Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

April 1, 2003

U.S. Nuclear Regulatory Commission
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Gentlemen:

In the Matter of) Docket No. 50-260
Tennessee Valley Authority)

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 2 - CORE OPERATING LIMITS REPORT (COLR), FOR CYCLE 13 OPERATION

In accordance with the requirements of Technical Specification 5.6.5.d, enclosed is Revision 0 of the Unit 2 Cycle 13, Core Operating Limits Report (COLR).

There are no new commitments contained in this letter. If you have any questions, please contact me at (256) 729-2636.

Sincerely,

T. E. Abney
Manager of Licensing
and Industry Affairs

Enclosure
cc: See page 2

A001

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Enclosure
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ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 2

CORE OPERATING LIMITS REPORT (COLR),
FOR CYCLE 13 OPERATION

(SEE ATTACHED)

Browns Ferry Nuclear Plant
Unit 2, Cycle 13

CORE OPERATING LIMITS REPORT (COLR)

TENNESSEE VALLEY AUTHORITY
Nuclear Fuel Division
BWR Fuel Engineering Department

Prepared By: _____ Date: 2-26-03
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BWR Fuel Engineering

Verified By: _____ Date: 2/26/03
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Approved By: _____ Date: 2/26/03
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Reviewed By: _____ Date: 2/27/03
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Reviewed By: _____ Date: 2/28/03
PORC Chairman

Revision Log

Revision	Date	Description	Affected Pages
0	2/26/2003	Initial Release for New Cycle	All

1. INTRODUCTION

This Core Operating Limits Report for Browns Ferry Unit 2, Cycle 13 is prepared in accordance with the requirements of Browns Ferry Technical Specification 5.6.5. The core operating limits presented here were developed using NRC-approved methods (References 1 and 2). One exception to this is an issue with the assumed uncertainty for the GEXL14 CPR correlation. The NRC has identified that the correlation lacked top-peaked axial power shape data in its formulation and in the calculation of the overall correlation uncertainty. As a long term corrective action, Global Nuclear Fuels has agreed to perform more GE14 testing to resolve this descrepancy and use the resulting data to generate an appropriate GEXL14 uncertainty. As an interim action, an increased GEXL14 uncertainty that incorporates a significant penalty has been calculated and applied to the MCPR Safety Limit (SLMCPR) for this cycle.

Results from the reload analyses for Browns Ferry Unit 2, Cycle 13 are documented in Reference 3.

The following core operating limits are included in this report:

a. Average Planar Linear Heat Generation Rate (APLHGR) Limit
(Technical Specifications 3.2.1 and 3.7.5)

b. Linear Heat Generation Rate (LHGR) Limit
(Technical Specification 3.2.3)

c. Minimum Critical Power Ratio Operating Limit (OLMCPR)
(Technical Specifications 3.2.2, 3.3.4.1, and 3.7.5)

d. Average Power Range Monitor (APRM) Flow Biased Rod Block Trip Setting
(Technical Requirements Manual Section 5.3.1 and Table 3.3.4-1)

e. Rod Block Monitor (RBM) Trip Setpoints and Operability
(Technical Specification Table 3.3.2.1-1)

f. Shutdown Margin (SDM) Limit
(Technical Specification 3.1.1)

2. APLHGR LIMIT (TECHNICAL SPECIFICATIONS 3.2.1 AND 3.7.5)

The APLHGR limits for full power and flow conditions for each type of fuel as a function of exposure are shown in Figures 1-11. The APLHGR limits for the GE11, GE13, and GE14 assemblies are for the most limiting lattice (excluding natural uranium) at each exposure point. The specific values for each lattice are given in Reference 4.

	Bundle Type	EDB No.
Figure 1	GE11-P9HUB366-12G4.0	2133
Figure 2	GE11-P9HUB367-14GZ	2135
Figure 3	GE13-P9HTB384-12G4.0	2218
Figure 4	GE13-P9DTB391-13GZ	2430
Figure 5	GE13-P9DTB412-2G7.0/11G5.0	2431
Figure 6	GE14-P10DNAB416-18GZ	2627
Figure 7	GE14-P10DNAB417-18GZ	2628
Figure 8	GE14-P10DNAB367-14GZ	2602
Figure 9	GE14-P10DNAB416-16GZ	2601
Figure 10	GE14-P10DNAB416-16GZ	2600
Figure 11	GE14-P10DNAB200-3GZ	2603

These APLHGR limits are adjusted for off-rated power and flow conditions using the ARTS factors, MAPFAC(P) and MAPFAC(F). The reduced power factor, MAPFAC(P), is given in Figure 12 (reference 11). Similarly, adjustments for reduced flow operation are performed using the MAPFAC(F) corrections given in Figure 13 (reference 5). Both factors are multipliers used to reduce the standard APLHGR limit. The most limiting power-adjusted or flow-adjusted value is taken as the APLHGR operating limit for the off-rated condition.

The APLHGR limits in Figures 1-11 are applicable for both Turbine Bypass In-Service (TBIS) and Out-Of-Service (TBOOS). The off-rated power corrections [MAPFAC(P)] in Figure 12 contain separate limits to be applied below Pbypass (30% rated power) for TBIS or TBOOS. The off-rated flow corrections [MAPFAC(F)] in Figure 13 bound both TBIS and TBOOS operation.

The APLHGR limits in Figures 1-11 are applicable for both Recirculation Pump Trip (RPT) In-Service (RPTIS) and Out-Of-Service (RPTOOS). The off-rated power [MAPFAC(P)] and flow corrections [MAPFAC(F)] in Figures 12 and 13 bound both RPTIS and RPTOOS operation. No corrections are required to the APLHGR limits for RPTOOS for either rated or off-rated operation.

For Single Recirculation Loop Operation (SLO), the most limiting of either the SLO multiplier or the off-rated MAPFAC correction is used to reduce the exposure dependent APLHGR limit. The SLO multipliers to be applied to this cycle is 0.84 for GE11, 0.84 for GE13, and 0.93 for GE14 (reference 3). It is not necessary to apply both the off-rated MAPFAC and SLO multiplier corrections at the same time.

3. LHGR LIMIT (TECHNICAL SPECIFICATION 3.2.3)

The LHGR limit is fuel type dependent. For Unit 2 Cycle 13 there are three (3) fuel types in the core, GE11, GE13 and GE14. The limits for these types are given below:

Fuel Type	LHGR Limit
GE11	14.4 kw/ft
GE13	14.4 kw/ft
GE14	13.4 kw/ft

4. OLMCPR (TECHNICAL SPECIFICATIONS 3.2.2, 3.3.4.1, AND 3.7.5)

a. **Rated Limits - OLMCPR(100):** The MCPR Operating Limit for rated power and flow conditions, OLMCPR(100), is equal to the fuel type and exposure dependent limits shown in Figures 14 - 17, as defined in the following table:

	Fuel Type	Exposure Range
Figure 14	GE11 & GE13	BOC to EOR-2200 MWD/ST
Figure 15	GE11 & GE13	BOC to EOC
Figure 16	GE14	BOC to EOR-2200 MWD/ST
Figure 17	GE14	BOC to EOC

EOR is defined as the end of full power capability at rated flow with normal feedwater temperature. It is acceptable to use the more restrictive Figures 15 and 17 limits at any point in the cycle.

As noted in the footnotes of Figures 14 through 17, an adder of 0.02 is applied for single loop operation.

The actual OLMCPR(100) value is dependent upon the scram time testing results, as described below (ref. 10):

$$\tau = 0.0 \quad \text{or} \quad \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B}, \quad \text{whichever is greater}$$

where; τ_A = **1.096** sec (analytical Option A scram time limit - based on dropout time for notch position 36)

$$\tau_{ave} = \frac{\sum_{i=1}^{n} \tau_i}{n}$$

$$\tau_B = \mu + 1.65 * \sigma * \left[\frac{N}{n}\right]^{\frac{1}{2}}$$

where; μ = **0.830** sec (mean scram time used in transient analysis - based on dropout time for notch position 36)

σ = **0.019** sec (standard deviation of μ)

N = Total number of active rods measured in Technical Specification Surveillance Requirement SR 3.1.4.1

n = Number of surveillance rod tests performed to date in cycle

τ_i = Scram time (dropout time) from fully withdrawn to notch position 36 for the ith rod

b. **Startup Limits:** Option A OLMCPR limits (τ=**1.0**) shall be used prior to the determination of τ in accordance with SR 3.1.4.1.

c. **Off-Rated Limits:** For off-rated power and flow conditions, power-adjusted [MCPR(P)] and flow-adjusted [MCPR(F)] operating limits are determined from Figures 18 and 19, respectively. The MCPR(P) curve above Pbypass (30% rated power) is a multiplier to be applied to the OLMCPR(100) limit. The MCPR(P) curve below Pbypass and the MCPR(F) curve are OLMCPR values to be used directly. The most limiting power-dependent or flow-dependent value is taken as the OLMCPR for the off-rated condition. Figures 18 and 19 have been rescaled for the cycle SLMCPR of 1.08 (documented in Reference 12), as specified in Appendix D of Reference 3.

d. **Equipment Out-Of-Service OLMCPR Limits:** Rated power OLMCPR(100) limits are provided for Recirculation Pump Trip Out-Of-Service (RPTOOS), Turbine Bypass Out-Of-Service (TBOOS), and the combined RPTOOS/TBOOS condition in Figures 14 through 17. Additionally an off-rated MCPR(P) correction from Figure 18 (references 11 & 12) shall be applied for TBOOS when the power is below Pbypass. This portion of Figure 18 has been rescaled for the cycle SLMCPR of 1.08 (documented in Reference 12), as specified in Appendix D of Reference 3.

e. **Single Loop Operation (SLO) Limits:** As noted in section 4.a above, a correction of 0.02 is to be applied to the OLMCPR(100) limits for SLO as described in the footnotes of Figures 14 through 17. The same adder applies to the off-rated MCPR(F) as noted in the footnote to Figure 19 and to the MCPR(P) value below Pbypass from Figure 18.

