

Technical Specification 6.9.1.f.4

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Subject: Core Operating Limits Report for Oyster Creek Cycle 20, Revision 0

Enclosed with this cover letter is the approved Oyster Creek Generating Station, Core Operating Limits Report for Oyster Creek Cycle 20, Revision 0. The report has been reviewed as required by the Oyster Creek Technical Specifications.

If any additional information is needed, please contact Dave Robillard at (610) 765-5952.

Very truly yours,

  
M. P. Gallagher  
Director - Licensing & Regulatory Affairs  
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Enclosure: Core Operating Limits Report for Oyster Creek Cycle 20, Revision 0

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**Core Operating Limits Report**  
**for**  
**Oyster Creek Cycle 20**  
**Revision 0**

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## 1. References

1. GNF Document, NEDE-31152P, Revision 8, "General Electric Fuel Bundle Design," April 2001.
2. GNF Document, 0000-0029-3151-SRLR, Revision 1, "Supplemental Reload Licensing Report for Oyster Creek Reload 20 Cycle 20," September 2004.
3. GNF Document, 0000-0029-3151-FBIR, Revision 0, "Fuel Bundle Information Report for Oyster Creek Reload 20 Cycle 20," October 2004.
4. "OPL3 Parameters for Oyster Creek Cycle 20 Transient Analysis", eDRF 0000-0026-5261, July 29, 2004.
5. Design Record File 20620.
6. GENE Document, NSA02-247, "Oyster Creek APRM Flow-Biased Setpoint Margin Between Scram and Rod Block for Stability Option II Adjustment", January 2002.
7. GPU Document, "Technical Evaluation of GE9B Fuel for Oyster Creek", TDR 1132, March 1994.
8. Passport EC 351429 (CAP O2004-2511)
9. Framatome ANP Document, "POWERPLEX-III Core Monitoring Software Specification", EMF-2469(P) Rev. 1.

## 2. Terms and Definitions

APLHGR	Average Planar Linear Heat Generation Rate
ARTS	APRM Rod Block Monitor Technical Specification (Improvement)
APRM	Average Power Range Monitor
BOC	Beginning of Cycle
BWROG	Boiling Water Reactor Owner's Group
Coastdown	Coastdown occurs when full power is not achievable with all rods out, maximum allowable core flow and feedwater temperature reduction, and equilibrium xenon
ELLLA	Extended Load Line Limit Analysis
EOC	End of Cycle
EOR	End of Rated Conditions (i.e., cycle exposure at 100% power, 100% flow, all-rods-out, all feedwater heaters in service and equilibrium xenon)
GNF	Global Nuclear Fuel
ICF	Increased Core Flow
ISOLATED	The recirculation loop suction, discharge and discharge bypass valves are in the closed position
K(f)	MCPR flow dependent multiplier (i.e., adjustment to the CPR limit when at core flows less than rated)
LHGR	Linear Heat Generation Rate
LPRM	Local Power Range Monitor
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
OOS	Out of Service
Option A	Option A refers to the Technical Specifications core average scram time speed that when applied results in a more restrictive MCPR limit
Option B	Option B refers to a specific core average scram time speed that when met allows the use of a lower MCPR limit
TIP	Traversing In Core Probe

### **3. General Information**

Oyster Creek is a non-ARTS plant. Therefore, there are no ARTS-based power or flow biased APLHGR, LHGR or CPR operating limits. There are, however, Oyster Creek specific flow biased CPR operating limits for operation at less than rated flow. The flow-biased limits are discussed in Section 5.1. Rated core flow is 61 Mlb/hr and operation up to 110.7% of rated is licensed for this cycle. Additionally, Oyster Creek utilizes an ELLLA operating domain which has expanded the power/flow map to allow for greater operational flexibility.

## 4. Average Planar Linear Heat Generation Rate

The MAPLHGR limits are discussed in Technical Specifications Section 3.10.A. The MAPLHGR limits for the lattices in each fuel type as a function of average planar exposure are given in Tables 4-1 through 4-10 for operation with zero ISOLATED RECIRCULATION LOOPS (Reference 2 and 5). For operation with one ISOLATED RECIRCULATION LOOP, multiply the limits in Tables 4-1 through 4-10 by the ISOLATED Loop multiplier listed in Table 4-11 (Reference 2).

