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Exelon Nuclear

RA07-071

August 7, 2007

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

LaSalle County Station, Units 1 and 2
Facility Operating License Nos. NPF-11 and NPF-18
NRC Docket Nos. 50-373 and 50-374

Subject: Unit 1 Cycle 12, Revision 3 and Unit 2 Cycle 12, Revision 1, Core Operating Limits Report (COLR)

The purpose of this letter is to transmit revisions to the LaSalle County Station (LSCS) Units 1 and 2 Cycle 12 Core Operating Limits Report (COLR). This report is being submitted in accordance with LSCS Technical Specification 5.6.5, "Core Operating Limits (COLR)," item d.

LSCS Units 1 and 2, Cycle 12 COLRs have been revised to include an additional note in COLR Section 10, "Modes of Operation," to provide additional clarification of the applicable combinations of turbine bypass valve out of service (TBVOOS). The analyses performed for these Cycle 12 revisions utilize NRC approved methodologies. The core operating characteristics are bounded by the Updated Final Safety Analysis Report (UFSAR) allowable limits.

Exelon Generation Company, LLC (EGC) has performed a review of the relevant licensing documents, associated TS Bases, and applicable references in accordance with 10 CFR 50.59, "Changes, tests, and experiments." The review process concluded that these revisions do not require NRC review and approval.

Should you have any questions concerning this submittal, please contact Mr. Terrence W. Simpkin, Regulatory Assurance Manager, at (815) 415-2800.

Respectfully,

for Susan R. Landahl
Site Vice President
LaSalle County Station

Attachment

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - LaSalle County Station

A001

NRR

LaSalle Unit 1 Cycle 12

Core Operating Limits Report

Revision 3

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List of Tables

1. References

1. Exelon Generation Company, LLC Docket No. 50-373 LaSalle County Station, Unit 1, License No. NPF-11.

2. NRC Letter from D. M. Crutchfield to All Power Reactor Licensees and Applicants, Generic Letter 88-16; Concerning the Removal of Cycle-Specific Parameter Limits from Tech Specs, October 3, 1988.

3. Framatome ANP Report EMF-3260 Revision 0, "LaSalle Unit 1 Cycle 12 Reload Analysis," Framatome ANP, Inc., January 2006.

4. Framatome ANP Report EMF-3165(P) Revision 0, "LaSalle Unit 1 Cycle 12 Principal Transient Analysis Parameters", Framatome ANP, Inc., June 2005.

5. Nuclear Fuels Letter NFM:MW:01-0106, from A. Giancatarino to J. Nugent, "LaSalle Unit 1 and Unit 2 Rod Block Monitor COLR Setpoint Change," April 3, 2001.

6. Framatome ANP Letter from R. G. Grummer to N. J. Carr, "Plant Startup Testing with POWERPLEX-III", RGG:04:001, January 8, 2004.

7. GNF Report 0000-0017-8285-SRLR,"Supplemental Reload Licensing Report for LaSalle County Nuclear Station Unit 1 Reload 10 Cycle 11," December 2003.

8. GE Document GE-NE-0000-0026-4769-00, "GE14 Fuel Design Cycle-Independent Analyses for LaSalle Unit 1 and Unit 2," Revision 0, January 2005.

9. GNF Letter TGO-EXN-HA103-011, from T. Orr to R. Chin, "Transmittal of Peak Pellet LHGR Limits for LaSalle 1 Cycle 11 GE14 Bundles with Gad Suppression," July 3, 2003.

10. GE Document GE-NE-0000-0022-8684-R1, "Exelon LaSalle Units 1 and 2 SAFER/GESTR Loss-of-Coolant-Accident Analysis for GE14 Fuel", December 2004.

11. GE Document GE-NE-A1300384-07-01, Rev. 1, "LaSalle County Station Power Uprate Project, Task 201: Reactor Power/Flow Map", September 1999.

12. Framatome ANP Letter from N. Carr to M. Hsiao, "Startup with TIP Equipment Out of Service", NJC:04:031, April 20, 2004.

13. AREVA Letter from A. W. Will to F. Trikur, "LaSalle Unit 1 Cycle 12 ICA Stability Analysis Exposure Extension", AWW:06:114, September 1, 2006.

14. AREVA Letter from D. B. McBurney to F. Trikur, "Transmittal of Transmittal of LaSalle Unit 1 Cycle 12 Combined EOOS Thermal Limits Evaluation", FAB06-2196, November 29, 2006.

15. AREVA Letter from D. B. McBurney to F. Trikur, "Transmittal of AREVA Support for L1C12 and L2C12 Operation With More Than One Turbine Bypass Valve Closed", FAB07-2213, May 8, 2007.

2. Terms and Definitions

APLHGR	Average planar linear heat generation rate
APRM	Average power range monitor
ATRM10	ATRIUM-10 fuel
BOC	Beginning of cycle
DLO	Dual loop operation
ELLLA	Extended load line limit analysis
EOC	End of cycle
EOOS	Equipment out of service
FANP	Framatome Advanced Nuclear Power
FFTR	Final feedwater temperature reduction
FHOOS	Feedwater heater out of service
GE14	GE14C fuel
GNF	Global Nuclear Fuel
ICF	Increased core flow
LHGR	Linear heat generation rate
LHGRFAC(F)	Flow dependent LHGR multiplier
LHGRFAC(P)	Power dependent LHGR multiplier
LPRM	Local power range monitor
MAPFAC(F)	Flow dependent MAPLHGR multiplier
MAPFAC(P)	Power dependent MAPLHGR multiplier
MAPLHGR	Maximum average planar linear heat generation rate
MCPR	Minimum critical power ratio
MCPR(F)	Flow dependent MCPR
MCPR(P)	Power dependent MCPR
MELLLA	Maximum extended load line limit analysis
MSIV	Main steam isolation valve
MSIVOOS	Main steam isolation valve out of service
NEOC	Near end of cycle
NSS	Nominal scram speed
OLMCPR	Operating limit minimum critical power ratio
OPRM	Oscillation power range monitor
PBDA	Period based detection algorithm
PLUOOS	Power load unbalance out of service
PPD	Plant Parameter Document
PROOS	Pressure regulator out of service
RBM	Rod block monitor
RPT	Recirculation pump trip
RPTOOS	Recirculation pump trip out of service
RWE	Rod withdrawal error
SLMCPR	Safety limit minimum critical power ratio
SLO	Single loop operation
SRVOOS	Safety-relief valve out of service
TBVOOS	Turbine bypass valve out of service
TCV	Turbine control valve
TCVOOS	Turbine control valve out of service
TIP	Traversing Incore Probe
TSSS	Technical specification scram speed
TSV	Turbine stop valve
TSVOOS	Turbine stop valve out of service

3. General Information

Power and flow dependent limits are listed for various power and flow levels. Linear interpolation is to be used to find intermediate values.

Rated core flow is 108.5 Mlb/hr. Operation up to 105% rated flow is licensed for this cycle. Licensed rated thermal power is 3489 MWth.

For thermal limit monitoring above 100% rated power or 100% rated core flow, the 100% rated power and the 100% core flow values, respectively, can be used unless otherwise indicated in the applicable table.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

Core Exposure Definitions (Reference 3):

Exposure Nomenclature	Core Average Exposure (MWD/MTU)
NEOC12	32933
EOC12	35180
Maximum Core Exposure	39180

4. Average Planar Linear Heat Generation Rate

The MAPLHGR values for the most limiting lattice (excluding natural uranium) of each fuel type as a function of average planar exposure is given in Tables 4-1 and 4-2. During single loop operation, these limits are multiplied by the SLO multiplier listed in Table 4-3.

Table 4-1 MAPLHGR for bundle(s):
A10-4039B-15GV75-100M
A10-4037B-16GV75-100M
A10-4046B-13GV80
A10-3537B-12GV80
A10-3537B-12GV80a
(Reference 3)

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	12.5
15.00	12.5
55.00	9.1
67.00	7.1

Table 4-2 MAPLHGR for bundle(s):
GE14-P10CNAB421-18GZ-120T-150-T6-2673
GE14-P10CNAB422-19GZ-120T-150-T6-2677
(Reference 7)

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	13.40
16.00	13.40
63.50	8.00
70.00	5.00

Table 4-3 MAPLHGR SLO multiplier for GE and FANP Fuel
(Reference 3 and 7)

Fuel Type	SLO Multiplier
ATRM10	0.82
GE14	0.78

5. Operating Limit Minimum Critical Power Ratio

5.1. Manual Flow Control MCPR Limits

The OLMCPR is determined for a given power and flow condition by evaluating the power-dependent MCPR and the flow-dependent MCPR and selecting the greater of the two.

5.1.1. Power-Dependent MCPR

The power-dependent MCPR limit, MCPR(P), is determined from Tables 5-1 through 5-12, and is dependent on exposure, fuel type, and scram speed, in addition to power level. Tables 5-1, 5-2, 5-5, 5-6, 5-9 and 5-10 are applicable to ATRIUM-10 fuel and Tables 5-3, 5-4, 5-7, 5-8, 5-11 and 5-12 are applicable to GE14 fuel.

5.1.2. Flow - Dependent MCPR

Tables 5-13 and 5-14 give the MCPR(F) limit as a function of the flow based on the applicable plant condition. The MCPR(F) limit determined from these tables is the flow dependent OLMCPR.

5.2. Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

5.3. Scram Time

NSS and TSSS refer to scram speeds.

To utilize the MCPR limits for Technical Specification Scram Speed (TSSS), the scram speed insertion time must be equal to or less than the values provided below.

To utilize the MCPR limits for Nominal Scram Speed (NSS), the scram speed insertion time must be equal to or less than the values provided below (Reference 4).

Notch Position	TSSS Time (sec.)	NSS Time (sec.)
45	0.53	0.38
39	0.85	0.68
25	1.90	1.68
05	3.45	2.68

5.4. Recirculation Flow Control Valve Settings

Cycle 12 was analyzed with a maximum core flow runout of 105%; therefore the recirculation pump flow control valve must be set to maintain core flow less than 105% (113.9 Mlb/hr) for all runout events (Reference 4). This value is consistent with the analyses of Reference 3.