5. APRM FLOW BIASED ROD BLOCK TRIP SETTING (TECHNICAL REQUIREMENTS MANUAL SECTION 5.3.1 AND TABLE 3.3.4-1)

The APRM Rod Block trip setting shall be:

$S_{RB} \leq (0.66(W-\Delta W) + 61\%)$ Allowable Value

$S_{RB} \leq (0.66(W-\Delta W) + 59\%)$ Nominal Trip Setpoint (NTSP)

where:

S_{RB} = Rod Block setting in percent of rated thermal power (3458 MWt)

W = Loop recirculation flow rate in percent of rated

ΔW = Difference between two-loop and single-loop effective recirculation flow at the same core flow (ΔW=0.0 for two-loop operation)

The APRM Rod Block trip setting is clamped at a maximum allowable value of 115% (corresponding to a NTSP of 113%).

6. ROD BLOCK MONITOR (RBM) TRIP SETPOINTS AND OPERABILITY (TECHNICAL SPECIFICATION TABLE 3.3.2.1-1)

The RBM trip setpoints and applicable power ranges shall be as follows (refs. 7-9):

RBM Trip Setpoint	Allowable Value (AV)	Nominal Trip Setpoint (NTSP)	
LPSP	27%	25%	
IPSP	62%	60%	
HPSP	82%	80%	
LTSP - unfiltered - filtered	121.7% 120.7%	120.0% 119.0%	(1),(2)
ITSP - unfiltered - filtered	116.7% 115.7%	115.0% 114.0%	(1),(2)
HTSP - unfiltered - filtered	111.7% 110.9%	110.0% 109.2%	(1),(2)
DTSP	90%	92%	

Notes: (1) These setpoints are based upon an Analytical Limit HTSP of 114% (w/o filter) which corresponds to a MCPR operating limit of 1.31 (using the cycle safety limit of 1.08), as reported in Section 10 of reference 3 [SRLR]. It is important to note that Unit 2 Cycle 13 has had a cycle specific RWE analysis performed and the table provided in Section 10 of reference 3 supercedes the OLMCPR values provided in references 6, 7, and 8.

(2) The unfiltered setpoints are consistent with a nominal RBM filter setting of 0.0 seconds (reference 8). The filtered setpoints are consistent with a nominal RBM filter setting $\leq$ 0.5 seconds (reference 7).

The RBM setpoints in Technical Specification Table 3.3.2.1-1 are applicable when:

THERMAL POWER (% Rated)	Applicable MCPR (1)	Notes from Table 3.3.2.1-1	
$\geq$ 27% and < 90%	< 1.72 < 1.75	(a), (b), (f), (h) (a), (b), (f), (h)	dual loop operation single loop operation
$\geq$ 90%	< 1.41	(g)	dual loop operation (2)

Notes: (1) The MCPR values shown correspond to a SLMCPR of 1.08 for dual recirculation loop operation and 1.10 for single loop operation.

(2) Greater than 90% rated power is not attainable in single loop operation.

7. SHUTDOWN MARGIN (SDM) LIMIT (TECHNICAL SPECIFICATION 3.1.1)

The core shall be subcritical with the following margin with the strongest OPERABLE control rod fully withdrawn and all other OPERABLE control rods fully inserted.

SDM $\geq$ 0.38% dk/k

8. REFERENCES

1. NEDE-24011-P-A-14, "General Electric Standard Application for Reactor Fuel", June 2000.

2. NEDE-24011-P-A-14-US, "General Electric Standard Application for Reactor Fuel (Supplement for United States)", June 2000.

3. 0000-0006-1355-SRLR Rev. 0, "Supplemental Reload Licensing Report for Browns Ferry Nuclear Plant Unit 2 Reload 12 Cycle 13", February 2003.

4. 0000-0006-1355-MAPL Rev. 0, "Lattice-Dependent MAPLHGR Report for Browns Ferry Nuclear Plant Unit 2 Reload 12 Cycle 13", February 2003.

5. NEDC-32774P Supplement 1 Revision 0, "Browns Ferry Nuclear Plant Units 1, 2, and 3 Turbine Bypass and End-of-Cycle Recirculation Pump Trip Combination Mode Out-Of-Service", dated February 2001.

6. NEDC-32433P, "Maximum Extended Load Line Limit and ARTS Improvement Program Analyses for Browns Ferry Nuclear Plant Unit 1, 2, and 3", dated April 1995.

7. EDE-28-0990 Rev. 3 Supplement E, "PRNM (APRM, RBM, and RFM) Setpoint Calculations [ARTS/MELLL (NUMAC) - Power-Uprate Condition] for Tennessee Valley Authority Browns Ferry Nuclear Plant", dated October 1997.

8. EDE-28-0990 Rev. 2 Supplement E, "PRNM (APRM, RBM, and RFM) Setpoint Calculations [ARTS/MELLL (NUMAC) - Power-Uprate Condition] for Tennessee Valley Authority Browns Ferry Nuclear Plant", dated October 1997.

9. GE Letter LB#: 262-97-133, "Browns Ferry Nuclear Plant Rod Block Monitor Setpoint Clarification - GE Proprietary Information", dated September 12, 1997. [L32 970912 800]

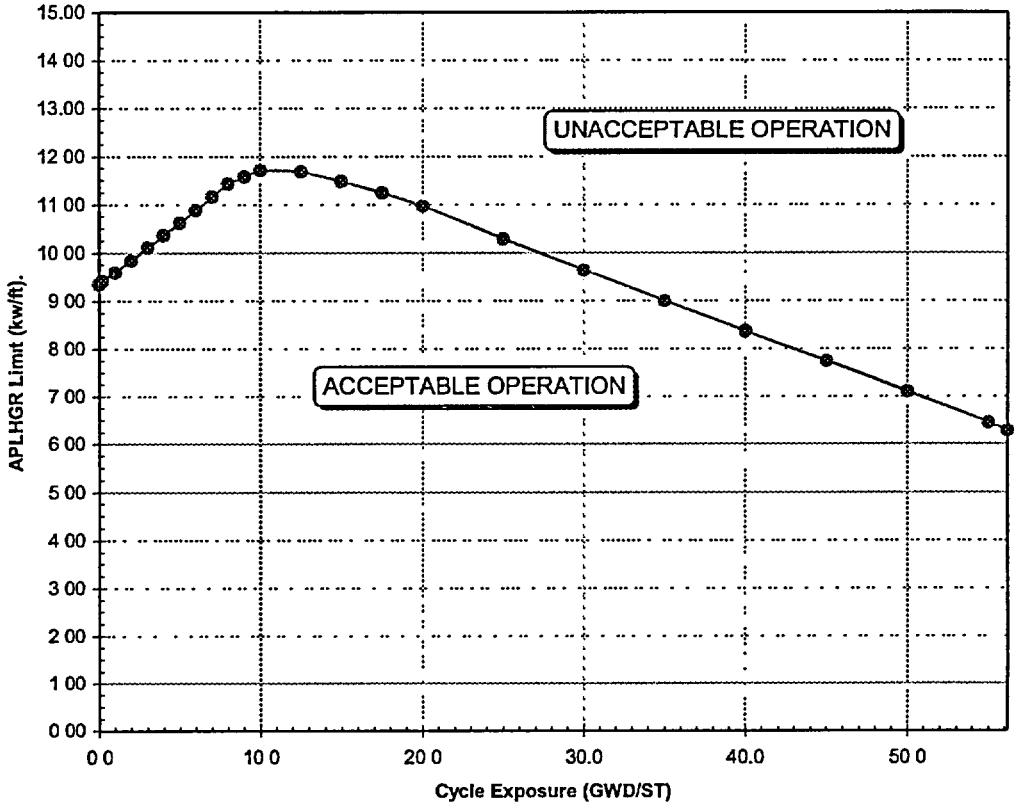
10. GE Letter JAB-T8019a, "Technical Specification Changes for Implementation of Advanced Methods", dated June 4, 1998. [L32 980608 800]

11. GE-NE-L12-00889-00-01P Revision 0, "GE14 Fuel Design Cycle-Independent Analyses for Browns Ferry Units 2 and 3", dated January 2002. [L32 020208 800]

12. Calculational File BFE-1626, "Adjust ARTS MCPR(P) and MCPR(F) Curves for SLMCPR Change", dated March 19, 2002. [L32 020319 802]

13. GNF Letter CJP:03-023, "Supplemental Information to the Browns Ferry 2 Cycle 13 SRLR", dated February 26, 2003. [L32 030226 802]

Figure 1
APLHGR Limits for Bundle Type GE11-P9HUB366-12G4.0
(GE11 EDB# 2133)



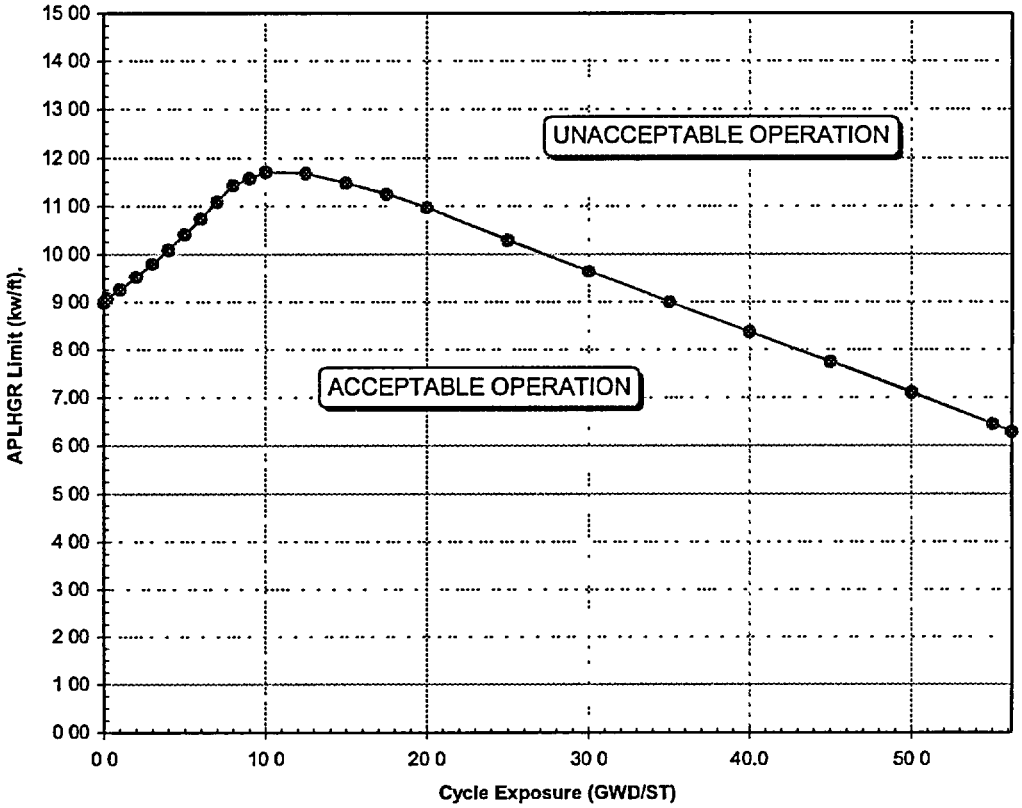
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.35	7.0	11.16	25.0	10.29
0.2	9.42	8.0	11.43	30.0	9.64
1.0	9.60	9.0	11.57	35.0	9.00
2.0	9.84	10 0	11.71	40.0	8.37
3.0	10.11	12.5	11.68	45 0	7.75
4.0	10.36	15.0	11.48	50.0	7.11
5.0	10.62	17.5	11.25	55.0	6.45
6.0	10.88	20 0	10.97	56.17	6.29

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.84 or the MAPFAC correction, as described in Section 2.