**Table 4-1 MAPLHGR for bundle: GE9B-P8DWB348-12GZ-80U-145-T6**  
**PPLX Lattice #18, #23, #24, #25, #26, #27**  
**GNF Lattice #3792, #3791, 3790, #3789, #3118**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	10.88
0.20	10.88
1.10	10.98
5.50	11.30
8.80	11.28
11.00	11.19
13.80	11.11
16.50	10.79
19.30	9.76
22.00	9.66
27.60	9.61
38.60	9.39
49.60	9.45
60.60	9.35
71.70	9.37



**Table 4-2 MAPLHGR for bundle: GE9B-P8DWB338-11GZ-80U-145-T6**  
**PPLX Lattice #17, #18, #19, #20, #21, #22**  
**GNF Lattice #3734, #3788, 3787, #3786, #3785, #3118**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	10.93
0.20	10.93
1.10	11.03
5.50	11.37
8.80	11.29
11.00	11.11
13.80	11.11
16.50	10.68
19.30	9.72
22.00	9.61
27.60	9.60
38.60	9.39
49.60	9.43
60.60	9.36
71.70	9.44

**Table 4-3 MAPLHGR for bundle: GE11-P9HUB374-13GZ-100T-145-T6-2559**  
**PPLX Lattice #36, #35, #33, #31**  
**GNF Lattice #5542, #5540, #5544, #5545**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	9.64
0.20	9.64
1.10	9.75
5.50	9.65
11.00	9.49
16.50	9.47
22.00	9.03
27.60	8.28
38.60	8.04
49.60	7.99
60.60	8.15
71.70	8.19

**Table 4-4 MAPLHGR for bundle: GE11-P9HUB374-13GZ-100T-145-T6-2559**  
**PPLX Lattices #32, #34**  
**GNF Lattices #5541, #5543**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	9.83
0.20	9.83
1.10	9.75
5.50	9.65
11.00	9.60
16.50	9.44
22.00	9.04
27.60	8.24
38.60	8.02
49.60	7.98
60.60	8.14
71.70	8.19

**Table 4-5 MAPLHGR for bundle: GE11-P9HUB369-12GZ-100T-145-T6-2560**  
**PPLX Lattices #43, #41, #45, #46**  
**GNF Lattices #5547, #5540, #5544, #5549**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	10.10
0.20	10.10
1.10	10.07
5.50	9.89
11.00	9.71
16.50	9.61
22.00	9.06
27.60	8.31
38.60	8.11
49.60	8.09
60.60	8.27
71.70	8.32

**Table 4-6 MAPLHGR for bundle: GE11-P9HUB369-12GZ-100T-145-T6-2560**  
**PPLX Lattices #42, #44**  
**GNF Lattices #5546, #5548**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	10.07
0.20	10.07
1.10	10.02
5.50	9.96
11.00	9.76
16.50	9.63
22.00	9.09
27.60	8.31
38.60	8.12
49.60	8.10
60.60	8.28
71.70	8.34

**Table 4-7 MAPLHGR for bundle: GE11-P9HUB363-12GZ-100T-145-T6-2817**  
**PPLX Lattices #3, #1**  
**GNF Lattices #6783, #6785**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	9.98
0.20	9.98
1.10	10.11
5.50	10.00
11.00	9.79
16.50	9.69
22.00	9.07
27.60	8.27
38.60	8.16
49.60	8.13
60.60	8.31
71.70	8.36

**Table 4-8 MAPLHGR for bundle: GE11-P9HUB363-12GZ-100T-145-T6-2817**  
**PPLX Lattices #2, #8, #9, #10**  
**GNF Lattices #6784, #6782, #6786, #6787**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	10.04
0.20	10.04
1.10	10.10
5.50	9.94
11.00	9.73
16.50	9.43
22.00	9.08
27.60	8.29
38.60	8.15
49.60	8.13
60.60	8.09
71.70	8.36

**Table 4-9 MAPLHGR for bundle: GE11-P9HUB364-14GZ-100T-145-T6-2818**  
**PPLX Lattices #7, #5**  
**GNF Lattices #6788, #6790**

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	9.96
0.20	9.96
1.10	9.97
5.50	9.85
11.00	9.73
16.50	9.57
22.00	9.03
27.60	8.26
38.60	8.10
49.60	8.05
60.60	8.23
71.70	8.29

**Table 4-10 MAPLHGR for bundle: GE11-P9HUB364-14GZ-100T-145-T6-2818**  
**PPLX Lattices #6, #11, #12, #4**  
**GNF Lattices #6789, #6782, #6791, #6792**

<b>Avg. Planar Exposure (GWd/MT)</b>	<b>MAPLHGR (kW/ft)</b>
0.00	9.93
0.20	9.93
1.10	9.91
5.50	9.85
11.00	9.62
16.50	9.61
22.00	9.04
27.60	8.26
38.60	8.10
49.60	8.08
60.60	8.25
71.70	8.31

**Table 4-11 MAPLHGR Multiplier with One ISOLATED Loop**

<b>Fuel Type</b>	<b>Isolated Loop Multiplier</b>
GE9B	0.98
GE11	0.98

## 5. Minimum Critical Power Ratio

The MCPR limits are discussed in Technical Specifications Section 3.10.C.

### 5.1. Manual Flow Control MCPR Limits

The flow adjusted MCPR is determined by multiplying the applicable rated condition MCPR limit shown in Table 5-1 or 5-2 by the applicable MCPR multiplier,  $K(f)$ , given in Table 5-3 or Table 5-4. The MCPR values are documented in Reference 2 while the  $K(f)$  multipliers are documented in Reference 1. The appropriate  $K(f)$  value may be determined by linear interpolation. A low flow correction factor is applied to the  $K(f)$  value for GE9 fuel (Table 5-3). The low flow correction factor does not apply to GE11 fuel (Table 5-4). The low flow correction factor applied to  $K(f)$  was obtained from Reference 7.

