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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 22, Cycle 23

Enclosed is a copy of Revision 16 of the Core Operating Limits Report (COLR) for Peach Bottom Atomic Power Station (PBAPS) Unit 3 for Reload 22, Cycle 23. This revision 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 Dan Dullum at (717) 456-3339.

Respectfully,

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Attachment: Core Operating Limits Report for PBAPS Unit 3, Revision 16

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CORE OPERATING LIMITS REPORT FOR

PEACH BOTTOM ATOMIC POWER STATION UNIT 3

RELOAD 22, CYCLE 23

(This revision is a complete re-write)

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Revision 16	New issue for Cycle 23

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1.0 Terms and Definitions

ABSP	Automated Backup Stability Protection
AFTO	Asymmetric Feedwater Temperature Operation
AFTO LFWH	Asymmetric Feedwater Temperature Operation Loss-of-Feedwater Heating
APRM	Average Power Range Monitor
ARTS	APRM, Rod Block and Technical Specification Improvement Program
BASE	The "BASE" condition is defined by a group of individual operating conditions that are applicable to all Modes of Operation discussed in Section 11. The "BASE" condition includes the EOOS conditions provided in Table 11-2 as well as operation with FWHOOS/FFWTR.
BOC	Beginning of Cycle
BSP	Backup Stability Protection
DLO	Dual Loop Operation
DSS-CD	Detect and Suppress Solution – Confirmation Density
ECCS-LOCA	Emergency Core Cooling System – Loss of Coolant Accident
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exposure at which reactor power is equal to 100% with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.
FOL	Facility Operating License
FFWTR	Final Feedwater Temperature Reduction
FWHOOS	Feedwater Heater(s) Out of Service
FWT	Feedwater Temperature
HFCL	High Flow Control Line
HTSP	Rod Block Monitor High Trip Setpoint
ICF	Increased Core Flow
ITSP	Rod Block Monitor Intermediate Trip Setpoint
K_p	Off-rated power dependent OLMCPR multiplier
LHGR	Linear Heat Generation Rate
LHGRFAC(F)	Off-rated flow dependent LHGR multiplier
LHGRFAC(P)	Off-rated power dependent LHGR multiplier
LTSP	Rod Block Monitor Low Trip Setpoint
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
$MCPR_{99.9\%}$	Limiting MCPR value such that 99.9 percent of the fuel in the core is not susceptible to boiling transition
MCPR(F)	Off-rated flow dependent OLMCPR
MCPR(P)	Off-rated power dependent OLMCPR
MELLLA	Maximum Extended Load Line Limit Analysis
MELLLA+	Maximum Extended Load Line Limit Analysis Plus
MSIVOOS	Main Steam Isolation Valve Out of Service
NCL	Natural Circulation Line
OLMCPR	Operating Limit Minimum Critical Power Ratio
PLUOOS	Power Load Unbalance Out of Service
PROOS	Pressure Regulator Out of Service
RBM	Rod Block Monitor
RDF	Recirculation Drive Flow
RPTOOS	Recirculation Pump Trip Out of Service
RTP	Rated Thermal Power
RWE	Rod Withdrawal Error
SFTO	Symmetric Feedwater Temperature Operation
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
SRVOOS	Safety/Relief Valve(s) Out of Service
Tau (τ)	A measure of scram time performance to notch position 36 throughout the cycle
TBSOOS	Turbine Bypass System Out of Service
TBVOOS	Turbine Bypass Valve(s) Out of Service
TCV/TSVOOS	Turbine Control Valve and/or Turbine Stop Valve Out of Service
TPO	Thermal Power Optimization, also known as Measurement Uncertainty Recapture

2.0 General Information

This report provides the following cycle-specific parameter limits for Peach Bottom Atomic Power Station Unit 3 Cycle 23 (Reload 22):

- 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
- SLO MCPR adjustment
- $MCPR_{99.9\%}$
- Linear Heat Generation Rate (LHGR)
- ARTS LHGR thermal limit multipliers
- SLO LHGR multipliers
- Rod Block Monitor (RBM) allowable values and MCPR limits
- Turbine Bypass Valve parameters
- EOC Recirculation Pump Trip (EOC-RPT) parameters
- Stability Protection Setpoints
- Asymmetric Feedwater Temperature Operation (AFTO) thermal limits

These values have been determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met. SLO, FWHOOS operation, and FFWTR operation are not permitted in the MELLLA+ Region as controlled by station procedures. For the MELLLA+ Region, a specific definition of FWHOOS is provided in Facility Operating License (FOL) Section 2.C(16).

