Exelon Generation®

Technical Specification 5.6.5

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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Nine Mile Point Nuclear Station, Unit 2
Renewed Facility Operating License No. NPF-69
NRC Docket No. 50-410

Subject: Core Operating Limits Report

Enclosed is a copy of the Core Operating Limits Report, Revision 5, for Nine Mile Point Unit 2, Cycle 18. This report is being submitted pursuant to NMP2 Technical Specification 5.6.5.d.

Should you have any questions regarding the information in this submittal, please contact Mr. John Darweesh at (315) 349-7444.

Sincerely,

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BKS/DJW

Enclosure: Core Operating Limits Report, Revision 5, for Nine Mile Point Unit 2, Cycle 18

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

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Enclosure

Core Operating Limits Report, Revision 5

For

Nine Mile Point Unit 2, Cycle 18

CORE OPERATING LIMITS REPORT

FOR

NINE MILE POINT UNIT 2 CYCLE 18

(This is a complete re-write; no revision bars are used)

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Summary of Revisions

Revision	Description
Revision 5	New Issue for Cycle 18

List of Tables

1.0 Terms and Definitions

ADSOOS	Automatic Depressurization System Out of Service
APLHGR	Average Planar Linear Heat Generation Rate
APRM	Average Power Range Monitor
ARTS	APRM and RBM Technical Specification Analysis
BSP	Backup Stability Protection
COLR	Core Operating Limits Report
DLO	Dual Loop Operation
ECCS	Emergency Core Cooling System
EIS	Equipment in Service
EOOS	Equipment Out of Service
EOR	End of Rated. The cycle exposure at which reactor power is equal to 100% rated (3988 MW_{th}), recirculation flow equal to 100% rated (108.5 Mlb/hr), and all control blades are fully withdrawn with equilibrium xenon.
EPU	Extended Power Uprate
GEH	General Electric-Hitachi
GNF	Global Nuclear Fuel
HFCL	High Flow Control Line
HTSP	High Trip Set Point (regarding RBM)
ICF	Increased Core Flow
INOP	Inoperable
ITSP	Intermediate Trip Set Point (regarding RBM)
K_P	Off-rated power dependent OLMCPR multiplier
LCO	Limiting Condition for Operation
LHGR	Linear Heat Generation Rate
$LHGRFAC_F$	Off-rated flow dependent LHGR multiplier
$LHGRFAC_P$	Off-rated power dependent LHGR multiplier
LOCA	Loss of Coolant Accident
LTSP	Low Trip Set Point (regarding RBM)
$MAPFAC_F$	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
MCPR99.9%	Limiting MCPR value such that 99.9 percent of the fuel in the core is not susceptible to boiling transition. Also known as the cycle-specific SLMCPR.
$MCPR_F$	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
NRC	Nuclear Regulatory Commission
OLMCPR	Operating Limit MCPR
OPRM	Oscillation Power Range Monitor
PROOS	Pressure Regulator Out of Service
RBM	Rod Block Monitor
RDF	Recirculation Drive Flow
RPTOOS	Recirculation Pump Trip Out of Service; also known as EOC-RPT
RTP	Rated Thermal Power (3988 MW_t)
RWE	Rod Withdrawal Error
SLMCPR	Safety Limit MCPR
SLO	Single Loop Operation
SRVOOS	Safety Relief Valve Out of Service
TBV	Turbine Bypass Valve
TBVOOS	Turbine Bypass Valve Out of Service. TBVOOS supports 3 of 5 TBVs slow open and 2 of 5 TBVs do not slow open (stuck closed)
TCV	Turbine Control Valve
TCVOOS	Turbine Control Valve Out of Service
TS	Technical Specification
TSV	Turbine Stop Valve
TSVOOS	Turbine Stop Valve Out of Service

2.0 General Information

This report is prepared in accordance with Technical Specification (TS) 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 for intermediate values.

This report provides the values of the power distribution limits, control rod withdraw block instrumentation, and stability protection setpoints for Nine Mile Point Unit 2 Cycle 18.

This report provides the following cycle-specific parameter limits for Nine Mile Point Unit 2 Cycle 18 (Reload 17):

- 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
- Single Loop Operation (SLO) MCPR adjustment
- Linear Heat Generation Rate (LHGR)
- ARTS LHGR thermal limit multipliers
- Single Loop Operation (SLO) LHGR multipliers
- Rod Block Monitor (RBM) Nominal Trip Setpoints, Allowable Values and MCPR Limits
- Turbine Bypass Valve (TBV) parameters
- Backup Stability Protection (BSP) parameters
- Cycle-specific SLMCPRs (MCPR99.9%)

The BASE thermal limit values shown in tables are for normal, equipment-in-service (EIS) two loop operation. Analysis also supports Increased Core Flow (ICF) for operational flexibility. Additional equipment out of service (EOOS) applicability can be found in Section 8.0, Modes of Operation.