Figure 2
APLHGR Limits for Bundle Type GE11-P9HUB367-14GZ
(GE11 EDB# 2135)



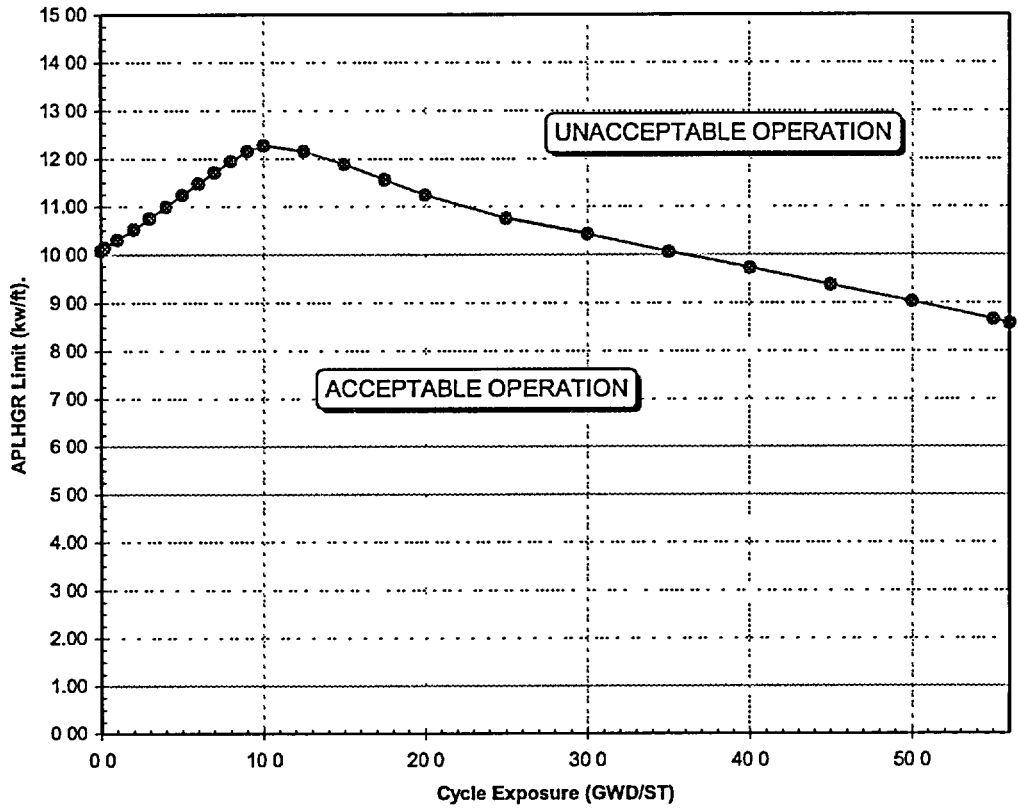
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	8.99	7.0	11.08	25.0	10.29
0.2	9.08	8.0	11.43	30.0	9.64
1.0	9.26	9.0	11.57	35.0	9.00
2.0	9.52	10.0	11.71	40.0	8.37
3.0	9.80	12.5	11.68	45.0	7.75
4.0	10.09	15.0	11.48	50.0	7.11
5.0	10 40	17.5	11.25	55.0	6.45
6.0	10.73	20.0	10.97	56.17	6.29

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.84 or the MAPFAC correction, as described in Section 2.

Figure 3
APLHGR Limits for Bundle Type GE13-P9HTB384-12G4.0
(GE13 EDB# 2218)



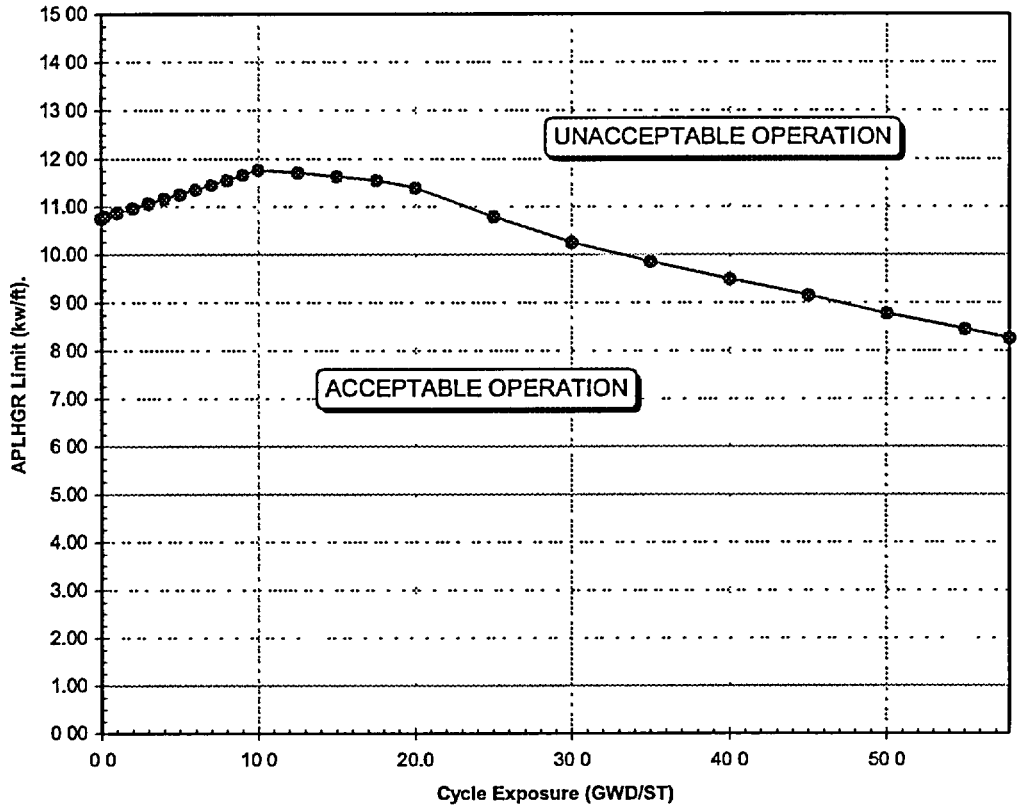
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	10.09	7.0	11.71	25.0	10.75
0.2	10.15	8.0	11.95	30.0	10.43
1.0	10.31	9.0	12.16	35.0	10.06
2.0	10.52	10.0	12.28	40.0	9.72
3.0	10.75	12.5	12.16	45.0	9.38
4.0	10.99	15.0	11.88	50.0	9.03
5.0	11.25	17.5	11.56	55.0	8.66
6.0	11.48	20.0	11.24	55.98	8.58

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.84 or the MAPFAC correction, as described in Section 2.

Figure 4
APLHGR Limits for Bundle Type GE13-P9DTB391-13GZ
(GE13 EDB# 2430)



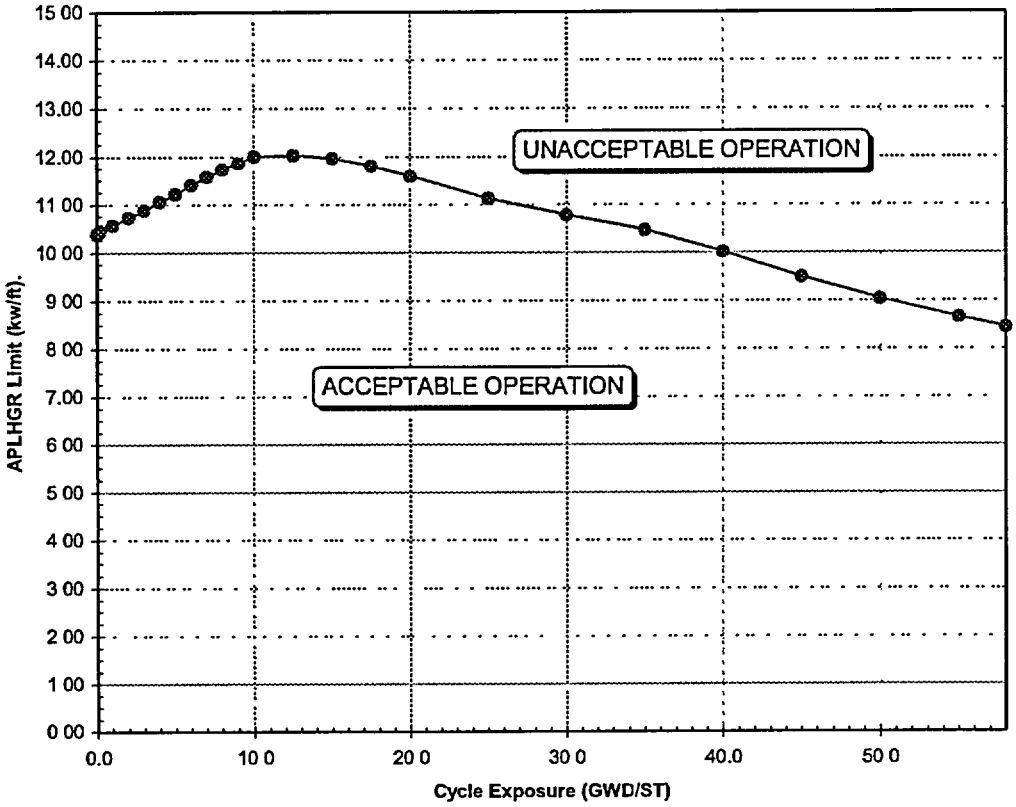
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	10.75	7.0	11.45	25 0	10.79
0.2	10.80	8.0	11.55	30.0	10.24
1.0	10.87	9.0	11.66	35.0	9.85
2.0	10.96	10.0	11.77	40.0	9.49
3.0	11.06	12.5	11.71	45.0	9.15
4.0	11.15	15.0	11.63	50.0	8.78
5.0	11.25	17.5	11.55	55.0	8.45
6.0	11.35	20.0	11.39	57.82	8.27

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.84 or the MAPFAC correction, as described in Section 2.

