



Technical Specification 6.6.5

NMP1L 3104
September 9, 2016

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: Core Operating Limits Report

Enclosed is a copy of the Core Operating Limits Report, Cycle 22, Revision 1 for Nine Mile Point Unit 1 (NMP1). This report is being submitted pursuant to NMP1 Technical Specification 6.6.5.d. The COLR is being revised to allow four loop operation at rated power with one loop isolated.

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

Sincerely,

A handwritten signature in black ink, appearing to read "Dennis M. Moore".

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 22 Revision 1

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

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Enclosure

Core Operating Limits Report

For

Nine Mile Point Unit 1 Cycle 22 Revision 1

Enclosure

Core Operating Limits Report

For

Nine Mile Point Unit 1 Cycle 22 Revision 1

CORE OPERATING LIMITS REPORT
FOR
NINE MILE POINT NUCLEAR STATION
UNIT 1 RELOAD 23 CYCLE 22

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Record of COLR Nine Mile Point 1 Cycle 22 Revisions

<u>Revision</u>	<u>Description</u>
Rev. Number – 1	Revise Reference 2 and Reference 6 and revise footnotes for Table 3-10 and Table 7-1. The COLR Nine Mile Point 1, Rev. 0 FCMS version has an illegible Appendix A (Figures B-1 thru B-9) (see IR 2626201). Appendix A has been verified to be legible in Revision 1.
Rev. Number – 0	New Issuance for Cycle 22

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1.0 Terms and Definitions

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reactor power is equal to rated thermal power with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.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 N1-OP-16, i.e. Turbine Driven Feedwater Pump (TDFWP) in service AND one Motor Driven Feedwater Pump (MDFWP) in service (bounds TDFWP in service OR one MDFWP in service OR two MDFWPs in service).
FWP Combination 2	Feedwater Pump Combination 2 as defined in N1-OP-16, i.e. TDFWP in service AND two MDFWPs in service.
Kp	Off-rated power dependent OLMCPR multiplier
Kf	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
OLMCPR	Operating Limit Minimum Critical Power Ratio
OOS	Out of Service
PROOS	Pressure Regulator Out of Service

2.0 General Information

This report provides the following cycle-specific parameter limits for Nine Mile Point Nuclear Station Unit 1 Cycle 22:

- Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
- Operating Limit Minimum Critical Power Ratio (OLMCPR)
- MCPR thermal limit adjustments and multipliers (MCPR(P) or MCPR(F))
- Three recirculation loop operation MCPR adjustment
- LHGR thermal limit multipliers (LHGRFAC(P))
- MAPLHGR four and three recirculation loop operation multipliers
- Linear Heat Generation Rate (LHGR)
- Limiting Power / Flow Line

This report is prepared in accordance with Technical Specification 6.6.5 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. 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 is 67.5 Mlb/hr,
- End-of-cycle coastdown to a minimum power level of 40% of rated 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 22 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

3.2 Description

The MAPLHGR limits for each bundle type as a function of average planar exposure is given in Tables 3-1 through 3-9. For partial loop operation, a fuel-type-dependent multiplier is used, which is shown in Table 3-10. For operation with either four or three recirculation loops in service, multiply the most limiting values shown in Tables 3-1 through 3-3 by the GE11 value in Table 3-10 and multiply the most limiting values shown in Tables 3-4 through 3-9 by the GNF2 value in Table 3-10. 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 2). LHGRFAC(P) and LHGRFAC(F) are addressed in Section 5.0.

Table 3-1
MAPLHGR Versus Average Planar Exposure – Bundle: GE11-P9DUB376-12GZ-100T-145-T6-2586
 (Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	9.63
0.20	9.63
1.00	9.60
5.00	9.40
10.00	9.37
15.00	9.24
20.00	8.76
25.00	8.34
35.00	8.10
45.00	8.03
55.00	8.02
65.00	6.18

¹ These MAPLHGRs are not lattice dependent.