Table 5-1 MCPR(P) for ATRIUM-10 Fuel
BOC to NEOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.12	2.12	1.53			1.42
Base Case SLO	2.13	2.13	1.54			1.43
FHOOS	2.25	2.25	1.57			1.43
FHOOS SLO	2.26	2.26	1.58			1.44
TBVOOS	2.15	2.15	1.61			1.45
TBVOOS SLO	2.16	2.16	1.62			1.46
One TBVOOS	2.12	2.12	1.54			1.42
One TBVOOS SLO	2.13	2.13	1.55			1.43
PROOS	2.30	2.30		1.63	1.48	1.42
PROOS SLO	2.31	2.31		1.64	1.49	1.43
PLUOOS	2.12	2.12	1.53			1.42
PLUOOS SLO	2.13	2.13	1.54			1.43
Combined EOOS	2.30	2.30		1.69	1.54	1.46
Combined EOOS SLO	2.31	2.31		1.70	1.55	1.47

Table 5-2 MCPR(P) for ATRIUM-10 Fuel
BOC to NEOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.17	2.17	1.54			1.46
Base Case SLO	2.18	2.18	1.55			1.47
FHOOS	2.31	2.31	1.59			1.46
FHOOS SLO	2.32	2.32	1.60			1.47
TBVOOS	2.23	2.23	1.62			1.48
TBVOOS SLO	2.24	2.24	1.63			1.49
One TBVOOS	2.18	2.18	1.56			1.46
One TBVOOS SLO	2.19	2.19	1.57			1.47
PROOS	2.31	2.31		1.64	1.50	1.46
PROOS SLO	2.32	2.32		1.65	1.51	1.47
PLUOOS	2.17	2.17	1.54			1.46
PLUOOS SLO	2.18	2.18	1.55			1.47
Combined EOOS	2.31	2.31		1.69	1.56	1.48
Combined EOOS SLO	2.32	2.32		1.70	1.57	1.49

Table 5-3 MCPR(P) for GE14 Fuel
BOC to NEOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.12	2.12	1.51			1.42
Base Case SLO	2.13	2.13	1.52			1.43
FHOOS	2.25	2.25	1.55			1.42
FHOOS SLO	2.26	2.26	1.56			1.43
TBVOOS	2.15	2.15	1.59			1.45
TBVOOS SLO	2.16	2.16	1.60			1.46
One TBVOOS	2.12	2.12	1.52			1.42
One TBVOOS SLO	2.13	2.13	1.53			1.43
PROOS	2.26	2.26		1.67	1.47	1.42
PROOS SLO	2.27	2.27		1.68	1.48	1.43
PLUOOS	2.12	2.12	1.51			1.43
PLUOOS SLO	2.13	2.13	1.52			1.44
Combined EOOS	2.27	2.27		1.77	1.54	1.47
Combined EOOS SLO	2.28	2.28		1.78	1.55	1.48

Table 5-4 MCPR(P) for GE14 Fuel
BOC to NEOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.17	2.17	1.53			1.44
Base Case SLO	2.18	2.18	1.54			1.45
FHOOS	2.30	2.30	1.61			1.44
FHOOS SLO	2.31	2.31	1.62			1.45
TBVOOS	2.22	2.22	1.60			1.47
TBVOOS SLO	2.23	2.23	1.61			1.48
One TBVOOS	2.18	2.18	1.54			1.44
One TBVOOS SLO	2.19	2.19	1.55			1.45
PROOS	2.28	2.28		1.69	1.49	1.44
PROOS SLO	2.29	2.29		1.70	1.50	1.45
PLUOOS	2.17	2.17	1.53			1.45
PLUOOS SLO	2.18	2.18	1.54			1.46
Combined EOOS	2.30	2.30		1.77	1.57	1.50
Combined EOOS SLO	2.31	2.31		1.78	1.58	1.51

Table 5-5 MCPR(P) for ATRIUM-10 Fuel
NEOC to EOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.12	2.12	1.53			1.44
Base Case SLO	2.13	2.13	1.54			1.45
FHOOS	2.25	2.25	1.57			1.44
FHOOS SLO	2.26	2.26	1.58			1.45
TBVOOS	2.15	2.15	1.61			1.47
TBVOOS SLO	2.16	2.16	1.62			1.48
One TBVOOS	2.12	2.12	1.55			1.44
One TBVOOS SLO	2.13	2.13	1.56			1.45
PROOS	2.30	2.30		1.64	1.49	1.44
PROOS SLO	2.31	2.31		1.65	1.50	1.45
PLUOOS	2.12	2.12	1.53			1.44
PLUOOS SLO	2.13	2.13	1.54			1.45
Combined EOOS	2.30	2.30		1.69	1.55	1.48
Combined EOOS SLO	2.31	2.31		1.70	1.56	1.49

Table 5-6 MCPR(P) for ATRIUM-10 Fuel
NEOC to EOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.17	2.17	1.54			1.47
Base Case SLO	2.18	2.18	1.55			1.48
FHOOS	2.31	2.31	1.59			1.47
FHOOS SLO	2.32	2.32	1.60			1.48
TBVOOS	2.23	2.23	1.62			1.49
TBVOOS SLO	2.24	2.24	1.63			1.50
One TBVOOS	2.18	2.18	1.56			1.47
One TBVOOS SLO	2.19	2.19	1.57			1.48
PROOS	2.31	2.31		1.65	1.51	1.47
PROOS SLO	2.32	2.32		1.66	1.52	1.48
PLUOOS	2.17	2.17	1.54			1.47
PLUOOS SLO	2.18	2.18	1.55			1.48
Combined EOOS	2.31	2.31		1.69	1.58	1.54
Combined EOOS SLO	2.32	2.32		1.70	1.59	1.55

Table 5-7 MCPR(P) for GE14 Fuel
NEOC to EOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.12	2.12	1.51			1.43
Base Case SLO	2.13	2.13	1.52			1.44
FHOOS	2.25	2.25	1.55			1.43
FHOOS SLO	2.26	2.26	1.56			1.44
TBVOOS	2.15	2.15	1.59			1.46
TBVOOS SLO	2.16	2.16	1.60			1.47
One TBVOOS	2.12	2.12	1.52			1.43
One TBVOOS SLO	2.13	2.13	1.53			1.44
PROOS	2.26	2.26		1.67	1.47	1.43
PROOS SLO	2.27	2.27		1.68	1.48	1.44
PLUOOS	2.12	2.12	1.51			1.43
PLUOOS SLO	2.13	2.13	1.52			1.44
Combined EOOS	2.27	2.27		1.77	1.54	1.48
Combined EOOS SLO	2.28	2.28		1.78	1.55	1.49

Table 5-8 MCPR(P) for GE14 Fuel
NEOC to EOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.17	2.17	1.53			1.45
Base Case SLO	2.18	2.18	1.54			1.46
FHOOS	2.30	2.30	1.61			1.45
FHOOS SLO	2.31	2.31	1.62			1.46
TBVOOS	2.22	2.22	1.60			1.47
TBVOOS SLO	2.23	2.23	1.61			1.48
One TBVOOS	2.18	2.18	1.54			1.45
One TBVOOS SLO	2.19	2.19	1.55			1.46
PROOS	2.28	2.28		1.69	1.49	1.45
PROOS SLO	2.29	2.29		1.70	1.50	1.46
PLUOOS	2.17	2.17	1.53			1.45
PLUOOS SLO	2.18	2.18	1.54			1.46
Combined EOOS	2.30	2.30		1.77	1.57	1.54
Combined EOOS SLO	2.31	2.31		1.78	1.58	1.55

Table 5-9 MCPR(P) for ATRIUM-10 Fuel
FFTR/Coastdown Operation
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.25	2.25	1.57			1.45
Base Case SLO	2.26	2.26	1.58			1.46
TBVOOS	2.25	2.25	1.64			1.47
TBVOOS SLO	2.26	2.26	1.65			1.48
One TBVOOS	2.25	2.25	1.58			1.45
One TBVOOS SLO	2.26	2.26	1.59			1.46
PROOS	2.30	2.30		1.64	1.51	1.45
PROOS SLO	2.31	2.31		1.65	1.52	1.46
PLUOOS	2.25	2.25	1.57			1.45
PLUOOS SLO	2.26	2.26	1.58			1.46
Combined EOOS	2.30	2.30		1.69	1.55	1.50
Combined EOOS SLO	2.31	2.31		1.70	1.56	1.51

Table 5-10 MCPR(P) for ATRIUM-10 Fuel
FFTR/Coastdown Operation
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.31	2.31	1.59			1.47
Base Case SLO	2.32	2.32	1.60			1.48
TBVOOS	2.31	2.31	1.66			1.49
TBVOOS SLO	2.32	2.32	1.67			1.50
One TBVOOS	2.31	2.31	1.60			1.47
One TBVOOS SLO	2.32	2.32	1.61			1.48
PROOS	2.31	2.31		1.65	1.53	1.47
PROOS SLO	2.32	2.32		1.66	1.54	1.48
PLUOOS	2.31	2.31	1.59			1.47
PLUOOS SLO	2.32	2.32	1.60			1.48
Combined EOOS	2.31	2.31		1.69	1.58	1.55
Combined EOOS SLO	2.32	2.32		1.70	1.59	1.56

Table 5-11 MCPR(P) for GE14 Fuel
FFTR/Coastdown Operation
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.25	2.25	1.55			1.44
Base Case SLO	2.26	2.26	1.56			1.45
TBVOOS	2.25	2.25	1.61			1.46
TBVOOS SLO	2.26	2.26	1.62			1.47
One TBVOOS	2.25	2.25	1.56			1.44
One TBVOOS SLO	2.26	2.26	1.57			1.45
PROOS	2.26	2.26		1.67	1.50	1.44
PROOS SLO	2.27	2.27		1.68	1.51	1.45
PLUOOS	2.25	2.25	1.55			1.44
PLUOOS SLO	2.26	2.26	1.56			1.45
Combined EOOS	2.27	2.27		1.77	1.54	1.50
Combined EOOS SLO	2.28	2.28		1.78	1.55	1.51