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 MELLLA+ Region down to 85.2% of rated core flow during full power (4016 MWt) operation (Appendix A)
- 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 FWHOOS)
- Asymmetric Feedwater Temperature Operation

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 documented in Reference 13. Supporting documentation for the ARTS-based limits is provided in Reference 2. The off-rated limits assumed in the ECCS-LOCA analyses bound the cycle-specific limits calculated for MELLLA+ operation. 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. The Peach Bottom Unit 3 Cycle 23 core is comprised entirely of GNF2 fuel.

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 limiting MAPLHGR value for the most limiting lattice of GNF2 fuel as a function of average planar exposure is given in Table 3-1. For single loop operation, a multiplier is used, which is shown in Table 3-2. The power- and flow-dependent LHGR multipliers are sufficient to provide adequate protection for the off-rated conditions from an ECCS-LOCA analysis perspective. The MAPLHGR multipliers can either be set to unity or set equal to the LHGR multipliers, which remain compliant with the basis of the ECCS-LOCA analysis with no loss of ECCS-LOCA margin. 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 Table 4-1. 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 (τ), 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). Table 4-1 is valid for a maximum FWT reduction of 90°F (Reference 2).

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 (bounding for FWHOOS operation) (Reference 2). 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.

The cycle-specific SLMCPRs, known as $MCPR_{99.9\%}$, can be found in Table 4-5 for dual loop and single loop operating conditions. The values in Table 4-5 or conservative values were used to calculate the MCPR limits and off-rated limits in this section and Section 10.

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

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR – 3995 MWd/ST	≥ EOR – 3995 MWd/ST
BASE	B	1.40	1.40
	A	1.44	1.48
BASE SLO[2]	B	1.43	1.43
	A	1.47	1.51
RPTOOS	B	1.40	1.43
	A	1.56	1.60
RPTOOS SLO[2]	B	1.43	1.46
	A	1.59	1.63
PR/PLUOOS	B	1.40	1.40
	A	1.44	1.48
PR/PLUOOS SLO[2]	B	1.43	1.43
	A	1.47	1.51
TBSOOS	B	1.46	1.46
	A	1.48	1.54
TBSOOS SLO[2]	B	1.49	1.49
	A	1.51	1.57

(1) When Tau does not equal 0 or 1, use linear interpolation.
(2) For single-loop operation, the MCPR operating limit is 0.03 higher than the two-loop value (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	22.6	≤ 26.3	> 26.3	40	55	65	85	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp					
Base	< 60	2.67	2.67	2.60	1.392	1.288	1.237	1.130	1.067	1.000
	≥ 60	2.99	2.99	2.83						
Base SLO	< 60	2.70	2.70	2.63	1.392	1.288	1.237	1.130	1.067	1.000
	≥ 60	3.02	3.02	2.86						
RPTOOS	< 60	2.67	2.67	2.60	1.392	1.288	1.237	1.130	1.067	1.000
	≥ 60	2.99	2.99	2.83						
RPTOOS SLO	< 60	2.70	2.70	2.63	1.392	1.288	1.237	1.130	1.067	1.000
	≥ 60	3.02	3.02	2.86						
PR/PLUOOS	< 60	2.67	2.67	2.60	1.392	1.288	1.237	1.210	1.147	1.000
	≥ 60	2.99	2.99	2.83						
PR/PLUOOS SLO	< 60	2.70	2.70	2.63	1.392	1.288	1.237	1.210	1.147	1.000
	≥ 60	3.02	3.02	2.86						
TBSOOS	< 60	3.64	3.64	3.25	1.399	1.323	1.237	1.155	1.079	1.000
	≥ 60	4.15	4.15	3.78						
TBSOOS SLO	< 60	3.67	3.67	3.28	1.399	1.323	1.237	1.155	1.079	1.000
	≥ 60	4.18	4.18	3.81						

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

Core Flow (% rated)	MCPR(F) Limit
0.0	1.73
30.0	1.56
86.0	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	1.76
30.0	1.59
86.0	1.28
110.0	1.28

Table 4-5
Cycle Specific SLMCPR ($MCPR_{99.9\%}$)
(Reference 2)

Loop Operation	$MCPR_{99.9\%}$
DLO	1.14
SLO	1.14

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 LHGR values for GNF2 fuel 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 (bounding for FWHOOS operation) (Reference 2). The flow-dependent multipliers are provided in Table 5-4 as a function of the number of recirculation loops in operation. 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. The power- and flow-dependent LHGR multipliers are sufficient to provide adequate protection for the off-rated conditions from an ECCS-LOCA analysis perspective.

