Exelon Generation

TS 5.6.5.d

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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington DC 20555-0001

Peach Bottom Atomic Power Station, Unit 3
Renewed Facility Operating License No. DPR- 56
NRC Docket No. 50-278

Subject: Issuance of the Core Operating Limits Report for Reload 20, Cycle 21, Revision 8

Enclosed is a copy of Revision 8 of the Core Operating Limits Report (COLR) for Peach Bottom Atomic Power Station (PBAPS) Unit 3 for Reload 20, Cycle 21. Revision 8 of this report incorporates the revised cycle specific parameters resulting from the new core configuration as a result of the PBAPS Unit 3 refueling outage.

This COLR is being submitted to the NRC as required by the PBAPS, Unit 3 Technical Specifications (TS) Section 5.6.5.d.

If you have any questions concerning this letter, please contact Dave Foss at (717) 456-4311.

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Attachment

Unit 3 Core Operating Limits Report for Reload 20, Cycle 21, Revision 8

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ATTACHMENT

Core Operating Limits Report for Reload 20, Cycle 21, Revision 8

CORE OPERATING LIMITS REPORT FOR

PEACH BOTTOM ATOMIC POWER STATION UNIT 3

RELOAD 20, CYCLE 21

(This is a Complete Re-write)

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1.0 Terms and Definitions

AFTO	Asymmetric Feedwater Temperature Operation
AFTO LFWH	Asymmetric Feedwater Temperature Operation Loss-of-Feedwater Heating
ARTS	APRM and RBM Technical Specification Analysis
BASE	Defines two (2) loop operation with at least seven turbine bypass valves in service, the reactor recirculation pump trip system in service, the power load unbalance device in service, and both pressure regulators in service.
BOC	Beginning Of Cycle
DTSP	Rod Block Monitor Downscale Trip Setpoint
EOC	End 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which reactor power is equal to 100% (3951 MWth) with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.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
FWT	Feedwater Temperature
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(F)	ARTS MCPR thermal limit flow dependent adjustments and multipliers
MCPR(P)	ARTS MCPR thermal limit power dependent adjustments and multipliers
MELLLA	Maximum Extended Load Line Limit Analysis
MSIVOOS	Main Steam Isolation Valve Out of Service
OLMCPR	Operating Limit Minimum Critical Power Ratio
OPRM PBDA	Oscillation Power Range Monitor Period Based Detection Algorithm
PLUOOS	Power Load Unbalance Out of Service
PROOS	Pressure Regulator Out of Service
PR/PLUOOS	Pressure Regulator Out of Service and/or Power Load Unbalance Out of Service
RPTOOS	Recirculation Pump Trip Out of Service
RWE	Rod Withdrawal Error
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
TBSOOS	Turbine Bypass System Out of Service
TCV/TSVOOS	Turbine Control Valve/Turbine Stop Valve 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 21 (RELOAD 20):

- 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
- PR/PLUOOS thermal limits
- 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 methodology 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 99% of rated core flow during full power (3951 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 (4^{th} and 5^{th} stage FFWTR)
- 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 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 Reference 2. The Allowable Values documented in Reference 5 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 are located in Section 10. Preparation of this report was performed in accordance with Exelon Nuclear procedures. This report is provided to the NRC 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 Analysis (ARTS/MELLLA) for Peach Bottom Unit 3 Cycle 21.

The "BASE" thermal limit values shown in tables are for normal two (2) loop operation with at least seven turbine bypass valves in service, the reactor recirculation pump trip system in service, the power load unbalance device in service, and both pressure regulators in service.

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 Table 3-1. 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 GNF2 as a function of axial location and average planar exposure shall be less than or equal to the applicable MAPLHGR limits for GNF2 fuel and lattice type. These MAPLHGR limits are specified in Reference 2 and the process computer databank. The SLO MAPLHGR multiplier is provided in Table 3-2 per Reference 2 and must be applied to the Table 3-1 limits when operating in SLO. The impact of AFTO on MAPLHGR is addressed in Section 10.