Table 5-12 MCPR(P) for GE14 Fuel
FFTR/Coastdown Operation
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.30	2.30	1.61			1.45
Base Case SLO	2.31	2.31	1.62			1.46
TBVOOS	2.30	2.30	1.63			1.47
TBVOOS SLO	2.31	2.31	1.64			1.48
One TBVOOS	2.30	2.30	1.61			1.45
One TBVOOS SLO	2.31	2.31	1.62			1.46
PROOS	2.30	2.30		1.69	1.53	1.45
PROOS SLO	2.31	2.31		1.70	1.54	1.46
PLUOOS	2.30	2.30	1.61			1.45
PLUOOS SLO	2.31	2.31	1.62			1.46
Combined EOOS	2.30	2.30		1.77	1.57	1.55
Combined EOOS SLO	2.31	2.31		1.78	1.58	1.56

Table 5-13 MCPR(F) Limits for FANP and GE Fuel, DLO and SLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3)

Flow (% rated)	MCPR(F) Limit
105.0	1.11
100.0	1.19
30.0	1.55
0.0	1.55

Table 5-14 MCPR(F) Limits for FANP and GE Fuel, DLO and SLO Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3)

Flow (% rated)	MCPR(F) Limit
105.0	1.11
100.0	1.30
30.0	1.75
0.0	1.75

6. Linear Heat Generation Rate

The linear heat generation rate (LHGR) limit is the product of the exposure dependent LHGR limit from Tables 6-1 through 6-7 and the minimum of: the power dependent LHGR Factor, LHGRFAC(P), or the flow dependent LHGR Factor, LHGRFAC(F) as applicable. The LHGRFAC(P) is determined from Tables 6-8 through 6-15. The LHGRFAC(F) is determined from Table 6-16 through 6-21.

Table 6-1: LHGR Limit for GE14-P10CNAB421-18GZ-120T-150-T6-2673
(Reference 9)

Lattices 6095, 6096, 6097, and 6100 LHGR Limit kW/ft	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	13.4
16.0	13.4
63.5	8.0
70.0	5.0

Table 6-2: LHGR Limit for GE14-P10CNAB422-19GZ-120T-150-T6-2677
(Reference 9)

Lattices 6095, 6118, 6119, and 6122 LHGR Limit kW/ft	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	13.4
16.0	13.4
63.5	8.0
70.0	5.0

Table 6-3: LHGR Limit for GE14-P10CNAB421-18GZ-120T-150-T6-2673 Lattice 6098
(Reference 9)

Lattice 6098 LHGR Limit kW/ft	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0000	13.4000
15.5218	13.4000
16.8142	13.3074
17.5176	13.2275
18.7876	13.0831
20.0443	12.9402
22.5182	12.659
26.1598	12.245
32.1441	11.5647
38.0565	10.8925
43.8915	10.2292
49.6458	9.5177
55.3237	8.7773
60.9382	8.1186
66.5101	6.6107
70.0000	5.0000

Table 6-4: LHGR Limit for GE14-P10CNAB421-18GZ-120T-150-T6-2673
Lattice 6099
(Reference 9)

Lattice 6099 LHGR Limit kW/ft	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0000	13.4000
15.0262	13.4000
16.3231	13.3633
17.6075	13.2172
18.8785	13.0728
20.1351	12.9299
22.6064	12.6490
26.2427	12.2356
32.2182	11.5562
38.1199	10.8609
43.9416	10.1559
49.6801	9.4886
55.3399	8.7823
60.9347	8.1259
66.4861	6.6218
70.0000	5.0000

Table 6-5: LHGR Limit for GE14-P10CNAB422-19GZ-120T-150-T6-2677
Lattice 6120
(Reference 9)

Lattice 6120 LHGR Limit kW/ft	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0000	13.4000
15.6543	13.4000
16.9580	13.2911
17.6320	13.2145
18.9097	13.0692
20.1735	12.9255
22.6582	12.6431
26.3052	12.2285
32.2788	11.5494
38.1764	10.8789
43.9971	10.2172
49.7379	9.5062
55.4034	8.7676
61.0066	8.1105
66.5684	6.5838
70.0000	5.0000

Table 6-6: LHGR Limit for GE14-P10CNAB422-19GZ-120T-150-T6-2677
Lattice 6121
(Reference 9)

Lattice 6121 LHGR Limit kW/ft	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0000	13.4000
15.1319	13.4000
16.4377	13.3502
17.7308	13.2032
19.0101	13.0578
20.2742	12.9141
22.7569	12.6318
26.3988	12.2178
32.3629	11.5398
38.2490	10.8484
44.0557	10.1457
49.7801	9.4804
55.4267	8.7718
61.0096	8.1170
66.5504	6.5921
70.0000	5.0000

Table 6-7: LHGR Limit for FANP ATRIUM-10 Fuel
A10-4039B-15GV75-100M
A10-4037B-16GV75-100M
A10-4046B-13GV80
A10-3537B-12GV80
A10-3537B-12GV80a
(Reference 3)

Pellet Exposure (GWd/MTU)	LHGR Limit (kW/ft)
0.00	13.40
17.70	13.40
61.10	9.10
70.40	7.30

Table 6-8 LHGRFAC(P) for ATRIUM10 Fuel
BOC to NEOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.73	0.73	1.00			1.00
Base Case SLO	0.73	0.73	1.00			1.00
FHOOS	0.68	0.68	0.93			1.00
FHOOS SLO	0.68	0.68	0.93			1.00
TBVOOS	0.72	0.72	0.93			1.00
TBVOOS SLO	0.72	0.72	0.93			1.00
One TBVOOS	0.73	0.73	0.96			1.00
One TBVOOS SLO	0.73	0.73	0.96			1.00
PROOS	0.65	0.65		0.90	1.00	1.00
PROOS SLO	0.65	0.65		0.90	1.00	1.00
PLUOOS	0.73	0.73	1.00			1.00
PLUOOS SLO	0.73	0.73	1.00			1.00
Combined EOOS	0.65	0.65		0.87	0.93	0.97
Combined EOOS SLO	0.65	0.65		0.87	0.93	0.97

Table 6-9 LHGRFAC(P) for ATRIUM10 Fuel
BOC to NEOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.71	0.71	1.00			1.00
Base Case SLO	0.71	0.71	1.00			1.00
FHOOS	0.67	0.67	0.92			1.00
FHOOS SLO	0.67	0.67	0.92			1.00
TBVOOS	0.70	0.70	0.91			1.00
TBVOOS SLO	0.70	0.70	0.91			1.00
One TBVOOS	0.71	0.71	0.95			1.00
One TBVOOS SLO	0.71	0.71	0.95			1.00
PROOS	0.65	0.65		0.89	1.00	1.00
PROOS SLO	0.65	0.65		0.89	1.00	1.00
PLUOOS	0.71	0.71	1.00			1.00
PLUOOS SLO	0.71	0.71	1.00			1.00
Combined EOOS	0.65	0.65		0.87	0.92	0.96
Combined EOOS SLO	0.65	0.65		0.87	0.92	0.96

Table 6-10 LHGRFAC(P) for ATRIUM10 Fuel
NEOC to EOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.73	0.73	1.00			1.00
Base Case SLO	0.73	0.73	1.00			1.00
FHOOS	0.68	0.68	0.92			1.00
FHOOS SLO	0.68	0.68	0.92			1.00
TBVOOS	0.72	0.72	0.93			1.00
TBVOOS SLO	0.72	0.72	0.93			1.00
One TBVOOS	0.73	0.73	0.96			1.00
One TBVOOS SLO	0.73	0.73	0.96			1.00
PROOS	0.65	0.65		0.90	1.00	1.00
PROOS SLO	0.65	0.65		0.90	1.00	1.00
PLUOOS	0.73	0.73	1.00			1.00
PLUOOS SLO	0.73	0.73	1.00			1.00
Combined EOOS	0.65	0.65		0.87	0.92	0.95
Combined EOOS SLO	0.65	0.65		0.87	0.92	0.95

Table 6-11 LHGRFAC(P) for ATRIUM10 Fuel
NEOC to EOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.71	0.71	1.00			1.00
Base Case SLO	0.71	0.71	1.00			1.00
FHOOS	0.67	0.67	0.91			1.00
FHOOS SLO	0.67	0.67	0.91			1.00
TBVOOS	0.70	0.70	0.91			1.00
TBVOOS SLO	0.70	0.70	0.91			1.00
One TBVOOS	0.71	0.71	0.95			1.00
One TBVOOS SLO	0.71	0.71	0.95			1.00
PROOS	0.65	0.65		0.89	1.00	1.00
PROOS SLO	0.65	0.65		0.89	1.00	1.00
PLUOOS	0.71	0.71	1.00			1.00
PLUOOS SLO	0.71	0.71	1.00			1.00
Combined EOOS	0.65	0.65		0.87	0.91	0.95
Combined EOOS SLO	0.65	0.65		0.87	0.91	0.95

Table 6-12 LHGRFAC(P) for ATRIUM10 Fuel
FFTR/Coastdown Operation
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.68	0.68	0.92			1.00
Base Case SLO	0.68	0.68	0.92			1.00
TBVOOS	0.68	0.68	0.88			1.00
TBVOOS SLO	0.68	0.68	0.88			1.00
One TBVOOS	0.68	0.68	0.91			1.00
One TBVOOS SLO	0.68	0.68	0.91			1.00
PROOS	0.65	0.65		0.90	0.96	1.00
PROOS SLO	0.65	0.65		0.90	0.96	1.00
PLUOOS	0.68	0.68	0.92			1.00
PLUOOS SLO	0.68	0.68	0.92			1.00
Combined EOOS	0.65	0.65		0.87	0.92	0.95
Combined EOOS SLO	0.65	0.65		0.87	0.92	0.95

