Exelon Generation®

Technical Specification 6.6.5

NMP1L 3143
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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-001

Nine Mile Point Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-63
NRC Docket No. 50-220

Subject: Nine Mile Point, Unit 1, Core Operating Limits Report

Enclosed is a copy of the Core Operating Limits Report, Cycle 23, Revision 3 for Nine Mile Point Unit 1 (NMP1). This report is being submitted pursuant to NMP1 Technical Specification 6.6.5.d.

Should you have any questions regarding the information in this submittal, please contact me at (315) 349-5219.

Sincerely,

Dennis M. Moore
Regulatory Assurance Manager, Nine Mile Point Nuclear Station
Exelon Generation Company, LLC

DMM/RSP

Enclosure: Core Operating Limits Report for Nine Mile Point Unit 1 Cycle 23, Revision 3

cc: NRC Regional Administrator, Region I
NRC Project Manager
NRC Senior Resident Inspector

A001
NRR

CORE OPERATING LIMITS REPORT

FOR

NINE MILE POINT NUCLEAR STATION

UNIT 1 RELOAD 24 CYCLE 23

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Record of COLR Nine Mile Point 1 Cycle 23 Revisions

Revision	Description
Rev. Number – 3	New Issuance for Cycle 23

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1.0 Terms and Definitions

APRM	Average Power Range Monitor
ARTS	APRM, Rod Block, and Technical Specification Improvement Program
ELLLA	Extended Load Line Limit Analysis
EOOS	Equipment Out of Service
EOR	End of Rated. The cycle exposure at which reactor power is equal to rated thermal power with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.
FWP Combination 1	Feedwater Pump Combination 1 as defined in Reference 9 Attachment 13 Section 4.0 - one TDFWP in service AND one MDFWP in service. This bounds TDFWP in service OR one MDFWP in service OR two MDFWPs in service.
FWP Combination 2	Feedwater Pump Combination 2 as defined in Reference 9 Attachment 13 Section 4.0 - TDFWP in service AND two MDFWPs in service.
K_P	Off-rated power dependent OLMCPR multiplier
K_F	Off-rated flow dependent OLMCPR multiplier
LHGR	Linear Heat Generation Rate
$LHGRFAC_F$	Off-rated LHGR flow dependent thermal limit multipliers
$LHGRFAC_P$	Off-rated LHGR power dependent thermal limit multipliers
$MAPFAC_F$	Off-rated flow dependent MAPLHGR multiplier
$MAPFAC_P$	Off-rated power dependent MAPLHGR multiplier
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
$MCPR_F$	Off-rated flow dependent OLMCPR
$MCPR_P$	Off-rated power dependent OLMCPR
MDFWP	Motor Driven Feedwater Pump
OLMCPR	Operating Limit Minimum Critical Power Ratio
PROOS	Pressure Regulator Out of Service
RTP	Rated Thermal Power
TDFWP	Turbine Driven Feedwater Pump

2.0 General Information

This report provides the following cycle-specific parameter limits for Nine Mile Point Nuclear Station Unit 1 Cycle 23:

- Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
- MAPLHGR four and three recirculation loop operation multipliers
- Operating Limit Minimum Critical Power Ratio (OLMCPR)
- Three recirculation loop operation MCPR adjustment
- MCPR thermal limit adjustments and multipliers ($MCPR_P$, $MCPR_F$, K_P, K_F)
- Linear Heat Generation Rate (LHGR)
- LHGR thermal limit multipliers ($LHGRFAC_P$)
- Limiting Power / Flow Line

This report is prepared in accordance with Technical Specification 6.6.5 of Reference 1 Appendix A. Power and flow dependent limits are listed for various power and flow levels. Linear interpolation is to be used to find intermediate values. Nine Mile Point Unit 1 is a non-ARTS plant that utilizes ELLLA operating domain.

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

- Extended Load Line Limit down to the minimum licensed core flow (i.e., 85.0% of rated) during full power operation,
- Rated core flow of 67.5 Mlb/hr,
- End-of-cycle coastdown to a minimum power level of 40% of rated thermal power,
- Feedwater temperature of no more than -10°F off nominal is licensed for this cycle.

Further information on the cycle-specific analyses for Nine Mile Point Unit 1 Cycle 23 and the associated operating domains discussed above is available in Reference 2.

3.0 MAPLHGR Limits

3.1 Technical Specification

3.1.7.a, 3.1.7.e , 6.6.5.a.1

3.2 Description

The MAPLHGR limits for each bundle type as a function of average planar exposure is given in Table 3-1. For reduced loop operation, a fuel type dependent multiplier is used, which is shown in Table 3-2. For operation with either four or three recirculation loops in service, multiply the values shown in Table 3-1 by the GNF2 value in Table 3-2. The power and flow dependent multipliers for MAPLHGR have been removed and replaced with $LHGRFAC_P$ and $LHGRFAC_F$; therefore, $MAPFAC_P$ and $MAPFAC_F$ are equal to 1.0 for all power and flow conditions (Reference 10 – Section 2). $LHGRFAC_P$ and $LHGRFAC_F$ are addressed in Section 5.0.