TABLE 5-1
Linear Heat Generation Rate Limits – UO2 rods
(References 11 and 13)

Fuel Type	LHGR Limit
GNF2	See Reference 13

TABLE 5-2
Linear Heat Generation Rate Limits – Gad rods
(References 11 and 13)

Fuel Type	LHGR Limit
GNF2	See Reference 13

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	22.6	≤ 26.3	> 26.3	40	55	65	85	100
		LHGRFAC(P) Multiplier								
Base	< 60	0.508	0.508	0.522	0.620	0.696	0.751	0.817	0.930	1.000
	≥ 60	0.508	0.508	0.522						
Base SLO	< 60	0.508	0.508	0.522	0.620	0.696	0.751	0.817	0.930	1.000
	≥ 60	0.508	0.508	0.522						
RPTOOS	< 60	0.508	0.508	0.522	0.620	0.696	0.751	0.817	0.930	1.000
	≥ 60	0.508	0.508	0.522						
RPTOOS SLO	< 60	0.508	0.508	0.522	0.620	0.696	0.751	0.817	0.930	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	0.930	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	0.930	1.000
	≥ 60	0.508	0.508	0.522						
TBSOOS	< 60	0.397	0.397	0.442	0.620	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	0.620	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 Allowable Values and MCPR Limits are provided in Table 6-1 with supporting documentation in References 2, 3, 9 and 10. The SFTO MCPR Limits apply when FWT difference is below 20°F. The AFTO MCPR Limits apply with FWT difference between 20 and 55°F. AFTO conditions are discussed further in Section 10. The values correspond to the OLMCPR values provided in Table 4-1.

TABLE 6-1
Rod Block Monitor Setpoints
(References 2, 3, 9 and 10)

Power Level	Allowable Value[1]	SFTO MCPR Limit	AFTO MCPR Limit
LTSP	124.0%	< 1.81 [2] < 1.49 [3]	< 1.86 [4] < 1.53 [5]
ITSP	119.2%	< 1.81 [2] < 1.49 [3]	< 1.86 [4] < 1.53 [5]
HTSP	114.2%	< 1.81 [2] < 1.49 [3]	< 1.86 [4] < 1.53 [5]
INOP	N/A	< 1.81 [2] < 1.49 [3]	< 1.86 [4] < 1.53 [5]

(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 for symmetric feedwater heating operation (given THERMAL POWER is ≥ 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 for symmetric feedwater heating operation (given THERMAL POWER is ≥ 90%) below which the RBM is required to be OPERABLE (see COLR Reference 2 and TS Table 3.3.2.1-1).

(4) This is the MCPR limit for asymmetric feedwater heating operation (given THERMAL POWER is ≥ 28.4% and < 90%) below which the RBM is required to be OPERABLE (see COLR Reference 2, 10 and TS Table 3.3.2.1-1).

(5) This is the MCPR limit for asymmetric feedwater heating operation (given THERMAL POWER is ≥ 90%) below which the RBM is required to be OPERABLE (see COLR Reference 2, 10 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 turbine 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 System response time parameters. The minimum number of bypass valves to maintain system operability is provided in Table 7-2.

TABLE 7-1
Turbine Bypass System Response Time
(Reference 12)

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 (whichever occurs first)

TABLE 7-2
Minimum Required Bypass Valves to Maintain System Operability
(Reference 12)

Reactor Power	No. of Valves in Service
$P \geq 22.6\%$	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. Table 8-1 includes the total RPT response time parameter.