Table 3-2
MAPLHGR Versus Average Planar Exposure – Bundle: GE11-P9DUB381-14GZ-100T-145-T6-2946
 (Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)					
	Lattice 7433	Lattice 7439	Lattice 7440	Lattice 7441	Lattice 7442	Lattice 7443
0.00	10.24	10.24	10.19	10.19	10.19	10.19
0.20	10.24	10.24	10.19	10.19	10.19	10.19
1.00	10.20	10.20	10.19	10.19	10.19	10.19
5.00	9.91	9.91	9.85	9.85	9.85	9.85
10.00	9.42	9.42	9.34	9.34	9.34	9.34
15.00	9.22	9.22	9.19	9.19	9.19	9.19
20.00	9.18	9.18	9.19	9.19	9.19	9.19
25.00	8.64	8.64	8.63	8.63	8.63	8.63
35.00	8.08	8.08	8.08	8.08	8.08	8.08
45.00	8.02	8.02	7.99	7.99	7.99	7.99
55.00	8.00	8.00	7.99	7.99	7.99	7.99
65.00	7.97	7.97	7.96	7.96	7.96	7.96

Table 3-3
MAPLHGR Versus Average Planar Exposure – Bundle: GE11-P9DUB380-13GZ-100T-145-T6-2948
 (Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)					
	Lattice 7433	Lattice 7449	Lattice 7450	Lattice 7451	Lattice 7447	Lattice 7448
0.00	9.71	9.71	9.69	9.69	9.69	9.69
0.20	9.71	9.71	9.69	9.69	9.69	9.69
1.00	9.68	9.68	9.67	9.67	9.67	9.67
5.00	9.56	9.56	9.50	9.50	9.50	9.50
10.00	9.38	9.38	9.32	9.32	9.32	9.32
15.00	9.23	9.23	9.24	9.24	9.24	9.24
20.00	9.28	9.28	9.31	9.31	9.31	9.31
25.00	8.43	8.43	8.45	8.45	8.45	8.45
35.00	8.09	8.09	8.09	8.09	8.09	8.09
45.00	7.98	7.98	8.02	8.02	8.02	8.02
55.00	7.97	7.97	7.98	7.98	7.98	7.98
65.00	7.91	7.91	7.93	7.93	7.93	7.93

¹ These MAPLHGRs are lattice dependent.

Table 3-4
MAPLHGR Versus Average Planar Exposure – Bundle: GNF2-P10DG2B384-16GZ-100T2-145-T6-3351
(Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	7.91
0.20	7.91
1.00	7.88
5.00	7.81
10.00	7.70
15.00	7.58
20.00	7.03
25.00	6.68
35.00	6.51
45.00	6.27
55.00	6.14
65.00	6.05

Table 3-5
MAPLHGR Versus Average Planar Exposure – Bundle: GNF2-P10DG2B386-13GZ-100T2-145-T6-3352
(Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	7.81
0.20	7.81
1.00	7.92
5.00	7.83
10.00	7.71
15.00	7.73
20.00	7.09
25.00	6.68
35.00	6.52
45.00	6.26
55.00	6.15
65.00	6.05

¹ These MAPLHGRs are not lattice dependent.

Table 3-6
MAPLHGR Versus Average Planar Exposure – Bundle: GNF2-P10DG2B384-16GZ-100T2-145-T6-4133
(Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	7.90
0.20	7.90
1.00	7.85
5.00	7.79
10.00	7.73
15.00	7.74
20.00	7.06
25.00	6.68
35.00	6.51
45.00	6.28
55.00	6.15
65.00	6.05

Table 3-7
MAPLHGR Versus Average Planar Exposure – Bundle: GNF2-P10DG2B386-13GZ-100T2-145-T6-4134
(Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	7.78
0.20	7.78
1.00	7.84
5.00	7.83
10.00	7.71
15.00	7.73
20.00	7.09
25.00	6.67
35.00	6.52
45.00	6.26
55.00	6.15
65.00	6.05

¹ These MAPLHGRs are not lattice dependent.