Table 6-13 LHGRFAC(P) for ATRIUM10 Fuel
FFTR/Coastdown Operation
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.67	0.67	0.91			1.00
Base Case SLO	0.67	0.67	0.91			1.00
TBVOOS	0.67	0.67	0.88			0.98
TBVOOS SLO	0.67	0.67	0.88			0.98
One TBVOOS	0.67	0.67	0.91			1.00
One TBVOOS SLO	0.67	0.67	0.91			1.00
PROOS	0.65	0.65		0.89	0.95	1.00
PROOS SLO	0.65	0.65		0.89	0.95	1.00
PLUOOS	0.67	0.67	0.91			1.00
PLUOOS SLO	0.67	0.67	0.91			1.00
Combined EOOS	0.65	0.65		0.87	0.91	0.95
Combined EOOS SLO	0.65	0.65		0.87	0.91	0.95

Table 6-14 LHGRFAC(P) for GE14 Fuel
DLO, All Exposures
Nominal Scram Speed (NSS)/Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)				
	0	25	40	60	100
	$LHGRFAC_P$ Multiplier				
Base Case	0.55	0.55		0.79	1.00
FHOOS	0.48	0.48		0.79	1.00
TBVOOS	0.54	0.54		0.79	1.00
One TBVOOS	0.55	0.55		0.79	1.00
PROOS	0.40	0.40			1.00
PLUOOS	0.55	0.55		0.79	1.00
Combined EOOS	0.40	0.40	0.50		0.98

Table 6-15 LHGRFAC(P) for GE14 Fuel
SLO, All Exposures
Nominal Scram Speed (NSS)/Technical Specification Scram Speed (TSSS)
(Reference 3 and 7)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	40	CP *	60	100
	$LHGRFAC_P$ Multiplier					
Base Case SLO	0.55	0.55		0.78	0.78	0.78
FHOOS SLO	0.48	0.48		0.78	0.78	0.78
TBVOOS SLO	0.54	0.54		0.78	0.78	0.78
One TBVOOS SLO	0.55	0.55		0.78	0.78	0.78
PROOS SLO	0.40	0.40		0.78		0.78
PLUOOS SLO	0.55	0.55		0.78	0.78	0.78
Combined EOOS SLO	0.40	0.40	0.50	0.78		0.78

* CP is the cutoff power level and equal to 58.54% for Base Case SLO, One TBVOOS SLO and PLUOOS SLO; 58.87% FHOOS SLO; 58.60% for TBVOOS SLO; 72.50% for PROOS SLO; and 75.00% for Combined EOOS SLO conditions.

Table 6-16 LHGRFAC(F) Multipliers for ATRIUM10 Fuel, DLO and SLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
105.00	1.00
75.00	1.00
30.00	0.78
0.00	0.78

Table 6-17 LHGRFAC(F) Multipliers for GE14 Fuel, DLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
105.00	1.00
75.00	1.00
30.00	0.55
0.00	0.55

Table 6-18 LHGRFAC(F) Multipliers for GE14 Fuel, SLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3 and 7)

Flow (% rated)	LHGRFAC(F) Multiplier
105.00	0.78
75.00	0.78
53.00	0.78
30.00	0.55
0.00	0.55

Table 6-19 LHGRFAC(F) Multipliers for ATRIUM10 Fuel, DLO and SLO Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
105.00	1.00
75.00	1.00
30.00	0.78
0.00	0.78

Table 6-20 LHGRFAC(F) Multipliers for GE14 Fuel, DLO
Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
105.00	1.00
89.00	1.00
30.00	0.41
0.00	0.41

Table 6-21 LHGRFAC(F) Multipliers for GE14 Fuel, SLO
Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3 and 7)

Flow (% rated)	LHGRFAC(F) Multiplier
105.00	0.78
89.00	0.78
67.00	0.78
30.00	0.41
0.00	0.41

7. Rod Block Monitor

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below (Reference 5):

ROD BLOCK MONITOR UPSCALE TRIP FUNCTION	ALLOWABLE VALUE
Two Recirculation Loop Operation	0.66 W_d + 54.0%
Single Recirculation Loop Operation	0.66 W_d + 48.7%

The setpoint may be lower/higher and will still comply with the rod withdrawal error (RWE) analysis because RWE is analyzed unblocked. The allowable value is clamped with a maximum value not to exceed the allowable value for a recirculation loop drive flow (W_d) of 100%.

W_d – percent of recirculation loop drive flow required to produce a rated core flow of 108.5 Mlb/hr.

8. Traversing In-Core Probe System

8.1 Description:

When the traversing in-core probe (TIP) system (for the required measurement locations) is used for recalibration of the LPRM detectors and monitoring thermal limits, the TIP system shall be operable with the following:

1. movable detectors, drives and readout equipment to map the core in the required measurement locations, and
2. indexing equipment to allow all required detectors to be calibrated in a common location.

The following applies for use of the SUBTIP methodology:

The total number of failed and bypassed LPRMs does not exceed 50% (Reference 12). With one or more TIP measurement locations inoperable, the TIP data for an inoperable measurement location may be replaced by data obtained from a 3-dimensional BWR core monitoring software system adjusted using the previously calculated uncertainties, provided the following conditions are met:

(A) When there is not a prior complete TIP-calibrated data set available:

1. To comply with Technical Specification SR 3.3.1.1.8, LPRMs, within their calibration frequency, in locations without a TIP trace are not recalibrated,
2. LPRMs in locations without a TIP trace will not be used by POWERPLEX in any core power distribution calculations, and
3. The total number of out-of-service TIPs does not exceed 42% (18 channels).

(B) When there is a prior complete TIP-calibrated data set available:

1. All TIP traces have previously been obtained at least once in the current operating cycle when the reactor core was operating above 20% power, (Reference 6) and
2. The total number of simulated channels (measurement locations) does not exceed 42% (18 channels).

Otherwise, with the TIP system inoperable, suspend use of the system for the above applicable monitoring or calibration functions.

8.2 Bases:

The operability of the TIP system with the above specified minimum complement of equipment ensures that the measurements obtained from use of this equipment accurately represent the spatial neutron flux distribution of the reactor core. The normalization of the required detectors is performed internal to the core monitoring software system.

Substitute TIP data, if needed, is 3-dimensional BWR core monitoring software calculated data which is adjusted based on axial and radial factors calculated from previous TIP sets. Since the simulation and adjustment process could introduce uncertainty, a maximum of 18 channels may be simulated to ensure that the uncertainties assumed in the substitution process methodology remain valid.

9. Stability Protection Setpoints

The OPRM PBDA Trip Settings (Reference 3):

PBDA Trip Amplitude Setpoint (Sp)	Corresponding Maximum Confirmation Count Setpoint (Np)
1.11	14

The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

The OPRM PBDA trip settings are applicable when the OPRM system is declared operable, and the associated Technical Specifications are implemented.

10. Modes of Operation

The allowed modes of operation with combinations of equipment out-of-service are as described below:

Equipment Out of Service Options[1, 2]	ELLLA	MELLLA	ICF	FFTR/ Coastdown[4]
Base Case	Yes	Yes	Yes	Yes
Base Case SLO	Yes	No[6]	N/A	Yes
FHOOS[8]	Yes	Yes	Yes	N/A[5]
FHOOS SLO[8]	Yes	No[6]	N/A	N/A[5]
TBVOOS[7]	Yes	Yes	Yes	Yes
TBVOOS SLO[7]	Yes	No[6]	N/A	Yes
One TBVOOS	Yes	Yes	Yes	Yes
One TBVOOS SLO	Yes	No[6]	N/A	Yes
PROOS	Yes	Yes	Yes	Yes
PROOS SLO	Yes	No[6]	N/A	Yes
PLUOOS	Yes	Yes	Yes	Yes
PLUOOS SLO	Yes	No[6]	N/A	Yes
Combined EOOS[3, 9]	Yes	Yes	Yes	Yes
Combined EOOS SLO[3, 9]	Yes	No[6]	N/A	Yes

[1] Limits support operation with any combination of 1 SRVOOS, up to 2 TIP machines OOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs OOS with an LPRM calibration frequency of 1250 effective full power hours (EFPH) (1000 EFPH +25%). All limits support PLUOOS $\leq$ 60% RTP.

[2] With or without 1 stuck closed TCV or TSV (except for TBVOOS – TBVOOS do not support TCV or TSV stuck closed). Note: The MCPR and LHGR operating limits may be different based on whether 1 TCV or TSV is or is not stuck closed due to MCPR(f) and LHGRFAC(f) considerations. The pressurization MCPR(f) limits and LHGRFAC(f) multipliers should be applied to support operation when any of the following EOOS conditions exist: one stuck closed TCV, or one stuck closed TSV or one MSIVOOS. Note that operation with 1 MSIVOOS is supported as long as core thermal power is maintained $\leq$ 75% of 3489 MWt.

[3] Any combination of TCV slow closure, no RPT and/or FHOOS. For FFTR/Coastdown any combination of TCV Slow Closure and/or no RPT (as a reduced feedwater temperature is already assumed as part of the base assumptions for FFTR/Coastdown).

[4] FFTR/Coastdown Operation is defined as any cycle exposure beyond full power/flow, all rods out condition with plant power slowly lowering while core flow is held constant. TBVOOS and one TBVOOS limits for FFTR/Coastdown operation are only valid for Cycle 12 core average exposures greater than 32,933 MWD/MTU. With the OPRM system armed, current analysis supports up to 100°F decrease in feedwater temperature.

[5] During FFTR/Coastdown portion of the cycle, feedwater heaters are taken out of service to achieve the FFTR.

[6] The SLO boundary was not moved up with the incorporation of MELLLA. The power-flow boundary for SLO at power uprated conditions remains the ELLLA boundary for pre-uprate conditions.

[7] The TBVOOS condition assumes that ALL the turbine bypass valves do not trip open on turbine control valve fast closure or on turbine stop valve closure. However, either TBV #1, #2, #3, or #4 must be capable of opening via the pressure control system in this EOOS (see Reference 15).