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

Average Planar Exposure (GWD/ST)	MAPLHGR Limit (kW/ft)
0.0	13.78
17.52	13.78
60.78	7.50
63.50	6.69

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

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

Separate OLMCPR values are presented in Table 4-1 for the following conditions:

- TBS In-Service (per section 7.0), RPT In-Service (per section 8.0), PLU/PR In-Service, and maximum FFWTR of 90 °F (a.k.a. "BASE")
- TBS Out-of-Service (per section 7.0), RPT In-Service (per section 8.0), PLU/PR In-Service, and maximum FFWTR of 90 °F
- TBS In-Service (per section 7.0), RPT In-Service (per section 8.0), PLU/PR Out-of-Service, and maximum FFWTR of 90°F
- TBS In-Service (per section 7.0), RPT Out-of-Service (per section 8.0), PLU/PR In-Service, and maximum FFWTR of 90 °F

The ARTS-based power-dependent MCPR limits are provided in Table 4-2. Table 4-2 is valid for a maximum temperature reduction of 90 °F for FFWTR operation. The flow-dependent MCPR limits are provided in Tables 4-3 and 4-4. Table 4-3 is valid for dual loop operating conditions with symmetric feedwater temperature operation and Table 4-4 is valid for single loop operating conditions with symmetric feedwater temperature operation. The impact of AFTO on MCPR is addressed in Section 10. For PR/PLUOOS + TBSOOS and PR/PLUOOS + RPTOOS conditions, the limits are listed in Section 10, these values are bounding for non-AFTO conditions.

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

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR - 2523 MWd/ST	≥ EOR – 2523 MWd/ST
BASE	B	1.35	1.39
	A	1.43	1.47
BASE SLO[2]	B	1.42	1.42
	A	1.46	1.50
RPTOOS	B	1.40	1.44
	A	1.57	1.61
RPTOOS SLO[2]	B	1.43	1.47
	A	1.60	1.64
PR/PLUOOS	B	1.35	1.39
	A	1.43	1.47
PR/PLUOOS SLO[2]	B	1.42	1.42
	A	1.46	1.50
TBSOOS	B	1.38	1.41
	A	1.47	1.50
TBSOOS SLO[2]	B	1.42	1.44
	A	1.50	1.53

(1) When Tau does not equal 0 or 1, use linear interpolation.
(2) For single-loop operation, the MCPR operating limit is 0.03 greater than the analyzed limiting two loop value. However a minimum value of 1.42 is required to obtain an OLMCPR limit set by the Single Loop Operation Recirculation Pump Seizure Event (Reference 2).

TABLE 4-2
Power Dependent MCPR(P) Limit Adjustments and Multipliers
(Symmetric Feedwater Heating)
(Reference 2)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	23	<26.7	≥26.7	40	55	65	85	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp					
Base	≤ 60	2.56	2.56	2.49	1.352	1.352	1.317	1.131	1.082	1.000
	> 60	2.86	2.86	2.71						
Base SLO	≤ 60	2.59	2.59	2.52	1.352	1.352	1.317	1.131	1.082	1.000
	> 60	2.89	2.89	2.74						
RPTOOS	≤ 60	2.56	2.56	2.49	1.352	1.352	1.317	1.131	1.082	1.000
	> 60	2.86	2.86	2.71						
RPTOOS SLO	≤ 60	2.59	2.59	2.52	1.352	1.352	1.317	1.131	1.082	1.000
	> 60	2.89	2.89	2.74						
PR/PLUOOS	≤ 60	2.56	2.56	2.49	1.392	1.352	1.317	1.210	1.147	1.000
	> 60	2.86	2.86	2.71						
PR/PLUOOS SLO	≤ 60	2.59	2.59	2.52	1.392	1.352	1.317	1.210	1.147	1.000
	> 60	2.89	2.89	2.74						
TBSOOS	≤ 60	3.48	3.48	3.11	1.659	1.479	1.373	1.155	1.082	1.000
	> 60	3.97	3.97	3.62						
TBSOOS SLO	≤ 60	3.51	3.51	3.14	1.659	1.479	1.373	1.155	1.082	1.000
	> 60	4.00	4.00	3.65						