Table 3-8

MAPLHGR Versus Average Planar Exposure – Bundle: GNF2-P10DG2B371-16GZ-100T2-145-T6-4312
 (Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	7.96
0.20	7.96
1.00	7.96
5.00	7.88
10.00	7.76
15.00	7.63
20.00	7.16
25.00	6.68
35.00	6.50
45.00	6.29
55.00	6.18
65.00	6.09

Table 3-9

MAPLHGR Versus Average Planar Exposure – Bundle: GNF2-P10DG2B375-11G5.0-100T2-145-T6-4313
 (Reference 2)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit ¹ (kW/ft)
0.00	7.90
0.20	7.90
1.00	7.91
5.00	7.85
10.00	7.76
15.00	7.65
20.00	7.25
25.00	6.69
35.00	6.45
45.00	6.28
55.00	6.17
65.00	6.08

Table 3-10

MAPLHGR Multiplier for Four and Three Recirculation Loop Operation
 (Reference 2)

Fuel Type	Four and Three Loop Operation Multiplier ²
GE11	0.98
GNF2	0.99

¹ These MAPLHGRs are not lattice dependent.

² The 4-loop MAPLHGR multiplier is applicable up to 100% of rated power and 100% of rated core flow if the Out-of-Service (OOS) loop is isolated or un-isolated from the reactor. The 3-loop MAPLHGR Multiplier is applicable to 90% rated power and 75% rated core flow regardless of whether the OOS recirculation loops are isolated or un-isolated.

4.0 MCPR Limits

4.1 Technical Specification

3.1.7.c, 3.1.7.e

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 are derived from Reference 2 and are valid for all Cycle 22 operating domains. Nine Mile Point Unit 1 Cycle 22 has a mid-cycle MCPR breakpoint, as defined in Table 4-1. An adder, presented in Table 4-2, is required to be applied to all limits in Table 4-1 and MCPR(P) in Table 4-3 in the event of three recirculation loop operation. Table 4-1 and 4-2 limits are bounding for both GE11 and GNF2 fuel types.

The power dependent MCPR limits are presented in Table 4-3 and are valid for both GE11 and GNF2 fuel types (Reference 2). When core thermal power is greater than or equal to 45% of rated, the applicable Kp multiplier from Table 4-3 is applied to the applicable rated condition OLMCPR value in Table 4-1 or adjusted OLMCPR value determined by using Table 4-2. Below 45% rated thermal power, the MCPR(P) limits in Table 4-3 are applied directly. The appropriate MCPR(P) or Kp value may be determined by linear interpolation.

The flow adjusted OLMCPR is determined by multiplying the applicable rated condition OLMCPR provided by either Table 4-1 or 4-2 by the applicable Kf multiplier given in Table 4-4. The Kf multipliers are valid for both GE11 and GNF2 fuel types and are documented in Reference 2. The appropriate Kf value may be determined by linear interpolation.

Table 4-1
Operating Limit Minimum Critical Power Ratio (OLMCPR)
(All Fuel Types, Four/Five Recirculation Loop Operation)
(Reference 2)

Feedwater Pump Combination ¹	SCRAM Time Option ²	Cycle Exposure	
		< EOR - 3609 MWd/ST	≥ EOR - 3609 MWd/ST
FWP Combination 1	B	1.47	1.54
	A	1.57	1.64
FWP Combination 2	B	1.52	1.59
	A	1.62	1.69

¹OLMCPR values are independent of pressure regulator in-service or out-of service conditions.

² 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:

$$\tau = (\tau_{ave} - \tau_B) / (\tau_A - \tau_B) \text{ where}$$

$$\tau_A = 0.868 \text{ seconds, control rod average scram insertion time limit to notch 39}$$

$$\tau_B = 0.672 + 1.65 * [N_j / \sum_{i=1}^n N_i]^{1/2} * 0.016$$

$$\tau_{ave} = \sum_{i=1}^n N_i \tau_i / \sum_{i=1}^n N_i$$

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_j = total number of active rods measured.