Figure 5
APLHGR Limits for Bundle Type GE13-P9DTB412-2G7.0/11G5.0
(GE13 EDB# 2431)



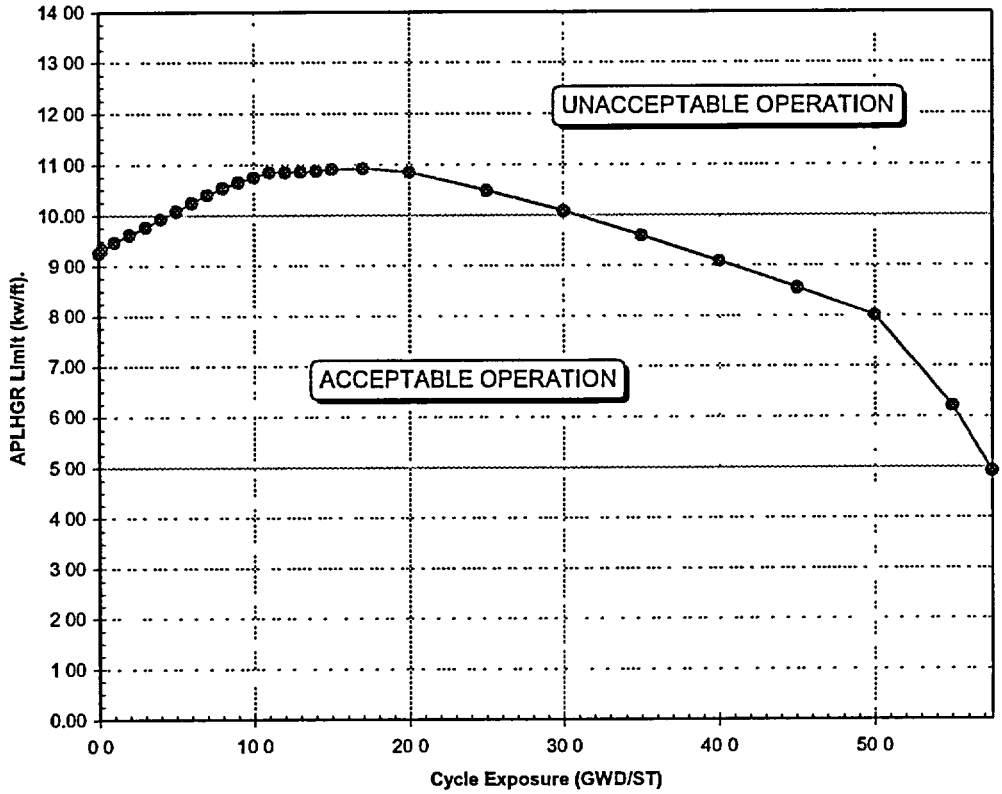
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	10.38	7.0	11.58	25.0	11.12
0.2	10.45	8.0	11.73	30.0	10.78
1.0	10.57	9.0	11.86	35.0	10.46
2.0	10.72	10.0	12.00	40.0	10.01
3.0	10.88	12.5	12.03	45.0	9.49
4.0	11.05	15.0	11.96	50.0	9.04
5.0	11.22	17.5	11.80	55 0	8.66
6.0	11.40	20.0	11.59	57.99	8.45

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.84 or the MAPFAC correction, as described in Section 2.

Figure 6
APLHGR Limits for Bundle Type GE14-P10DNAB416-18GZ
(GE14 EDB# 2627)



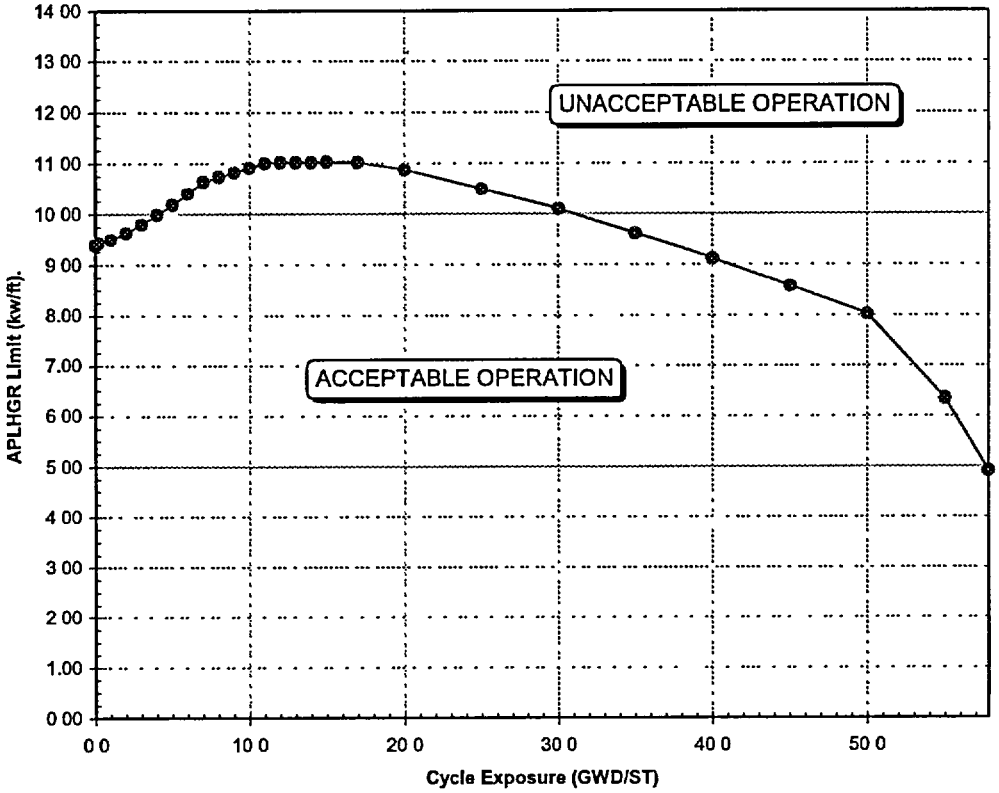
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.26	8.0	10.54	20.0	10.85
0.2	9.34	9.0	10.65	25.0	10.49
1.0	9.47	10.0	10.75	30.0	10.09
2.0	9.62	11.0	10.85	35.0	9.60
3.0	9.77	12.0	10.85	40.0	9.09
4.0	9.93	13.0	10.86	45.0	8.56
5.0	10.09	14.0	10.88	50.0	8.01
6.0	10.25	15.0	10.91	55.0	6.21
7.0	10.41	17.0	10.93	57.53	4.93

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.93 or the MAPFAC correction, as described in Section 2.

Figure 7
APLHGR Limits for Bundle Type GE14-P10DNAB417-18GZ
(GE14 EDB# 2628)



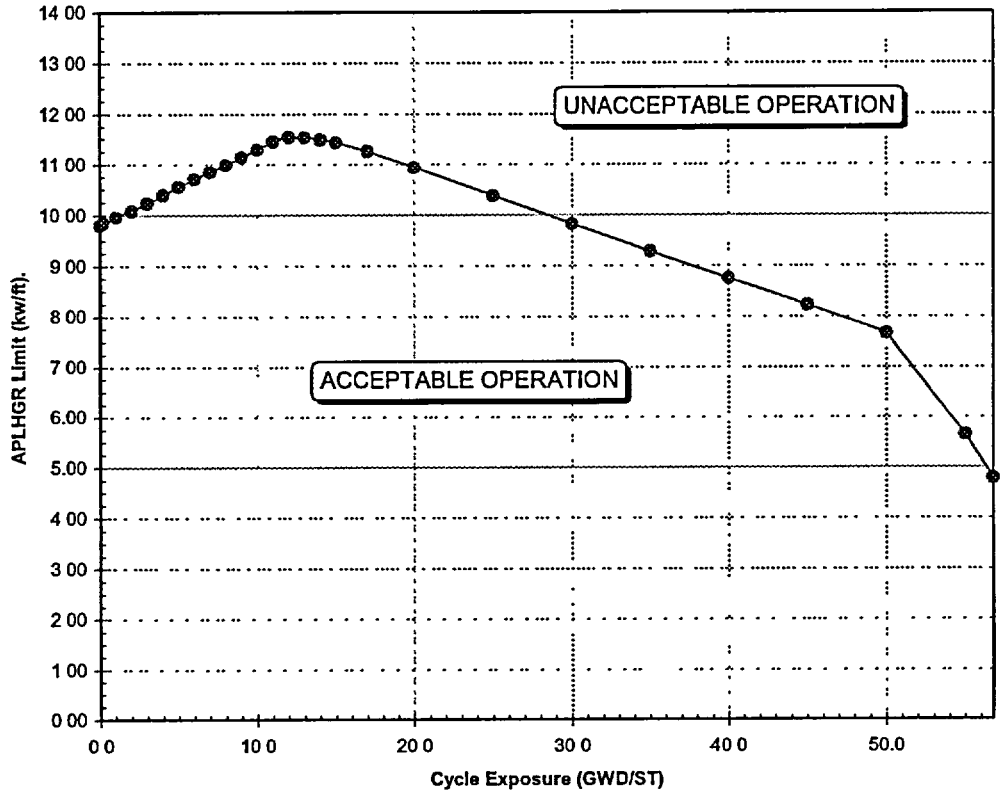
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.39	8.0	10.74	20.0	10.88
0.2	9.43	9.0	10.83	25.0	10.50
1.0	9.50	10.0	10.91	30.0	10.10
2.0	9.63	11.0	11.00	35.0	9.62
3.0	9.80	12.0	11.02	40.0	9.12
4.0	9.99	13.0	11.02	45.0	8.58
5.0	10.19	14.0	11.02	50.0	8.02
6.0	10.41	15.0	11.03	55.0	6.35
7.0	10.64	17.0	11.02	57.82	4.92

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.93 or the MAPFAC correction, as described in Section 2.

