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April 7, 2006

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN, P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of)
Tennessee Valley Authority)

Docket No. 50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 3 - CORE OPERATING LIMITS REPORT (COLR), FOR CYCLE 13 OPERATION

In accordance with the requirements of Technical Specification 5.6.5.d, enclosed is the Unit 3 Cycle 13, Core Operating Limits Report.

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

Sincerely,

William D. Crouch

William D. Crouch
Manager of Licensing
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Enclosure
cc: See page 2

A001

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ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 3

CORE OPERATING LIMITS REPORT (COLR)
FOR CYCLE 13 OPERATION

(SEE ATTACHED)

Browns Ferry Nuclear Plant
Unit 3 Cycle 13

CORE OPERATING LIMITS REPORT (COLR)

TENNESSEE VALLEY AUTHORITY
Nuclear Fuel Design
BWR Fuel Engineering Department

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Revision Log

Revision	Date	Description	Affected Pages
0	2/14/2006	Initial Release for New Cycle	All

1. INTRODUCTION

This Core Operating Limits Report for Browns Ferry Nuclear Plant Unit 3 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 2 and 3). 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 an interim action, an increased GEXL14 uncertainty that incorporates a significant penalty has been calculated and applied to the MCPR Safety Limit (SLMCPR) calculation for this cycle.

Results from the reload analyses for Browns Ferry Unit 3 Cycle 13 are documented in Reference 1.

The following core operating and Technical Specification 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, 3.3.4.1, and 3.7.5)

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)

The Unit 3 Cycle 13 core is composed of Framatome-ANP ATRIUM™-10 and Global Nuclear Fuel GE-14™ assemblies. Throughout this document these are referred to as A10 and GE14 with the trademark implied.

2. APLHGR LIMIT (TECHNICAL SPECIFICATIONS 3.2.1 AND 3.7.5)

The APLHGR limit is determined by adjusting the rated power APLHGR limit for off-rated power, off-rated flow, and SLO conditions. The most limiting of these is then used as follows:

$$\text{APLHGR limit} = \text{MIN}\ (\ \text{APLHGR}_P\ ,\ \text{APLHGR}_F,\ \text{APLHGR}_{SLO}\ )$$

where:	APLHGR_P	off-rated power APLHGR limit	[APLHGR_{RATED} * MAPFAC(F)]
	APLHGR_F	off-rated flow APLHGR limit	[APLHGR_{RATED} * MAPFAC(F)]
	APLHGR_{SLO}	SLO APLHGR limit	[ALPHGR_{RATED} * SLO_Multiplier]

The off-rated power and flow corrections to the APLHGR limit only apply to the GE14 fuel in the Browns Ferry Unit 3 Cycle 13 core. For that reason, this multiplier is set to 1.0 as shown below for the A10 fuel.

Rated Power and Flow Limits: APLHGR_{RATED}

The APLHGR limits for full power and flow conditions for each type of fuel as a function of exposure are shown in Figures 1-4. The APLHGR limits provided in the COLR figures for the GE14 assemblies are for the most limiting lattice (excluding natural uranium) at each exposure point. The specific values for each GE14 lattice are given in Reference 4. The ATRIUM-10 values are provided in Reference 1.

Bundle Type	Rated Power APLHGR Limit
GE14-P10DNAB402-15GZ	Figure 1
GE14-P10DNAB401-14GZ	Figure 2
A10-3813B-13GV80	Figure 3
A10-4077B-15GV80	Figure 3
A10-4088B-15GV80	Figure 3
A10-1623B-5GV80	Figure 4
A10-4171B-14GV80	Figure 3
A10-4163B-16GV80	Figure 3
A10-4181B-13GV80	Figure 3

Off-Rated Power Corrections: APLHGR$_P$

The APLHGR limits for the GE14 fuel lattices are adjusted for off-rated power conditions using the ARTS multiplier, MAPFAC(P), which is provided in Reference 1. No off-rated power correction is required for the A10 rated APLHGR limits.

Product Line	MAPFAC(P)
GE14	Figure 5
A10	1.0

Off-Rated Flow Corrections: APLHGR$_F$

The APLHGR limits for the GE14 fuel lattices are adjusted for off-rated flow conditions using the ARTS multiplier, MAPFAC(F), which is provided in Reference 1. No off-rated flow correction is required for the A10 rated APLHGR limits.

Product Line	MAPFAC(F)
GE14	Figure 6
A10	1.0

SLO Corrections: APLHGR$_{SLO}$

Single Recirculation Loop Operation (SLO) requires that the rated power APLHGR limit (APLHGR$_{rated}$) be reduced by applying the following multipliers. The GE14 multiplier is provided in Reference 5. The A10 multiplier is provided in Reference 1.

Product Line	SLO Multiplier
GE14	0.93
A10	0.85

Equipment Out-Of-Service (EOOS) Corrections:

The rated APLHGR limits in Figures 1-4 are applicable for operation with all equipment In-Service as well as the following Equipment Out-Of-Service (EOOS) options. This includes combinations of these EOOS options.

In-Service	All equipment In-Service (includes 1 SRVOOS)
RPTOOS	EOC-Recirculation Pump Trip Out-Of-Service
TBVOOS	Turbine Bypass Valve(s) Out-Of-Service
PLUOOS	Power Load Unbalance Out-Of-Service
FHOOS (or FFTR)	Feedwater Heaters Out-Of-Service (or Final Feedwater Temperature Reduction)

Single Recirculation Loop Operation (SLO) requires the application of the SLO multipliers to the rated APLHGR limits as described previously.

The off-rated power corrections [MAPFAC(P)] in Figure 5 is dependent upon operation of the Turbine Bypass Valve system. For this reason, separate limits are to be applied for TBVIS or TBVOOS operation. The MAPFAC(P) limits have no dependency on RPTOOS, PLUOOS, SLO, or FHOOS/FFTR.

The off-rated flow corrections [MAPFAC(F)] in Figure 6 bound both equipement In-Service or EOOS operation.

3. LHGR LIMIT (TECHNICAL SPECIFICATION 3.2.3, 3.3.4.1, and 3.7.5)

The LHGR limit is determined by adjusting the rated power LHGR limit for off-rated power and off-rated flow conditions. The most limiting of these is then used, as follows:

$$\text{LHGR limit} = \text{MIN}\ (\ LHGR_P\ ,\ LHGR_F\ )$$

where:	$LHGR_P$	off-rated power LHGR limit	$[LHGR_{RATED} * LHGRFAC(P)]$
	$LHGR_F$	off-rated flow LHGR limit	$[LHGR_{RATED} * LHGRFAC(F)]$

The off-rated power and flow corrections to the LHGR limit only apply to the A10 fuel in the Browns Ferry Unit 3 Cycle 13 core. For that reason, the multiplier for the GE14 fuel is set to 1.0 as shown below.

<u>Rated Power and Flow Limits</u>: $LHGR_{RATED}$

The LHGR limit is fuel type dependent. The limits for these types are given below:

Fuel Type	LHGR Limit
GE14	Figure 7
A10	Figure 8

The A10 LHGR limit is provided in Reference 6. The GE14 LHGR limit is provided in Reference 12.

<u>Off-Rated Power Corrections</u>: $LHGR_P$

The LHGR limits for the A10 fuel are adjusted for off-rated power conditions using the LHGRFAC(P) multiplier which is provided in Reference 1. The LHGRFAC(P) multiplier is dependent on whether the Turbine Bypass system is in-service (TBVIS) or out-of-service (TBVOOS). No off-rated power correction is required for the GE14 rated LHGR limits.

Product Line	LHGRFAC(P)
GE14	1.0
A10	Figure 9

Off-Rated Flow Corrections: $LHGR_F$

The LHGR limits for the A10 fuel are adjusted for off-rated flow conditions using the LHGRFAC(F) multiplier which is provided in Reference 1. No off-rated flow correction is required for the GE14 rated LHGR limits.

Product Line	LHGRFAC(F)
GE14	1.0
A10	Figure 10

Equipment Out-Of-Service (EOOS) Corrections:

The rated LHGR limits are applicable for operation with all equipment In-Service as well as the following Equipment Out-Of-Service (EOOS) options. This includes combinations of these EOOS options.

In-Service	All equipment In-Service (includes 1 SRVOOS)
RPTOOS	EOC-Recirculation Pump Trip Out-Of-Service
TBVOOS	Turbine Bypass Valve(s) Out-Of-Service
PLUOOS	Power Load Unbalance Out-Of-Service
SLO	Single Recirculation Loop Operation
FHOOS (or FFTR)	Feedwater Heaters Out-Of-Service (or Final Feedwater Temperature Reduction)

The off-rated power corrections [LHGRFAC(P)] in Figure 9 are dependent upon operation of the Turbine Bypass Valve system. For this reason, separate limits are to be applied for TBVIS or TBVOOS operation. The LHGRFAC(P) limits have no dependency on RPTOOS, PLUOOS, SLO, or FHOOS/FFTR.

The off-rated flow corrections [LHGRFAC(F)] in Figure 10 bound both equipment In-Service or EOOS operation.

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

The MCPR Operating Limit (OLMCPR) is calculated to be the most limiting of the flow-dependent MCPR ($MCPR_F$) and power-dependent MCPR ($MCPR_P$).

OLMCPR limit = MAX ($MCPR_F$, $MCPR_P$)

where:	$MCPR_F$	core flow-dependent MCPR limit
	$MCPR_P$	power-dependent MCPR limit

$MCPR_F$ limits are provided by fuel type in Figures 11 and 12. $MCPR_P$ limits are provided in Tables 1 through 6.