[8] The FHOOS option supports a feedwater temperature reduction of 100°F from BOC to 5100 MWD/MTU and 50°F from 5100 MWD/MTU to 6600 MWD/MTU. Upon arming of the OPRM system, the 50°F feedwater temperature reduction exposure dependent ICA restriction is not applicable and the feedwater temperature reduction of 100°F will apply. ICA regions are only applicable up to an exposure of 6600 MWD/MTU. Operation beyond 6600 MWD/MTU supports a 100°F feedwater temperature reduction with the OPRM system armed.

[9] Any combination of TCV slow closure, in combination with one (or more) TBVOOS. Any combination of TCV slow closure, in combination with one TBVOOS and 1 TCV or TSV stuck closed. TCV slow closure in combination with more than one TBVOOS and 1 TCV or TSV stuck closed is not supported per Note 2.

11. Methodology

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. XN-NF-81-58 (P)(A), Revision 2 and Supplements 1 and 2, "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," March 1984.

2. ANF-524 (P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," November 1990.

3. ANF-913 (P)(A) Volume 1 Revision 1, and Volume 1 Supplements 2, 3, 4, "COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses," August 1990.

4. XN-NF-84-105 (P)(A), Volume 1 and Volume 1 Supplements 1 and 2; Volume 1 Supplement 4, "XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis," February 1987 and June 1988, respectively.

5. EMF-2209 (P)(A), Revision 2, "SPCB Critical Power Correlation," September 2003.

6. ANF-89-98 (P)(A), Revision 1 and Revision 1 Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," May 1995.

7. ANF-91-048 (P)(A), "Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR ECCS Evaluation Model," January 1993.

8. EMF-85-74 (P)(A) Revision 0 and Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," February 1998.

9. EMF-CC-074 (P) Volume 4 Revision 0, "BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2," August 2000.

10. ANF-CC-33(P)(A) Supplement 1 Revision 1 and Supplement 2, "HUXY: A Generalized Multirod Heatup Code with 10CFR50, Appendix K Heatup Option," August 1986 and January 1991, respectively.

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2. Terms and Definitions

APLHGR	Average planar linear heat generation rate
APRM	Average power range monitor
ATRM10	ATRIUM-10 fuel
BOC	Beginning of cycle
DLO	Dual loop operation
ELLLA	Extended load line limit analysis
EOC	End of cycle
EOOS	Equipment out of service
FFTR	Final feedwater temperature reduction
FHOOS	Feedwater heater out of service
GE14	GE14C fuel
GNF	Global Nuclear Fuel
ICF	Increased core flow
LHGR	Linear heat generation rate
LHGRFAC(F)	Flow dependent LHGR multiplier
LHGRFAC(P)	Power dependent LHGR multiplier
LPRM	Local power range monitor
MAPLHGR	Maximum average planar linear heat generation rate
MCPR	Minimum critical power ratio
MCPR(F)	Flow dependent MCPR
MCPR(P)	Power dependent MCPR
MELLLA	Maximum extended load line limit analysis
MSIV	Main steam isolation valve
MSIVOOS	Main steam isolation valve out of service
NEOC	Near end of cycle
NSS	Nominal scram speed
OLMCPR	Operating limit minimum critical power ratio
OPRM	Oscillation power range monitor
PBDA	Period based detection algorithm
PLUOOS	Power load unbalance out of service
PPD	Plant Parameter Document
PROOS	Pressure regulator out of service
RBM	Rod block monitor
RPT	Recirculation pump trip
RPTOOS	Recirculation pump trip out of service
RWE	Rod withdrawal error
SLMCPR	Safety limit minimum critical power ratio
SLO	Single loop operation
SRVOOS	Safety-relief valve out of service
TBVOOS	Turbine bypass valve out of service
TCV	Turbine control valve
TCVOOS	Turbine control valve out of service
TIP	Traversing Incore Probe
TSSS	Technical Specification scram speed
TSV	Turbine stop valve
TSVOOS	Turbine stop valve out of service

3. General Information

Power and flow dependent limits are listed for various power and flow levels. Linear interpolation is to be used to find intermediate values.

Rated core flow is 108.5 Mlb/hr. Operation up to 105% rated flow is licensed for this cycle. Licensed rated thermal power is 3489 MWth.

For thermal limit monitoring above 100% rated power or 100% rated core flow, the 100% rated power and the 100% core flow values, respectively, can be used unless otherwise indicated in the applicable table.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

Core Exposure Definitions (Reference 3):

Exposure Nomenclature	Core Average Exposure (MWD/MTU)
NEOC12	31988
EOC12	34673
Maximum Core Exposure	38673

4. Average Planar Linear Heat Generation Rate

The MAPLHGR values for the most limiting lattice (excluding natural uranium) of each fuel type as a function of average planar exposure is given in Tables 4-1 and 4-2. During single loop operation, these limits are multiplied by the SLO multiplier listed in Table 4-3.

Table 4-1 MAPLHGR for bundle(s):
A10-4061B-13GV80
A10-3561B-12GV80
A10-3982B-15GV80-100M
A10-4025B-15GV80-100M
(Reference 3)

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	12.5
15.00	12.5
55.00	9.1
67.00	7.1

Table 4-2 MAPLHGR for bundle(s):
GE14-P10CNAB406-18GZ-120T-150-T6-2823
GE14-P10CNAB407-16GZ-120T-150-T6-2822
(Reference 7)

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	13.40
16.00	13.40
63.50	8.00
70.00	5.00

Table 4-3 MAPLHGR SLO multiplier for GE and AREVA Fuel
(Reference 3 and 7)

Fuel Type	SLO Multiplier
ATRM10	0.82
GE14	0.78

5. Operating Limit Minimum Critical Power Ratio

5.1. Manual Flow Control MCPR Limits

The OLMCPR is determined for a given power and flow condition by evaluating the power-dependent MCPR and the flow-dependent MCPR and selecting the greater of the two.

5.1.1. Power-Dependent MCPR

The power-dependent MCPR limit, MCPR(P), is determined from Tables 5-1 through 5-12, and is dependent on exposure, fuel type, and scram speed, in addition to power level. Tables 5-1, 5-2, 5-5, 5-6, 5-9 and 5-10 are applicable to ATRIUM-10 fuel and Tables 5-3, 5-4, 5-7, 5-8, 5-11 and 5-12 are applicable to GE14 fuel.

5.1.2. Flow - Dependent MCPR

Tables 5-13 and 5-14 give the MCPR(F) limit as a function of the core flow based on the applicable plant condition. The MCPR(F) limit determined from these tables is the flow dependent OLMCPR.

5.2. Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

5.3. Scram Time

NSS and TSSS refer to scram speeds.

To utilize the MCPR limits for Technical Specification Scram Speed (TSSS), the scram speed insertion time must be equal to or less than the values provided below.

To utilize the MCPR limits for Nominal Scram Speed (NSS), the scram speed insertion time must be equal to or less than the values provided below (Reference 4).

Notch Position	TSSS Time (sec.)	NSS Time (sec.)
45	0.53	0.38
39	0.85	0.68
25	1.90	1.68
05	3.45	2.68

5.4. Recirculation Flow Control Valve Settings

Cycle 12 was analyzed with a maximum core flow runout of 108%; therefore the recirculation pump flow control valve must be set to maintain core flow less than 108% (117.18 Mlb/hr) for all runout events (Reference 4). This value is consistent with the analyses of Reference 3.

Table 5-1 MCPR(P) for ATRIUM-10 Fuel
BOC to NEOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.10	2.10	1.52	[redacted]	[redacted]	1.41
Base Case SLO	2.11	2.11	1.53	[redacted]	[redacted]	1.42
FHOOS	2.22	2.22	1.57	[redacted]	[redacted]	1.42
FHOOS SLO	2.23	2.23	1.58	[redacted]	[redacted]	1.43
TBVOOS	2.13	2.13	1.59	[redacted]	[redacted]	1.44
TBVOOS SLO	2.14	2.14	1.60	[redacted]	[redacted]	1.45
One TBVOOS	2.10	2.10	1.53	[redacted]	[redacted]	1.41
One TBVOOS SLO	2.11	2.11	1.54	[redacted]	[redacted]	1.42
PROOS	2.30	2.30	[redacted]	1.63	1.47	1.41
PROOS SLO	2.31	2.31	[redacted]	1.64	1.48	1.42
PLUOOS	2.10	2.10	1.52	[redacted]	[redacted]	1.42
PLUOOS SLO	2.11	2.11	1.53	[redacted]	[redacted]	1.43
Combined EOOS	2.31	2.31	[redacted]	1.69	1.52	1.44
Combined EOOS SLO	2.32	2.32	[redacted]	1.70	1.53	1.45

Table 5-2 MCPR(P) for ATRIUM-10 Fuel
BOC to NEOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.16	2.16	1.53			1.45
Base Case SLO	2.17	2.17	1.54			1.46
FHOOS	2.30	2.30	1.58			1.45
FHOOS SLO	2.31	2.31	1.59			1.46
TBVOOS	2.22	2.22	1.61			1.48
TBVOOS SLO	2.23	2.23	1.62			1.49
One TBVOOS	2.17	2.17	1.55			1.45
One TBVOOS SLO	2.18	2.18	1.56			1.46
PROOS	2.32	2.32		1.64	1.49	1.45
PROOS SLO	2.33	2.33		1.65	1.50	1.46
PLUOOS	2.16	2.16	1.53			1.45
PLUOOS SLO	2.17	2.17	1.54			1.46
Combined EOOS	2.32	2.32		1.69	1.54	1.47
Combined EOOS SLO	2.33	2.33		1.70	1.55	1.48

Table 5-3 MCPR(P) for GE14 Fuel
BOC to NEOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.09	2.09	1.49			1.40
Base Case SLO	2.10	2.10	1.50			1.41
FHOOS	2.23	2.23	1.53			1.41 [1]
FHOOS SLO	2.24	2.24	1.54			1.42 [1]
TBVOOS	2.12	2.12	1.56			1.43
TBVOOS SLO	2.13	2.13	1.57			1.44
One TBVOOS	2.10	2.10	1.50			1.40
One TBVOOS SLO	2.11	2.11	1.51			1.41
PROOS	2.26	2.26		1.64	1.45	1.40
PROOS SLO	2.27	2.27		1.65	1.46	1.41
PLUOOS	2.09	2.09	1.49			1.40
PLUOOS SLO	2.10	2.10	1.50			1.41
Combined EOOS	2.26	2.26		1.72	1.50	1.44
Combined EOOS SLO	2.27	2.27		1.73	1.51	1.45