TABLE 8-1
Recirculation Pump Trip Response Time
(Reference 12)

Total Recirculation Pump Trip Response Time *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 as described in Reference 7.*	0.175 sec

9.0 STABILITY PROTECTION

9.1 Technical Specification

Section 3.3.1.1, Table 3.3.1.1-1 Function 2.f

9.2 Description

Per Reference 2, the Cycle 23 DSS-CD S_{AD} Setpoint was confirmed to be 1.10 for DLO and SLO. The Automated Backup Stability Protection (BSP) Setpoints are provided in Table 9-1. The Manual BSP Endpoints for Normal Feedwater Temperature and Reduced Feedwater Temperature are provided in Tables 9-2 and 9-3, respectively. Table 9-3 is intended for feedwater temperatures 10-90°F below nominal.

TABLE 9-1
Automated BSP Setpoints for the Scram Region
(Reference 2)

Parameter	Symbol	Value
Slope of ABSP APRM flow-biased trip linear segment	m_{Trip}	1.37
ABSP APRM flow-biased trip setpoint power intercept. Constant Power Line for Trip from zero Drive Flow to Flow Breakpoint value	$P_{BSP\text{-}Trip}$	39.3 %RTP
ABSP APRM flow-biased trip setpoint drive flow intercept. Constant Flow Line for Trip	$W_{BSP\text{-}Trip}$	46.5 %RDF
Flow Breakpoint value	$W_{BSP\text{-}Break}$	20.3 %RDF

TABLE 9-2[1]
Manual BSP Endpoints for Normal Feedwater Temperature
(Reference 2)

Endpoint	Power (%)	Flow (%)	Definition
A1	74.2	50.6	Scram Region Boundary, HFCL
B1	40.0	31.0	Scram Region Boundary, NCL
A2	63.5	50.0	Controlled Entry Region Boundary, HFCL
B2	27.6	30.1	Controlled Entry Region Boundary, NCL

Note: The BSP Boundary for Normal and Reduced Feedwater Temperature is defined by the MELLLA boundary line, per Reference 2.

TABLE 9-3[1]
Manual BSP Endpoints for Reduced Feedwater Temperature
(Reference 2)

Endpoint	Power (%)	Flow (%)	Definition
A1'	64.4	51.3	Scram Region Boundary, HFCL
B1'	33.7	30.6	Scram Region Boundary, NCL
A2'	66.8	54.4	Controlled Entry Region Boundary, HFCL
B2'	27.6	30.1	Controlled Entry Region Boundary, NCL

Note: The BSP Boundary for Normal and Reduced Feedwater Temperature is defined by the MELLLA boundary line, per Reference 2.

(1) Station may elect to place additional administrative margin on the endpoints provided in Table 9-2 and Table 9-3.

10.0 ASYMMETRIC FEEDWATER TEMPERATURE OPERATION (AFTO)

Asymmetric feedwater heating 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. 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 13 of Reference 10 will be implemented when the threshold asymmetry temperature is exceeded; this will minimize the number of AFTO thermal limit tables in the COLR and core monitoring system. There is no AFTO penalty for a FWT difference below 20°F, between 20 and 55°F difference there is a 4% LHGR/MAPLHGR penalty and a 3% MCPR penalty, and thermal limits are unanalyzed for a difference above 55°F. The MCPR penalty for AFTO also applies to RBM Operability MCPR Limits which are addressed in Section 6.0.

10.1 MAPLHGR LIMITS

An appropriate penalty must be applied to MAPLHGR limits under asymmetric feedwater temperature operation (AFTO) for varying temperature differentials per Reference 10. The reduction factor listed in Table 10-1 is the maximum penalty for the full range of analyzed FWT mismatches, bounding all smaller temperature deltas.

TABLE 10-1
AFTO MAPLHGR Reduction Factor
(Asymmetric Feedwater Heating)
(Reference 10)

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

10.2 MCPR LIMITS

The OLMCPRs during asymmetric feedwater temperature operation with a feedwater temperature difference greater than 20°F are provided in Table 10-2. The ARTS-based power-dependent MCPR limits for use during AFTO conditions are provided in Table 10-3. The flow-dependent MCPR limits for AFTO are provided in Table 10-4. The power- and flow-dependent OLMCPR curves were obtained from Reference 2 and were adjusted with a penalty for feedwater temperature difference greater than 20°F as per Reference 10. PR/PLUOOS + TBSOOS and PR/PLUOOS + RPTOOS values were obtained by taking the most limiting values of the two EOOS conditions (Reference 8). No MCPR penalties are required for asymmetric temperature differentials less than or equal to 20°F.