<u>Flow-Dependent MCPR Limits:</u> $MCPR_F$

The $MCPR_F$ limits are dependent upon:

- Core Flow (% of Rated)
- Max Core Flow Limit (Rated or Increased Core Flow, ICF)
- Fuel Type (GE14 or A10)

The $MCPR_F$ limits are provided by fuel type in Figure 11 (GE14) and Figure 12 (A10). These limits are valid for all EOOS combinations. No adjustment is required to the $MCPR_F$ limits for SLO. The $MCPR_F$ limits are found in Reference 1.

<u>Power-Dependent MCPR Limits:</u> $MCPR_P$

The $MCPR_P$ limits are dependent upon:

- Core Power Level (% of Rated)
- Technical Specification Scram Speed (TSSS) or Nominal Scram Speed (NSS)
- Fuel Type (GE14 or A10)
- Cycle Operating Exposure (NEOC, EOC, and CD - as defined in this section)
- Equipment Out-Of-Service Options
- Two or Single recirculation Loop Operation (TLO vs. SLO)

The $MCPR_P$ limits (Ref. 1) are provided in the following tables, where each table contains the limits for all fuel types and EOOS options (for a specified scram speed and exposure range). The $MCPR_P$ limits are determined from these tables using linear interpolation between the specified powers.

Exposure Range	Scram Speed	$MCPR_P$
BOC to NEOC	NSS TSSS	Table 1 Table 2
BOC to EOC	NSS TSSS	Table 3 Table 4
BOC to CD	NSS TSSS	Table 5 Table 6

a. Scram Speed Dependent Limits (TSSS vs. NSS)

$MCPR_P$ limits are provided for two different sets of assumed scram speeds. The Technical Specification Scram Speed (TSSS) $MCPR_P$ limits are applicable at all times as long as the scram time surveillance demonstrates that the times in Technical Specification table 3.1.4-1 have been met. Nominal Scram Speeds (NSS) may be used as long as the scram time surveillance demonstrates that the times in the following table are met (Ref. 8).

Notch Position	Nominal Scram Speed (seconds)
46	0.42
36	0.98
26	1.60
06	2.90

In demonstrating compliance with this table, the same surveillance requirements from Technical Specification 3.1.4 apply, except that the definition of SLOW rods should conform to the scram speeds in the table above. If conformance to this table is not demonstrated, TSSS $MCPR_P$ limits shall be used.

On initial cycle startup, TSSS limits are used until the successful completion of scram timing confirms that NSS limits may be used.

b. Fuel Type Dependent Limits

Separate $MCPR_P$ limits are provided for the GE14 and A10 fuel types.

c. Exposure Dependent Limits

Exposures are tracked on a Core Average Exposure basis (not Cycle Exposure). The higher exposure $MCPR_P$ limits are always more limiting and may be used for any Core Average Exposure up to the ending exposure.

$MCPR_P$ limits are provided for the following exposure ranges (Ref. 1):

BOC to NEOC	NEOC corresponds to	**31,555 MWd / MTU**
BOC to EOC	EOC corresponds to	**33,663 MWd / MTU**
BOC to CD	CD corresponds to	**34,731 MWd / MTU**

NEOC refers to a Near EOC exposure point.

The EOC exposure point is not the true End-Of-Cycle exposure. Instead it corresponds to a licensing exposure window that exceeds expected end-of-full-power-life.

The CD (CoastDown) exposure point represents a licensing exposure point that exceeds the expected end-of-cycle exposure including cycle extension options.

d. Equipment Out-Of-Service (EOOS) Options

EOOS options included in the $MCPR_P$ limits are:

In-Service	All equipment In-Service (includes 1 SRVOOS)
RPTOOS	EOC-Recirculation Pump Trip Out-Of-Service
TBVOOS	Turbine Bypass Valve(s) Out-Of-Service
RPTOOS+TBVOOS	Combined RPTOOS and TBVOOS
PLUOOS	Power Load Unbalance Out-Of-Service
PLUOOS+RPTOOS	Combined PLUOOS and RPTOOS
PLUOOS+TBVOOS	Combined PLUOOS and TBVOOS
PLUOOS+TBVOOS+RPTOOS	Combined PLUOOS, RPTOOS, and TBVOOS
FHOOS (or FFTR)	Feedwater Heaters Out-Of-Service (or Final Feedwater Temperature Reduction)

For exposure ranges up to NEOC and EOC, additional combinations of $MCPR_P$ limits are also provided that include FHOOS. The CD exposure range assumes application of FFTR, so the CD based $MCPR_P$ limits already include FHOOS.

e. Single-Loop-Operation (SLO) Limits

The $MCPR_P$ limits for SLO are to be increased by 0.02 (Ref. 1).

f. Below Pbypass Limits

Below Pbypass (30% rated power), the $MCPR_P$ limits are dependent upon core flow. One set of $MCPR_P$ limits applies if the core flow is above 50% of rated with a second set that applies if the core flow is less than or equal to 50% rated.

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 (Ref. 9):

$S_{RB} \leq (0.66(W-\Delta W) + 61\%)$ 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. 9 & 10):

RBM Trip Setpoint	Allowable Value (AV)	Nominal Trip Setpoint (NTSP)	
LPSP	27%	25%	
IPSP	62%	60%	
HPSP	82%	80%	
LTSP - unfiltered - filtered	124.7% 123.5%	123.0% 121.8%	(1),(2)
ITSP - unfiltered - filtered	119.7% 118.7%	118.0% 117.0%	(1),(2)
HTSP - unfiltered - filtered	114.7% 113.7%	113.0% 112.0%	(1),(2)
DTSP	90%	92%	

Notes: (1) These setpoints are based upon an Analytical Limit HTSP of 117% (w/o filter) which corresponds to a MCPR operating limit of **1.33(GE14/A10)**, as reported in section 5.5 of Reference 1. Unit 3 Cycle 13 has had a cycle specific CRWE analysis performed and the table provided in section 5.5 of Reference 1 supercedes the OLMCPR values of references 9 and 11.

(2) The unfiltered setpoints are consistent with a nominal RBM filter setting of 0.0 seconds (reference 9.b). The filtered setpoints are consistent with a nominal RBM filter setting ≤ 0.5 seconds (reference 9.a).

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

THERMAL POWER (% Rated)	Applicable MCPR [2]	Notes from Table 3.3.2.1-1	
≥ 27% and < 90%	< 1.74 < 1.77	(a), (b), (f), (h) (a), (b), (f), (h)	dual loop operation single loop operation
≥ 90%	< 1.43	(g)	dual loop operation [3]

Notes: (1) The table confirms that the generic operability limits from reference 11 are bounded by the Unit 3 Cycle 13 CRWE analysis. The actual cycle specific results indicate that the SLMCPR remains protected throughout the cycle without RBM operation (i.e. unblocked) per reference 1.

(2) The MCPR values shown correspond to a SLMCPR of 1.09 for dual recirculation loop operation and 1.11 for single loop operation.

(3) 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 (Ref. 7).

SDM $\geq$ 0.38% dk/k

8. REFERENCES

1. EMF-3264 Rev. 0, "Browns Ferry Unit 3 Cycle 13 Reload Analysis", dated December 2005.

2. Framatome-ANP Analytical Methodology References:
   a) XN-NF-81-58(P)(A) Revision 2 and Supplements 1 and 2, *RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model*, Exxon Nuclear Company, March 1984.
   b) XN-NF-85-67(P)(A) Revision 1, *Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel*, Exxon Nuclear Company, September 1986.
   c) EMF-85-74(P) Revision 0 Supplement 1(P)(A) and Supplement 2(P)(A), *RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model*, Siemens Power Corporation, February 1998.
   d) ANF-89-98(P)(A) Revision 1 and Supplement 1, *Generic Mechanical Design Criteria for BWR Fuel Designs*, Advanced Nuclear Fuels Corporation, May 1995.
   e) XN-NF-80-19(P)(A) Volume 1 and Supplements 1 and 2, *Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis*, Exxon Nuclear Company, March 1983.
   f) XN-NF-80-19(P)(A) Volume 4 Revision 1, *Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads*, Exxon Nuclear Company, June 1986.
   g) EMF-2158(P)(A) Revision 0, *Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2*, Siemens Power Corporation, October 1999.
   h) XN-NF-80-19(P)(A) Volume 3 Revision 2, *Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description*, Exxon Nuclear Company, January 1987.
   i) XN-NF-84-105(P)(A) Volume 1 and Volume 1 Supplements 1 and 2, *XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis*, Exxon Nuclear Company, February 1987.
   j) ANF-524(P)(A) Revision 2 and Supplements 1 and 2, *ANF Critical Power Methodology for Boiling Water Reactors*, Advanced Nuclear Fuels Corporation, November 1990.
   k) ANF-913(P)(A) Volume 1 Revision 1 and Volume 1 Supplements 2, 3 and 4, *COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses*, Advanced Nuclear Fuels Corporation, August 1990.
   l) ANF-1358(P)(A) Revision 1, *The Loss of Feedwater Heating Transient in Boiling Water Reactors*, Advanced Nuclear Fuels Corporation, September 1992.
   m) EMF-2209(P)(A) Revision 2, *SPCB Critical Power Correlation*, Siemens Power Corporation, September 2003.
   n) EMF-2245(P)(A) Revision 0, *Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel*, Siemens Power Corporation, August 2000.
   o) EMF-2361(P)(A) Revision 0, *EXEM BWR-2000 ECCS Evaluation Model*, Framatome ANP, May 2001.
   p) EMF-2292(P)(A) Revision 0, *ATRIUM™-10: Appendix K Spray Heat Transfer Coefficients*, Siemens Power Corporation, September 2000.