[1] the 100% MCPR(P) values for FHOOS and FHOOS SLO was raised 0.01 to allow use of OPRM PBDA trip setpoint of 1.11 (See Section 9)

Table 5-4 MCPR(P) for GE14 Fuel
BOC to NEOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.17	2.17	1.50			1.41
Base Case SLO	2.18	2.18	1.51			1.42
FHOOS	2.30	2.30	1.57			1.42
FHOOS SLO	2.31	2.31	1.58			1.43
TBVOOS	2.20	2.20	1.57			1.45
TBVOOS SLO	2.21	2.21	1.58			1.46
One TBVOOS	2.17	2.17	1.51			1.41
One TBVOOS SLO	2.18	2.18	1.52			1.42
PROOS	2.27	2.27		1.65	1.46	1.41
PROOS SLO	2.28	2.28		1.66	1.47	1.42
PLUOOS	2.17	2.17	1.50			1.42
PLUOOS SLO	2.18	2.18	1.51			1.43
Combined EOOS	2.30	2.30		1.72	1.52	1.48
Combined EOOS SLO	2.31	2.31		1.73	1.53	1.49

Table 5-5 MCPR(P) for ATRIUM-10 Fuel
NEOC to EOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.10	2.10	1.52			1.43
Base Case SLO	2.11	2.11	1.53			1.44
FHOOS	2.22	2.22	1.57			1.43
FHOOS SLO	2.23	2.23	1.58			1.44
TBVOOS	2.13	2.13	1.60			1.46
TBVOOS SLO	2.14	2.14	1.61			1.47
One TBVOOS	2.10	2.10	1.54			1.43
One TBVOOS SLO	2.11	2.11	1.55			1.44
PROOS	2.30	2.30		1.64	1.48	1.43
PROOS SLO	2.31	2.31		1.65	1.49	1.44
PLUOOS	2.10	2.10	1.52			1.43
PLUOOS SLO	2.11	2.11	1.53			1.44
Combined EOOS	2.31	2.31		1.69	1.54	1.47
Combined EOOS SLO	2.32	2.32		1.70	1.55	1.48

Table 5-6 MCPR(P) for ATRIUM-10 Fuel
NEOC to EOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.16	2.16	1.53			1.46
Base Case SLO	2.17	2.17	1.54			1.47
FHOOS	2.30	2.30	1.58			1.46
FHOOS SLO	2.31	2.31	1.59			1.47
TBVOOS	2.22	2.22	1.61			1.48
TBVOOS SLO	2.23	2.23	1.62			1.49
One TBVOOS	2.17	2.17	1.55			1.46
One TBVOOS SLO	2.18	2.18	1.56			1.47
PROOS	2.32	2.32		1.64	1.50	1.46
PROOS SLO	2.33	2.33		1.65	1.51	1.47
PLUOOS	2.16	2.16	1.53			1.46
PLUOOS SLO	2.17	2.17	1.54			1.47
Combined EOOS	2.32	2.32		1.69	1.57	1.52
Combined EOOS SLO	2.33	2.33		1.70	1.58	1.53

Table 5-7 MCPR(P) for GE14 Fuel
NEOC to EOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.09	2.09	1.49			1.41
Base Case SLO	2.10	2.10	1.50			1.42
FHOOS	2.23	2.23	1.53			1.41
FHOOS SLO	2.24	2.24	1.54			1.42
TBVOOS	2.12	2.12	1.56			1.44
TBVOOS SLO	2.13	2.13	1.57			1.45
One TBVOOS	2.10	2.10	1.50			1.41
One TBVOOS SLO	2.11	2.11	1.51			1.42
PROOS	2.26	2.26		1.64	1.45	1.41
PROOS SLO	2.27	2.27		1.65	1.46	1.42
PLUOOS	2.09	2.09	1.49			1.41
PLUOOS SLO	2.10	2.10	1.50			1.42
Combined EOOS	2.26	2.26		1.72	1.51	1.47
Combined EOOS SLO	2.27	2.27		1.73	1.52	1.48

Table 5-8 MCPR(P) for GE14 Fuel
NEOC to EOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.17	2.17	1.50			1.43
Base Case SLO	2.18	2.18	1.51			1.44
FHOOS	2.30	2.30	1.57			1.43
FHOOS SLO	2.31	2.31	1.58			1.44
TBVOOS	2.20	2.20	1.57			1.46
TBVOOS SLO	2.21	2.21	1.58			1.47
One TBVOOS	2.17	2.17	1.51			1.43
One TBVOOS SLO	2.18	2.18	1.52			1.44
PROOS	2.27	2.27		1.65	1.47	1.43
PROOS SLO	2.28	2.28		1.66	1.48	1.44
PLUOOS	2.17	2.17	1.50			1.43
PLUOOS SLO	2.18	2.18	1.51			1.44
Combined EOOS	2.30	2.30		1.72	1.54	1.52
Combined EOOS SLO	2.31	2.31		1.73	1.55	1.53

Table 5-9 MCPR(P) for ATRIUM-10 Fuel
FFTR/Coastdown Operation
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.22	2.22	1.57			1.44
Base Case SLO	2.23	2.23	1.58			1.45
TBVOOS	2.22	2.22	1.64			1.47
TBVOOS SLO	2.23	2.23	1.65			1.48
One TBVOOS	2.22	2.22	1.58			1.44
One TBVOOS SLO	2.23	2.23	1.59			1.45
PROOS	2.30	2.30		1.64	1.51	1.44
PROOS SLO	2.31	2.31		1.65	1.52	1.45
PLUOOS	2.22	2.22	1.57			1.44
PLUOOS SLO	2.23	2.23	1.58			1.45
Combined EOOS	2.31	2.31		1.69	1.54	1.49
Combined EOOS SLO	2.32	2.32		1.70	1.55	1.50

Table 5-10 MCPR(P) for ATRIUM-10 Fuel
FFTR/Coastdown Operation
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.30	2.30	1.58			1.46
Base Case SLO	2.31	2.31	1.59			1.47
TBVOOS	2.30	2.30	1.65			1.48
TBVOOS SLO	2.31	2.31	1.66			1.49
One TBVOOS	2.30	2.30	1.59			1.46
One TBVOOS SLO	2.31	2.31	1.60			1.47
PROOS	2.32	2.32		1.64	1.52	1.46
PROOS SLO	2.33	2.33		1.65	1.53	1.47
PLUOOS	2.30	2.30	1.58			1.46
PLUOOS SLO	2.31	2.31	1.59			1.47
Combined EOOS	2.32	2.32		1.70	1.57	1.53
Combined EOOS SLO	2.33	2.33		1.71	1.58	1.54

Table 5-11 MCPR(P) for GE14 Fuel
FFTR/Coastdown Operation
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.23	2.23	1.53			1.42
Base Case SLO	2.24	2.24	1.54			1.43
TBVOOS	2.23	2.23	1.59			1.45
TBVOOS SLO	2.24	2.24	1.60			1.46
One TBVOOS	2.23	2.23	1.54			1.42
One TBVOOS SLO	2.24	2.24	1.55			1.43
PROOS	2.26	2.26		1.64	1.48	1.42
PROOS SLO	2.27	2.27		1.65	1.49	1.43
PLUOOS	2.23	2.23	1.53			1.42
PLUOOS SLO	2.24	2.24	1.54			1.43
Combined EOOS	2.26	2.26		1.72	1.51	1.48
Combined EOOS SLO	2.27	2.27		1.73	1.52	1.49

Table 5-12 MCPR(P) for GE14 Fuel
FFTR/Coastdown Operation
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$MCPR_P$					
Base Case	2.30	2.30	1.57			1.43
Base Case SLO	2.31	2.31	1.58			1.44
TBVOOS	2.30	2.30	1.61			1.46
TBVOOS SLO	2.31	2.31	1.62			1.47
One TBVOOS	2.30	2.30	1.57			1.43
One TBVOOS SLO	2.31	2.31	1.58			1.44
PROOS	2.30	2.30		1.65	1.50	1.43
PROOS SLO	2.31	2.31		1.66	1.51	1.44
PLUOOS	2.30	2.30	1.57			1.43
PLUOOS SLO	2.31	2.31	1.58			1.44
Combined EOOS	2.30	2.30		1.72	1.56	1.53
Combined EOOS SLO	2.31	2.31		1.73	1.57	1.54

Table 5-13 MCPR(F) Limits for AREVA and GE Fuel, DLO and SLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3)

Flow (% rated)	MCPR(F) Limit
108.0	1.11
100.0	1.19
30.0	1.55
0.0	1.55

Table 5-14 MCPR(F) Limits for AREVA and GE Fuel, DLO and SLO Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3)

Flow (% rated)	MCPR(F) Limit
108.0	1.11
100.0	1.30
30.0	1.75
0.0	1.75

6. Linear Heat Generation Rate

The linear heat generation rate (LHGR) limit is the product of the exposure dependent LHGR limit from Tables 6-1 through 6-5 and the minimum of: the power dependent LHGR Factor, LHGRFAC(P), or the core flow dependent LHGR Factor, LHGRFAC(F) as applicable. The LHGRFAC(P) is determined from Tables 6-6 through 6-13. The LHGRFAC(F) is determined from Table 6-14 through 6-19.