Table 4-2
MCPR Adder for Three Recirculation Loop Operation
 (All Fuel Types)
 (Reference 2)

Three Recirculation Loop Operation Adder ¹	0.03
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Table 4-3
Power Dependent MCPR Limits and Multipliers MCPR(P) and Kp
 (All Fuel Types)
 (Reference 2)

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	3.28	3.28	2.36	1.349	1.216	1.133	1.133	1.000
	> 60	3.40	3.40	2.86					
FWP Combination 2	≤ 60	3.28	3.28	2.36	1.349	1.216	1.133	1.133	1.000
	> 60	3.40	3.40	2.86					
PROOS ²	≤ 60	3.28	3.28	2.36	1.553	1.336	1.198	1.133	1.000
	> 60	3.40	3.40	2.86					

Table 4-4
Operating Limit MCPR Multiplier, Kf
 (All Fuel Types)
 (Reference 2)

Flow (% rated)	MCPR Multiplier, Kf ³
0.0	1.500
45.0	1.500
>45.0	1.132
75.0	1.000
100.0	1.000

¹ Increase the values in Table 4-1 and the MCPR(P) values in Table 4-3 by 0.03 in the event of Three Recirculation Loop Operation.

² Limits apply to PROOS coincident with FWP Combination 1 or 2.

³ 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

5.2 Description

The Linear Heat Generation Rate (LHGR) for all fuel bundles shall not exceed either 11.0 kW/ft¹ or the LHGR limits presented in Tables 5-1 and 5-2. Linear interpolation should be used for points not listed in Appendix A or 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 both GE11 and GNF2 fuel types (Reference 2). The power adjusted LHGR is determined by multiplying the applicable Appendix A 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 – UO₂ Rods
 (References 3 and 4)**

Fuel Type	LHGR
GE11	See Appendix A
GNF2 ¹	See Appendix B of Reference 4

**Table 5-2
 Linear Heat Generation Rate Limits – Gadolinia Rods
 (References 3 and 4)**

Fuel Type	LHGR
GE11	See Appendix A
GNF2 ¹	See Appendix B of Reference 4

¹ GNF2 LHGR limit has been set down to a maximum value of 11 kW/ft to address Emergency Procedure Guidelines (EPG) requirements (Reference 6).

Table 5-3
Power Dependent LHGR Multiplier LHGRFAC(P) for PROOS
(All Fuel Types)
(Reference 2)