3. Global Nuclear Fuel Analytical Methodology References:
   a) NEDE-24011-P-A-14, "General Electric Standard Application for Reactor Fuel", June 2000.
   b) NEDE-24011-P-A-14-US, "General Electric Standard Application for Reactor Fuel (Supplement for United States)", June 2000.

4. J11-03963MAPL Rev. 0, "Lattice-Dependent MAPLHGR Report for Browns Ferry Nuclear Plant Unit 3 Reload 10 Cycle 11", March 2002.

5. J11-03963SRLR Rev. 0, "Supplemental Reload Licensing Report for Browns Ferry Nuclear Plant Unit 3 Reload 10 Cycle 11", March 2002.

6. EMF-3213(P) Rev. 0, "Mechanical Design Report for Browns Ferry Unit 3 Reload BFE3-13 ATRIUM™-10 Fuel Assemblies", dated September 2005.

7. TVA-COLR-BF3C12 Rev. 1, "Browns Ferry Nuclear Plant Unit 3, Cycle 12 Core Operating Limits Report (COLR)", dated October 26, 2005.

8. EMF-3191(P) Rev. 0, "Browns Ferry Unit 3 Cycle 13 Plant Parameters Document", dated June 2005.

9. PRNM Setpoint Calculation:
   a) *Filtered Setpoints* - 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.
   b) *Unfiltered Setpoints* - 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.

10. GE Letter LB#: 262-97-133, "Browns Ferry Nuclear Plant Rod Block Monitor Setpoint Clarification - GE Proprietary Information", dated September 12, 1997.

11. 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.

12. GE-NE-L12-00889-00-01P Rev. 0, "GE14 Fuel Design Cycle-Independent Analyses for Browns Ferry Units 2 and 3", dated January 2002.

Table 1: $MCPR_P$ Limits for BOC to NEOC Exposures – NSS Scram Times
(Applicable up to Core Average Exposure of 31,555 MWd / MTU)

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
In-Service	100	1.34	1.34
	65	1.55	1.54
	60	1.56	1.59
	50	1.68	1.71
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
RPTOOS	100	1.34	1.34
	65	1.55	1.54
	60	1.56	1.59
	50	1.68	1.71
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
TBVOOS	100	1.38	1.37
	65	1.59	1.58
	60	1.61	1.62
	50	1.70	1.73
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
RPTOOS TBVOOS	100	1.38	1.37
	65	1.59	1.58
	60	1.61	1.62
	50	1.70	1.73
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
FHOOS	100	1.37	1.37
	65	1.56	1.59
	60	1.61	1.64
	50	1.74	1.77
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
RPTOOS FHOOS	100	1.37	1.37
	65	1.56	1.59
	60	1.61	1.64
	50	1.74	1.77
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
TBVOOS FHOOS	100	1.40	1.40
	65	1.60	1.61
	60	1.64	1.66
	50	1.76	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
RPTOOS TBVOOS FHOOS	100	1.40	1.40
	65	1.60	1.61
	60	1.64	1.66
	50	1.76	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above $MCPR_P$ limits for SLO.

Table 1 (Continued): $MCPR_P$ Limits for BOC to NEOC Exposures – NSS Scram Times
(Applicable up to Core Average Exposure of 31,555 MWd / MTU)

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
PLUOOS	100	1.35	1.34
	65	1.55	1.54
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS RPTOOS	100	1.35	1.34
	65	1.55	1.54
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS TBVOOS	100	1.38	1.37
	65	1.59	1.58
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2,96
PLUOOS RPTOOS TBVOOS	100	1.38	1.37
	65	1.59	1.58
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
PLUOOS FHOOS	100	1.37	1.37
	65	1.56	1.59
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS RPTOOS FHOOS	100	1.37	1.37
	65	1.56	1.59
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS TBVOOS FHOOS	100	1.40	1.40
	65	1.60	1.61
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
PLUOOS RPTOOS TBVOOS FHOOS	100	1.40	1.40
	65	1.60	1.61
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above $MCPR_P$ limits for SLO.

Table 2: $MCPR_P$ Limits for BOC to NEOC Exposures – TSSS Scram Times
(Applicable up to Core Average Exposure of 31,555 MWd / MTU)

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
In-Service	100	1.36	1.36
	65	1.57	1.56
	60	1.58	1.61
	50	1.69	1.73
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
RPTOOS	100	1.36	1.36
	65	1.57	1.56
	60	1.58	1.61
	50	1.69	1.73
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
TBVOOS	100	1.40	1.40
	65	1.61	1.59
	60	1.63	1.64
	50	1.72	1.75
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
RPTOOS TBVOOS	100	1.40	1.40
	65	1.61	1.59
	60	1.63	1.64
	50	1.72	1.75
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.62	1.66
	50	1.75	1.79
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
RPTOOS FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.62	1.66
	50	1.75	1.79
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
TBVOOS FHOOS	100	1.42	1.42
	65	1.62	1.63
	60	1.66	1.69
	50	1.77	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
RPTOOS TBVOOS FHOOS	100	1.42	1.42
	65	1.62	1.63
	60	1.66	1.69
	50	1.77	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above $MCPR_P$ limits for SLO.

Table 2 (Continued): MCPR$_P$ Limits for BOC to NEOC Exposures – TSSS Scram Times
(Applicable up to Core Average Exposure of 31,555 MWd / MTU)

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS	100	1.37	1.36
	65	1.57	1.56
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS RPTOOS	100	1.37	1.36
	65	1.57	1.56
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS TBVOOS	100	1.40	1.40
	65	1.61	1.59
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
PLUOOS RPTOOS TBVOOS	100	1.40	1.40
	65	1.61	1.59
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS RPTOOS FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS TBVOOS FHOOS	100	1.42	1.42
	65	1.62	1.63
	60	1.74	1.74
	50	---	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
PLUOOS RPTOOS TBVOOS FHOOS	100	1.42	1.42
	65	1.62	1.63
	60	1.74	1.74
	50	---	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above MCPR$_P$ limits for SLO.

Table 3: $MCPR_P$ Limits for BOC to EOC Exposures – NSS Scram Times
(Applicable up to Core Average Exposure of 33,663 MWd / MTU)

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
In-Service	100	1.36	1.36
	65	1.55	1.54
	60	1.56	1.59
	50	1.68	1.71
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
RPTOOS	100	1.36	1.36
	65	1.55	1.54
	60	1.56	1.59
	50	1.68	1.71
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
TBVOOS	100	1.41	1.40
	65	1.59	1.58
	60	1.61	1.62
	50	1.70	1.73
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
RPTOOS TBVOOS	100	1.41	1.40
	65	1.59	1.58
	60	1.61	1.62
	50	1.70	1.73
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
FHOOS	100	1.38	1.37
	65	1.56	1.59
	60	1.61	1.64
	50	1.74	1.77
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
RPTOOS FHOOS	100	1.38	1.37
	65	1.56	1.59
	60	1.61	1.64
	50	1.74	1.77
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
TBVOOS FHOOS	100	1.41	1.41
	65	1.60	1.61
	60	1.64	1.66
	50	1.76	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
RPTOOS TBVOOS FHOOS	100	1.41	1.41
	65	1.60	1.61
	60	1.64	1.66
	50	1.76	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above $MCPR_P$ limits for SLO.

Table 3 (Continued): MCPR$_P$ Limits for BOC to EOC Exposures – NSS Scram Times
(Applicable up to Core Average Exposure of 33,663 MWd / MTU)

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS	100	1.37	1.37
	65	1.55	1.54
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS RPTOOS	100	1.37	1.37
	65	1.55	1.54
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.06	2.12
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS TBVOOS	100	1.41	1.40
	65	1.59	1.58
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
PLUOOS RPTOOS TBVOOS	100	1.41	1.40
	65	1.59	1.58
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.08	2.14
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS FHOOS	100	1.38	1.37
	65	1.56	1.59
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS RPTOOS FHOOS	100	1.38	1.37
	65	1.56	1.59
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS TBVOOS FHOOS	100	1.41	1.41
	65	1.60	1.61
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
PLUOOS RPTOOS TBVOOS FHOOS	100	1.41	1.41
	65	1.60	1.61
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above MCPR$_P$ limits for SLO.

Table 4: $MCPR_P$ Limits for BOC to EOC Exposures – TSSS Scram Times
(Applicable up to Core Average Exposure of 33,663 MWd / MTU)

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
In-Service	100	1.38	1.37
	65	1.57	1.56
	60	1.58	1.61
	50	1.69	1.73
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
RPTOOS	100	1.38	1.38
	65	1.57	1.56
	60	1.58	1.61
	50	1.69	1.73
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
TBVOOS	100	1.42	1.41
	65	1.61	1.59
	60	1.63	1.64
	50	1.72	1.75
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
RPTOOS TBVOOS	100	1.42	1.42
	65	1.61	1.59
	60	1.63	1.64
	50	1.72	1.75
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.62	1.66
	50	1.75	1.79
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
RPTOOS FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.62	1.66
	50	1.75	1.79
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
TBVOOS FHOOS	100	1.43	1.42
	65	1.62	1.63
	60	1.66	1.69
	50	1.77	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
RPTOOS TBVOOS FHOOS	100	1.43	1.43
	65	1.62	1.63
	60	1.66	1.69
	50	1.77	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above $MCPR_P$ limits for SLO.