TABLE 4-3
Flow Dependent MCPR Limits MCPR(F)
(Symmetric Feedwater Heating)
(Reference 2)

Core Flow (% rated)	MCPR(F) Limit
0.0	1.70
30.0	1.53
79.0	1.25
110.0	1.25

TABLE 4-4
SLO Flow Dependent MCPR Limits MCPR(F)
(Symmetric Feedwater Heating)
(Reference 2)

Core Flow (% rated)	MCPR(F) Limit
0.0	1.70
30.0	1.53
79.0	1.25
110.0	1.25

5.0 LINEAR HEAT GENERATION RATE LIMITS

5.1 Technical Specification

Section 3.2.3, 3.3.4.2, 3.4.1 and 3.7.6

5.2 Description

The LHGR values for GNF2 fuel type are provided in Tables 5-1 and 5-2. The ARTS-based LHGR power-dependent multipliers are provided in Table 5-3. Table 5-3 is valid for a maximum temperature reduction of 90° F for FFWTR operation. The flow-dependent multipliers are provided in Table 5-4 as a function of the number of recirculation loops in operation. The SLO LHGR multiplier is 0.73 and is accounted for in Table 5-4. The power- and flow-dependent LHGR multipliers were obtained from Reference 2. The impact of AFTO on LHGR is addressed in Section 10. For PR/PLUOOS + TBSOOS and PR/PLUOOS + RPTOOS conditions, the limits are listed in Section 10, these values are bounding for non-AFTO conditions.

TABLE 5-1
Linear Heat Generation Rate Limits – UO2 rods
(References 4 and 11)

Fuel Type	LHGR Limit
GNF2	See Appendix B of Reference 4

TABLE 5-2
Linear Heat Generation Rate Limits – Gad rods
(References 4 and 11)

Fuel Type	LHGR Limit
GNF2	See Appendix B of Reference 4

TABLE 5-3
Power Dependent LHGR Multiplier LHGRFAC(P)
(Symmetric Feedwater Heating)
(Reference 2)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	23	<26.7	≥26.7	40	55	65	85	100
		LHGRFAC(P) Multiplier								
Base	≤ 60	0.508	0.508	0.522	0.748	0.756	0.771	0.817	0.959	1.000
	> 60	0.508	0.508	0.522						
Base SLO	≤ 60	0.508	0.508	0.522	0.748	0.756	0.771	0.817	0.959	1.000
	> 60	0.508	0.508	0.522						
RPTOOS	≤ 60	0.508	0.508	0.522	0.748	0.756	0.771	0.817	0.959	1.000
	> 60	0.508	0.508	0.522						
RPTOOS SLO	≤ 60	0.508	0.508	0.522	0.748	0.756	0.771	0.817	0.959	1.000
	> 60	0.508	0.508	0.522						
PR/PLUOOS	≤ 60	0.508	0.508	0.522	0.620	0.696	0.751	0.817	0.959	1.000
	> 60	0.508	0.508	0.522						
PR/PLUOOS SLO	≤ 60	0.508	0.508	0.522	0.620	0.696	0.751	0.817	0.959	1.000
	> 60	0.508	0.508	0.522						
TBSOOS	≤ 60	0.397	0.397	0.442	0.635	0.655	0.714	0.817	0.930	1.000
	> 60	0.397	0.397	0.417						
TBSOOS SLO	≤ 60	0.397	0.397	0.442	0.635	0.655	0.714	0.817	0.930	1.000
	> 60	0.397	0.397	0.417						

TABLE 5-4
Flow Dependent LHGR Multiplier LHGRFAC(F)
(Symmetric Feedwater Heating)
(Reference 2)

EOOS Combination	Core Flow (% of rated)					
	0	30	33.6	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.506	0.706	0.730	0.973	1.000	1.000
Single Loop	0.506	0.706	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 with supporting documentation in References 2 and 9.

TABLE 6-1
Rod Block Monitor Setpoints
(References 2 and 9)

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]

(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 based on other events (see COLR References 2 and 9).

