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An Exelon Company

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10CFR50.36

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

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Issuance of the Core Operating Limits Report for Clinton Power Station, Unit 1, Cycle 11

In accordance with Technical Specification 5.6.5, "Core Operating Limits Report (COLR)," Item d., AmerGen Energy Company (AmerGen), LLC is submitting the COLR for Clinton Power Station, Unit 1, Cycle 11.

Should you have any questions concerning this report, please contact Mr. Bill Iliff, Regulatory Assurance Manager, at (217) 937-2800.

Respectfully,

Robert S. Bement
Site Vice President
Clinton Power Station

JLP/blf

Attachment

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Clinton Power Station

A001

CORE OPERATING LIMITS REPORT

FOR

CLINTON POWER STATION UNIT 1 CYCLE 11

Prepared By: _____ Giuseppe Rubinaccio Date: 1/31/06

Reviewed By: _____ William P. Gassmann Date: 1/31/06

Approved By: _____ James J. Tusar Date: 1-31-06

Station Qualified Reviewer By: _____ Date: 2/1/06

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1.0 Terms and Definitions

Base Case	A case analyzed with two (2) Safety-Relief Valves Out-of-Service (OOS), one (1) ADS valve OOS, and up to a 50°F feedwater temperature reduction (FWTR includes feedwater heater OOS or final feedwater temperature reduction) at any point in the cycle operation in Dual Loop mode (Reference 3).
Coastdown	The reactor condition where thermal power gradually decreases due to fuel depletion while the following conditions are met: 1) all operable control rods are fully withdrawn and 2) all cycle extension techniques have been exhausted including FFWTR and ICF.
DLO	Dual Reactor Recirculation Loop Operation
FFWTR	Final Feedwater Temperature Reduction
FWHOOS	Feedwater Heaters Out of Service
ICF	Increased Core Flow
LHGR	Linear Heat Generation Rate
LHGRFAC(F)	LHGR thermal limit flow dependent adjustments and multipliers
LHGRFAC(P)	LHGR thermal limit power dependent adjustments and multipliers
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MCPR(P)	MCPR thermal limit power dependent adjustments and multipliers
MCPR(F)	MCPR thermal limit flow dependent adjustments and multipliers
OLMCPR	Operating Limit Minimum Critical Power Ratio
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Reactor Recirculation Loop Operation

2.0 General Information

This report is prepared in accordance with Technical Specification 5.6.5 of Reference 1. Power and flow dependent limits are listed for various power and flow levels. Linear interpolation is to be used to find intermediate values.

The data presented in this report is valid for all licensed operating domains on the operating map, including:

- Maximum Extended Load Line Limit down to 99% of rated core flow during full power operation
- Increased Core Flow (ICF) up to 107% of rated core flow
- Final Feedwater Temperature Reduction (FFWTR) up to 50°F during cycle extension operation
- Feedwater Heater Out of Service (FWHOOS) up to 50°F feedwater temperature reduction at any time during the cycle prior to cycle extension.

3.0 MAPLHGR Limits

3.1 Technical Specification Reference:

Sections 3.2.1 and 3.4.1.

3.2 Description:

Table 3-1 is used to determine the maximum average planar linear heat generation rate (MAPLHGR) limit for each fuel type. Limits listed in Table 3-1 are for dual reactor recirculation loop operation (DLO).

For single reactor recirculation loop operation (SLO), the MAPLHGR limits given in Table 3-1 must be multiplied by a SLO MAPLHGR multiplier provided in Table 3-2. The SLO MAPLHGR multiplier for GE14 fuel is 0.76 (Reference 3).

Table 3-1
MAPLHGR for all GE14C Fuel[1]
(Reference 3 and 13)

Avg. Planar Exposure (GWd/ST)	MAPLHGR Limit (kW/ft)
0.00	12.82
14.51	12.82
19.13	12.82
57.61	8.00
63.50	5.00

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

Fuel Type	MAPLHGR SLO Multiplier
GE14C	0.76

[1] Linear interpolation should be used for points not listed in Table 3-1.