Table 3-1
MAPLHGR Versus Average Planar Exposure – GNF2[1]:
(Reference 2 – Section 16.3)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit[1] (kW/ft)
0.00	9.85
13.61	9.85
16.33	9.50
25.40	9.50
29.94	9.00
41.10	9.00
57.15	6.96

Table 3-2
MAPLHGR Multiplier for Four and Three Recirculation Loop Operation
(Reference 2 – Section 16.3)

Fuel Type	Four and Three Loop Operation Multiplier
GNF2	1.00

[1] These MAPLHGRs are lattice independent.

4.0 MCPR Limits

4.1 Technical Specification

3.1.7.c, 3.1.7.e, 6.6.5.a.2, 6.6.5.a.3

4.2 Description

The OLMCPR is determined for a given power and flow condition by evaluating the power dependent MCPR and the flow dependent MCPR and selecting the greater of the two. Tables 4-1 and 4-2 originate in Reference 2 and are valid for all Cycle 23 operating domains. Nine Mile Point Unit 1 Cycle 23 has a mid-cycle MCPR breakpoint, as defined in Table 4-1. Note that PROOS has no effect on the base OLMCPRs in Table 4-1; however there are PROOS K_P multipliers in Table 4-3.

For three loop recirculation, the adder presented in Table 4-2 must be applied to all limits in Table 4-1 and $MCPR_P$ in Table 4-3.

The power dependent MCPR limits are presented in Table 4-3 and are valid for all GNF2 bundles. Below 45% rated thermal power, the $MCPR_P$ limits in Table 4-3 are applied directly; at or above 45% power, the K_P multiplier is applied to the OLMCPR from Table 4-1. The appropriate $MCPR_P$ or K_P value may be determined by linear interpolation for statepoints not explicitly listed.

The flow adjusted OLMCPR is determined by multiplying the applicable rated condition OLMCPR provided by Table 4-1 (and as affected by Table 4-2) by the applicable K_F multiplier given in Table 4-4. The appropriate K_F value may be determined by linear interpolation.

Table 4-1
Operating Limit Minimum Critical Power Ratio (OLMCPR)
(GNF2, Four/Five Recirculation Loop Operation)
(Reference 2 – Section 11)

Feedwater Pump Combination[2]	SCRAM Time Option[3]	Cycle Exposure	
		< EOR – 2037 MWd/ST	≥ EOR - 2037 MWd/ST
FWP Combination 1	B	1.48	1.53
	A	1.58	1.63
FWP Combination 2	B	1.52	1.57
	A	1.62	1.67

[2] OLMCPR values are independent of pressure regulator in-service or out-of service conditions.
[3] For tau (τ) = 0, use SCRAM Time Option B limits. For (τ) = 1, use SCRAM Time Option A limits. When tau does not equal 0 or 1, use linear interpolation. Tau is defined as:

$$\tau = \frac{(\tau_{ave} - \tau_B)}{(\tau_A - \tau_B)} \text{ where} \qquad \text{(Ref. 7 – Item 2)}$$

τ_A = 0.868 seconds, control rod average scram insertion time limit to notch 39 (Ref. 1 Appendix A–T.S. 3.1.1.c.1)

$$\tau_B = 0.672 + 1.65 \cdot \sqrt{\frac{N_1}{\sum_{i=1}^{n} N_i}} \cdot 0.016 \qquad \text{(Ref. 3 - Table 6-11, Ref. 6 – Item 1.2.K, Ref. 7 – Item 2)}$$

$$\tau_{ave} = \left(\frac{\sum_{i=1}^{n} N_i \tau_i}{\sum_{i=1}^{n} N_i} \right)$$

where n = number of surveillance tests performed in cycle; N_i = number of active control rods measured in the i^{th} surveillance test; τ_i = average scram time to notch 39 of all rods measures in the i^{th} surveillance test; and N_1 = total number of active rods measured.