Table 4 (Continued): MCPR$_P$ Limits for BOC to EOC Exposures – TSSS Scram Times
(Applicable up to Core Average Exposure of 33,663 MWd / MTU)

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS	100	1.39	1.38
	65	1.57	1.56
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS RPTOOS	100	1.39	1.39
	65	1.57	1.56
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.08	2.13
	30 (> 50%F)	2.36	2.42
	25 (> 50%F)	2.53	2.57
	30 (≤ 50%F)	2.29	2.39
	25 (≤ 50%F)	2.46	2.56
PLUOOS TBVOOS	100	1.42	1.41
	65	1.61	1.59
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96
PLUOOS RPTOOS TBVOOS	100	1.42	1.42
	65	1.61	1.59
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.10	2.16
	30 (> 50%F)	2.85	2.90
	25 (> 50%F)	3.18	3.22
	30 (≤ 50%F)	2.54	2.64
	25 (≤ 50%F)	2.88	2.96

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS RPTOOS FHOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.74	1.74
	50	---	---
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS TBVOOS FHOOS	100	1.43	1.42
	65	1.62	1.63
	60	1.74	1.74
	50	---	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
PLUOOS RPTOOS TBVOOS FHOOS	100	1.43	1.43
	65	1.62	1.63
	60	1.74	1.74
	50	---	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above MCPR$_P$ limits for SLO.

Table 5: $MCPR_P$ Limits for BOC to CD Exposures – NSS Scram Times

(Applicable up to Core Average Exposure of 34,731 MWd / MTU)

All Values Include FFTR/FHOOS and Bound Heaters In-Service

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
In-Service	100	1.38	1.37
	65	1.56	1.59
	60	1.61	1.64
	50	1.74	1.77
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
RPTOOS	100	1.38	1.37
	65	1.56	1.59
	60	1.61	1.64
	50	1.74	1.77
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
TBVOOS	100	1.42	1.41
	65	1.60	1.61
	60	1.64	1.66
	50	1.76	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
RPTOOS TBVOOS	100	1.42	1.42
	65	1.60	1.61
	60	1.64	1.66
	50	1.76	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

EOOS Option	Power (% Rated)	$MCPR_P$ Limit A10	$MCPR_P$ Limit GE14
PLUOOS	100	1.38	1.37
	65	1.56	1.59
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS RPTOOS	100	1.38	1.38
	65	1.56	1.59
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.16	2.22
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS TBVOOS	100	1.42	1.41
	65	1.60	1.61
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
PLUOOS RPTOOS TBVOOS	100	1.42	1.42
	65	1.60	1.61
	60	1.73	1.73
	50	---	---
	50	1.79	1.79
	30	2.17	2.23
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above $MCPR_P$ limits for SLO.

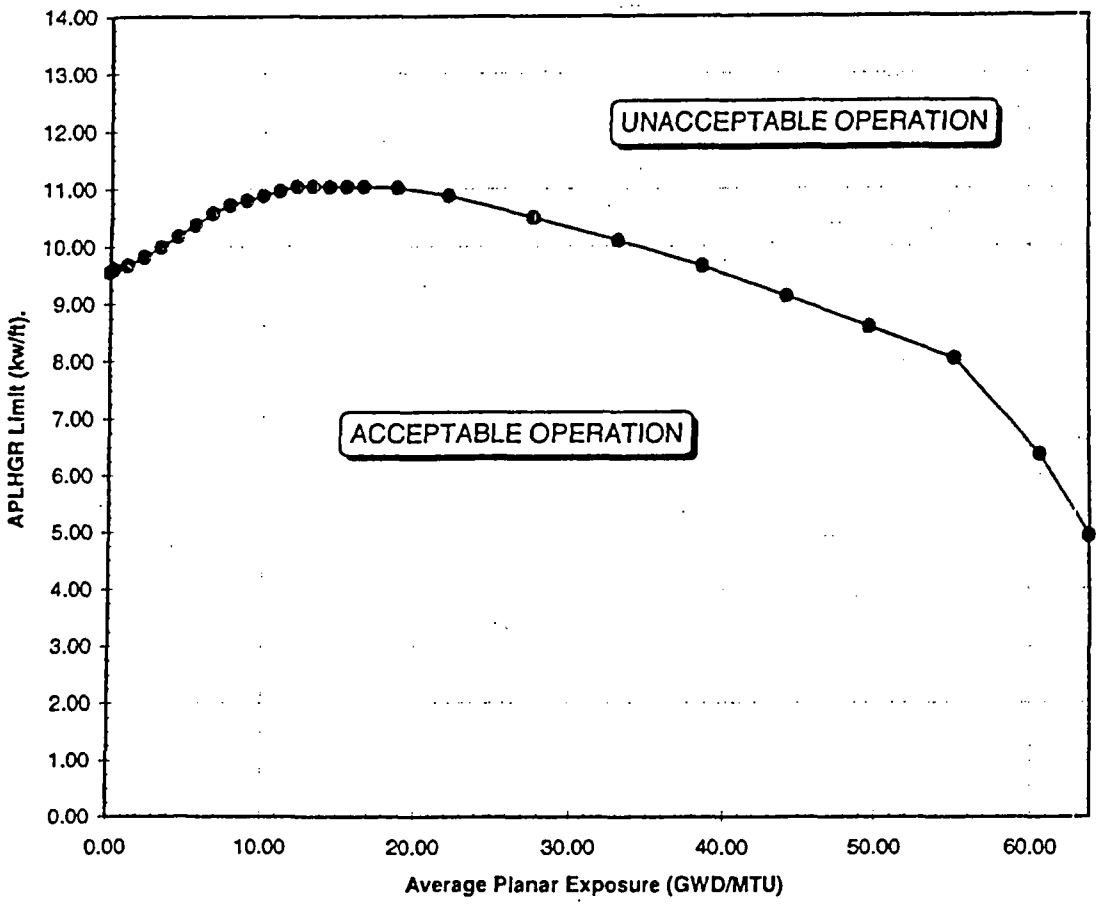
Table 6: MCPR$_P$ Limits for BOC to CD Exposures – TSSS Scram Times
(Applicable up to Core Average Exposure of **34,731 MWd / MTU**)
All Values Include FFTR/FHOOS and Bound Heaters In-Service

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
In-Service	100	1.39	1.39
	65	1.58	1.61
	60	1.62	1.66
	50	1.75	1.79
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
RPTOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.62	1.66
	50	1.75	1.79
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
TBVOOS	100	1.43	1.43
	65	1.62	1.63
	60	1.66	1.69
	50	1.77	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
RPTOOS TBVOOS	100	1.43	1.44
	65	1.62	1.63
	60	1.66	1.69
	50	1.77	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

EOOS Option	Power (% Rated)	MCPR$_P$ Limit A10	MCPR$_P$ Limit GE14
PLUOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.75	1.75
	50	---	---
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS RPTOOS	100	1.39	1.39
	65	1.58	1.61
	60	1.75	1.75
	50	---	---
	50	1.80	1.80
	30	2.18	2.24
	30 (> 50%F)	2.45	2.52
	25 (> 50%F)	2.65	2.69
	30 (≤ 50%F)	2.36	2.48
	25 (≤ 50%F)	2.56	2.67
PLUOOS TBVOOS	100	1.43	1.43
	65	1.62	1.63
	60	1.75	1.75
	50	---	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05
PLUOOS RPTOOS TBVOOS	100	1.43	1.44
	65	1.62	1.63
	60	1.75	1.75
	50	---	---
	50	1.80	1.81
	30	2.20	2.25
	30 (> 50%F)	2.93	2.99
	25 (> 50%F)	3.27	3.31
	30 (≤ 50%F)	2.61	2.71
	25 (≤ 50%F)	2.97	3.05

Add 0.02 to the above MCPR$_P$ limits for SLO.

Figure 1: APLHGR Limits for Bundle Type GE14-P10DNAB402-15GZ (GE14)