Figure 8
APLHGR Limits for Bundle Type GE14-P10DNAB367-14GZ
(GE14 EDB# 2602)



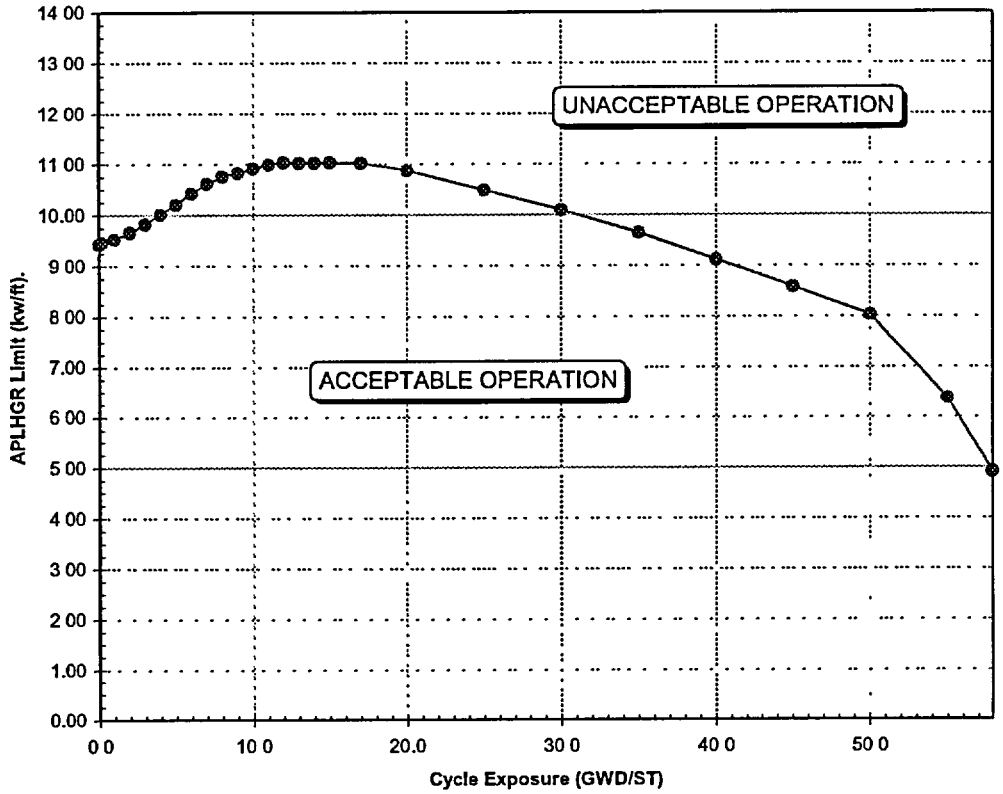
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.80	8.0	10.99	20.0	10.94
0.2	9.86	9.0	11.14	25.0	10.38
1.0	9.96	10.0	11.29	30.0	9.83
2.0	10.09	11.0	11.45	35.0	9.29
3.0	10.24	12.0	11.54	40.0	8.76
4.0	10.40	13.0	11.53	45.0	8.23
5.0	10.56	14.0	11.49	50.0	7.67
6.0	10.71	15.0	11.43	55.0	5.66
7.0	10.85	17.0	11.26	56.76	4.79

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.93 or the MAPFAC correction, as described in Section 2.

Figure 9
APLHGR Limits for Bundle Type GE14-P10DNAB416-16GZ
(GE14 EDB#2601)



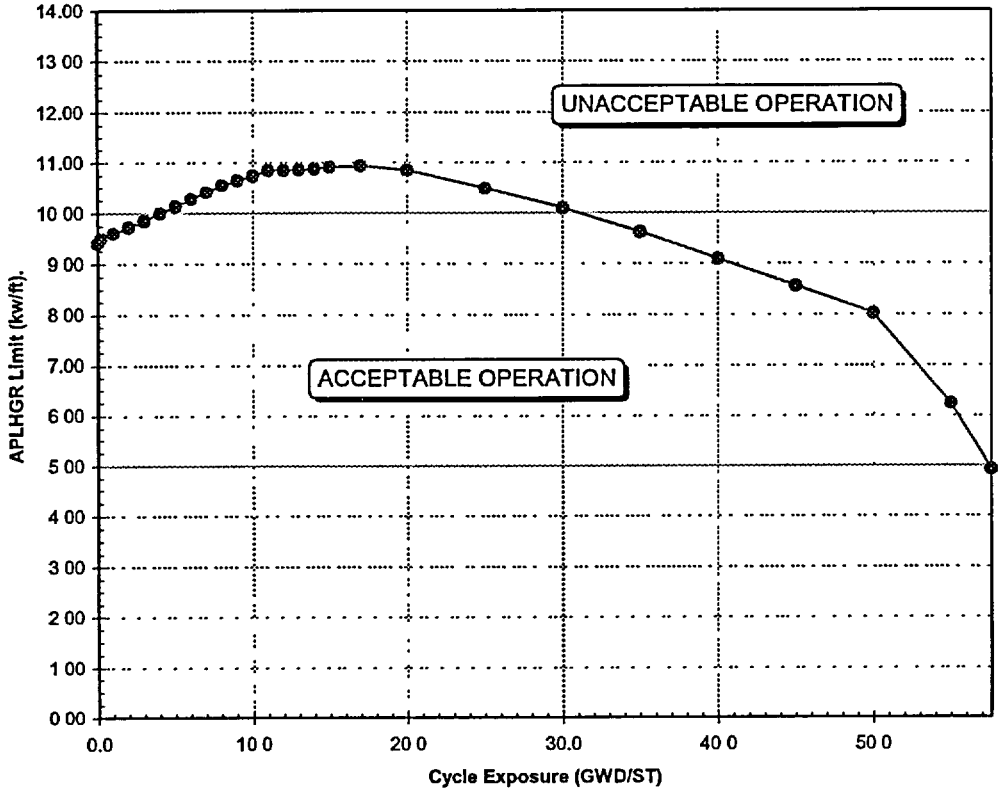
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.43	8.0	10.76	20.0	10.88
0.2	9.47	9.0	10.83	25.0	10.50
1.0	9.54	10.0	10.91	30.0	10.10
2.0	9.67	11.0	10.99	35.0	9.66
3.0	9.83	12.0	11.03	40.0	9.13
4.0	10.02	13.0	11.02	45.0	8.59
5.0	10.21	14.0	11.02	50.0	8.03
6.0	10.43	15.0	11.03	55.0	6.38
7.0	10.62	17.0	11.02	57.90	4.92

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.93 or the MAPFAC correction, as described in Section 2.

Figure 10
APLHGR Limits for Bundle Type GE14-P10DNAB416-16GZ
(GE14 EDB#2600)



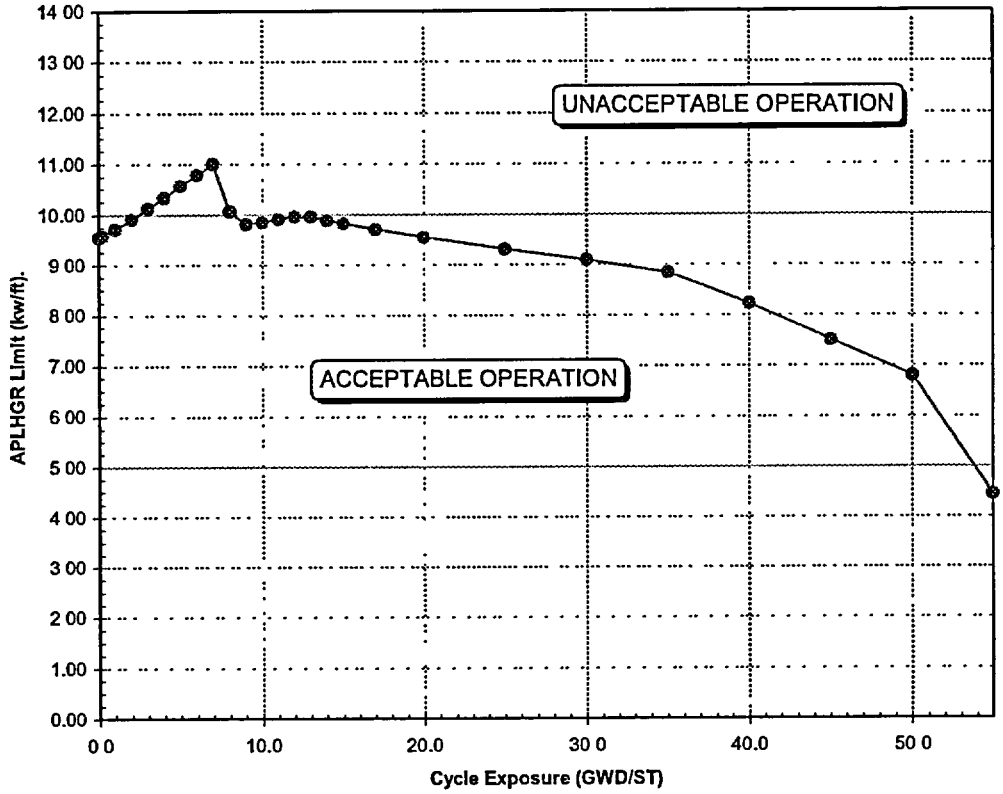
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.41	8.0	10.56	20.0	10 85
0.2	9.51	9.0	10.65	25.0	10.50
1.0	9.61	10.0	10.74	30.0	10.10
2.0	9.73	11.0	10.85	35.0	9.63
3.0	9.86	12.0	10.85	40.0	9.10
4.0	10.00	13.0	10.86	45.0	8.57
5.0	10.14	14.0	10.88	50.0	8.02
6.0	10.28	15.0	10.91	55.0	6.24
7.0	10.42	17.0	10.94	57.60	4.93

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.93 or the MAPFAC correction, as described in Section 2.

