Enclosure 2
Core Operating Limits Report for Peach Bottom Atomic Power Station (PBAPS) Unit 3 Reload 17, Cycle 18, Revision 5
Non-Proprietary Version

CORE OPERATING LIMITS REPORT FOR

PEACH BOTTOM ATOMIC POWER STATION UNIT 3

RELOAD 17, CYCLE 18

(This revision is a complete re-write)

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1.0 TERMS AND DEFINITIONS

AFTO	Asymmetric Feedwater Temperature Operation
ARTS	APRM and RBM Technical Specification Analysis
BASE	Defines two (2) loop operation with at least seven turbine bypass valves in service and the reactor recirculation pump trip system in service.
BOC	Beginning Of Cycle
EOOS	Equipment Out of Service. An analyzed option that assumes certain equipment to be non-operational
EOR	End of Rated. The cycle exposure at which reactor power is equal to 100% (3514 MWth) with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.
FFWTR	Final Feedwater Temperature Reduction
FWHOOS	Feedwater Heaters Out of Service
HTSP	Rod Block Monitor High Trip Setpoint
ICF	Increased Core Flow
ITSP	Rod Block Monitor Intermediate Trip Setpoint
LHGR	Linear Heat Generation Rate
LHGRFAC(F)	ARTS LHGR thermal limit flow dependent adjustments and multipliers
LHGRFAC(P)	ARTS LHGR thermal limit power dependent adjustments and multipliers
LTSP	Rod Block Monitor Low Trip Setpoint
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MCPR(P)	ARTS MCPR thermal limit power dependent adjustments and multipliers
MCPR(F)	ARTS MCPR thermal limit flow dependent adjustments and multipliers
MELLLA	Maximum Extended Load Line Limit Analysis
OLMCPR	Operating Limit Minimum Critical Power Ratio
OPRM PBDA	Oscillation Power Range Monitor Period Based Detection Algorithm
RCF	Rated Core Flow
RPTOOS	Recirculation Pump Trip Out of Service
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
TBVOOS	Turbine Bypass Valves Out of Service

2.0 GENERAL INFORMATION

This report provides the following cycle-specific parameter limits for Peach Bottom Atomic Power Station Unit 3 Cycle 18 (Reload 17):

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

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

This report provides cycle-specific Operating Limit MCPR, LHGR, MAPLHGR thermal limits, and related information for the following conditions:

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

ARTS provides for power-and flow-dependent thermal limit adjustments and multipliers that allow for a more reliable administration of the MCPR and LHGR thermal limits. The OLMCPR for each fuel type is determined by the cycle-specific reload analyses in Reference 2. Rated LHGR values are obtained from the bundle-specific thermal-mechanical analysis. Supporting documentation for the ARTS-based limits is provided in References 2, 6, 7, 9, 15 and 17. The Allowable Values, documented in Reference 6, for feedwater temperature as a function of thermal power for both FWHOOS and FFWTR are specified in the appropriate Peach Bottom procedures.

Also note that the following description of MAPLHGR, LHGR and MCPR limits pertain to NON – AFTO conditions. A separate description of AFTO limits and their associated ARTS tables is located in Section 10. Preparation of this report was performed in accordance with Exelon Nuclear procedures. This report is submitted in accordance with Technical Specification 5.6.5 of Reference 1 and contains all thermal limit parameters related to the implementation of the ARTS Improvement Program and Maximum Extended Load Line Limit Analyses (ARTS/MELLLA) for Peach Bottom Unit 3 Cycle 18.

3.0 MAPLHGR LIMITS

3.1 Technical Specification

Section 3.2.1, 3.3.4.2, 3.4.1 and 3.7.6

3.2 Description

The MAPLHGR limits (kW/ft) obtained from the emergency core cooling system (ECCS) analysis are provided in Tables 3-1 and 3-2. The MAPLHGR limits comprise a given fuel type as a function of average planar exposure. The MAPLHGR tables are used when hand calculations are required. All MAPLHGR values for each fuel type as a function of axial location and average planar exposure shall be less than or equal to the applicable MAPLHGR limits for the respective fuel and lattice types. These MAPLHGR limits are specified in Reference 2 and the process computer databank. The SLO MAPLHGR reduction factor is applied as shown in Table 3-3 per Reference 2. This value is based on the limiting GE14 product line. The impact of AFTO on MAPLHGR is addressed in Section 10. MAPFAC(P) and MAPFAC(F) are 1.0 for all conditions.