Table 4-2
MCPR Adder for Three Recirculation Loop Operation
(GNF2)
(Reference 2 – Footnote 7)

Three Recirculation Loop Operation Adder	0.03

Table 4-3
Power Dependent MCPR Limits and Multipliers, $MCPR_P$ and K_P
(GNF2)
(Reference 2 – Appendix D)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of Rated)							
		0	25	< 45	≥ 45	65	≤ 85	> 85	100
		Operating Limit MCPR, $MCPR_P$			Operating Limit MCPR Multiplier, Kp				
FWP Combination 1	≤ 60	3.24	3.24	2.30	1.349	1.216	1.133	1.133	1.000
	> 60	3.34	3.34	2.77					
FWP Combination 2	≤ 60	3.24	3.24	2.30	1.349	1.216	1.133	1.133	1.000
	> 60	3.34	3.34	2.77					
PROOS[4]	≤ 60	3.24	3.24	2.30	1.553	1.336	1.198	1.133	1.000
	> 60	3.34	3.34	2.77					

Table 4-4
Flow Dependent Operating Limit MCPR Multiplier, K_F
(GNF2)
(Reference 2 – Appendix D)

Flow (% rated)	MCPR Multiplier, K_F[5]
0.0	1.500
≤45.0	1.500
>45.0	1.132
75.0	1.000
102.5	1.000

[4] Limits apply to PROOS coincident with FWP Combination 1 or 2.
[5] Values are applicable up to a Maximum Runout Flow of 102.5% of rated. Values apply to operation in either FWP Combination 1 or 2 with or without Pressure Regulator in-service.

5.0 LHGR Limits

5.1 Technical Specification

3.1.7.b, 6.6.5.a.4

5.2 Description

The Linear Heat Generation Rate for all fuel bundles shall not exceed the LHGR limits presented in Tables 5-1 and 5-2 nor 11 kW/ft[6]. Linear interpolation should be used for points not listed in Appendix B of Reference 4. Power adjusted LHGR limits are required for operation with PROOS at greater than or equal to 45% RTP. Below 45% RTP, no additional limits are required. These power dependent LHGR multipliers ($LHGRFAC_P$) are provided in Table 5-3 for Option B and Option A scram times and are applicable to GNF2 (Reference 2). The power adjusted LHGR is determined by multiplying the applicable LHGR limit by the LHGR multiplier, $LHGRFAC_P$. The $LHGRFAC_P$ curves are independent of recirculation loop operability. The appropriate $LHGRFAC_P$ values may be determined by linear interpolation. Flow dependent LHGR multipliers ($LHGRFAC_F$) are not required (Reference 2).

Table 5-1
Linear Heat Generation Rate Limits – UO_2 Rods
(Reference 4)

Fuel Type	LHGR
GNF2	See Table B-3 of Reference 4

Table 5-2
Linear Heat Generation Rate Limits – Gadolinia Rods
(Reference 4)

Fuel Type	LHGR
GNF2	See Table B-4 of Reference 4

Table 5-3
Power Dependent LHGR Multiplier $LHGRFAC_P$ for PROOS
(GNF2)
(Reference 2 – Appendix D)

Scram Time Option	Core Thermal Power (% of rated)					
	0	<45	≥45	65	85	100
Option A (i.e. $\tau > 0$)	1.000	1.000	0.518	0.518	0.636	1.000
Option B	1.000	1.000	0.737	0.867	0.987	1.000

[6] The GNF2 LHGR limit has been set down to a maximum value of 11 kW/ft for Emergency Procedure Guidelines (EPG) requirements.