### 5.2. Scram Time

Core average scram insertion times are determined per Technical Specifications 3.2. Based on the results of the scram time surveillance testing and calculation of the core average insertion time, a MCPR limit is chosen from Table 5-1 or Table 5-2. If the core average scram insertion time does not meet the Option B criteria, but has met Option A criteria, then the appropriate MCPR value may be determined from a linear interpolation between the Option A and B limits with standard mathematical rounding to two decimal places.

Table 5-1 MCPR Limit for Four or Five Recirculation Loops in Service

Option	Cycle Exposure	
	BOC to EOR-2205 MWD/MT	$\geq$ EOR-2205 MWD/MT to EOC
A	1.47	1.51
B	1.36	1.40

Table 5-2 MCPR Limit for Three Recirculation Loops in Service

Option	Cycle Exposure	
	BOC to EOR-2205 MWD/MT	$\geq$ EOR-2205 MWD/MT to EOC
A	1.49	1.53
B	1.38	1.42

**Table 5-3 GE9B K(f) Multiplier<sup>1</sup>**

Flow (% rated)	K(f)
120.0	1.00
100.0	1.00
90.0	1.00
80.0	1.05
70.0	1.09
60.0	1.13
50.0	1.18
40.0	1.22
30.0	1.33

**Table 5-4 GE11 K(f) Multiplier<sup>2</sup>**

Flow (% rated)	K(f)
120.0	1.00
100.0	1.00
90.0	1.00
80.0	1.05
70.0	1.09
60.0	1.13
50.0	1.18
40.0	1.22
30.0	1.28

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<sup>1</sup> Table 5-3 incorporates a required low flow correction multiplier

<sup>2</sup> Table 5-4 does not require a low flow correction multiplier

## 6. Linear Heat Generation Rate

The LHGR limits are discussed in Technical Specifications Section 3.10.B. The maximum LHGR shall not exceed the LHGR limits as specified in Reference 3. The maximum values at beginning of life are a function of fuel type; these values are 13.4 (kW/ft) for GE9B fuel (Reference 3) and 12.0 (kW/ft) for GE11 fuel (Reference 3). The exposure dependent LHGR limits are contained in Reference 3 for both GE9B fuel and GE11 fuel.

## 7. Stability Protection Settings

The stability protection settings are discussed in Technical Specifications 2.3. Oyster Creek utilizes the BWROG Option II solution in the licensing stability calculations for Oyster Creek. Table 7-1 provides the analytical limit equations for APRM based stability protection settings and related Control Rod Block settings to support Option II implementation (Reference 2 and Reference 6).

**Table 7-1 OPTION II Stability Protection Settings**

Technical Specification 2.3.A.1 Neutron Flux, Scram - APRM

For  $W \leq 27.5 \times 10^6 \text{ lb / hr}$ :

$$S \leq (1.433 \times 10^{-6}) W + 24.8$$

where:

S = setting in percent of rated power

W = recirculation flow (lb/hr)

Technical Specification 2.3.B Neutron Flux, Control Rod Block

For  $W \leq 27.5 \times 10^6 \text{ lb / hr}$ :

$$S \leq (1.433 \times 10^{-6}) W + 17.5$$

where:

S = setting in percent of rated power

W = recirculation flow (lb/hr)



## 8. Modes of Operation

The allowed Modes of Operation are as described below:

Options <sup>1,3</sup>	Operating Region		
	Standard	ELLLA	ICF <sup>2</sup>
Five-loop Operation, Option A or B	Yes	Yes	Yes
Four-loop Operation, Option A or B	Yes	Yes	Yes
Three-loop Operation, Option A or B	Yes	Yes	Yes
Main Steam Line OOS <sup>4</sup>	Yes	Yes	Yes
TIP OOS <sup>5</sup>	Yes	Yes	Yes

<sup>1</sup> Each operational mode may be combined with up to a 100°F reduction in feedwater temperature (Final Feedwater Temperature Reduction or Feedwater Heaters OOS) at any point in the cycle.

<sup>2</sup> Operation up to 67.5 Mlb/hr core flow is licensed for this cycle.

<sup>3</sup> Each operational mode may be coincident with coastdown operation. The minimum coastdown power level is 40%.

<sup>4</sup> Reference 8 documents the Main Steam Line OOS condition.

<sup>5</sup> Reference 9 documents the allowance of TIP machines OOS.

## 9. Methodology

1. GNF Document, NEDE-31462P, "Oyster Creek NGS SAFER/CORECOOL/GESTR-LOCA Loss-of-Coolant Accident Analysis," August 1987.
2. GNF Document, NEDE-24011-P-A-14 and Supplement NEDE-24011-P-A-14-US, "General Electric Standard Application for Reload Fuel," June 2000.
3. GNF Document, NEDC-33065P, Rev. 0, "Application of Stability Long-Term Solution Option II for Oyster Creek," April 2002.