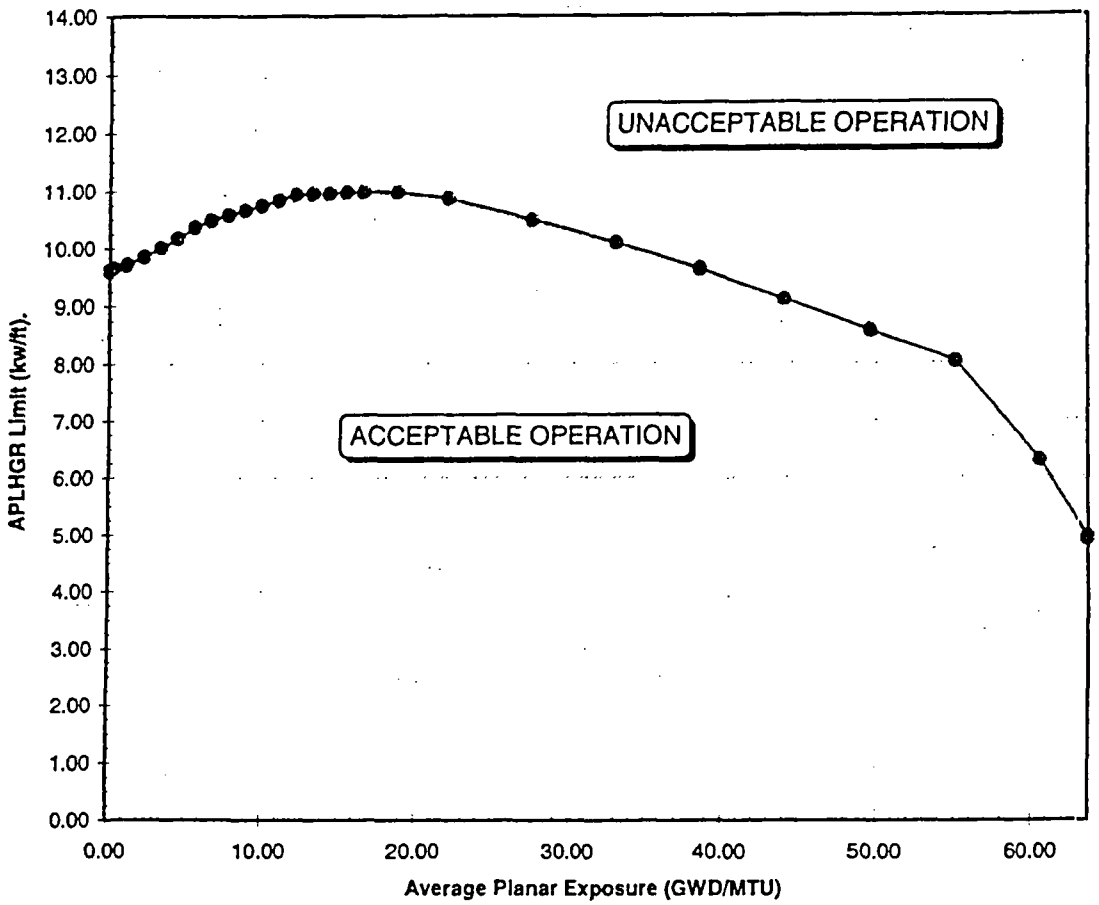


Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)
0.00	9.57	8.82	10.80	22.05	10.88
0.22	9.61	9.92	10.88	27.56	10.50
1.10	9.68	11.02	10.96	33.07	10.10
2.20	9.82	12.13	11.04	38.58	9.66
3.31	9.99	13.23	11.05	44.09	9.13
4.41	10.18	14.33	11.04	49.60	8.59
5.51	10.38	15.43	11.04	55.12	8.03
6.61	10.58	16.53	11.04	60.63	6.36
7.72	10.72	18.74	11.02	63.75	4.92

These limits are for dual recirculation loop operation. Single Loop Operation (SLO) adjustments are performed as described in Section 2. These rated power limits are applicable for all other EOOS options.

Figure 2: APLHGR Limits for Bundle Type GE14-P10DNAB401-14GZ (GE14)

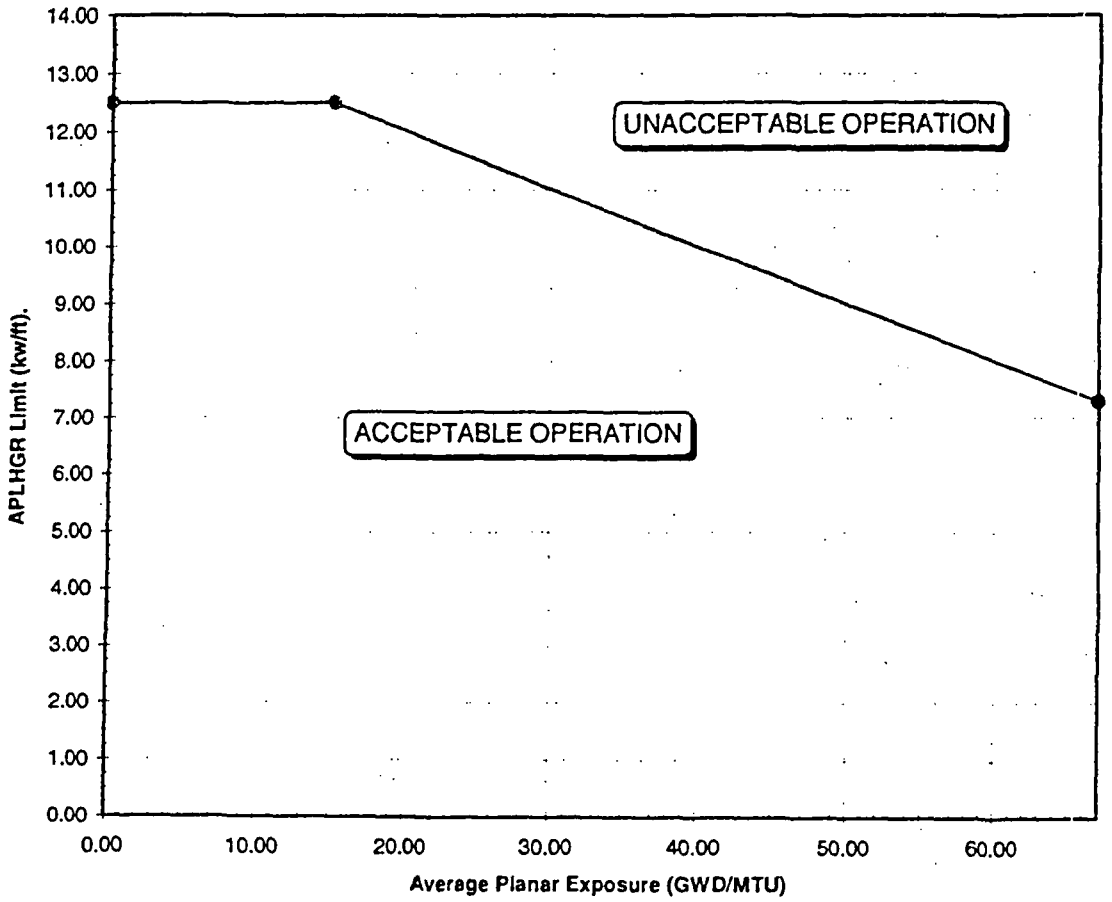


Most Limiting Lattice
for Each Exposure Point

Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)	Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)
0.00	9.63	8.82	10.67	22.05	10.87
0.22	9.67	9.92	10.75	27.56	10.50
1.10	9.73	11.02	10.84	33.07	10.10
2.20	9.86	12.13	10.94	38.58	9.64
3.31	10.01	13.23	10.96	44.09	9.11
4.41	10.18	14.33	10.96	49.60	8.57
5.51	10.37	15.43	10.98	55.12	8.03
6.61	10.50	16.53	10.99	60.63	6.30
7.72	10.58	18.74	10.99	63.63	4.93

These limits are for dual recirculation loop operation. Single Loop Operation (SLO) adjustments are performed as described in Section 2. These rated power limits are applicable for all other EOOS options.

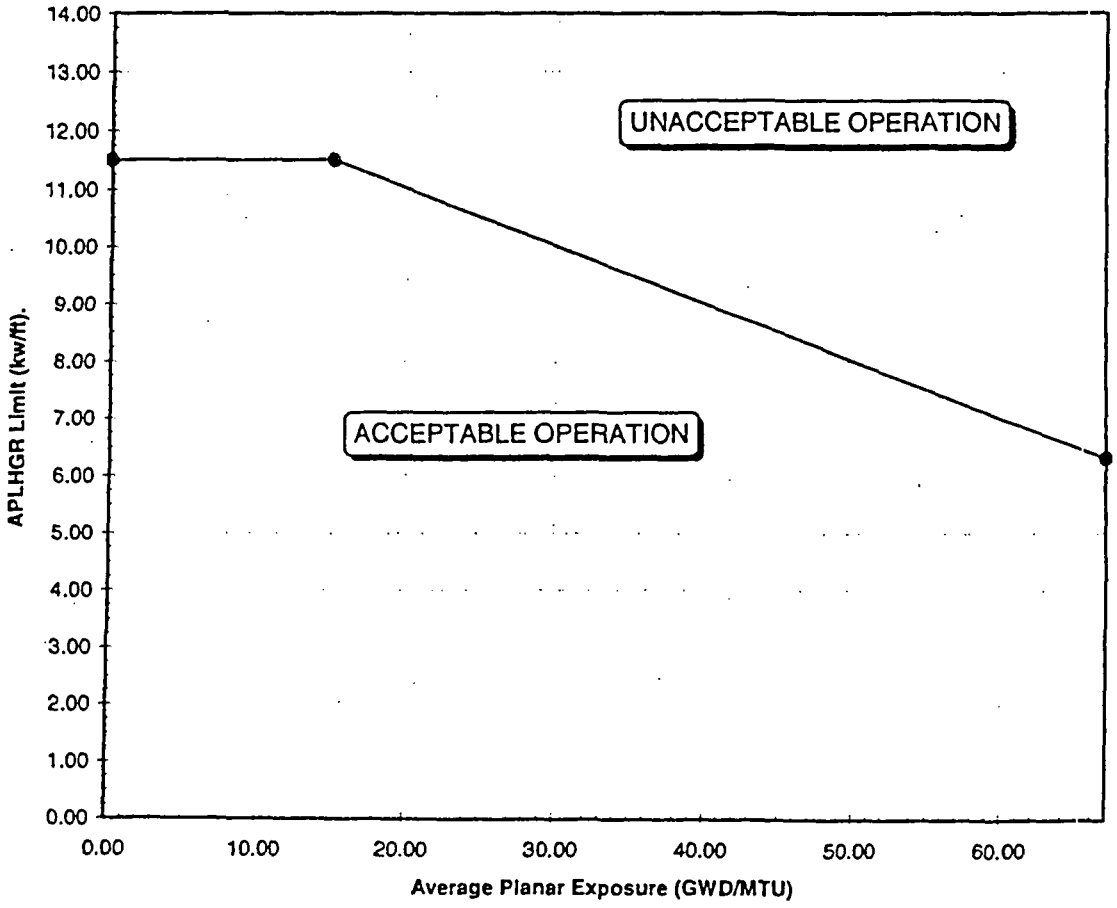
Figure 3: APLHGR Limits for all ATRIUM-10 except A10-1623B-5GV80 (A10)



Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)
0.00	12.50
15.00	12.50
67.00	7.30

These limits are for dual recirculation loop operation. Single Loop Operation (SLO) adjustments are performed as described in Section 2. These rated power limits are applicable for all other EOOS options.