Figure 11
APLHGR Limits for Bundle Type GE14-P10DNAB200-3GZ
(GE14 EDB#2603)



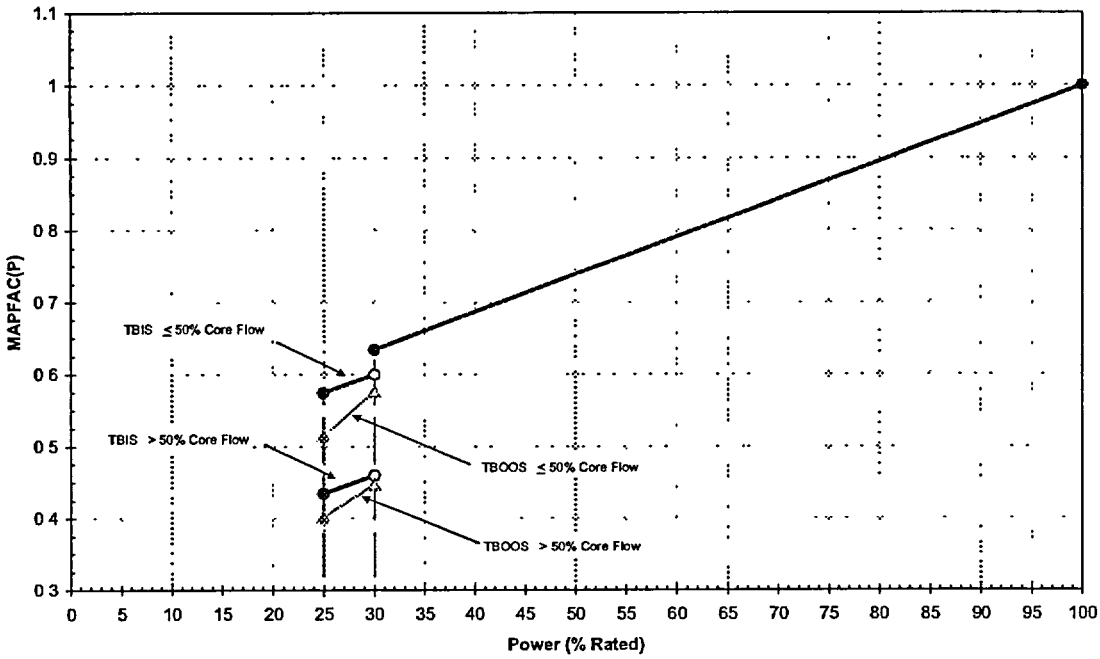
Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/ST)	LHGR Limit (kw/ft)
0.0	9.55	8.0	10.07	20.0	9.55
0.2	9.58	9.0	9.82	25.0	9.31
1.0	9.72	10.0	9.85	30.0	9.10
2.0	9.92	11.0	9.91	35.0	8.85
3.0	10.13	12.0	9.97	40.0	8.23
4.0	10.34	13.0	9.96	45.0	7.50
5.0	10.57	14.0	9.89	50.0	6.80
6.0	10.79	15.0	9.83	54.91	4.46
7.0	11.01	17.0	9.71		

These values apply to both Turbine Bypass In-Service and Out-Of-Service.
These values apply to both Recirculation Pump Trip In-Service and Out-Of-Service.

The APLHGR limits shown are for dual recirculation loop operation. For single loop operation, these values should be multiplied by the most limiting of either 0.93 or the MAPFAC correction, as described in Section 2.

Figure 12
Power Dependent MAPLHGR Factor - MAPFAC(P)



Below Pbypass (30% Rated Power) the Value is dependent Upon whether the Turbine Bypass System is In-Service (TBIS) or Out-Of-Service (TBOOS)

MAPLHGR(P) = MAPFAC(P) x MAPLHGRstd

MAPLHGRstd = Standard MAPLHGR Limits

Below Core Monitoring Power Threshold (25% Rated Power)

For 25% > P : NO THERMAL LIMITS MONITORING REQUIRED
NO LIMITS SPECIFIED

Below Pbypass with Turbine Bypass System In-Service (TBIS)

For 25% ≤ P < 30% : MAPFAC(P) = 0.600 + 0.005(P-30%) For ≤ 50% CORE FLOW
: MAPFAC(P) = 0.460 + 0.005(P-30%) For > 50% CORE FLOW

Below Pbypass with Turbine Bypass System Out-Of-Service (TBOOS)

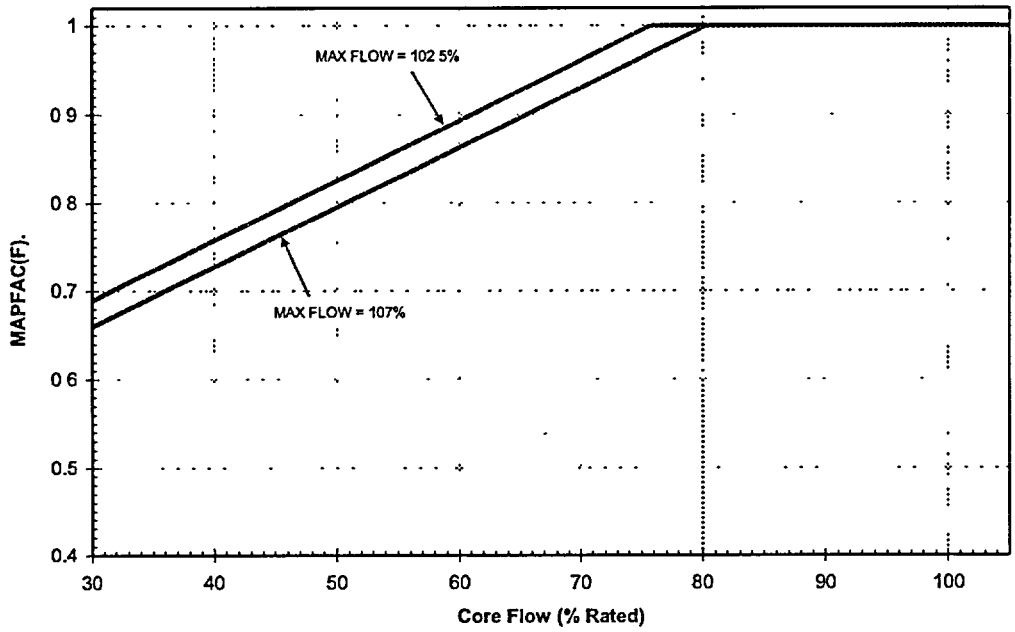
For 25% ≤ P < 30% : MAPFAC(P) = 0.577 + 0.0124(P-30%) For ≤ 50% CORE FLOW
: MAPFAC(P) = 0.448 + 0.0092(P-30%) For > 50% CORE FLOW

Above Pbypass

For 30% ≤ P : MAPFAC(P) = 1.0 + 0.005224(P-100%)

These Curves Bound both the Recirculation Pump Trip In-Service (RPTIS) and Out-Of-Service (RPTOOS)

Figure 13
Flow Dependent MAPLHGR Factor - MAPFAC(F)



FOR Wc (% Rated Core Flow) >= 30%

MAPLHGR(F) = MAPFAC(F) x MAPLHGRstd

MAPLHGRstd = Standard MAPLHGR Limits

MAPFAC(F) = MINIMUM(1.0 , Af * Wc /100 + Bf)

Af and Bf are Constants Given Below:

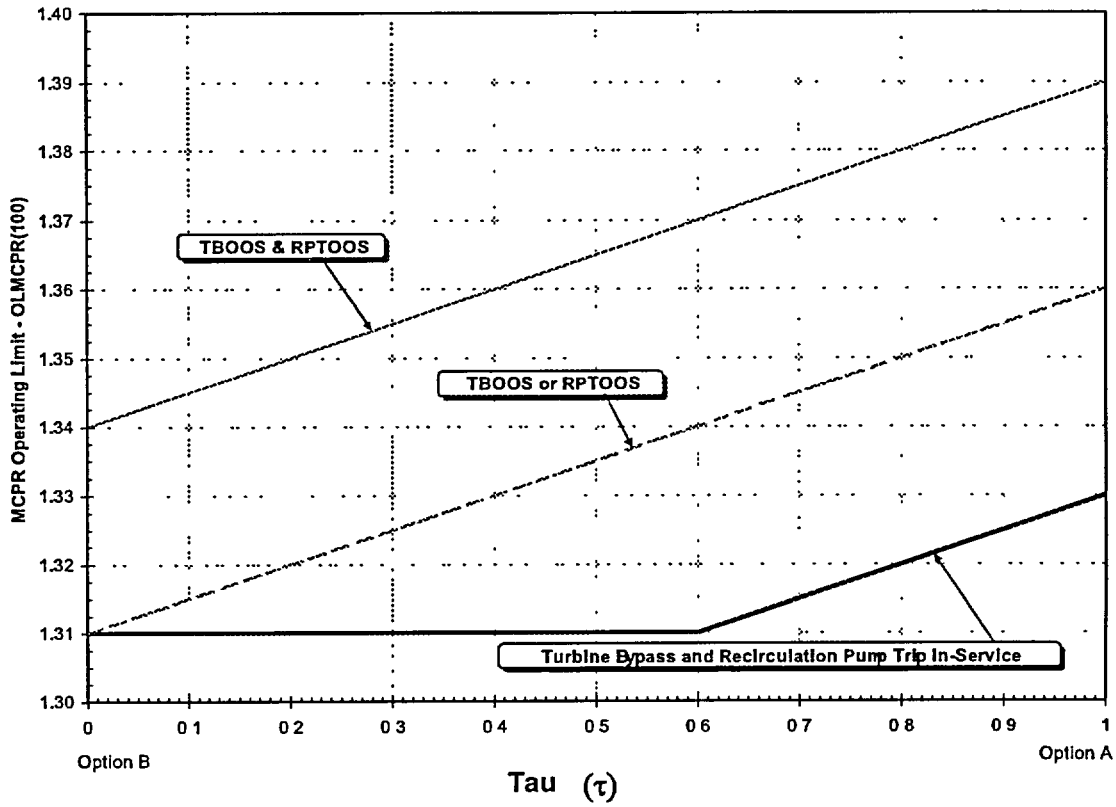
Maximum Core Flow (% Rated)	Af	Bf
102.5	0.6784	0.4861
107.0	0.6758	0.4574

These values bound both Turbine Bypass In-Service and Out-Of-Service.
These values bound both Recirculation Pump Trip In-Service and Out-Of-Service.

