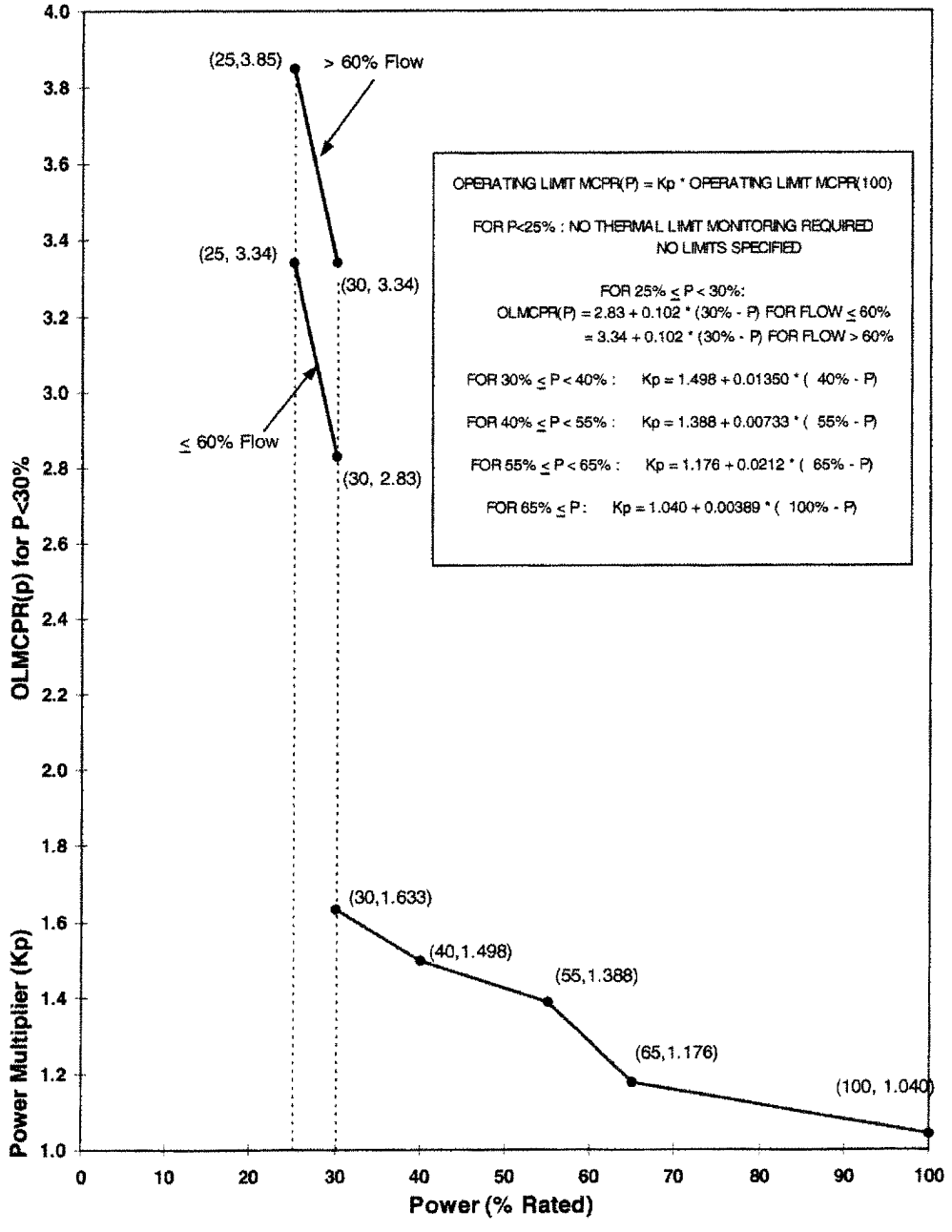
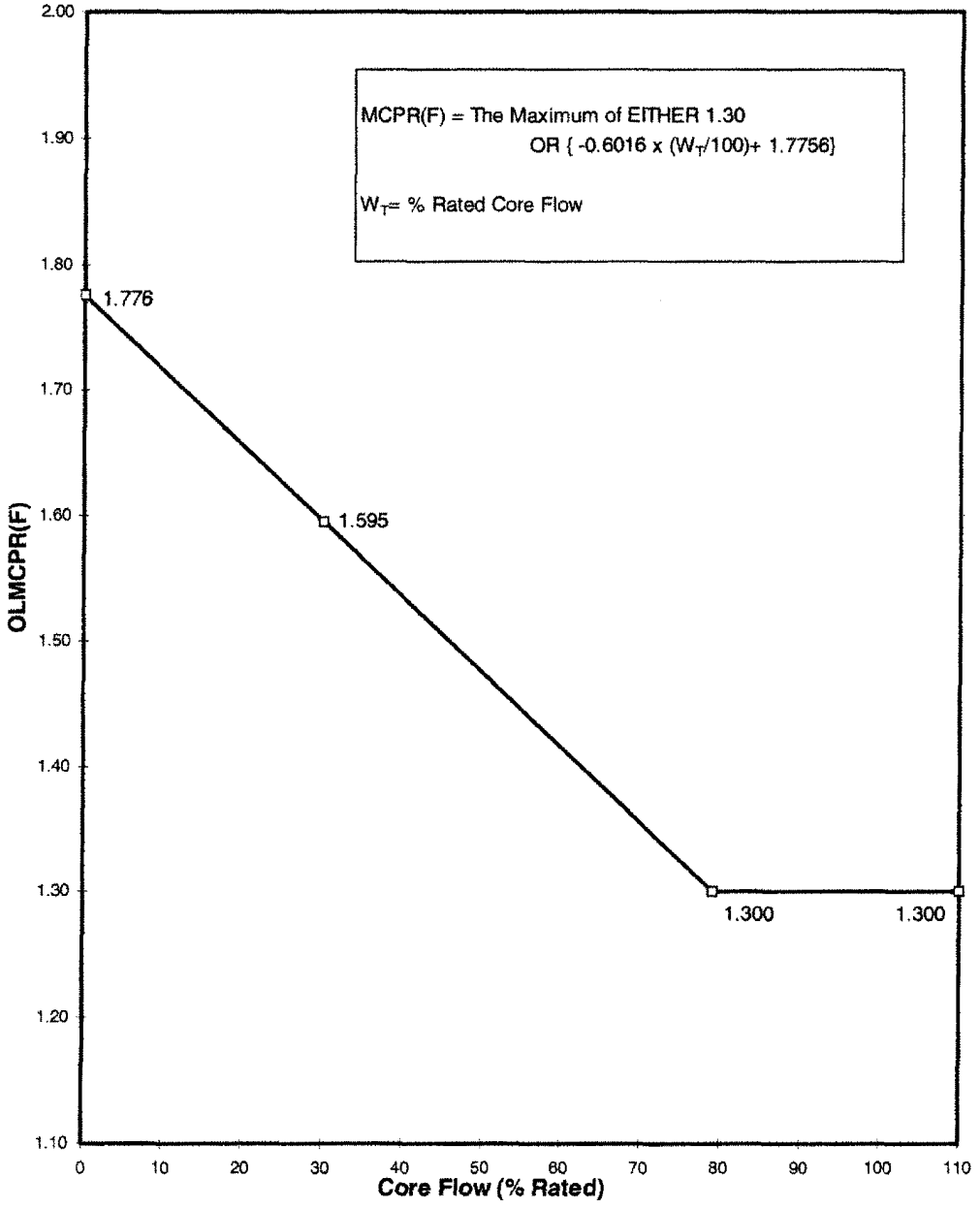


FIGURE 15

FLOW-DEPENDENT MCPR LIMITS, OLMCPR(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2 AND 3.4.1

VALID FOR ALL CONDITIONS WITH MAXIMUM 55 °F TEMPERATURE DIFFERENTIAL BETWEEN FEEDWATER SPARGER LINES (AFTO)