(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 COLR Reference 2 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 COLR Reference 2 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 System Out-of-Service (TBSOOS) must be used. Additionally, the OLMCPR for TBSOOS must be applied. Table 7-1 includes the Turbine Bypass Valve response time parameters. The minimum number of bypass valves to maintain system operability is provided in Table 7-2 per Reference 14.

TABLE 7-1
Turbine Bypass System Response Time
(Reference 14)

Maximum delay time before start of bypass valve opening following initial turbine inlet valve movement(1)	0.10 sec
Maximum time after initial turbine inlet valve movement(1) for bypass valve position to reach 80% of full flow (includes the above delay time)	0.30 sec

(1) First movement of any TSV or any TCV or generation of the turbine bypass valve flow signal (whichever occurs first)

TABLE 7-2
Minimum Required Bypass Valves To Maintain System Operability
(Reference 14)

Reactor Power	No. of Valves in Service
$P \geq 23\%$	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 Out Of Service (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 and is defined as the time from when the turbine valves (turbine control valve or turbine stop valve) start to close until complete arc suppression of the EOC-RPT circuit breakers. Reference 7 provides the basis for the RPT response time.

9.0 STABILITY PROTECTION OSCILLATION POWER RANGE MONITOR (OPRM)

9.1 Technical Specification

Section 3.3.1.1, Table 3.3.1.1-1 Function 2.f

9.2 Description

The CYCLE 21 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 13. 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 (SPID's) 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
1.10	13

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
1.18	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. This temperature mismatch may result in errors in the thermal limit values calculated by the core monitoring system. Thermal limit values for all conditions and events are impacted by these errors excluding SLO conditions. The P3C21 COLR Rev. 8 is the first COLR to no longer require implementation of SLO AFTO penalty files for this unit. The station no longer requires SLO AFTO files or penalties due to a 3D MONICORE upgrade required for EPU operation. 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 10. To simplify the implementation of the AFTO limits, only the maximum AFTO penalties indicated in Table 10-1 will be implemented when the threshold asymmetry temperature (temperature above which a penalty is required) is exceeded. This will minimize the number of AFTO thermal limit tables in the COLR and core monitoring system.

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

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

LHGR LIMITS

The ARTS-based LHGR power-dependent multipliers for AFTO operation are provided in Table 10-2. The flow-dependent multipliers for AFTO in DLO are provided in Table 10-3. The power-and flow-dependent LHGR multipliers were obtained from Reference 2 and were adjusted with the appropriate penalties displayed in Table 10-1 as per Reference 10. PR/PLUOOS + TBSOOS and PR/PLUOOS + RPTOOS values were obtained by taking the most limiting OLMCPR values of the two EOOS conditions, these values are bounding for non-AFTO conditions. The maximum feedwater temperature difference allowed without a thermal limit penalty is 20 °F. Once the temperature difference exceeds 20 °F the maximum penalties from Table 10-1 are applied to the thermal limits. Additionally, no LHGR penalties are required for asymmetric feedwater temperature option while in SLO as previously discussed.

TABLE 10-2
AFTO Power Dependent LHGR Multiplier LHGRFAC(P) 20F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2 and 10)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	23	<26.7	≥26.7	40	55	65	85	100
		LHGRFAC(P) Multiplier								
Base	≤ 60	0.488	0.488	0.501	0.718	0.726	0.740	0.784	0.921	0.960
	> 60	0.488	0.488	0.501						
RPTOOS	≤ 60	0.488	0.488	0.501	0.718	0.726	0.740	0.784	0.921	0.960
	> 60	0.488	0.488	0.501						
PR/PLUOOS	≤ 60	0.488	0.488	0.501	0.595	0.668	0.721	0.784	0.921	0.960
	> 60	0.488	0.488	0.501						
TBSOOS	≤ 60	0.381	0.381	0.424	0.610	0.629	0.685	0.784	0.893	0.960
	> 60	0.381	0.381	0.400						
PR/PLUOOS + TBSOOS	≤ 60	0.381	0.381	0.424	0.595	0.629	0.685	0.784	0.893	0.960
	> 60	0.381	0.381	0.400						
PR/PLUOOS + RPTOOS	≤ 60	0.488	0.488	0.501	0.595	0.668	0.721	0.784	0.921	0.960
	> 60	0.488	0.488	0.501						