TABLE 10-2
AFTO Operating Limit Minimum Critical Power Ratio 20°F < FWT DELTA ≤ 55°F
(Asymmetric Feedwater Heating)
(References 2, 8, and 10)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		< EOR – 3995 MWd/ST	≥ EOR – 3995 MWd/ST
BASE	B	1.44	1.44
	A	1.48	1.52
RPTOOS	B	1.44	1.47
	A	1.61	1.65
PR/PLUOOS	B	1.44	1.44
	A	1.48	1.52
TBSOOS	B	1.50	1.50
	A	1.52	1.59
PR/PLUOOS + TBSOOS	B	1.50	1.50
	A	N/A	N/A
PR/PLUOOS + RPTOOS	B	1.44	1.47
	A	N/A	N/A

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

TABLE 10-3
AFTO Power Dependent MCPR Limit Adjustments And Multipliers MCPR(P) 20°F < FWT DELTA ≤ 55°F
(Asymmetric Feedwater Heating)
(References 2, 8, and 10)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	22.6	≤26.3	>26.3	40	55	65	85	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp					
Base	< 60	2.75	2.75	2.68	1.392	1.288	1.237	1.130	1.067	1.000
	≥ 60	3.08	3.08	2.91						
RPTOOS	< 60	2.75	2.75	2.68	1.392	1.288	1.237	1.130	1.067	1.000
	≥ 60	3.08	3.08	2.91						
PR/PLUOOS	< 60	2.75	2.75	2.68	1.392	1.288	1.237	1.210	1.147	1.000
	≥ 60	3.08	3.08	2.91						
TBSOOS	< 60	3.75	3.75	3.35	1.399	1.323	1.237	1.155	1.079	1.000
	≥ 60	4.27	4.27	3.89						
PR/PLUOOS + TBSOOS	< 60	3.75	3.75	3.35	1.399	1.323	1.237	1.210	1.147	1.000
	≥ 60	4.27	4.27	3.89						
PR/PLUOOS + RPTOOS	< 60	2.75	2.75	2.68	1.392	1.288	1.237	1.210	1.147	1.000
	≥ 60	3.08	3.08	2.91						

TABLE 10-4
AFTO Flow Dependent MCPR Limits MCPR(F) 20°F < FWT DELTA ≤ 55°F
(Asymmetric Feedwater Heating)
(References 2 and 10)

Flow (% rated)	MCPR(F) Limit
0.0	1.78
30.0	1.61
86.0	1.29
110.0	1.29

10.3 LHGR LIMITS

The ARTS-based LHGR power-dependent multipliers for AFTO operation are provided in Table 10-5. The flow-dependent multipliers for AFTO in DLO are provided in Table 10-6. The power- and flow-dependent LHGR multipliers were obtained from Reference 2 and were adjusted with the appropriate penalties per Reference 10. PR/PLUOOS + TBSOOS and PR/PLUOOS + RPTOOS values were obtained by taking the most limiting values of the two EOOS conditions (Reference 8). 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 Reference 10 are applied to the thermal limits. Additionally, no LHGR penalties are required for AFTO while in SLO as previously discussed.

TABLE 10-5
AFTO Power Dependent LHGR Multiplier LHGRFAC(P) 20°F < FWT DELTA ≤ 55°F
(Asymmetric Feedwater Heating)
(References 2, 8, and 10)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	22.6	≤26.3	>26.3	40	55	65	85	100
		LHGRFAC(P) Multiplier								
Base	< 60	0.488	0.488	0.501	0.595	0.668	0.721	0.784	0.893	0.960
	≥ 60	0.488	0.488	0.501						
RPTOOS	< 60	0.488	0.488	0.501	0.595	0.668	0.721	0.784	0.893	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	0.893	0.960
	≥ 60	0.488	0.488	0.501						
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 + 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	0.893	0.960
	≥ 60	0.488	0.488	0.501						

TABLE 10-6
AFTO Flow Dependent LHGR Multiplier LHGRFAC(F) 20°F < FWT DELTA ≤ 55°F
(Asymmetric Feedwater Heating)
(References 2 and 10)

EOOS Combination	Core Flow (% of rated)					
	0	30	33.6	70	80	110
	LHGRFAC(F) Multiplier					
Dual Loop	0.486	0.678	0.701	0.934	0.960	0.960

11.0 MODES OF OPERATION

The following conditions are supported by the Peach Bottom 3 Cycle 23 licensing analysis; operation in a condition (or conditions) is controlled by station procedures. If a combination of options is not listed, it is not supported. Table 11-1 provides allowed modes of operation with thermal limit sets in the COLR. Table 11-2 provides allowed modes of operation that do not contain explicit thermal limit sets in the COLR.