Table 6-1: LHGR Limit for GE14-P10CNAB406-18GZ-120T-150-T6-2823
(Reference 8)

Lattices 6806, 6812, 6813, 6814 and 6816 LHGR Limit kW/ft **6806: P10CNAL071-NOG-120T-T6-6806** **6812: P10CNAL435-18G7.0-120T-T6-6812** **6813: P10CNAL435-6G7.0/9G6.0-120T-T6-6813** **6814: P10CNAL429-6G7.0/9G6.0-120T-E-T6-6814** **6816: P10CNAL071-18GE-120T-V-T6-6816**	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	13.4
16.0	13.4
63.5	8.0
70.0	5.0

Table 6-2: LHGR Limit for GE14-P10CNAB407-16GZ-120T-150-T6-2822
(Reference 8)

Lattices 6806, 6807, 6808, 6809 and 6811 LHGR Limit kW/ft **6806: P10CNAL071-NOG-120T-T6-6806** **6807: P10CNAL437-6G8.0/10G7.0-120T-T6-6807** **6808: P10CNAL437-2G8.0/7G7.0/5G6.0-120T-T6-6808** **6809: P10CNAL430-2G8.0/7G7.0/5G6.0-120T-E-T6-6809** **6811: P10CNAL071-16GE-120T-V-T6-6811**	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	13.4
16.0	13.4
63.5	8.0
70.0	5.0

Table 6-3 LHGR Limit for: GE14-P10CNAB406-18GZ-120T-150-T6-2823, Lattice 6815
(Reference 8)

Lattice 6815 LHGR Limit kW/ft P10CNAL429-6G7.0/9G6.0-120T-V-T6-6815	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	13.40
16.0	13.40
17.3	13.25
18.5	13.11
19.8	12.97
21.8	12.74
25.5	12.32
31.5	11.63
37.6	10.95
43.5	10.27
49.4	9.61
55.1	8.89
60.8	8.24
66.5	6.63
70.0	5.00

Table 6-4 LHGR Limit for GE14-P10CNAB407-16GZ-120T-150-T6-2822, Lattice 6810
(Reference 8)

Lattice 6810 LHGR Limit kW/ft P10CNAL430-2G8.0/7G7.0/5G6.0-120T-V-T6-6810	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	13.40
14.8	13.40
16.1	13.39
17.4	13.24
18.6	13.10
19.9	12.96
21.7	12.75
25.4	12.33
31.4	11.64
37.4	10.96
43.4	10.29
49.2	9.62
55.0	8.91
60.7	8.26
66.4	6.68
70.0	5.00

Table 6-5 LHGR Limit for AREVA ATRIUM-10 Fuel
A10-4061B-13GV80
A10-3561B-12GV80
A10-3982B-15GV80-100M
A10-4025B-15GV80-100M
(Reference 3)

Pellet Exposure (GWd/MTU)	LHGR Limit (kW/ft)
0.00	13.40
17.70	13.40
61.10	9.10
70.40	7.30

Table 6-6 LHGRFAC(P) for ATRIUM10 Fuel
BOC to NEOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.72	0.72	1.00			1.00
Base Case SLO	0.72	0.72	1.00			1.00
FHOOS	0.67	0.67	0.93			1.00
FHOOS SLO	0.67	0.67	0.93			1.00
TBVOOS	0.72	0.72	0.95			1.00
TBVOOS SLO	0.72	0.72	0.95			1.00
One TBVOOS	0.72	0.72	0.97			1.00
One TBVOOS SLO	0.72	0.72	0.97			1.00
PROOS	0.65	0.65		0.90	1.00	1.00
PROOS SLO	0.65	0.65		0.90	1.00	1.00
PLUOOS	0.72	0.72	1.00			1.00
PLUOOS SLO	0.72	0.72	1.00			1.00
Combined EOOS	0.65	0.65		0.88	0.94	0.98
Combined EOOS SLO	0.65	0.65		0.88	0.94	0.98

Table 6-7 LHGRFAC(P) for ATRIUM10 Fuel
BOC to NEOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.71	0.71	1.00			1.00
Base Case SLO	0.71	0.71	1.00			1.00
FHOOS	0.66	0.66	0.93			1.00
FHOOS SLO	0.66	0.66	0.93			1.00
TBVOOS	0.69	0.69	0.93			1.00
TBVOOS SLO	0.69	0.69	0.93			1.00
One TBVOOS	0.71	0.71	0.97			1.00
One TBVOOS SLO	0.71	0.71	0.97			1.00
PROOS	0.64	0.64		0.89	1.00	1.00
PROOS SLO	0.64	0.64		0.89	1.00	1.00
PLUOOS	0.71	0.71	1.00			1.00
PLUOOS SLO	0.71	0.71	1.00			1.00
Combined EOOS	0.64	0.64		0.88	0.93	0.97
Combined EOOS SLO	0.64	0.64		0.88	0.93	0.97

Table 6-8 LHGRFAC(P) for ATRIUM10 Fuel
NEOC to EOC
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.72	0.72	1.00			1.00
Base Case SLO	0.72	0.72	1.00			1.00
FHOOS	0.67	0.67	0.93			1.00
FHOOS SLO	0.67	0.67	0.93			1.00
TBVOOS	0.72	0.72	0.94			1.00
TBVOOS SLO	0.72	0.72	0.94			1.00
One TBVOOS	0.72	0.72	0.97			1.00
One TBVOOS SLO	0.72	0.72	0.97			1.00
PROOS	0.65	0.65		0.90	1.00	1.00
PROOS SLO	0.65	0.65		0.90	1.00	1.00
PLUOOS	0.72	0.72	1.00			1.00
PLUOOS SLO	0.72	0.72	1.00			1.00
Combined EOOS	0.65	0.65		0.88	0.93	0.96
Combined EOOS SLO	0.65	0.65		0.88	0.93	0.96

Table 6-9 LHGRFAC(P) for ATRIUM10 Fuel
NEOC to EOC
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.71	0.71	1.00			1.00
Base Case SLO	0.71	0.71	1.00			1.00
FHOOS	0.66	0.66	0.93			1.00
FHOOS SLO	0.66	0.66	0.93			1.00
TBVOOS	0.69	0.69	0.93			1.00
TBVOOS SLO	0.69	0.69	0.93			1.00
One TBVOOS	0.71	0.71	0.97			1.00
One TBVOOS SLO	0.71	0.71	0.97			1.00
PROOS	0.64	0.64		0.89	1.00	1.00
PROOS SLO	0.64	0.64		0.89	1.00	1.00
PLUOOS	0.71	0.71	1.00			1.00
PLUOOS SLO	0.71	0.71	1.00			1.00
Combined EOOS	0.64	0.64		0.88	0.93	0.95
Combined EOOS SLO	0.64	0.64		0.88	0.93	0.95

Table 6-10 LHGRFAC(P) for ATRIUM10 Fuel
FFTR/Coastdown Operation
Nominal Scram Speed (NSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.67	0.67	0.93			1.00
Base Case SLO	0.67	0.67	0.93			1.00
TBVOOS	0.67	0.67	0.90			1.00
TBVOOS SLO	0.67	0.67	0.90			1.00
One TBVOOS	0.67	0.67	0.93			1.00
One TBVOOS SLO	0.67	0.67	0.93			1.00
PROOS	0.65	0.65		0.90	0.96	1.00
PROOS SLO	0.65	0.65		0.90	0.96	1.00
PLUOOS	0.67	0.67	0.93			1.00
PLUOOS SLO	0.67	0.67	0.93			1.00
Combined EOOS	0.65	0.65		0.88	0.93	0.96
Combined EOOS SLO	0.65	0.65		0.88	0.93	0.96

Table 6-11 LHGRFAC(P) for ATRIUM10 Fuel
FFTR/Coastdown Operation
Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	60	80	80(80.1)	100
	$LHGRFAC_P$ Multiplier					
Base Case	0.66	0.66	0.93			1.00
Base Case SLO	0.66	0.66	0.93			1.00
TBVOOS	0.66	0.66	0.89			1.00
TBVOOS SLO	0.66	0.66	0.89			1.00
One TBVOOS	0.66	0.66	0.92			1.00
One TBVOOS SLO	0.66	0.66	0.92			1.00
PROOS	0.64	0.64		0.89	0.96	1.00
PROOS SLO	0.64	0.64		0.89	0.96	1.00
PLUOOS	0.66	0.66	0.93			1.00
PLUOOS SLO	0.66	0.66	0.93			1.00
Combined EOOS	0.64	0.64		0.88	0.93	0.95
Combined EOOS SLO	0.64	0.64		0.88	0.93	0.95

Table 6-12 LHGRFAC(P) for GE14 Fuel
DLO, All Exposures
Nominal Scram Speed (NSS)/Technical Specification Scram Speed (TSSS)
(Reference 3)

EOOS Combination	Core Thermal Power (% of rated)				
	0	25	40	60	100
	$LHGRFAC_P$ Multiplier				
Base Case	0.54	0.54		0.79	1.00
FHOOS	0.48	0.48		0.79	1.00
TBVOOS	0.54	0.54		0.79	1.00
One TBVOOS	0.54	0.54		0.79	1.00
PROOS	0.40	0.40			1.00
PLUOOS	0.54	0.54		0.79	1.00
Combined EOOS	0.40	0.40	0.50		0.97

Table 6-13 LHGRFAC(P) for GE14 Fuel
SLO, All Exposures
Nominal Scram Speed (NSS)/Technical Specification Scram Speed (TSSS)
(Reference 3 and 7)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	40	CP *	60	100
	$LHGRFAC_P$ Multiplier					
Base Case SLO	0.54	0.54		0.78	0.78	0.78
FHOOS SLO	0.48	0.48		0.78	0.78	0.78
TBVOOS SLO	0.54	0.54		0.78	0.78	0.78
One TBVOOS SLO	0.54	0.54		0.78	0.78	0.78
PROOS SLO	0.40	0.40		0.78		0.78
PLUOOS SLO	0.54	0.54		0.78	0.78	0.78
Combined EOOS SLO	0.40	0.40	0.50	0.78		0.78

* CP is the cutoff power level and equal to 58.60% for Base Case SLO, TBVOOS SLO, One TBVOOS SLO and PLUOOS SLO; 58.87% FHOOS SLO; 72.50% for PROOS SLO; and 75.74% for Combined EOOS SLO conditions.