TABLE 3-1
MAPLHGR Versus Average Planar Exposure - GE14
(Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit (kW/ft)
0.0	12.82
19.13	12.82
57.61	8.00
63.50	5.00

TABLE 3-2
MAPLHGR Versus Average Planar Exposure -GNF2
(Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit (kW/ft)
0.0	13.71
18.00	13.71
60.78	7.50
63.50	6.69

TABLE 3-3
MAPLHGR Single Loop Operation (SLO) Reduction Factor
(Reference 2)

SLO Reduction Factor	0.73

4.0 MCPR LIMITS

4.1 Technical Specification

Section 2.1.1.2, 3.2.2, 3.3.4.2, 3.4.1 and 3.7.6

4.2 Description

The Operating Limit MCPR (OLMCPR) for GE14 is provided in Table 4-1. The Operating Limit MCPR (OLMCPR) for GNF2 is provided in Table 4-2. These values are determined by the cycle-specific fuel reload analyses in Reference 2. Control rod scram time verification is required per Technical Specification 3.1.4, "Control Rod Scram Times". Tau, a measure of scram time performance to notch position 36 throughout the cycle, is determined based on the cumulative scram time test results. The calculation of Tau shall be performed in accordance with site procedures. Linear interpolation shall be used to calculate the OLMCPR value if Tau is between 0.0 (Tau Option B) and 1.0 (Tau Option A).

Separate OLMCPR values are presented in Table 4-1 and Table 4-2 for the following domains:

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

The ARTS-based power-dependent MCPR limits are provided in Table 4-3. Table 4-3 is valid for a maximum temperature reduction of 90 °F for FWTR operation. The flow-dependent MCPR limits are provided in Table 4-4. The impact of AFTO on MCPR is addressed in Section 10.

TABLE 4-1
Operating Limit Minimum Critical Power Ratio - GE14
(Reference 2)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR - 2600 MWd/ST	≥ EOR – 2600 MWd/ST
BASE	B	1.33	1.38
	A	1.36	1.41
BASE SLO[2]	B	1.35	1.40
	A	1.38	1.43
TBVOOS	B	1.38	1.44
	A	1.41	1.47
TBVOOS SLO[2]	B	1.40	1.46
	A	1.43	1.49
RPTOOS	B	1.38	1.46
	A	1.49	1.63
RPTOOS SLO[2]	B	1.40	1.48
	A	1.51	1.65

TABLE 4-2
Operating Limit Minimum Critical Power Ratio - GNF2
(Reference 2)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR - 2600 MWd/ST	≥ EOR – 2600 MWd/ST
BASE	B	1.38	1.45
	A	1.43	1.50
BASE SLO[2]	B	1.40	1.47
	A	1.45	1.52
TBVOOS	B	1.42	1.51
	A	1.47	1.56
TBVOOS SLO[2]	B	1.44	1.53
	A	1.49	1.58
RPTOOS	B	1.40	1.50
	A	1.50	1.60
RPTOOS SLO[2]	B	1.42	1.52
	A	1.52	1.62

[1] When Tau does not equal 0 or 1, use linear interpolation.
[2] For single-loop operation, the MCPR operating limit is 0.02 greater than the two loop limit per Reference 2.