TABLE 11-1
Modes of Operation
(Reference 2)

EOOS Options	Supported Scram Speed Option	Supported Recirculation Loop Operation	Supported SFTO/AFTO
Base[1,2]	A or B	DLO or SLO[3]	SFTO or AFTO
TBSOOS	A or B	DLO or SLO[3]	SFTO or AFTO
RPTOOS	A or B	DLO or SLO[3]	SFTO or AFTO
PLUOOS	A or B	DLO or SLO[3]	SFTO or AFTO
PROOS	A or B	DLO or SLO[3]	SFTO or AFTO
PR/PLUOOS and TBSOOS	B	DLO	AFTO[4]
PR/PLUOOS and RPTOOS	B	DLO	AFTO[4]

TABLE 11-2
EOOS Options Included in 'Base' Conditions
(Reference 2)

EOOS Condition
TCV/TSVOOS[5]
MSIVOOS[5]
SRVOOS
TBVOOS

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," Global Nuclear Fuel Document No. NEDE-24011-P-A-29, October 2019 and U.S. Supplement NEDE-24011-P-A-29-US, October 2019.

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1 The 'Base' condition includes the options listed in Table 11-2.

2 The 'Base' condition includes operation with FWHOOS/FFWTR. Operation not permitted in the MELLLA+ Region for reduced FWT conditions as controlled by station procedures.

3 Operation in SLO not permitted in the MELLLA+ Region as controlled by station procedures.

4 AFTO limits bound SFTO limits.

5 Permitted at power levels provided in the applicable station procedure.

13.0 REFERENCES

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

2. "Supplemental Reload Licensing Report for Peach Bottom Unit 3 Reload 22 Cycle 23," Global Nuclear Fuel Document No. 004N8287, Revision 0, August 2019.

3. "Removal of Generic ARTS Rated RWE DCPR for Limerick Units 1 and 2, Nine Mile Point Unit 2, and Peach Bottom Units 2 and 3," General Electric Hitachi Nuclear Energy Document No. 005N2836-R0, Revision 0, July 2019.

4. "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," Global Nuclear Fuel Document No. NEDC-33270P, Revision 9, December 2017.

5. "Clarify Rated Feedwater Temp for Feedwater Temp Reduction Curves," Exelon Technical Evaluation EC 628049, Revision 0, August 2019.

6. "Safety Analysis Report for Peach Bottom Atomic Power Station Units 2 and 3 Thermal Power Optimization," General Electric Hitachi Nuclear Energy Document No. NEDO-33873, Revision 0, February 2017.

7. "Determination of Time Required to Initiate Trip Signal to the RPT CKT," Exelon Calculation No. PE-0173, Revision 1A, January 2019.

8. "Peach Bottom Atomic Power Station Units 2 and 3 TRACG Implementation for Reload Licensing Transient Analysis," General Electric Hitachi Nuclear Energy Document No. 0000-0135-9000-R2, June 2017.

9. "Provide Allowable Values (AV) and Nominal Trip Setpoints (NTSP) for Various Setpoint Functions of the NUMAC PRNM System," Exelon Calculation No. PE-0251, Revision 4, July 2017.