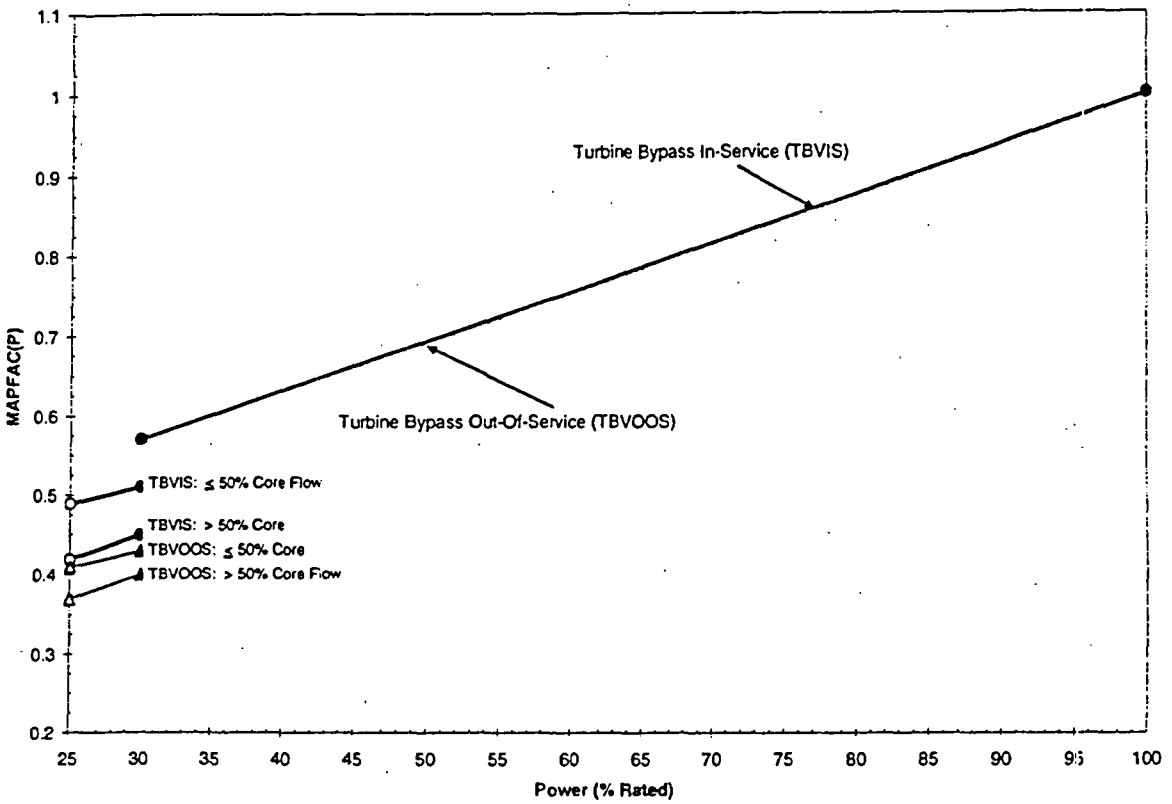
Figure 4: APLHGR Limits for A10-1623B-5GV80 (A10)



Average Planar Exposure (GWD/MTU)	LHGR Limit (kw/ft)
0.00	11.50
15.00	11.50
67.00	6.30

These limits are for dual recirculation loop operation. Single Loop Operation (SLO) adjustments are performed as described in Section 2. These rated power limits are applicable for all other EOOS options.

Figure 5: GE14 Power Dependent MAPLHGR Multiplier - MAPFAC(P)
NSS/TSSS Insertion Times - All Exposures



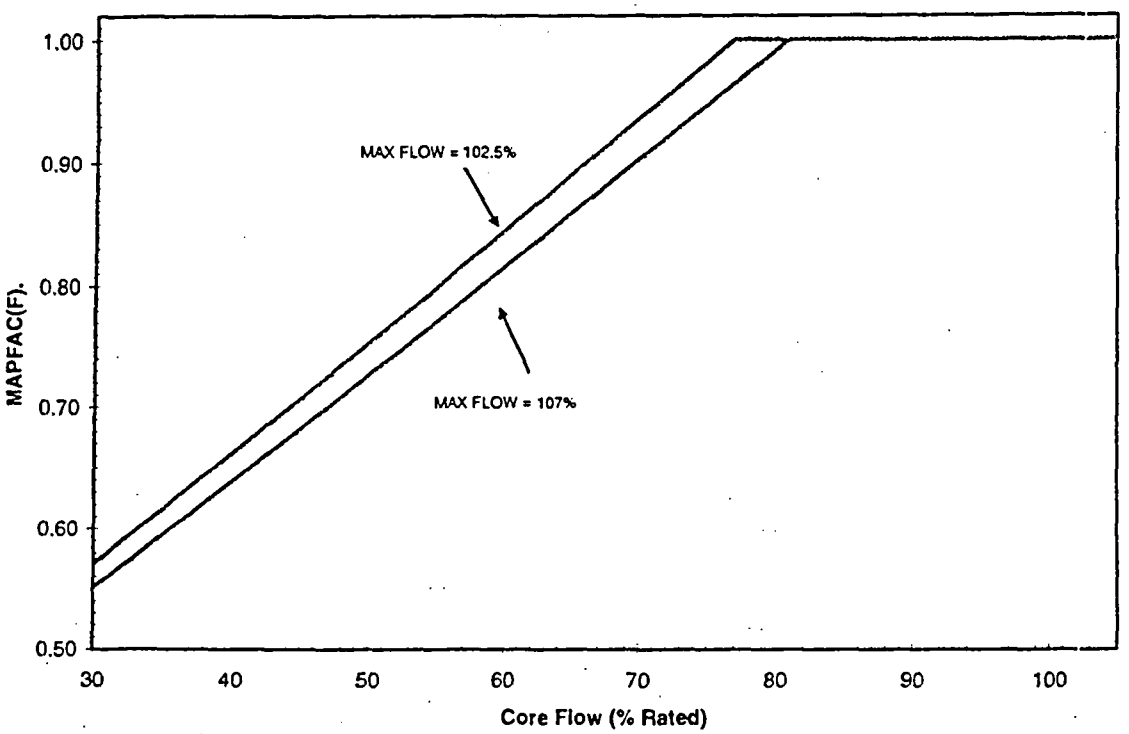
Turbine Bypass In-Service

Core Power (% rated)	MAPFAC(P)
100	1
30	0.57
Core Flow > 50% rated	
30	0.45
25	0.42
Core Flow ≤ 50% rated	
30	0.51
25	0.49

Turbine Bypass Out-Of-Service

Core Power (% rated)	MAPFAC(P)
100	1
30	0.57
Core Flow > 50% rated	
30	0.40
25	0.37
Core Flow ≤ 50% rated	
30	0.43
25	0.41

Figure 6: GE14 Flow Dependent MAPLHGR Factor - MAPFAC(F)
(GE14)