6.0 Limiting Power/Flow Line

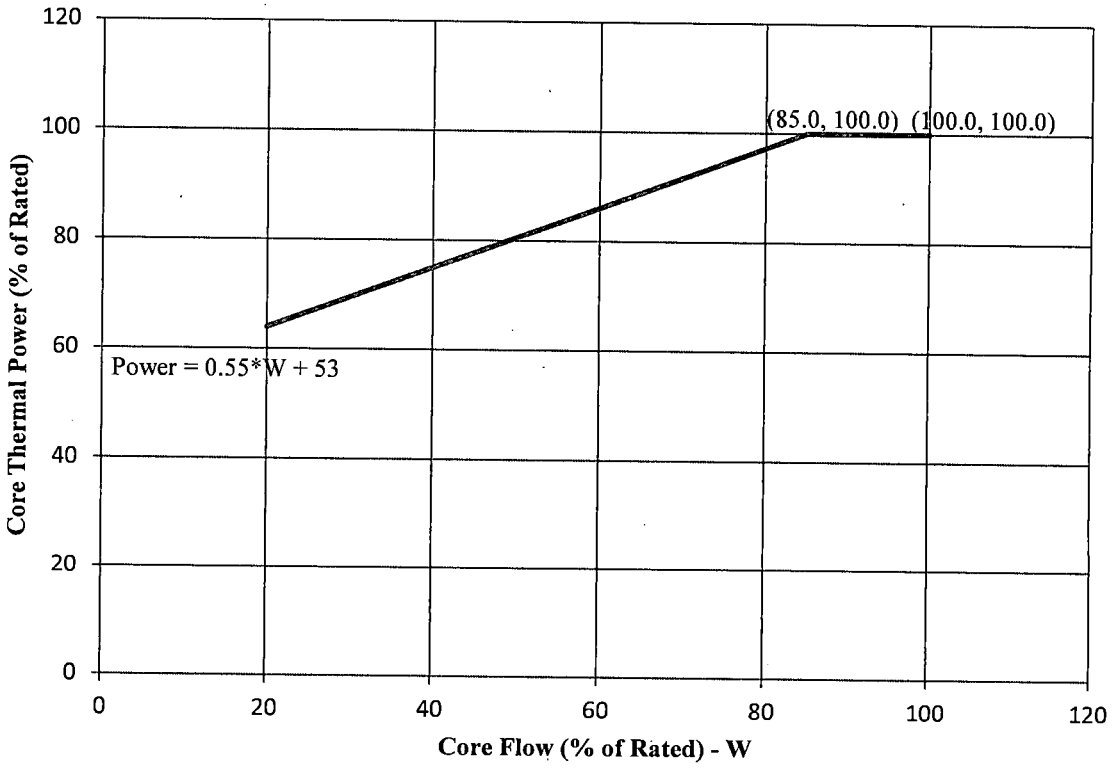
6.1 Technical Specification

3.1.7.d, 3.1.7.e, 6.6.5.a.5

6.2 Description

The Nine Mile Point Unit 1 power/flow relationship is shown in Figure 6-1.

Figure 6-1
Limiting Power/Flow Line
(References 5 and 8)



7.0 Modes of Operation

The allowable modes of operation are found in Table 7-1. Operation with PROOS is supported in all modes of operation, provided the restrictions identified in the applicable station procedures are met. Operation up to 67.5 Mlb/hr core flow is licensed for this cycle (Reference 2). The minimum coastdown thermal power level is 40% per GESTAR II (Methodology Document 1).

- All EOOS options allow for three recirculation loop operation.
- All EOOS options allow for operation in either Option A or Option B.
- Each mode supports operation with up to 10°F reduction in feedwater temperature.
- Each mode may be coincident with coastdown operation.

Table 7-1
Modes of Operation
(Reference 2)

Options	Allowed Operating Region
Four/Five-loop Operation, FWP Combination 1	Yes
Four/Five-loop Operation, FWP Combination 2	Yes
PROOS, Four/Five-loop Operation, FWP Combination 1 or 2	Yes
Three-loop Operation, FWP Combination 1	Yes[7]
Three-loop Operation, FWP Combination 2	Yes[7]
PROOS, Three-loop Operation, FWP Combination 1	Yes[7]
PROOS, Three-loop Operation, FWP Combination 2	Yes[7]

[7] Per Ref. 1 Appendix A – TS 3.1.7.e, during three-loop operation power is restricted to 90% of rated.

8.0 Methodology

8.1 Technical Specification

6.6.5.b.1

8.2 Description

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," Global Nuclear Fuel Document No. NEDE-24011-P-A-24, March 2017 and U.S. Supplement NEDE-24011-P-A-24-US, March 2017.

9.0 References

1. "Nine Mile Point Nuclear Station, Unit 1 Renewed Facility Operating License", Docket No. 50-220, License No. DPR-63.

2. "Supplemental Reload Licensing Report for Nine Mile Point 1 Reload 24 Cycle 25", Global Nuclear Fuel Document No. 002N6949, Revision 0, March 2017.

3. "Engineering Report for Nine Mile Point Nuclear Station Unit 1 Reload 19", Global Nuclear Fuels Document No. 0000-0053-5247-ER Rev. 0, February 2007.[8]

4. "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," Global Nuclear Fuel Document No. NEDC-33270P, Revision 7, October 2016.

5. "Limiting Relationship Between Core Power and Core Flow Rate (TAC 63532)," NRC Letter, Nine Mile Point 1 Technical Specification Amendment 92 to Facility Operating License No. DPR-63, March 24, 1987.

6. "Final Resolved OPL-3 Parameters for Nine Mile Point Unit 1 Cycle 23 (25)", Exelon Document No. ES1600018 Rev. 0, September 2016.

7. "Qualification of the One-Dimensional Core Transient Model for Boiling Water Reactors," General Electric Document ID NEDO-24154 and NEDE-24154P, Volumes I, II, and III, August 1986.

8. "Nine Mile Point 1 Cycle 24 Limiting Load Line Analysis," Global Nuclear Fuel Letter, Document No. 002N5662-R0, March 18, 2015.

9. "Feedwater System Booster Pump to Reactor", N1-OP-16 Rev. 06401, Nine Mile Point Nuclear Station Unit 1 Operating Procedure

10. "Nine Mile Point Nuclear Station Unit 1 TRACG-LOCA Loss-of-Coolant Accident Analysis for GNF2", GEH Nuclear Energy Doc No. 002N3714 Rev. 0, March 2017.

[8] The information referenced from this report (see COLR Section 4.2) is cycle independent.