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

6.0 Limiting Power/Flow Line

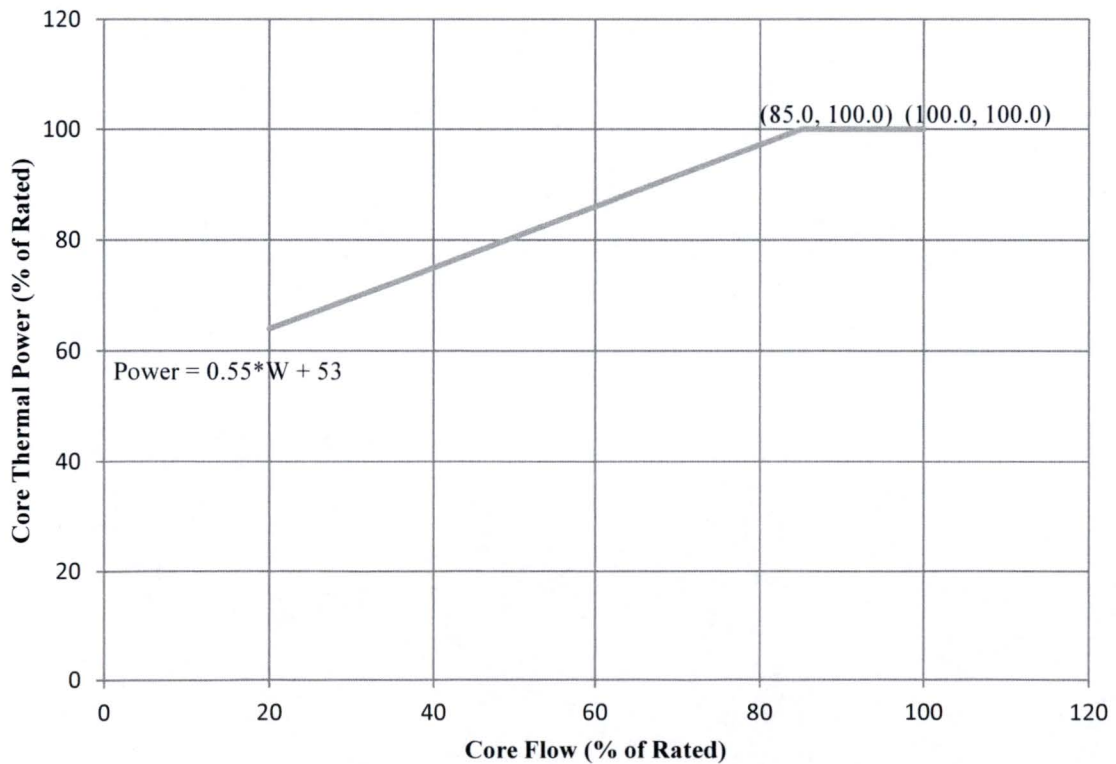
6.1 Technical Specification

3.1.7.d, 3.1.7.e

6.2 Description

The Nine Mile Point Unit 1 power/flow relationship is shown in the figure below.

Figure 6-1
Limiting Power/Flow Line
(References 5, 7, and 8)



7.0 Modes of Operation

7.1 Description

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. All EOOS options allow for three recirculation loop operation. Operation up to 67.5 Mlb/hr core flow is licensed for this cycle (Reference 2). Each mode supports operation with up to 10°F reduction in feedwater temperature and each mode may be coincident with coastdown operation. The minimum coastdown power level is 40% per GESTAR II (Methodology Document 1).

Table 7-1
Modes of Operation
(Reference 2)

Options	Allowed Operating Region
Four/Five-loop Operation, FWP Combination 1, Option A or B	Yes
Four/Five-loop Operation, FWP Combination 2, Option A or B	Yes
PROOS, Four/Five-loop Operation, FWP Combination 1 or 2, Option A or B	Yes
Three-loop Operation, FWP Combination 1, Option A or B	Yes ¹
Three-loop Operation, FWP Combination 2, Option A or B	Yes ¹
PROOS, Three-loop Operation, FWP Combination 1 or 2, Option A or B	Yes ¹

¹ In 3-loop operation, power is limited to 90% of rated power/75% of rated core flow regardless of whether the OOS recirculation loops are isolated or un-isolated as described in Section 3 (Reference 2).

8.0 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-20, December 2013 and U.S. Supplement NEDE-24011-P-A-20-US, December 2013.

9.0 References

1. "Nine Mile Point Nuclear Station, Unit 1 Renewed Facility Operating License", Docket No. 50-220, License No. DPR-63, Appendix A – Radiological Technical Specifications.
2. "Supplemental Reload Licensing Report for Nine Mile Point 1 Reload 23 Cycle 22", Global Nuclear Fuel Document No. 002N2884-SRLR, Revision 2, January 2016.
3. "Fuel Bundle Information Report for Nine Mile Point 1 Reload 23 Cycle 22", Global Nuclear Fuel Document No. 002N2885-FBIR, Revision 0, November 2014.
4. "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," Global Nuclear Fuel Document No. NEDC-33270P, Revision 5, May 2013.
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. "Nine Mile Point Nuclear Station Unit 1 GNF2 ECCS-LOCA Evaluation," GE Hitachi Nuclear Energy Document No. 0000-0098-3457-R2/000N1093-R0, January 2014.
7. "General Electric Boiling Water Reactor Extended Load Line Limit Analysis for Nine Mile Point 1 Cycle 9," General Electric Document No. NEDC-31126, February 1986.
8. "Nine Mile Point 1 Cycle 24 Limiting Load Line Analysis," Global Nuclear Fuel Letter, Document No. 002N5662-R0, March 18, 2015.

Appendix A