TABLE 10-3
AFTO Flow Dependent LHGR Multiplier LHGRFAC(F) 20F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2 and 10)

EOOS Combination	Core Flow (% of rated)					
	0	30	33.60	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.486	0.678	0.701	0.934	0.960	0.960

MCPR LIMITS

The OLMCPRs during asymmetric feedwater temperature operation with a feedwater temperature difference greater than 20 °F are provided in Table 10-4. The ARTS-based power-dependent MCPR limits for use during AFTO conditions are provided in Table 10-5. The flow-dependent MCPR limits for AFTO are provided in Table 10-6. The power and flow-dependent OLMCPR curves were obtained from Reference 2 and were adjusted with a 3% penalty for feedwater temperature difference greater than 20 °F as displayed in Table 10-1 as per Reference 10. PR/PLUOOS + TBSOOS and PR/PLUOOS + RPTOOS values were obtained by taking the most limiting OLMCPR values of the two EOOS conditions, these values are bounding for non-AFTO conditions. No MCPR penalties are required for asymmetric temperature differentials less than or equal to 20 °F. Additionally, no MCPR penalties are required for asymmetric feedwater temperature option while in SLO as previously discussed.

TABLE 10-4
AFTO Operating Limit Minimum Critical Power Ratio 20F < FWT DELTA ≤ 55F
(Asymmetric Feedwater Heating)
(References 2 and 10)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR – 2523 MWd/ST	≥ EOR – 2523 MWd/ST
BASE	B	1.39	1.43
	A	1.47	1.51
RPTOOS	B	1.44	1.48
	A	1.62	1.66
PR/PLUOOS	B	1.39	1.43
	A	1.47	1.51
TBSOOS	B	1.42	1.45
	A	1.51	1.55
PR/PLUOOS + TBSOOS	B	1.42	1.45
	A	N/A	N/A
PR/PLUOOS + RPTOOS	B	1.44	1.48
	A	N/A	N/A

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

TABLE 10-5
AFTO Power Dependent MCPR Limit Adjustments And Multipliers MCPR(P) 20F < FWT DELTA ≤ 55F (Asymmetric Feedwater Heating)
(References 2 and 10)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	23	<26.7	≥26.7	40	55	65	85	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp					
Base	≤ 60	2.64	2.64	2.56	1.352	1.352	1.317	1.131	1.082	1.000
	> 60	2.95	2.95	2.79						
RPTOOS	≤ 60	2.64	2.64	2.56	1.352	1.352	1.317	1.131	1.082	1.000
	> 60	2.95	2.95	2.79						
PR/PLUOOS	≤ 60	2.64	2.64	2.56	1.392	1.352	1.317	1.210	1.147	1.000
	> 60	2.95	2.95	2.79						
TBSOOS	≤ 60	3.58	3.58	3.20	1.659	1.479	1.373	1.155	1.082	1.000
	> 60	4.09	4.09	3.73						
PR/PLUOOS + TBSOOS	≤ 60	3.58	3.58	3.20	1.659	1.479	1.373	1.210	1.147	1.000
	> 60	4.09	4.09	3.73						
PR/PLUOOS + RPTOOS	≤ 60	2.64	2.64	2.56	1.392	1.352	1.317	1.210	1.147	1.000
	> 60	2.95	2.95	2.79						

TABLE 10-6
AFTO Flow Dependent MCPR Limits MCPR(F) 20F < FWT DELTA ≤ 55F
(BOC to EOC)(Asymmetric Feedwater Heating)
(References 2 and 10)

Flow (% rated)	MCPR(F) Limit
0.0	1.75
30.0	1.58
79.0	1.29
110.0	1.29

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 as per Reference 10. No MAPLHGR penalties are required for asymmetric feedwater temperature option while in SLO as previously discussed.