The data presented in this report is valid for all licensed operating domains on the operating map, including (Reference 2):

- Maximum Extended Load Line Limit Analysis Plus (MELLLA+) to a minimum core flow of 85% of rated.
- ICF up to 105% rated (rated core flow is 108.5 Mlb/hr).
- Extended Power Uprate (EPU) to 3988 MW_{th}.
- Coastdown operation down to 40% Rated Thermal Power (RTP)

3.0 MAPLHGR Limits

Technical Specification Sections 3.2.1, 3.4.1

The MAPLHGR limits obtained from the ECCS analysis are provided in Table 3-1. The limiting MAPLHGR value for the most limiting lattice of each fuel type as a function of exposure is given. For SLO, a multiplier is used as 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 and there is no need for MAPLHGR multipliers, in addition to off-rated LHGR multipliers per Reference 2 – Section 16.

Table 3-1
MAPLHGR Versus Average Planar Exposure
All Fuel Types
(Reference 2 – Table 7)

Average Planar Exposure [GWD/ST]	MAPLHGR Limit [KW/ft]
0.00	13.78
17.15	13.78
60.78	6.87
63.50	5.50

Table 3-2
MAPLHGR SLO Multiplier
All Fuel Types
(Reference 2 – Table 8)

Fuel Type	SLO Multiplier
GNF2	0.78

4.0 MCPR Limits

Technical Specification Sections 3.2.2, 3.3.4.1, 3.4.1, 3.7.5

OLMCPR values listed in Table 4-1 cover all conditions listed in Section 8.0, Modes of Operation. Additional EOOS information can be found in Section 8.0. ARTS provides for power and flow dependent thermal limits adjustments, which allow for a more reliable administration of the MCPR thermal limit. Per TS 3.2.2, all MCPR's shall be verified in accordance with limits specified in this section.

Control rod scram time verification is also required per TS 3.1.4, Control Rod Scram Times. The applicable MCPR thermal limit set shall be determined with Tau (τ), a measure of scram time performance throughout the cycle based on the cumulative plant scram time test results. The calculation of Tau shall be performed in accordance with site procedures.

ARTS power and flow dependent thermal limits have been confirmed for the following modes of operation: Base, Turbine Bypass Valves Out-Of-Service (TBVOOS), Recirculation Pump Trip Out-Of-Service (RPTOOS) and Pressure Regulator Out-Of-Service (PROOS).

The cycle-specific SLMCPRs, known as MCPR99.9%, 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.

Table 4-1
Operating Limit Minimum Critical Power Ratio (OLMCPR)
All Fuel Types
(Reference 2 – Section 11)

EOOS Combination	SCRAM Time Option[1]	Cycle Exposure	
		<EOR-3414 MWD/ST	≥EOR-3414 MWD/ST
BASE	A	1.62	1.69
	B	1.46	1.49
BASE SLO	A	1.65	1.72
	B	1.49	1.52
TBVOOS	A	1.75	1.75
	B	1.52	1.52
TBVOOS SLO	A	1.78	1.78
	B	1.55	1.55
RPTOOS	A	1.68	1.73
	B	1.46	1.49
RPTOOS SLO	A	1.71	1.76
	B	1.49	1.52
PROOS	A	1.62	1.69
	B	1.46	1.49

[1] 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 in accordance with site procedure to calculate OLMCPR.

Table 4-2
Power Dependent MCPR Limits ($MCPR_P$) and Multipliers (K_P)
All Fuel Types
(Reference 2 – Appendix D)

EOOS Combination	Core Flow [% of rated]	Core Thermal Power [% of rated]							
		0	23	≤26	>26	55	60	85	100
		Operating Limit $MCPR_P$			Operating Limit MCPR Multiplier (K_P)				
BASE	≥75				1.218	1.180	1.150	1.056	1.000
	<75	2.65	2.65	2.57					
BASE SLO	≥75				1.218	1.180	1.150	1.056	1.000
	<75	2.68	2.68	2.60					
TBVOOS	≥75				1.218	1.180	1.150	1.056	1.000
	<75	3.51	3.51	3.22					
TBVOOS SLO	≥75				1.218	1.180	1.150	1.056	1.000
	<75	3.54	3.54	3.25					
RPTOOS	≥75				1.218	1.180	1.150	1.056	1.000
	<75	2.65	2.65	2.57					
RPTOOS SLO	≥75				1.218	1.180	1.150	1.056	1.000
	<75	2.68	2.68	2.60					
PROOS	≥75				1.218	1.180	1.172	1.056	1.000
	<75	2.65	2.65	2.57					