TABLE 4-3
Power Dependent MCPR(P) Limit Adjustments And Multipliers
(Symmetric Feedwater Heating)
(References 2 and 17)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)							
		0	25	<30	≥30	40	55	65	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp				
Base	≤ 60	2.45	2.45	2.36	1.340	1.286	1.256	1.131	1.000
	> 60	2.70	2.70	2.50					
Base SLO	≤ 60	2.47	2.47	2.38	1.340	1.286	1.256	1.131	1.000
	> 60	2.72	2.72	2.52					
RPTOOS	≤ 60	3.19	3.19	2.70	1.570	1.440	1.335	1.131	1.000
	> 60	3.68	3.68	3.19					
RPTOOS SLO	≤ 60	3.21	3.21	2.72	1.570	1.440	1.335	1.131	1.000
	> 60	3.70	3.70	3.21					
TBVOOS	≤ 60	3.19	3.19	2.70	1.570	1.440	1.335	1.131	1.000
	> 60	3.68	3.68	3.19					
TBVOOS SLO	≤ 60	3.21	3.21	2.72	1.570	1.440	1.335	1.131	1.000
	> 60	3.70	3.70	3.21					

TABLE 4-4
Flow Dependent MCPR Limits MCPR(F)
(Symmetric Feedwater Heating)
(References 2, 7, and 15)

Core Flow (% rated)	MCPR(F) Limit
0.0	1.7073
79.06	1.250
110.0	1.250

5.0 LHGR LIMITS

5.1 Technical Specification

Section 3.2.3, 3.3.4.2, 3.4.1 and 3.7.6

5.2 Description

The UO2 rod LHGR limits for GE14 are provided in Table 5-1. The UO2 rod LHGR limits for GNF2 are provided in Table 5-2. The Gadolinia rod LHGR limits for GE14 are provided in Table 5-3. The Gadolinia rod LHGR limits for GNF2 are provided in Table 5-4. The LHGR values as a function of peak pellet exposure are provided in Reference 13. The ARTS-based LHGR power-dependent multipliers are provided in Table 5-5. Table 5-5 is valid for a maximum temperature reduction of 90° F for FWTR operation. The flow-dependent multipliers are provided in Table 5-6 as a function of the number of recirculation loops in operation. The SLO LHGR multiplier of 0.73 is accounted for in Table 5-6. The power-and flow-dependent LHGR multipliers were obtained from References 2, 6, 7, and 17. The impact of AFTO on LHGR is addressed in Section 10.

TABLE 5-1
Linear Heat Generation Rate Limits – GE14 UO2 rods
(Reference 13)

	Peak Pellet Exposure (GWD/ST)	LHGR Limit (kW/ft)
GE14	0.00	13.40
	14.51	13.40
	57.61	8.00
	63.50	5.00

TABLE 5-2
Linear Heat Generation Rate Limits – GNF2 UO2 rods
(Reference 13)

	Peak Pellet Exposure (GWD/ST)	LHGR Limit (kW/ft)
GNF2	[[	
		]]

[[GNF Proprietary Information removed between double brackets]]

TABLE 5-3
Linear Heat Generation Rate Limits – GE14 Gadolinia rods
(Reference 13)

	Peak Pellet Exposure (GWD/ST)	LHGR Limit (kW/ft)
GE14	0.00	11.76
	12.08	11.76
	54.21	7.02
	59.98	4.39

TABLE 5-4
Linear Heat Generation Rate Limits – GNF2 Gadolinia rods
(Reference 13)

	Peak Pellet Exposure (GWD/ST)	LHGR Limit (kW/ft)
GNF2	[[	
		]]

[[GNF Proprietary Information removed between double brackets]]

TABLE 5-5
Power Dependent LHGR Multiplier LHGRFAC(P)
(Symmetric Feedwater Heating)
(References 2, 6, and 17)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)									
		0	25	<30	≥30	40	55	65	85	95	100
		LHGRFAC(P) Multiplier									
Base	≤ 60	0.584	0.584	0.600	0.750	0.798	0.798	0.900	1.000	1.000	1.000
	> 60	0.532	0.532	0.568							
Base SLO	≤ 60	0.584	0.584	0.600	0.750	0.798	0.798	0.900	1.000	1.000	1.000
	> 60	0.532	0.532	0.568							
RPTOOS	≤ 60	0.507	0.507	0.572	0.698	0.706	0.744	0.806	0.930	1.000	1.000
	> 60	0.421	0.421	0.460							
RPTOOS SLO	≤ 60	0.507	0.507	0.572	0.698	0.706	0.744	0.806	0.930	1.000	1.000
	> 60	0.421	0.421	0.460							
TBVOOS	≤ 60	0.507	0.507	0.572	0.698	0.706	0.744	0.806	0.930	1.000	1.000
	> 60	0.421	0.421	0.460							
TBVOOS SLO	≤ 60	0.507	0.507	0.572	0.698	0.706	0.744	0.806	0.930	1.000	1.000
	> 60	0.421	0.421	0.460							