TABLE 10-7
AFTO MAPLHGR Reduction Factor
(Asymmetric Feedwater Heating)
(References 2 and 10)

AFTO Reduction Factor	
20F < FWT DELTA ≤ 55F	0.960

11.0 MODES OF OPERATION

TABLE 11-1
Modes of Operation
(Reference 2)

EOOS Options[1]	Supported Operating Region[2]
Base, Option A or B	Yes
Base SLO, Option A or B	Yes
TBSOOS, Option A or B	Yes
TBSOOS SLO, Option A or B	Yes
RPTOOS, Option A or B	Yes
RPTOOS SLO, Option A or B	Yes
PLUOOS, Option A or B	Yes
PLUOOS SLO, Option A or B	Yes
PROOS, Option A or B	Yes
PROOS SLO, Option A or B	Yes
PR/PLUOOS and TBSOOS, Option B	Yes
PR/PLUOOS and RPTOOS, Option B	Yes
TBSOOS and RPTOOS, Option A or B	No
TBSOOS and RPTOOS SLO, Option A or B	No

TABLE 11-2
Additional Equipment Out of Service Modes of Operation

EOOS
TCV/TSVOOS (controlled via station procedures)
MSIVOOS (controlled via station procedures)
AFTO LFWH (controlled via station procedures)

[1] Modes of operation with thermal limit sets in the COLR
[2] Operating Region refers to operation on the Power to Flow map with or without FFWTR or AFTO

12.0 METHODOLOGY

The analytical methods used in determining the core operating limits have been 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-21, May 2015 and U.S. Supplement NEDE-24011-P-A-21-US, May 2015.

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

3. "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications", NEDO-32465-A, Revision 0, August 1996.

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. Global Nuclear Fuel Document "Supplemental Reload Licensing Report for Peach Bottom Unit 3, Reload 20, Cycle 21 Extended Power Uprate (EPU)," GNF Document No. 001N3876, Revision 0, July 2015.

3. Global Nuclear Fuel Document "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-21, May 2015 and U.S. Supplement NEDE-24011-P-A-21-US, May 2015.

4. Global Nuclear Fuel Document NEDC-33270P Rev. 5, "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," May 2013.

5. General Electric Hitachi Document 001N2494-R0, "Peach Bottom EPU Evaluation of Feedwater Temperature vs. Reactor Power for Feedwater Temperature Conditions of Nominal Rated, FWHOOS (Nominal -55°F) and FFWTR (Nominal -90°F)," July 2014. This document is searchable in Exelon EDMS under document number "PEAM-EPU-1 Rev. 00A."

6. Not Used

7. PECO Calculation PE-0173, "Determination of Total Time Required to Initiate the Trip Signal to the EOC-RPT Circuit Breakers Trip Coils and to Complete the Recirculation Pump Trip," Rev. 1 dated 12/22/98.

8. Not Used.

9. PECO Calculation PE-0251, Revision 2A, "PRNMS Setpoint Calculation," dated 10/19/14.

10. General Electric Hitachi Document 001N6733-R1, "Final Evaluation Report Exelon Nuclear Generating Company LLC, Peach Bottom Units 2 & 3, MELLLA+, Asymmetric Feedwater Temperature Operation for EPU/MELLLA+," Revision 1, September 2014. This document is searchable in Exelon EDMS under document number "PEAM-EPU-68 Rev. 1."

11. Global Nuclear Fuel Document 002N8938, Revision 0, "Fuel Bundle Information Report for Peach Bottom Unit 3 Reload 20 Cycle 21 Extended Power Uprate (EPU)/Maximum Extended Load Line Limit Analysis Plus (MELLLA+) and Extended Power Uprate (EPU)/Maximum Extended Load Line Limit Analysis (MELLLA)," July 2015.

12. Not Used

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

14. Exelon TODI ENSAF ID# ES1500001, Rev. 0, "Final Resolved OPL-3 Parameters for Peach Bottom Unit 3 Cycle 21: EPU/MELLLA+," February 17, 2015.