Max Core Flow 102.5% Rated

Core Flow (% rated)	MAPFAC(F)
30	0.57
77	1.00
102.5	1.00

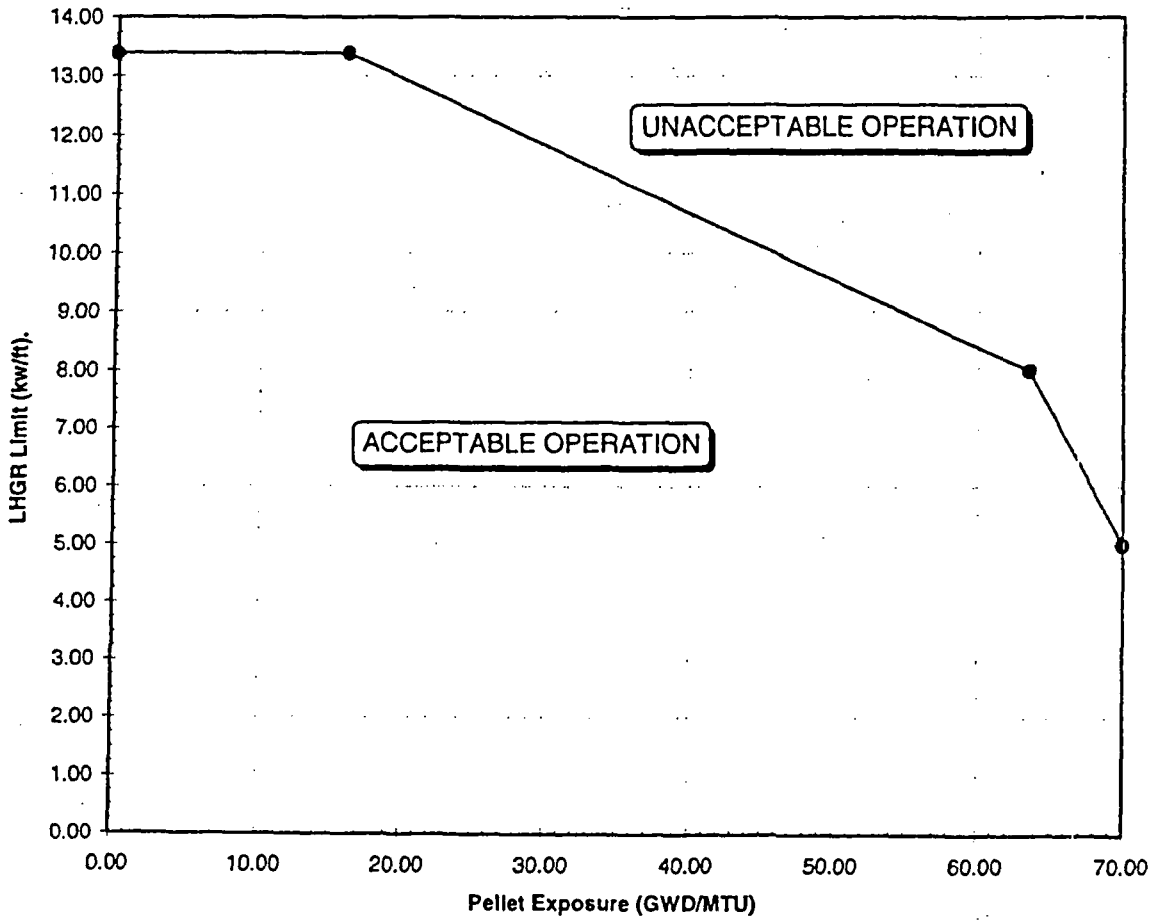
Max Core Flow 107% Rated

Core Flow (% rated)	MAPFAC(F)
30	0.55
81	1.00
107	1.00

These values bound all Equipment In-Service and Out-Of-Service options.

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).

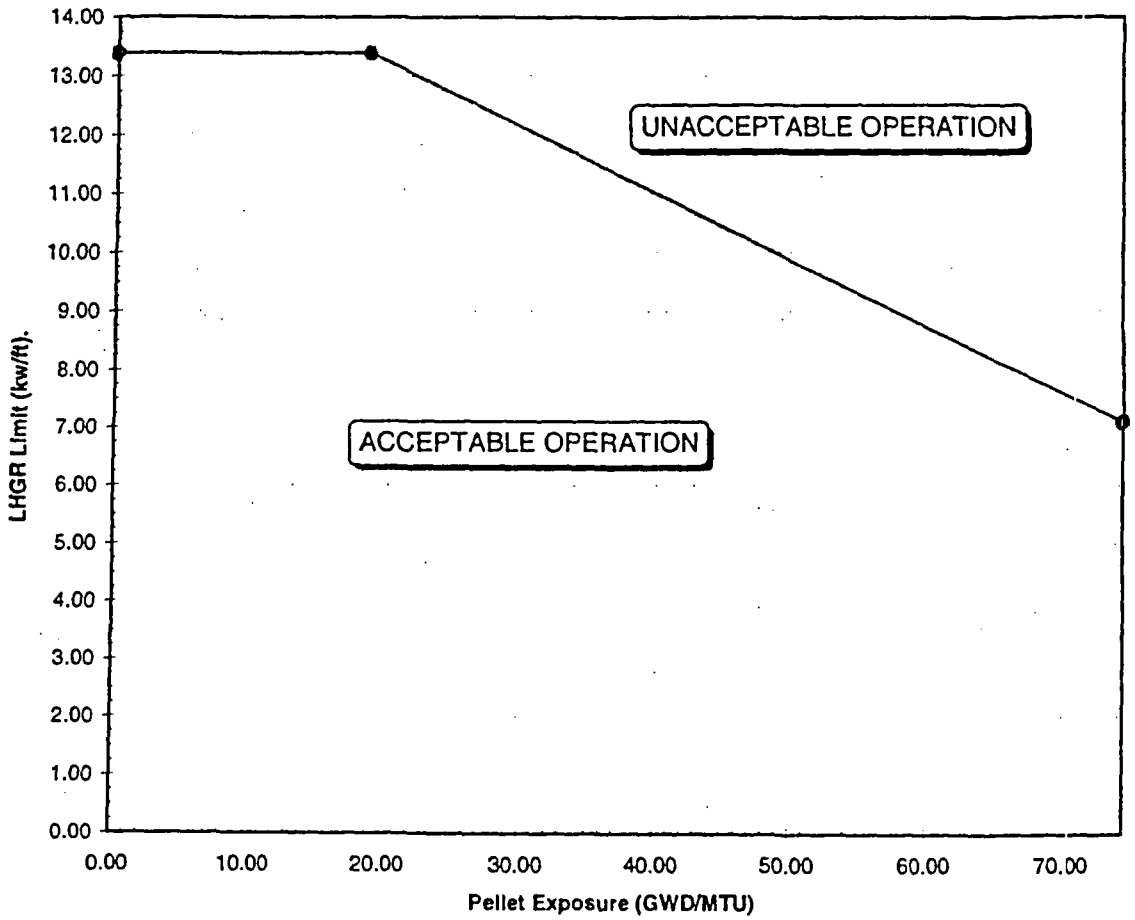
Figure 7: LHGR Limits for all GE14
(GE14)



Pellet Exposure (GWD/MTU)	LHGR Limit (kw/ft)
0.00	13.40
16.00	13.40
63.50	8.00
70.00	5.00

These rated power limits bound all Equipment In-Service and Out-Of-Service options.

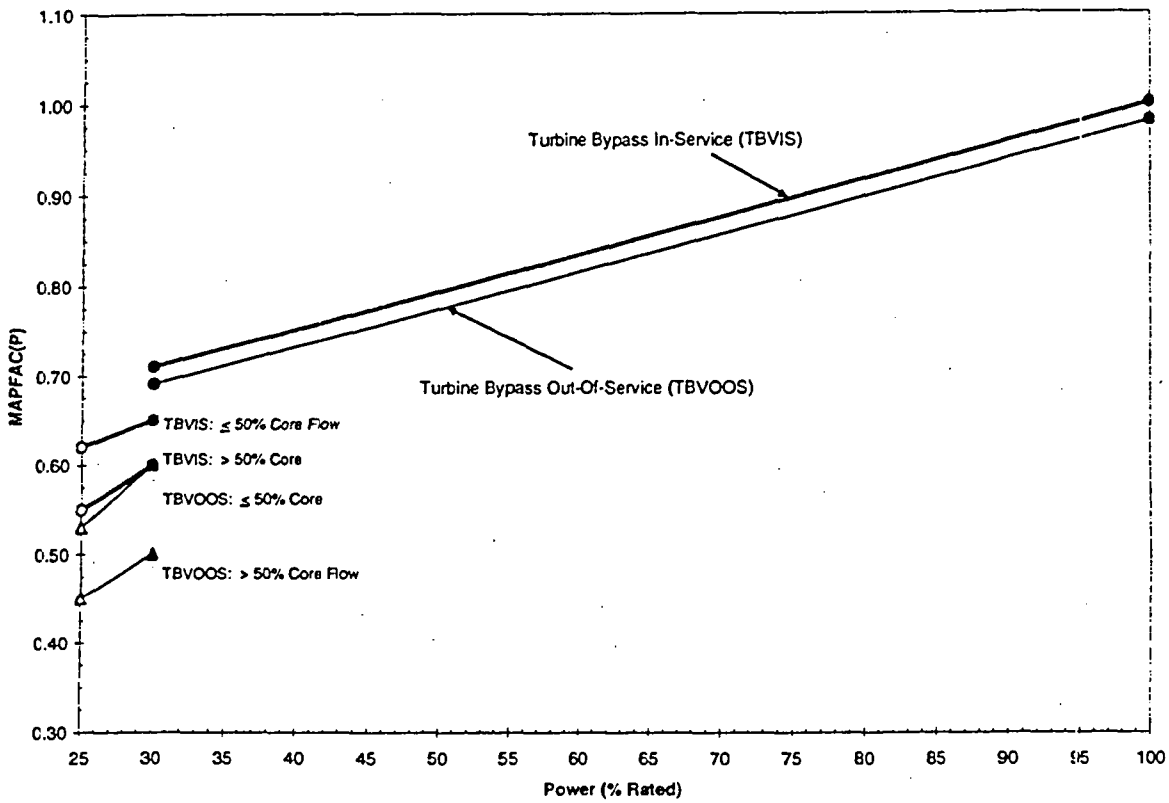
Figure 8: LHGR Limits for all ATRIUM-10 (A10)



Pellet Exposure (GWD/MTU)	LHGR Limit (kw/ft)
0.00	13.40
18.90	13.40
74.40	7.10

These rated power limits bound all Equipment In-Service and Out-Of-Service options.