TABLE 5-6
Flow Dependent LHGR Multiplier LHGRFAC(F)
(Symmetric Feedwater Heating)
(References 2, 6, and 7)

EOOS Combination	Core Flow (% of rated)					
	0	25	33.6	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.506	0.673	0.730	0.973	1.000	1.000
Single Loop	0.506	0.673	0.730	0.730	0.730	0.730

6.0 ROD BLOCK MONITOR SETPOINTS

6.1 Technical Specification

Section 3.3.2.1

6.2 Description

The RBM power-biased Analytical Limits, Allowable Values and MCPR Limits are provided in Table 6-1 based on Reference 4 with supporting documentation from References 2 and 10.

TABLE 6-1
Rod Block Monitor Setpoints
(References 2, 4 and 10)

Power Level	Analytical Limit[1]	Allowable Value[1]	MCPR Limit
LTSP	123.0%	121.2%	< 1.70 [2] < 1.40 [3]
ITSP	118.0%	116.2%	< 1.70 [2] < 1.40 [3]
HTSP	113.2%	111.4%	< 1.70 [2] < 1.40 [3]
INOP	N/A	N/A	< 1.70 [2] < 1.40 [3]

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(1) These setpoints (with RBM filter time constant between 0.1 seconds and 0.55 seconds) are based on a cycle-specific rated RWE MCPR limit which is less than or equal to the minimum cycle OLMCPR (see References 2, 4 and 10).

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

(3) This is the MCPR limit (given THERMAL POWER is $\geq$ 90%) below which the RBM is required to be OPERABLE (see References 2 and 4 and TS Table 3.3.2.1-1).

7.0 TURBINE BYPASS VALVE PARAMETERS

7.1 Technical Specification

Section 3.7.6

7.2 Description

The operability requirements for the steam bypass system are governed by Technical Specification 3.7.6. If the requirements cannot be met, the appropriate power and flow dependent limits for Turbine Bypass Valves Out-of-Service (TBVOOS) must be used. Additionally the OLMCPR for TBVOOS must be applied. The minimum number of bypass valves to maintain system operability is provided in Table 7-2 per References 2 and 18. Table 7-1 also includes other Turbine Bypass Valve response time parameters.

TABLE 7-1
Turbine Bypass System Response Time
(Reference 18)

Maximum delay time before start of bypass valve opening following generation of the turbine bypass valve flow signal	0.10 sec
Maximum time after generation of a turbine bypass valve flow signal for bypass valve position to reach 80% of full flow (includes the above delay time)	0.30 sec

TABLE 7-2
Minimum Required Bypass Valves To Maintain System Operability
(References 2 and 18)

Reactor Power	No. of Valves in Service
$P \geq 25\%$	7

8.0 EOC RECIRCULATION PUMP TRIP (EOC-RPT) OPERABILITY

8.1 Technical Specification

Section 3.3.4.2

8.2 Description

The operability requirements for the EOC Recirculation Pump Trip are governed by Technical Specification 3.3.4.2. If the requirements cannot be met, the appropriate power and flow dependent limits for EOC Recirculation Pump Trip (RPTOOS) must be used. Additionally the OLMCPR for RPTOOS must be applied.

A total RPT response time of 0.175 seconds is assumed in the safety analysis for both trips and is defined as the time from the turbine valves (TCV or TSV) start to close until complete arc suppression of the EOC-RPT circuit breakers. Reference 8 provides the basis for the RPT response time.