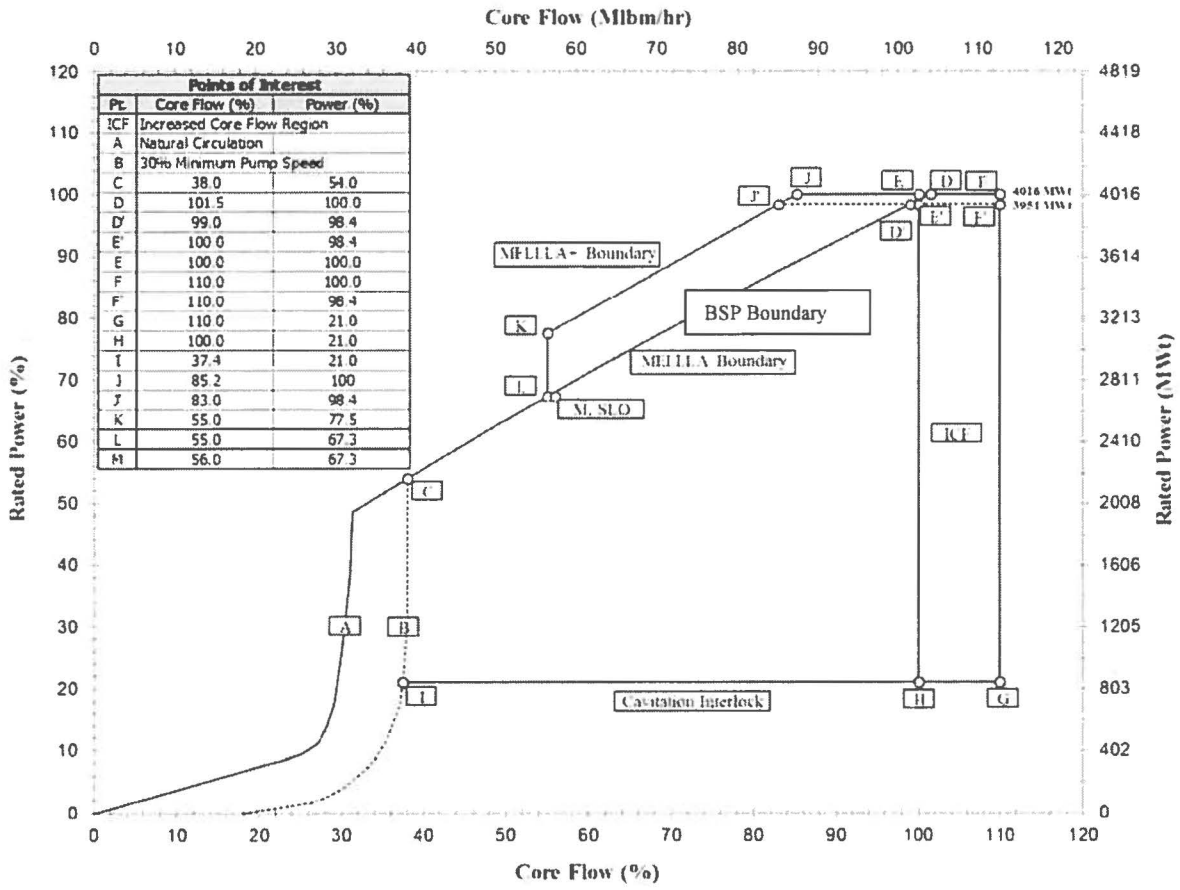
10. "Final Evaluation Report Exelon Nuclear Generating Company LLC Peach Bottom Units 2 & 3 TPO with EPU/MELLLA+ PCR E03: Asymmetric Feedwater Temperature Operation for TPO with EPU/MELLLA+," General Electric Hitachi Nuclear Energy Document No. 001N6733, Revision 2, Sept. 2017. This is searchable in EDMS as "PEAM-MUR-PCR-E03," Revision 0.

11. "Fuel Bundle Information Report for Peach Bottom Unit 3 Reload 22 Cycle 23," Global Nuclear Fuel Document No. 004N8288, Revision 0, August 2019.

12. "Final Resolved OPL-3 Parameters for Peach Bottom Unit 3 Cycle 23," Exelon TODI ENSAF ID# ES1900006, Revision 0, May 2019.

13. "PRIME-Based GNF2 LHGR Envelopes for Peach Bottom Atomic Power Station Units 2 and 3," Global Nuclear Fuel Document No. 004N7833-P, Revision 0, April 2018.

APPENDIX A
Power/Flow Operating Map for MELLLA+ with TPO
(Reference 6)



Points of Interest		
Pt.	Core Flow (%)	Power (%)
ICF	Increased Core Flow Region	
A	Natural Circulation	
B	30% Minimum Pump Speed	
C	38.0	54.0
D	101.5	100.0
D'	99.0	98.4
E'	100.0	98.4
E	100.0	100.0
F	110.0	100.0
F'	110.0	98.4
G	110.0	21.0
H	100.0	21.0
I	37.4	21.0
J	85.2	100
J'	83.0	98.4
K	55.0	77.5
L	55.0	67.3
M	56.0	67.3