The 102.5% maximum flow line is used for operation up to 100% rated flow.
The 107% maximum flow line is used for operation up to 105% rated flow (ICF).

Figure 14
MCPR Operating Limit for All GE11 & GE13 Bundles

For Cycle Exposures up to EOR-2200 MWD/ST (see note 3)



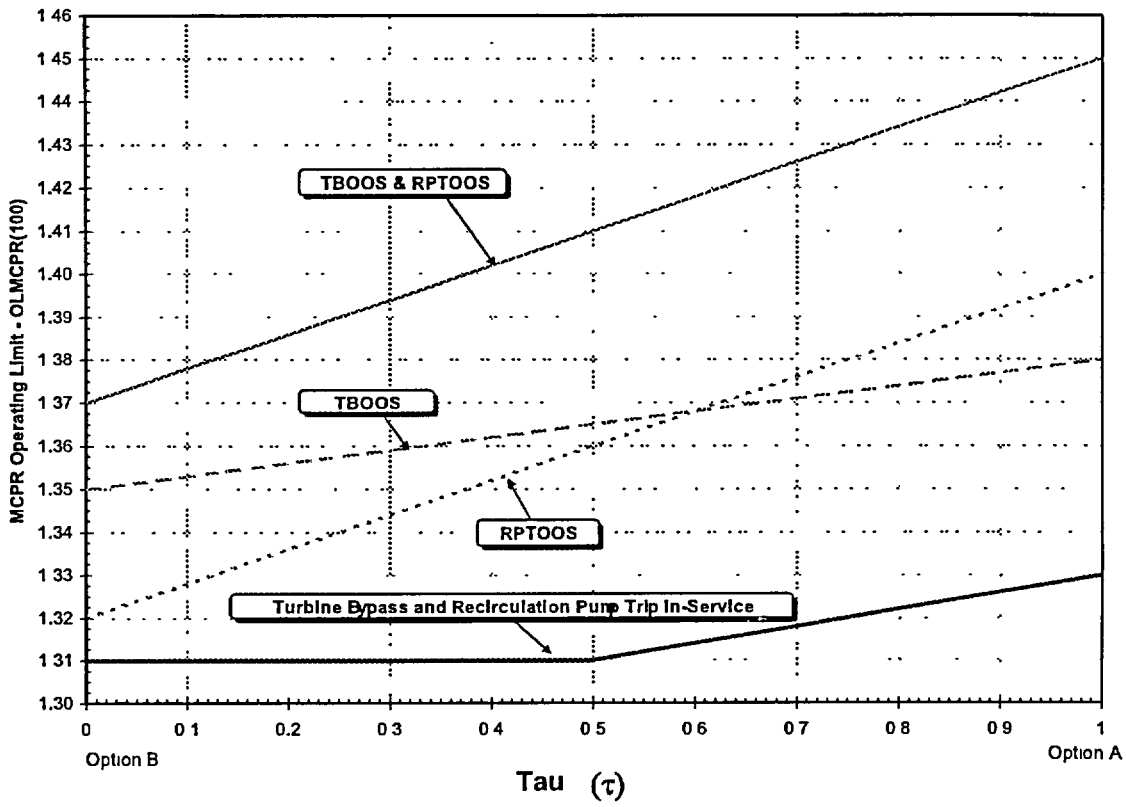
Exposure Range	Out-Of-Service	Option A (1) Tau=1.0	Option B Tau=0.0
BOC13 to (EOR-2200 MWD/ST)	na	1.33	1.31
BOC13 to (EOR-2200 MWD/ST)	Turbine Bypass (TBOOS)	1.36	1.31
BOC13 to (EOR-2200 MWD/ST)	Recirculation Pump Trip (RPTOOS)	1.36	1.31
BOC13 to (EOR-2200 MWD/ST)	TBOOS and RPTOOS	1.39	1.34

Notes
1. Use this value prior to performing scram time testing per SR 3.1.4.1.
2. The values shown are for dual recirculation loop operation (1.08 SLMCPR). Increase any value shown by 0.02 for Single Loop Operation (SLO.SLMCPR=1.10).
3. EOR refers to the end of Full Power Capabilityat Rated Flow with normal Feedwater Heating.

Figure 15

MCPR Operating Limit for All GE11 & GE13 Bundles

Optional for All Cycle Exposures - Required after EOR-2200 MWD/ST Is reached (see note 3)

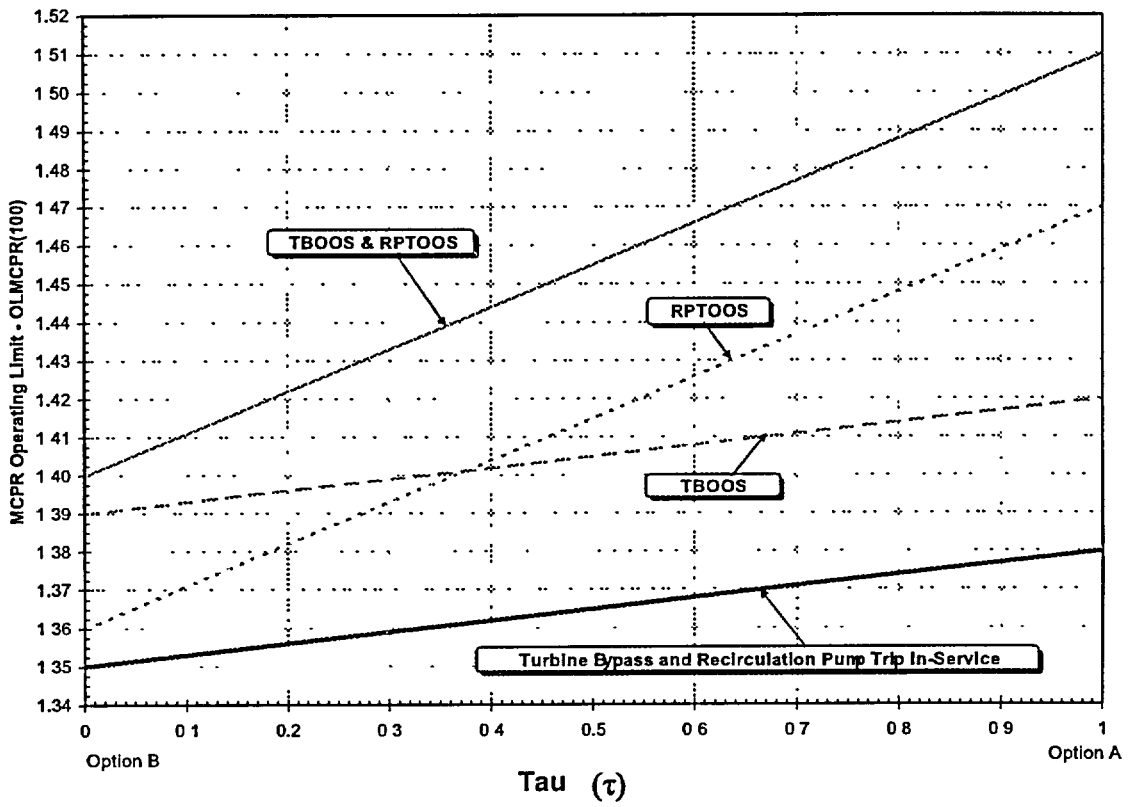


Exposure Range	Out-Of-Service	Option A (1) Tau=1.0	Option B Tau=0.0
BOC13 to EOC13	na	1.33	1.31
BOC13 to EOC13	Turbine Bypass (TBOOS)	1.38	1.35
BOC13 to EOC13	Recirculation Pump Trip (RPTOOS)	1.40	1.32
BOC13 to EOC13	TBOOS and RPTOOS	1.45	1.37

Notes
1. Use this value prior to performing scram time testing per SR 3.1.4.1.
2. The values shown are for dual recirculation loop operation (1.08 SLMCPR). Increase any value shown by 0.02 for Single Loop Operation (SLO:SLMCPR=1.10).
3. EOR refers to the end of Full Power Capabilityat Rated Flow with normal Feedwater Heating.

Figure 16
MCPR Operating Limit for All GE14 Bundles

For Cycle Exposures up to EOR-2200 MWD/ST (see note 3)