9.0 STABILITY PROTECTION OSCILLATION POWER RANGE MONITOR (OPRM)

9.1 Technical Specification

Section 3.3.1, Table 3.3.1.1-1 Function 2.f

9.2 Description

The Cycle 18 OPRM Period Based Detection Algorithm (PBDA) Trip Settings are provided in Table 9-1 and 9-2. These values are based on the cycle specific analysis documented in Reference 2. The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system Reference 16. The OPRM Growth Rate Algorithm (GRA) and Amplitude Based Algorithm (ABA) trip settings for dual loop and single loop can be found in the Power Range Neutron Monitoring Configuration Control Documents (SPIDs) G-080-VC-174 through 177 (Unit-3).

TABLE 9-1
OPRM PBDA Trip Settings
(Valid for All Conditions)
(Reference 2)

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
1.12	14

TABLE 9-2
OPRM PBDA Trip Settings – SLO[1]
(Valid For SLO Conditions Only)
(Reference 2)

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
1.16	17

[1] The standard two loop operation OPRM Trip Settings specified in Table 9-1 must be implemented prior to restarting the idle pump when exiting the SLO condition.

10.0 ASYMMETRIC FEEDWATER TEMPERATURE OPERATION (AFTO)

Asymmetric feedwater heating (resulting from removing a heater string, or individual feedwater heaters, from operation) is the result of the specific configuration of the feedwater lines at Peach Bottom. A reduction in heating in either the 'A' or the 'C' heater strings will result in a temperature mismatch between the feedwater flows entering the opposite sides of the reactor vessel. Asymmetric feedwater temperature operation (AFTO) is defined as operation in a feedwater heater/string configuration that results in a specified threshold difference as described in Reference 11. The threshold values are incorporated in the station procedures that govern AFTO.

LHGR LIMITS

The ARTS-based LHGR power-dependent multipliers for AFTO operation are provided in Tables 10-2, 10-3, and 10-4. The flow-dependent multipliers for AFTO are provided in Tables 10-5, 10-6, and 10-7 as a function of the number of recirculation loops in operation only. The power-and flow-dependent LHGR multipliers were obtained from References 2, 6, 7, 11 and 17 and were adjusted with the appropriate penalties displayed in Table 10-1 per Reference 11. The SLO multiplier and the AFTO multiplier must be simultaneously applied. The maximum feedwater temperature difference allowed without a thermal limit penalty is 20 °F. Once the temperature difference exceeds 20 °F the graduated penalties from Table 10-1 are applied to the thermal limits.

TABLE 10-1
AFTO Thermal Limit Penalties
(Asymmetric Feedwater Heating)
(Reference 11)

	MFLCPR	MFLPD/MAPRAT
40F < FWT DELTA ≤ 55F	2%	4%
30F < FWT DELTA ≤ 40F	2%	3%
20F < FWT DELTA ≤ 30F	No Penalty / Max Allowable	2%
0F < FWT DELTA ≤ 20F	No Penalty	No Penalty / Max Allowable

TABLE 10-2
AFTO Power Dependent LHGR Multiplier LHGRFAC(P) 20F < FWT DELTA ≤ 30F
(Asymmetric Feedwater Heating)
(References 2, 6, 11 and 17)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)									
		0	25	<30	≥30	40	55	65	85	95	100
		LHGRFAC(P) Multiplier									
Base	≤ 60	0.572	0.572	0.588	0.735	0.782	0.782	0.882	0.980	0.980	0.980
	> 60	0.521	0.521	0.557							
Base SLO	≤ 60	0.572	0.572	0.588	0.735	0.782	0.782	0.882	0.980	0.980	0.980
	> 60	0.521	0.521	0.557							
RPTOOS	≤ 60	0.497	0.497	0.561	0.684	0.692	0.729	0.790	0.911	0.980	0.980
	> 60	0.413	0.413	0.451							
RPTOOS SLO	≤ 60	0.497	0.497	0.561	0.684	0.692	0.729	0.790	0.911	0.980	0.980
	> 60	0.413	0.413	0.451							
TBVOOS	≤ 60	0.497	0.497	0.561	0.684	0.692	0.729	0.790	0.911	0.980	0.980
	> 60	0.413	0.413	0.451							
TBVOOS SLO	≤ 60	0.497	0.497	0.561	0.684	0.692	0.729	0.790	0.911	0.980	0.980
	> 60	0.413	0.413	0.451							