4.0 MCPR Limits

4.1 Technical Specification Reference:

Sections 3.2.2 and 3.4.1

4.2 Description:

The various MCPR limits are described below.

4.2.1 Manual Flow Control MCPR Limits

The Operating Limit MCPR (OLMCPR) is determined from either section 4.2.1.1 or 4.2.1.2, whichever is greater at any given power and flow condition.

4.2.1.1 Power-Dependent MCPR

For operation less than or equal to 33.3% core thermal power, the OLMCPR as a function of core thermal power is shown in Table 4-2. For operation at greater than 33.3% core thermal power, the OLMCPR as a function of core thermal power is determined by multiplying the applicable rated condition OLMCPR limit shown in Table 4-1 by the applicable MCPR multiplier K(P) given in Table 4-2.

4.2.1.2 Flow-Dependent MCPR

Tables 4-3 through 4-4 give the MCPR(F) as a function of flow based on the applicable plant condition. The limits for dual loop operation are listed in Tables 4-3. The limits for single loop operation are listed in Tables 4-4. The MCPR(F) determined from these tables is the flow dependent OLMCPR.

4.2.2 Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

4.2.3 Option A and Option B

Option A and Option B refer to use of scram speeds for establishing MCPR operating limits.

Option A scram speed is the BWR/6 Technical Specification scram speed. The Technical Specification scram speeds must be met to utilize the Option A MCPR limits. Reload analyses performed by GNF for Cycle 11 Option A MCPR limits utilized a 20% core average insertion time of 0.516 seconds (Reference 15).

To utilize the MCPR limits for the Option B scram speed, the cycle average scram insertion time for 20% insertion must satisfy equation 2 in Reference 5 Section 4. If the cycle average scram insertion time does not meet the Option B criteria, the appropriate MCPR value may be determined from a linear interpolation between the Option A and B limits as specified by equation 4 in Reference 5 Section 4.

4.2.4 Recirculation Flow Control Valve Settings

Cycle 11 was analyzed with a maximum core flow runout of 109%; therefore the recirculation flow control valve must be set to maintain core flow less than 109% (92.105 Mlb/hr) for all runout events (Reference 14).

Table 4-1
Operating Limit Minimum Critical Power Ratio
(Reference 3)

EOOS Combination	Option B All exposures	Option A All exposures
Base Case	1.28	1.30
Base Case SLO	1.31	1.33

Table 4-2
Power Dependent MCPR Limit Adjustments and Multipliers MCPR(P)
(Reference 7 and 11)

EOOS Combination	Core Flow (% of Rated)	MCPR(P)			Core Thermal Power (%) K(P)				
		0	21.6	≤33.3	>33.3	≤43	≤70	>70	100
Base Case	≤ 50	2.20	2.20	1.97	1.351	1.313	1.212	1.15	1.00
	> 50	2.46	2.46	2.17					
Base Case SLO	≤ 50	2.23	2.23	2.00	1.351	1.313	1.212	1.15	1.00
	> 50	2.49	2.49	2.20					

Notes for Table 4-2:

1. Values are interpolated between relevant power levels.
2. Allowable EOOS conditions are listed in Section 8.

Table 4-3
Flow Dependent MCPR Limits MCPR(F)[1]
(Reference 7 and 11)

Core Flow (% rated)	MCPR(F)
0	1.8755
25	1.6954
93.78	1.20
109	1.20

Table 4-4
Single Loop Operation (SLO) Flow Dependent MCPR Limits MCPR(F)[2]
(Reference 7 and 11)

Core Flow (% rated)	MCPR(F)
0	1.9055
25	1.7254
93.78	1.23
109	1.23

1 Linear interpolation should be used for points not listed in Table 4-3.
2 Linear interpolation should be used for points not listed in Table 4-4.

5.0 Linear Heat Generation Rate Limits

5.1 Technical Specification Reference:

Section 3.2.3 and 3.4.1.