Figure 9: ATRIUM-10 Power Dependent LHGR Multiplier - LHGRFAC(P)
NSS/TSSS Insertion Times - All Exposures
(A10)



Turbine Bypass In-Service

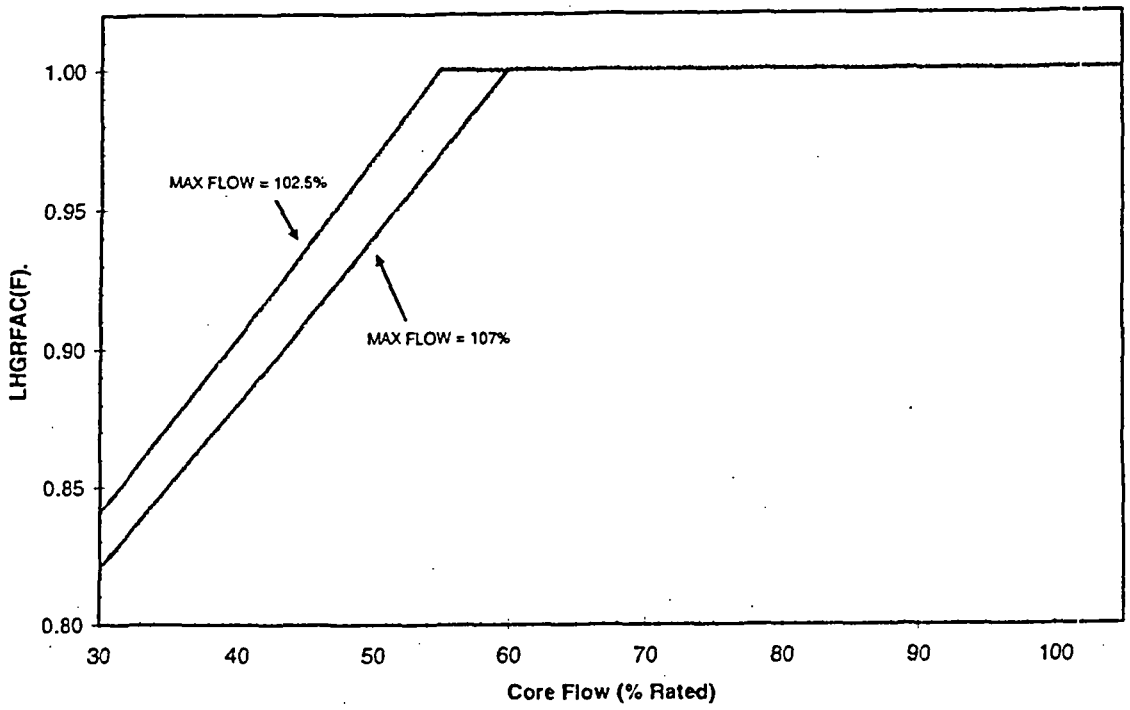
Core Power (% rated)	LHGRFAC(P)
100	1.00
30	0.71
Core Flow > 50% rated	
30	0.60
25	0.55
Core Flow ≤ 50% rated	
30	0.65
25	0.62

Turbine Bypass Out-Of-Service

Core Power (% rated)	LHGRFAC(P)
100	0.98
30	0.69
Core Flow > 50% rated	
30	0.50
25	0.45
Core Flow ≤ 50% rated	
30	0.60
25	0.53

LHGRFAC(P) is not dependent upon any Equipment Out-Of-Service except Turbine Bypass.

Figure 10: ATRIUM-10 Flow Dependent LHGR Multiplier - LHGRFAC(F) (A10)



Max Core Flow 102.5% Rated

Core Flow (% rated)	LHGRFAC(F)
30	0.84
55	1.00
102.5	1.00

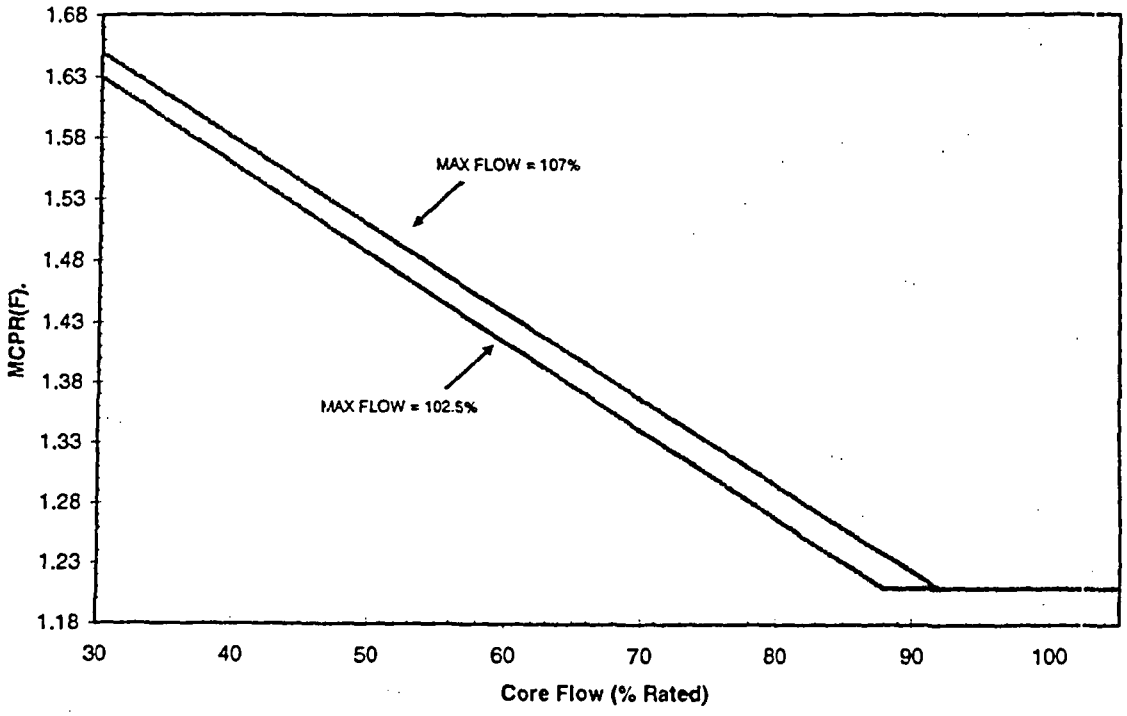
Max Core Flow 107% Rated

Core Flow (% rated)	LHGRFAC(F)
30	0.82
60	1.00
107	1.00

These values bound all Equipment In-Service and Out-Of-Service options.

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 11: GE14 Flow Dependent MCPR Limit - MCPR(F)
(GE14)



Max Core Flow 102.5% Rated

Core Flow (% rated)	MCPR(F)
30	1.63
88	1.21
102.5	1.21

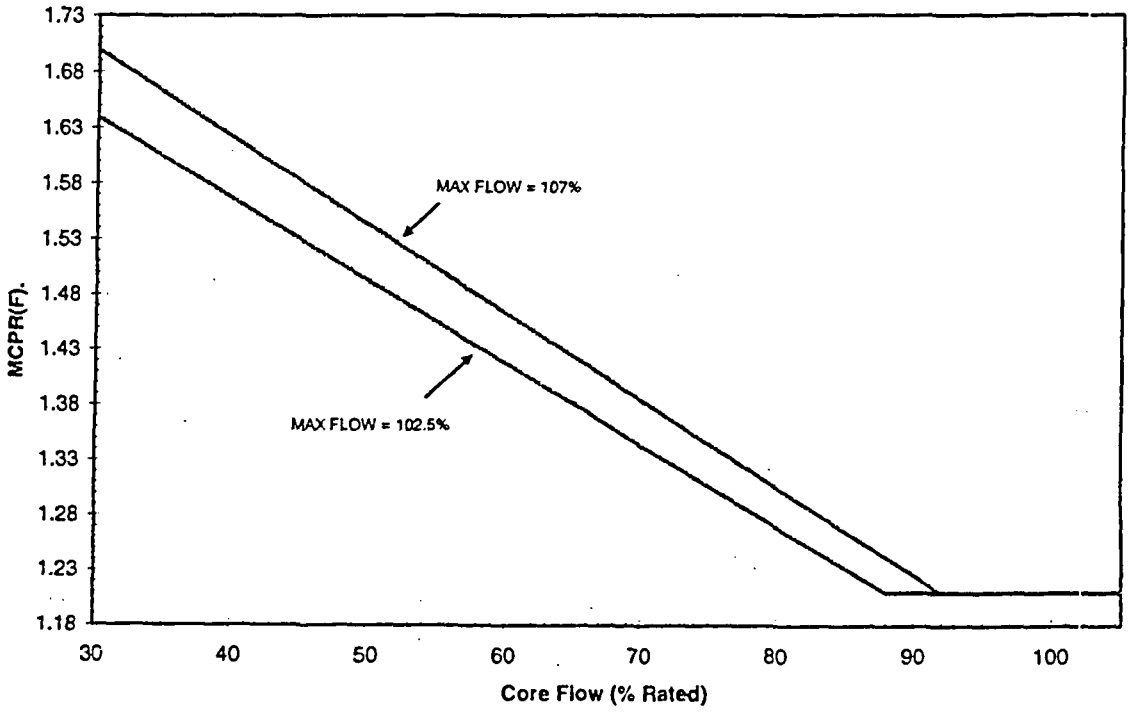
Max Core Flow 107% Rated

Core Flow (% rated)	MCPR(F)
30	1.65
92	1.21
107	1.21

These values bound all Equipment In-Service and Out-Of-Service options.

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 12: ATRIUM-10 Flow Dependent MCPR Limit - MCPR(F) (A10)



Max Core Flow 102.5% Rated

Core Flow (% rated)	MCPR(F)
30	1.64
88	1.21
102.5	1.21

Max Core Flow 107% Rated

Core Flow (% rated)	MCPR(F)
30	1.70
92	1.21
107	1.21

These values bound all Equipment In-Service and Out-Of-Service options.

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).