TABLE 10-3
AFTO Power Dependent LHGR Multiplier LHGRFAC(P) 30F < FWT DELTA ≤ 40F
(Asymmetric Feedwater Heating)
(References 2, 6, 11 and 17)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)									
		0	25	<30	≥30	40	55	65	85	95	100
		LHGRFAC(P) Multiplier									
Base	≤ 60	0.566	0.566	0.582	0.728	0.774	0.774	0.873	0.970	0.970	0.970
	> 60	0.516	0.516	0.551							
Base SLO	≤ 60	0.566	0.566	0.582	0.728	0.774	0.774	0.873	0.970	0.970	0.970
	> 60	0.516	0.516	0.551							
RPTOOS	≤ 60	0.492	0.492	0.555	0.677	0.685	0.722	0.782	0.902	0.970	0.970
	> 60	0.408	0.408	0.446							
RPTOOS SLO	≤ 60	0.492	0.492	0.555	0.677	0.685	0.722	0.782	0.902	0.970	0.970
	> 60	0.408	0.408	0.446							
TBVOOS	≤ 60	0.492	0.492	0.555	0.677	0.685	0.722	0.782	0.902	0.970	0.970
	> 60	0.408	0.408	0.446							
TBVOOS SLO	≤ 60	0.492	0.492	0.555	0.677	0.685	0.722	0.782	0.902	0.970	0.970
	> 60	0.408	0.408	0.446							

TABLE 10-4
AFTO Power Dependent LHGR Multiplier LHGRFAC(P) 40F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2, 6, 11 and 17)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)									
		0	25	<30	≥30	40	55	65	85	95	100
		LHGRFAC(P) Multiplier									
Base	≤ 60	0.561	0.561	0.576	0.720	0.766	0.766	0.864	0.960	0.960	0.960
	> 60	0.511	0.511	0.545							
Base SLO	≤ 60	0.561	0.561	0.576	0.720	0.766	0.766	0.864	0.960	0.960	0.960
	> 60	0.511	0.511	0.545							
RPTOOS	≤ 60	0.487	0.487	0.549	0.670	0.678	0.714	0.774	0.893	0.960	0.960
	> 60	0.404	0.404	0.442							
RPTOOS SLO	≤ 60	0.487	0.487	0.549	0.670	0.678	0.714	0.774	0.893	0.960	0.960
	> 60	0.404	0.404	0.442							
TBVOOS	≤ 60	0.487	0.487	0.549	0.670	0.678	0.714	0.774	0.893	0.960	0.960
	> 60	0.404	0.404	0.442							
TBVOOS SLO	≤ 60	0.487	0.487	0.549	0.670	0.678	0.714	0.774	0.893	0.960	0.960
	> 60	0.404	0.404	0.442							

TABLE 10-5
AFTO Flow Dependent LHGR Multiplier LHGRFAC(F) 20F < FWT DELTA ≤ 30F
(Asymmetric Feedwater Heating)
(References 2, 6, 7 and 11)

EOOS Combination	Core Flow (% of rated)					
	0	25	33.6	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.496	0.660	0.715	0.954	0.980	0.980
Single Loop	0.496	0.660	0.715	0.715	0.715	0.715

TABLE 10-6
AFTO Flow Dependent LHGR Multiplier LHGRFAC(F) 30F < FWT DELTA ≤ 40F
(Asymmetric Feedwater Heating)
(References 2, 6, 7 and 11)

EOOS Combination	Core Flow (% of rated)					
	0	25	33.6	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.491	0.653	0.708	0.944	0.970	0.970
Single Loop	0.491	0.653	0.708	0.708	0.708	0.708

TABLE 10-7
AFTO Flow Dependent LHGR Multiplier LHGRFAC(F) 40F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2, 6, 7 and 11)

EOOS Combination	Core Flow (% of rated)					
	0	25	33.6	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.486	0.646	0.701	0.934	0.960	0.960
Single Loop	0.486	0.646	0.701	0.701	0.701	0.701