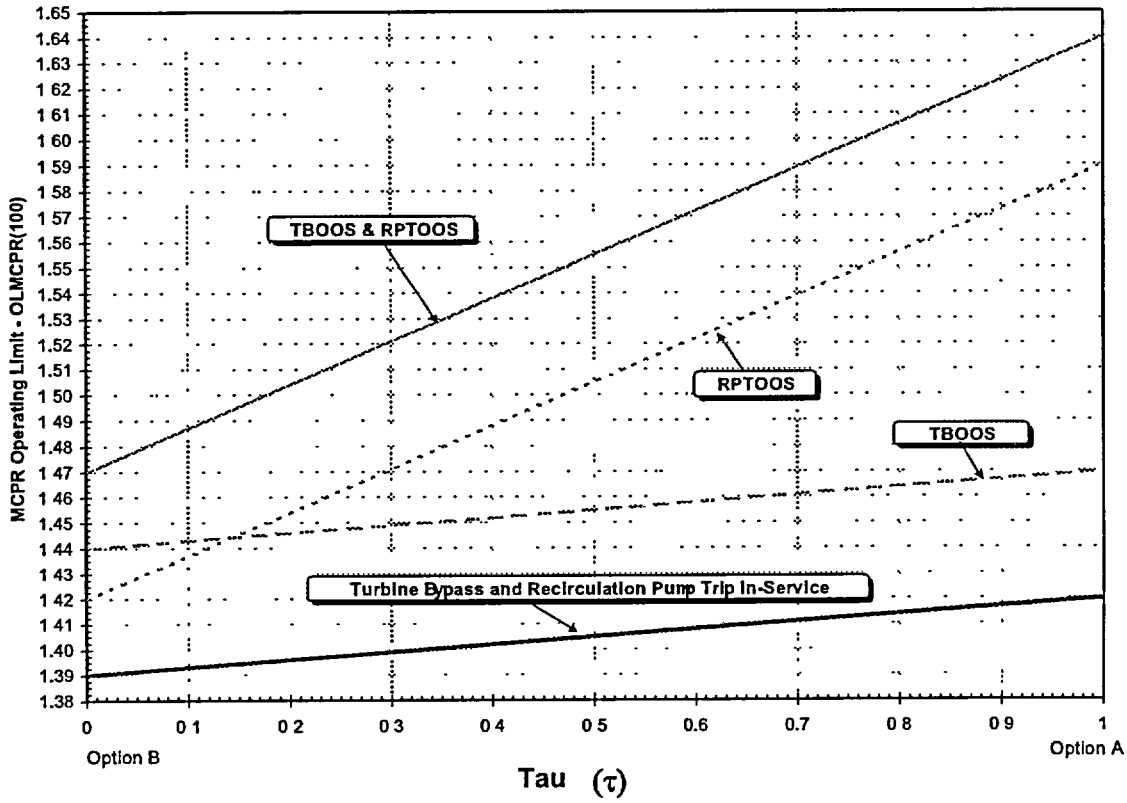


Exposure Range	Out-Of-Service	Option A (1) Tau=1.0	Option B Tau=0.0
BOC13 to (EOR-2200 MWD/ST)	na	1.38	1.35
BOC13 to (EOR-2200 MWD/ST)	Turbine Bypass (TBOOS)	1.42	1.39
BOC13 to (EOR-2200 MWD/ST)	Recirculation Pump Trip (RPTOOS)	1.47	1.36
BOC13 to (EOR-2200 MWD/ST)	TBOOS and RPTOOS	1.51	1.40

Notes
1. Use this value prior to performing scram time testing per SR 3.1.4.1.
2. The values shown are for dual recirculation loop operation (1.08 SLMCPR). Increase any value shown by 0.02 for Single Loop Operation (SLO:SLMCPR=1.10).
3. EOR refers to the end of Full Power Capabilityat Rated Flow with normal Feedwater Heating.

Figure 17
MCPR Operating Limit for All GE14 Bundles

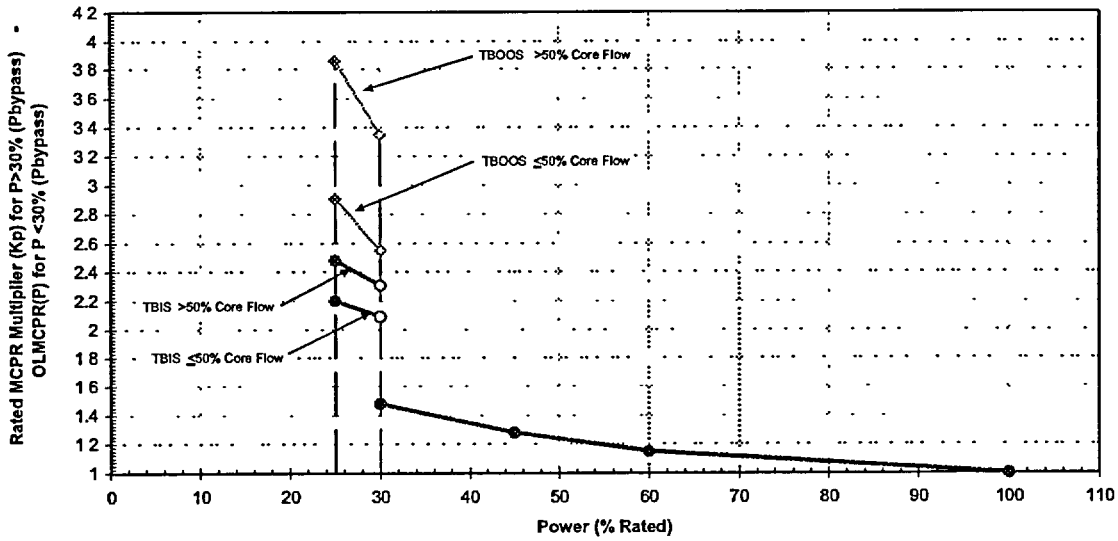
Optional for All Cycle Exposures - Required after EOR-2200 MWD/ST is reached (see note 3)



Exposure Range	Out-Of-Service	Option A (1) Tau=1.0	Option B Tau=0.0
BOC13 to EOC13	na	1.42	1.39
BOC13 to EOC13	Turbine Bypass (TBOOS)	1.47	1.44
BOC13 to EOC13	Recirculation Pump Trip (RPTOOS)	1.59	1.42
BOC13 to EOC13	TBOOS and RPTOOS	1.64	1.47

Notes
1. Use this value prior to performing scram time testing per SR 3.1.4.1.
2. The values shown are for dual recirculation loop operation (1.08 SLMCPR). Increase any value shown by 0.02 for Single Loop Operation (SLO:SLMCPR=1.10).
3. EOR refers to the end of Full Power Capabilityat Rated Flow with normal Feedwater Heating.

Figure 18
Power Dependent MCPR(P) Limits



Below Pbypass (30% Rated Power) the Value is dependent Upon whether the Turbine Bypass System is In-Service (TBIS) or Out-Of-Service (TBOOS)

OPERATING LIMIT MCPR(P) = Kp * OLMCPR(100)

Below Core Monitoring Power Threshold (25% Rated Power)

For P < 25% : NO THERMAL LIMITS MONITORING REQUIRED
NO LIMITS SPECIFIED

Below Pbypass with Turbine Bypass System In-Service (TBIS)

For 25% ≤ P < 30% : MCPR(P) = 2.09 + 0.022(30%-P) For ≤ 50% CORE FLOW
: MCPR(P) = 2.31 + 0.034(30%-P) For > 50% CORE FLOW

Below Pbypass with Turbine Bypass System Out-Of-Service (TBOOS)

For 25% ≤ P < 30% : MCPR(P) = 2.55 + 0.072(30%-P) For ≤ 50% CORE FLOW
: MCPR(P) = 3.35 + 0.102(30%-P) For > 50% CORE FLOW

Above Pbypass

For 30% ≤ P < 45% : Kp = 1.28 + 0.01340(45%-P)

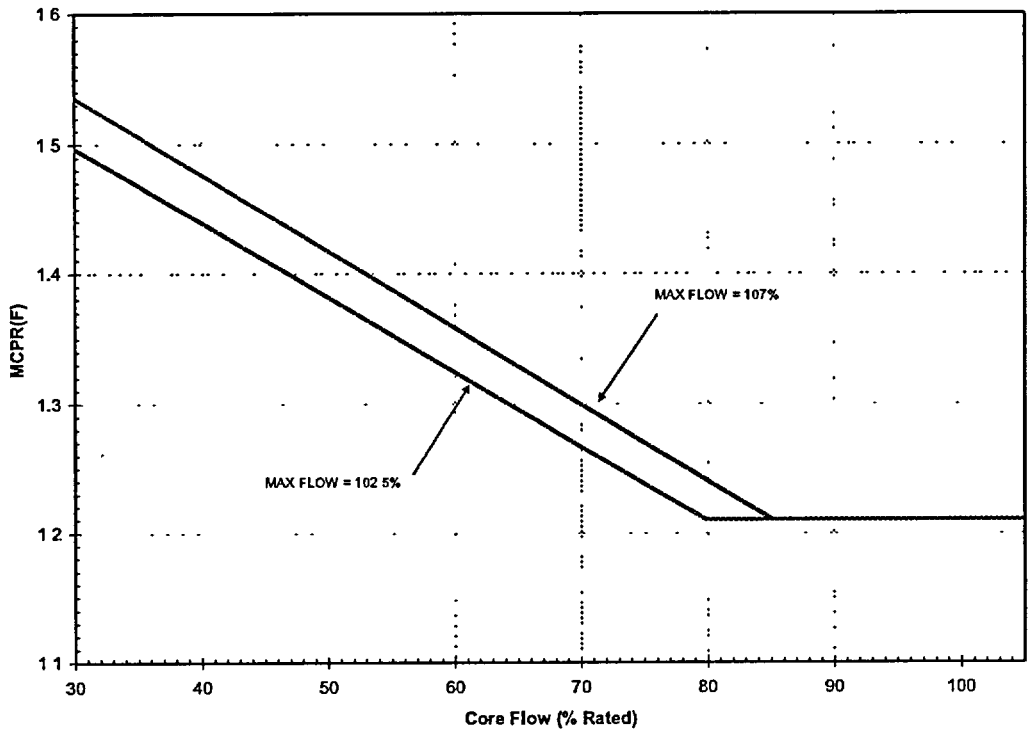
For 45% ≤ P < 60% : Kp = 1.15 + 0.00867(60%-P)

For 60% ≤ P : Kp = 1.00 + 0.00375(100%-P)

These Curves Bound both the Recirculation Pump Trip In-Service (RPTIS) and Out-Of-Service (RPTOOS)

Note: The OLMCPR below Pbypass is based upon the dual recirculation loop SLMCPR of 1.08. Add 0.02 to the OLMCPR in Single Loop Operation [SLMCPR(for SLO) = 1.10].

Figure 19
Flow Dependent MCPR Operating Limit - MCPR(F)



For Wc ≥ 30% : MCPR(F) = MAX(1.21, Af*Wc/100 + Bf)

Wc = % Rated Core Flow

Af and Bf are Constants Given Below:

Maximum Core Flow (% Rated)	Af	Bf
102.5	-0 576	1 670
107.0	-0 591	1.713

These values bound both Turbine Bypass In-Service and Out-Of-Service.
These values bound both Recirculation Pump Trip In-Service and Out-Of-Service

The 102.5% maximum flow line is used for operation up to 100% rated flow.
The 107% maximum flow line is used for operation up to 105% rated flow (ICF).

This figure is based upon the dual recirculation loop operation SLMCPR of 1.08.
Add 0.02 to these values for Single Loop Operation [SLMCPR(for SLO) = 1.10).