Table 6-14 LHGRFAC(F) Multipliers for ATRIUM10 Fuel, DLO and SLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
108.00	1.00
80.00	1.00
30.00	0.75
0.00	0.75

Table 6-15 LHGRFAC(F) Multipliers for GE14 Fuel, DLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
108.00	1.00
83.60	1.00
30.00	0.55
0.00	0.55

Table 6-16 LHGRFAC(F) Multipliers for GE14 Fuel, SLO Supports Base Case, FHOOS, TBVOOS, One TBVOOS, PROOS, PLUOOS and Combined EOOS
(Reference 3 and 7)

Flow (% rated)	LHGRFAC(F) Multiplier
108.00	0.78
83.60	0.78
57.40	0.78
30.00	0.55
0.00	0.55

Table 6-17 LHGRFAC(F) Multipliers for ATRIUM10 Fuel, DLO and SLO Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
108.00	1.00
80.00	1.00
30.00	0.75
0.00	0.75

Table 6-18 LHGRFAC(F) Multipliers for GE14 Fuel, DLO
Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3)

Flow (% rated)	LHGRFAC(F) Multiplier
108.00	1.00
100.20	1.00
30.00	0.41
0.00	0.41

Table 6-19 LHGRFAC(F) Multipliers for GE14 Fuel, SLO
Supports any scenario with One Stuck TCV/TSV and/or One MSIVOOS
(Reference 3 and 7)

Flow (% rated)	LHGRFAC(F) Multiplier
108.00	0.78
100.20	0.78
74.02	0.78
30.00	0.41
0.00	0.41

7. Rod Block Monitor

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below (Reference 5):

ROD BLOCK MONITOR UPSCALE TRIP FUNCTION	ALLOWABLE VALUE
Two Recirculation Loop Operation	0.66 W_d + 54.0%
Single Recirculation Loop Operation	0.66 W_d + 48.7%

The setpoint may be lower/higher and will still comply with the rod withdrawal error (RWE) analysis because RWE is analyzed unblocked. The allowable value is clamped with a maximum value not to exceed the allowable value for a recirculation loop drive flow (W_d) of 100%.

W_d – percent of recirculation loop drive flow required to produce a rated core flow of 108.5 Mlb/hr.

8. Traversing In-Core Probe System

8.1 Description:

When the traversing in-core probe (TIP) system (for the required measurement locations) is used for recalibration of the LPRM detectors and monitoring thermal limits, the TIP system shall be operable with the following:

1. movable detectors, drives and readout equipment to map the core in the required measurement locations, and
2. indexing equipment to allow all required detectors to be calibrated in a common location.

The following applies for use of the SUBTIP methodology:

The total number of failed and bypassed LPRMs does not exceed 50% (Reference 10). With one or more TIP measurement locations inoperable, the TIP data for an inoperable measurement location may be replaced by data obtained from a 3-dimensional BWR core monitoring software system adjusted using the previously calculated uncertainties, provided the following conditions are met:

(A) When there is not a prior complete TIP-calibrated data set available:

1. To comply with Technical Specification SR 3.3.1.1.8, LPRMs, within their calibration frequency, in locations without a TIP trace are not recalibrated,
2. LPRMs in locations without a TIP trace will not be used by POWERPLEX in any core power distribution calculations, and
3. The total number of out-of-service TIPs does not exceed 42% (18 channels).

(B) When there is a prior complete TIP-calibrated data set available:

1. All TIP traces have previously been obtained at least once in the current operating cycle when the reactor core was operating above 20% power, (Reference 6) and
2. The total number of simulated channels (measurement locations) does not exceed 42% (18 channels).

Otherwise, with the TIP system inoperable, suspend use of the system for the above applicable monitoring or calibration functions.

8.2 Bases:

The operability of the TIP system with the above specified minimum complement of equipment ensures that the measurements obtained from use of this equipment accurately represent the spatial neutron flux distribution of the reactor core. The normalization of the required detectors is performed internal to the core monitoring software system.

Substitute TIP data, if needed, is 3-dimensional BWR core monitoring software calculated data which is adjusted based on axial and radial factors calculated from previous TIP sets. Since the simulation and adjustment process could introduce uncertainty, a maximum of 18 channels may be simulated to ensure that the uncertainties assumed in the substitution process methodology remain valid.

9. Stability Protection Setpoints

The OPRM PBDA Trip Settings (Reference 3):

PBDA Trip Amplitude Setpoint (Sp)	Corresponding Maximum Confirmation Count Setpoint (Np)
1.11	14

The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

The OPRM PBDA trip settings are applicable when the OPRM system is declared operable, and the associated Technical Specifications are implemented.

10. Modes of Operation

The allowed modes of operation with combinations of equipment out-of-service are as described below:

Equipment Out of Service Options[1, 2]	ELLLA	MELLLA	ICF	FFTR/ Coastdown[4]
Base Case	Yes	Yes	Yes	Yes
Base Case SLO	Yes	No[6]	N/A	Yes
FHOOS[8]	Yes	Yes	Yes	N/A[5]
FHOOS SLO[8]	Yes	No[6]	N/A	N/A[5]
TBVOOS[7]	Yes	Yes	Yes	Yes
TBVOOS SLO[7]	Yes	No[6]	N/A	Yes
One TBVOOS[10]	Yes	Yes	Yes	Yes
One TBVOOS SLO[10]	Yes	No[6]	N/A	Yes
PROOS	Yes	Yes	Yes	Yes
PROOS SLO	Yes	No[6]	N/A	Yes
PLUOOS	Yes	Yes	Yes	Yes
PLUOOS SLO	Yes	No[6]	N/A	Yes
Combined EOOS[3, 9]	Yes	Yes	Yes	Yes
Combined EOOS SLO[3, 9]	Yes	No[6]	N/A	Yes

[1] Limits support operation with any combination of 1 SRVOOS, up to 2 TIP machines OOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs OOS with an LPRM calibration frequency of 1250 effective full power hours (EFPH) (1000 EFPH +25%). All limits support PLUOOS $\leq$ 60% RTP.

[2] With or without 1 stuck closed TCV or TSV (except for TBVOOS – TBVOOS do not support TCV or TSV stuck closed). Note: The MCPR and LHGR operating limits may be different based on whether 1 TCV or TSV is or is not stuck closed due to MCPR(f) and LHGRFAC(f) considerations. The pressurization MCPR(f) limits and LHGRFAC(f) multipliers should be applied to support operation when any of the following EOOS conditions exist: one stuck closed TCV, or one stuck closed TSV or one MSIVOOS. Note that operation with 1 MSIVOOS is supported as long as core thermal power is maintained $\leq$ 75% of 3489 MWt.

[3] Any combination of TCV slow closure, no RPT and/or FHOOS. For FFTR/Coastdown any combination of TCV Slow Closure and/or no RPT (as a reduced feedwater temperature is already assumed as part of the base assumptions for FFTR/Coastdown).

[4] FFTR/Coastdown Operation is defined as any cycle exposure beyond full power/flow, all rods out condition with plant power slowly lowering while core flow is held constant. TBVOOS and one TBVOOS limits for FFTR/Coastdown operation are only valid for Cycle 12 core average exposures greater than 31,988 MWD/MTU. The current analysis supports up to 100°F decrease in feedwater temperature.

[5] During FFTR/Coastdown portion of the cycle, feedwater heaters are taken out of service to achieve the FFTR.

[6] The SLO boundary was not moved up with the incorporation of MELLLA. The power-flow boundary for SLO at power uprated conditions remains the ELLLA boundary for pre-uprate conditions.

[7] The TBVOOS condition assumes that ALL the turbine bypass valves do not trip open on turbine control valve fast closure or on turbine stop valve closure. However, either TBV #1, #2, #3, or #4 must be capable of opening via the pressure control system in this EOOS (see Reference 11).

[8] The FHOOS option supports a feedwater temperature reduction of 100°F.

[9] Any combination of TCV slow closure, in combination with one (or more) TBVOOS. Any combination of TCV slow closure, in combination with one TBVOOS and 1 TCV or TSV stuck closed. At core thermal powers of less than or equal to 85% of rated, any combination of 1 TCV or TSV stuck closed, TCV slow closure, and 1TBVOOS (i.e. only 4 TBVs will open on turbine trip and 3 TBVs will open for pressure control, which must consist of any combination of TBV #1, #2, #3 and #4) (see Reference 12).

[10] The one TBVOOS condition assumes that one turbine bypass valve does not trip open on turbine control valve fast closure or on turbine stop valve closure. Operation of one turbine bypass valve via the pressure control system is not credited, i.e. this EOOS assumes the one bypass valve is not capable of opening.

11. Methodology

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. XN-NF-81-58 (P)(A), Revision 2 and Supplements 1 and 2, "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," March 1984.

2. ANF-524 (P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," November 1990. [XN-NF-524 (P)(A)]

3. ANF-913 (P)(A) Volume 1 Revision 1, and Volume 1 Supplements 2, 3, 4, "COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses," August 1990.

4. XN-NF-84-105 (P)(A), Volume 1 and Volume 1 Supplements 1 and 2; Volume 1 Supplement 4, "XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis," February 1987 and June 1988, respectively.

5. EMF-2209 (P)(A), Revision 2, "SPCB Critical Power Correlation," September 2003.

6. ANF-89-98 (P)(A), Revision 1 and Revision 1 Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," May 1995.

7. EMF-85-74 (P)(A) Revision 0 and Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," February 1998.

8. EMF-CC-074 (P) Volume 4 Revision 0, "BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2," August 2000.

9. ANF-CC-33(P)(A) Supplement 1 Revision 1 and Supplement 2, "HUXY: A Generalized Multirod Heatup Code with 10CFR50, Appendix K Heatup Option," August 1986 and January 1991, respectively.

10. 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," June 1986.

11. XN-NF-80-19 (P)(A) Volume 3 Revision 2, "Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description," January 1987.

12. 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," March 1983.

13. NEDE-24011-P-A-14, June 2000 and the U.S. Supplement NEDE-24011-P-A-14-US, June 2000, "General Electric Standard Application for Reactor Fuel".

14. 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.

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