MCPR LIMITS

The OLMCPRs for GE14 and GNF2 during asymmetric feedwater temperature operation with a feedwater temperature difference greater then 30 °F are provided in Tables 10-8 and Table 10-9. The ARTS-based power-dependent MCPR limits for use during AFTO conditions are provided in Table 10-10. The flow-dependent MCPR limits for AFTO are provided in Table 10-11. The power and flow-dependent OLMCPR curves were obtained from References 2, 4, 7, 9, 15 and 17 and were adjusted with a 2% penalty for feedwater temperature difference greater than 30 °F as displayed in Table 10-1 per References 11 and 14. No MCPR penalties are required for asymmetric temperature differentials less than or equal to 30 °F.

TABLE 10-8
AFTO Operating Limit Minimum Critical Power Ratio-GE14 30F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2, 4, 7, 9 and 11)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR - 2600 MWd/ST	≥ EOR – 2600 MWd/ST
BASE	B	1.36	1.41
	A	1.39	1.44
BASE SLO[2]	B	1.38	1.43
	A	1.41	1.46
TBVOOS	B	1.41	1.47
	A	1.44	1.50
TBVOOS SLO[2]	B	1.43	1.49
	A	1.46	1.52
RPTOOS	B	1.41	1.49
	A	1.52	1.66
RPTOOS SLO[2]	B	1.43	1.51
	A	1.54	1.68

TABLE 10-9
AFTO Operating Limit Minimum Critical Power Ratio-GNF2 30F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2, 4, 7, 9 and 11)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR - 2600 MWd/ST	≥ EOR – 2600 MWd/ST
BASE	B	1.41	1.48
	A	1.46	1.53
BASE SLO[2]	B	1.43	1.50
	A	1.48	1.55
TBVOOS	B	1.45	1.54
	A	1.50	1.59
TBVOOS SLO[2]	B	1.47	1.56
	A	1.52	1.61
RPTOOS	B	1.43	1.53
	A	1.53	1.63
RPTOOS SLO[2]	B	1.45	1.55
	A	1.55	1.65

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

(2) For single-loop operation, the MCPR operating limit is 0.02 greater than the two loop limit per Reference 2.

TABLE 10-10
AFTO Power Dependent MCPR Limit Adjustments And Multipliers
MCPR(P) 30F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2, 7, 9, 11, 14 and 17)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)							
		0	25	<30	≥30	40	55	65	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp				
Base	≤ 60	2.50	2.50	2.41	1.340	1.286	1.256	1.131	1.000
	> 60	2.75	2.75	2.55					
Base SLO	≤ 60	2.52	2.52	2.43	1.340	1.286	1.256	1.131	1.000
	> 60	2.77	2.77	2.57					
RPTOOS	≤ 60	3.25	3.25	2.75	1.570	1.440	1.335	1.131	1.000
	> 60	3.75	3.75	3.25					
RPTOOS SLO	≤ 60	3.27	3.27	2.77	1.570	1.440	1.335	1.131	1.000
	> 60	3.77	3.77	3.27					
TBVOOS	≤ 60	3.25	3.25	2.75	1.570	1.440	1.335	1.131	1.000
	> 60	3.75	3.75	3.25					
TBVOOS SLO	≤ 60	3.27	3.27	2.77	1.570	1.440	1.335	1.131	1.000
	> 60	3.77	3.77	3.27					

TABLE 10-11
AFTO Flow Dependent MCPR Limits MCPR(F) 30F < FWT DELTA ≤ 55F
(BOC to EOC)
(Asymmetric Feedwater Heating)
(References 2, 7, 9, 11, 14 and 15)

Flow (% rated)	MCPR(F) Limit
0	1.741
79.06	1.275
110	1.275

MAPLHGR LIMITS

An appropriate penalty must be applied to MAPLHGR limits under asymmetric feedwater temperature operation (AFTO) for varying temperature differentials as displayed in Table 10-1 per Reference 11. For single-loop operation, the AFTO multiplier is also applied to the MAPLHGR limits. The SLO multiplier in Table 3-3 and the AFTO multiplier in Table 10-12 must be simultaneously applied. Therefore, the SLO MAPLHGR multiplier is clamped at the value shown in Table 10-13 to ensure peak clad temperatures are maintained within the limits of the cycle-specific LOCA analysis for single recirculation loop and asymmetric feedwater temperature operation.