5.2 Description:

The linear heat generation rate (LHGR) limit is the product of the exposure dependent LHGR limit (from Table 5-1 for UO2 fuel rods and Tables 5-2 for Gadolinia fuel rods) and the minimum of: the power dependent LHGR Factor, LHGRFAC(P), the flow dependent LHGR Factor, LHGRFAC(F), or the single loop operation (SLO) multiplication factor if applicable. The LHGRFAC(P) is determined from Table 5-3. The LHGRFAC(F) is determined from Table 5-4. The SLO multiplication factor can be found in Table 5-5. Tables 5-1 and 5-2 are the LHGR limit as a function of peak pellet exposure.

The Gadolinia fuel rod limits in Tables 5-2 are the most limiting Gadolinia fuel rods. The most limiting values are provided here as a convenience and do not imply that all the Gadolinia fuel rods must satisfy the listed values.

For Loss of 'FULL' Feedwater Heating (±10 °F of design NORMAL temperature), LHGRFAC(P) is determined from Table 5-6 and LHGRFAC(F) is determined from Table 5-7. Concurrent operation with SLO and reduced feedwater heating has not been evaluated and thus not a valid operating mode. (Reference 3, 7, 8, 9 and 10)

Table 5-1
Linear Heat Generation Rate Limits for UO_2 Rods [1]
(Reference 4 and 12)

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

[1] Linear interpolation should be used for points not listed in Table 5-1. The values listed in Table 5-1 are limiting for all bundle types.

Table 5-2
Linear Heat Generation Rate Limits for Gad Rods [1]
(Reference 4 and 12)

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

Table 5-3
Power Dependent LHGR Multiplier LHGRFAC(P) [2]
(Reference 7 and 11)

EOOS Combination	Core Flow (%)	Core Thermal Power (% Rated)				
		0	21.6	≤ 33.3	>33.3	100
		LHGRFAC(P)				
Base Case	≤ 50	0.634	0.634	0.689	0.689	1.000
	> 50	0.572	0.572	0.600		
Base Case SLO	≤ 50	0.634	0.634	0.689	0.689	1.000
	> 50	0.572	0.572	0.600		

Table 5-4
Flow Dependent LHGR Multiplier LHGRFAC(F) [3]
(Reference 7 and 11)

Core Flow (% rated)	LHGRFAC(F)
0.00	0.443
25.00	0.612
30.00	0.646
82.18	1.00
107.00	1.00

1 Linear interpolation should be used for points not listed in Table 5-2. The values listed in Table 5-2 are limiting for all bundle types.
2 Linear interpolation should be used for points not listed in Table 5-3.
3 Linear interpolation should be used for points not listed in Table 5-4.

Table 5-5
LHGR Single Loop Operation (SLO) Reduction Factor
(Reference 3)

Fuel Type	LHGR SLO Multiplier
GE14C	0.76

Table 5-6
Power Dependent LHGR Multiplier LHGRFAC(P)
(Loss of 'FULL' Feedwater Heating)[1]
(Reference 7, 8, 9, 10 and 11)

EOOS Combination	Core Flow	Core Thermal Power (% Rated)				
		0	21.6	≤ 33.3	> 33.3	100
		LHGRFAC(P)				
Base Case	≤ 50	0.627	0.627	0.682	0.682	0.99
	> 50	0.566	0.566	0.594		
Base Case SLO						

Table 5-7
Flow Dependent LHGR Multiplier LHGRFAC(F)
(Loss of 'FULL' Feedwater Heating)[2]
(Reference 7, 8, 9, 10 and 11)

Core Flow (% rated)	LHGRFAC(F)
0.00	0.438
25.00	0.606
30.00	0.639
82.18	0.99
107.00	0.99

[1] Linear interpolation should be used for points not listed in Table 5-6.

[2] Linear interpolation should be used for points not listed in Table 5-7.

6.0 Reactor Protection System (RPS) Instrumentation

6.1 Technical Specification Reference:

Section 3.3.1.1

6.2 Description:

The Average Power Range Monitor (APRM) simulated thermal power time constant, shall be between 5.4 seconds and 6.6 seconds (Reference 15).