TABLE 10-12
AFTO MAPLHGR Reduction Factor
(Asymmetric Feedwater Heating)
Valid For All Conditions Except Single Loop
(References 2 and 11)

AFTO Reduction Factor	
20F < FWT DELTA ≤ 30F	0.980
30F < FWT DELTA ≤ 40F	0.970
40F < FWT DELTA ≤ 55F	0.960

TABLE 10-13
AFTO MAPLHGR Single Loop Operation (SLO) Reduction Factor
(Asymmetric Feedwater Heating)
(References 2 and 11)

SLO AFTO Reduction Factor	
20F < FWT DELTA ≤ 30F	0.715
30F < FWT DELTA ≤ 40F	0.708
40F < FWT DELTA ≤ 55F	0.701

11.0 MODES OF OPERATION

TABLE 11-1
Modes of Operation
(References 2, 7 and 12)

EOOS Options	Operating Region[1]
Base, Option A or B	Yes
Base SLO, Option A or B	Yes
TBVOOS, Option A or B	Yes
TBVOOS SLO, Option A or B	Yes
RPTOOS, Option A or B	Yes
RPTOOS SLO, Option A or B	Yes
TBVOOS and RPTOOS, Option A or B	No
TBVOOS and RPTOOS SLO, Option A or B	No

12.0 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. "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-16, October 2007; and the U.S. Supplement, NEDE-24011-P-A-16-US, October 2007.

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

3. PECo-FMS-0001-A, "Steady-State Thermal Hydraulic Analysis of Peach Bottom Units 2 and 3 using the FIBWR Computer Code"

4. PECo-FMS-0002-A, "Method for Calculating Transient Critical Power Ratios for Boiling Water Reactors (RETRAN-TCPPECo)"

5. PECo-FMS-0003-A, "Steady-State Fuel Performance Methods Report"

6. PECo-FMS-0004-A, "Methods for Performing BWR Systems Transient Analysis"

7. PECo-FMS-0005-A, "Methods for Performing BWR Steady-State Reactor Physics Analysis"

8. PECo-FMS-0006-A, "Methods for Performing BWR Reload Safety Evaluations"

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

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[1] Operating Region refers to operation on the Power to Flow map with or without FFWTR.

13.0 REFERENCES

1. "Technical Specifications for Peach Bottom Atomic Power Station Unit 3", Docket No. 50-278, Appendix A to License No. DPR-56.

2. "Supplemental Reload Licensing Report for Peach Bottom Unit 3 Reload 17 Cycle 18", GNF Document No. 0000-0094-9487-SRLR, Revision 0, August 2009.

3. "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-16, October 2007; and the U.S. Supplement NEDE-24011-P-A-16-US, October 2007.

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

5. DELETED

6. "Peach Bottom Atomic Power Station Evaluation for Extended Final Feedwater Temperature Reduction of 90° F", NEDC-32707P, Supplement 1, May 1998.

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

8. PECO Calculation PE-0173, Revision 1, "Determination of Total Time Required to Initiate the Trip Signal to the EOC-RPT Circuit Breaker".

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

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

11. "Peach Bottom Asymmetric Feedwater Temperature Operation Fuel Thermal Limits Evaluation Update", GE-NE-0000-0057-0522-R0, January 2007.

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

13. "Fuel Bundle Information Report for Peach Bottom Unit 3 Reload 17 Cycle 18", GNF Document No. 0000-0094-9487-FBIR, Revision 0, August 2009.

14. CR 00171805, AFTO ARTS thermal limit penalties not applied above 100% CTP.

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

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

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

18. "Final Resolved OPL-3 Parameters for Peach Bottom Unit 3 Cycle 18", TODI ES0900013, August 11, 2009.