7.0 Stability Protection Setpoints

The Clinton 1 Cycle 11 OPRM Period Based Detection Algorithm (PBDA) Trip Setpoints for the OPRM System for use in Technical Specification 3.3.1.3 are found in Table 7-1. These values are based on the cycle specific analysis documented in Reference 3.

Any change to the OLMCPR value and/or ARTS-based power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA Trip Setpoints.

The OPRM PBDA Trip Setpoints are applicable when the associated Technical Specification (TS Table 3.3.1.3) is implemented.

Table 7-1
OPRM PBDA Trip Setpoints
(Reference 3)

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
1.13	15

8.0 Modes Of Operation

The Allowed Modes of Operation with combinations of Equipment Out-of-Service (EOOS) are as described below:

Table 8-1
Modes of Operation
(Reference 3)

	Operating Region				
EOOS Options[1,2]	Standard	MELLLA	ICF[3]	FWTR[4]	Coastdown
Base Case, Option A	Yes	Yes	Yes	Yes	Yes
Base Case SLO[4], Option A	Yes	No	No	No	Yes
Base Case, Option B	Yes	Yes	Yes	Yes	Yes
Base Case SLO[4], Option B	Yes	No	No	No	Yes

Notes:
1. A single Main Steam Isolation Valve (MSIV) may be taken OOS (shut) under any one OOS Option so long as core thermal power is maintained ≤75% of 3473 MWt (Reference 3).
2. Pressure Regulator Out-Of-Service (PROOS) was evaluated for thermal limits only in dual loop mode with up to 50°F feedwater temperature reduction at any point in the cycle (Reference 3). PROOS has **not** been evaluated for Balance of Plant operation.
3. The maximum ICF flow utilized in licensing analysis is 107.0% (Reference 3).
4. Concurrent operation with SLO and Loss of 'FULL' Feedwater Heating (±10°F of design NORMAL temperature) or FWTR has not been evaluated and thus not a valid operating mode. (Reference 3, 7, 8, 9 and 10)

9.0 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 document:

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

10.0 References

1. Technical Specifications for Clinton Power Station Unit 1, Docket No. 50-461, License No. NPF-62, Core Operating Limits Report (COLR).

2. General Electric Standard Application for Reactor Fuel (GESTAR II) and US supplement, NEDE-24011-P-A-14, June 2000.

3. Document 0000-0038-3490SRLR Revision 1, "Supplemental Reload Licensing Report for Clinton Power Station Unit 1 Reload 10 Cycle 11", January 2006.

4. Document 0000-0000-0038-3490FBIR Revision 0, "Fuel Bundle Information Report for Clinton Power Station Unit 1 Reload 10 Cycle 11", December 2005

5. Document GE-NE-0000-0000-7456-01P, "Option B Scram Times For Clinton Power Station", February 2002

6. NEDC-32694P-A, "Power Distribution Uncertainties for Safety Limit MCPR Evaluations," August 1999.

7. GE-NE-0000-0042-4570-R0, "Clinton Offrated Analyses Below the PLU Power Level," September 2005.

8. Calculation GENE-0000-0030-8309, "Clinton Assessment of Feedwater Riser Flow Deviation," Rev. 0.

9. EC 355034 R0, "Feedwater Riser Flow Deviation Assessment"

10. EC 354185 R0, "Uncertainty in Feedwater Temperature for Two Loop and Single Loop Operation"

11. GE-NE-0000-0026-1857-R0, " Evaluation of Operation With Equipment Out-Of-Service for the Clinton Power Station", May 7, 2004

12. Document 0000-0000-0016-5277FBIR Revision 0, "Fuel Bundle Information Report for Clinton Power Station Unit 1 Reload 9 Cycle 10", December 2003

13. Document 000-0016-5277SRLR Revision 1, "Supplemental Reload Licensing Report For Clinton Power Station Unit 1 Reload 9 Cycle 10"

14. TODI NF0500144 Revision 0, "Clinton Unit 1 Cycle 11 FRED Form Exelon Approval"

15. TODI CPS-05-011 Revision 0, "Clinton: Cycle-11, OPL3 Customer Proposed Values", August 2005