Table 4-3
Flow Dependent MCPR Limits ($MCPR_F$) for DLO
All Fuel Types
(Reference 2 – Appendix D)

Flow [% rated]	$MCPR_F$ Limit
0.0	2.01
30.0	1.78
94.2	1.29
112.0	1.29

Table 4-4
Flow Dependent MCPR Limits ($MCPR_F$) for SLO
All Fuel Types
(Reference 2 – Appendix D)

Flow [% rated]	$MCPR_F$ Limit
0.0	2.04
30.0	1.81
94.2	1.32
112.0	1.32

Table 4-5
Cycle Specific SLMCPR (MCPR99.9%)
(Reference 2 – Section 11)

Flow Mode	MCPR99.9%
DLO	1.14
SLO	1.14

5.0 LHGR Limits

Technical Specification Section 3.2.3

The LHGR limit is the product of the exposure dependent LHGR limit and the minimum of the $LHGRFAC_P$ or the $LHGRFAC_F$.

The off-rated limits assumed in the ECCS-LOCA analyses are confirmed to be consistent with the cycle-specific off-rated LHGR multipliers calculated for MELLLA+ operation. The off-rated LHGR multipliers provide adequate protection for MELLLA+ operation (Reference 2).

Table 5-1
LHGR Limits for UO_2 Fuel Rods
(Reference 3, Reference 5, Reference 11)

Fuel Type	LHGR Limit [KW/ft]
GNF2	See Reference 5

Table 5-2
LHGR Limits for Gadolinia Rods
(Reference 3, Reference 5, Reference 11)

Fuel Type	LHGR Limit [KW/ft]
GNF2	See Reference 5

Table 5-3
Power Dependent LHGR Multipliers ($LHGRFAC_P$)
All Fuels Types
(Reference 2 – Appendix D)

EOOS Combination	Core Flow [% of rated]	Core Thermal Power [% of rated]							
		0	23	≤26	>26	55	60	85	100
BASE	≥75				0.613	0.720	0.791	0.922	1.000
	<75	0.495	0.495	0.502					
BASE SLO	≥75				0.613	0.720	0.791	0.922	1.000
	<75	0.495	0.495	0.502					
TBVOOS	≥75				0.613	0.720	0.791	0.922	1.000
	<75	0.475	0.475	0.502					
TBVOOS SLO	≥75				0.613	0.720	0.791	0.922	1.000
	<75	0.475	0.475	0.502					
RPTOOS	≥75				0.613	0.720	0.791	0.922	1.000
	<75	0.495	0.495	0.502					
RPTOOS SLO	≥75				0.613	0.720	0.791	0.922	1.000
	<75	0.495	0.495	0.502					
PROOS	≥75				0.613	0.720	0.740	0.831	1.000
	<75	0.495	0.495	0.502					

Table 5-4
Flow Dependent LHGR Multipliers ($LHGRFAC_F$)
All Fuel Types and Modes of Operation
(Reference 2 – Appendix D)

EOOS Condition	Core Flow [% of rated]					
	0	30	40	52.7	85	112
DLO	0.241	0.580	0.693		1.000	1.000
SLO	0.241	0.580	0.693	0.780	0.780	0.780

6.0 Rod Block Monitor Setpoints

Technical Specification Section 3.3.2.1

Per Technical Specifications 3.3.2.1, the RBM instrumentation channels will be operable with the allowable values set to the values shown in Table 6-1. The values given in Table 6-1 are unfiltered; these unfiltered values are applicable as the time filter constant is set to zero. (Reference 7 – Table 5B). The RBM operability requirements have been evaluated and shown to be sufficient to ensure that the cycle specific SLMCPR and cladding 1% plastic strain criteria will not be exceeded in the event of a Rod Withdrawal Error.

The ARTS RWE analysis validated the MCPR values in Table 6-2 below for use in Cycle 18. The RWE MCPR values have been analyzed at discrete setpoint values and unblocked (continuous withdrawal) conditions.

Table 6-1
Rod Block Monitor Setpoints[2]
(Reference 2 – Section 10, Reference 8 – Section 3)

Power Level	Allowable Value	Nominal Trip Setpoint	Analytical Limit
LTSP	121.6%	121.2%	124.0%
ITSP	116.6%	116.2%	119.0%
HTSP	111.6%	111.2%	114.0%

Table 6-2
ARTS RWE Validated MCPR Values
(Reference 2 – Section 10)

Power Level [% Rated]	MCPR
<90%	≥1.81
≥90%	≥1.49

[2] See Reference 8 for filtered values.

7.0 Turbine Bypass Valve Parameters

Technical Specification Section 3.7.5

Per Technical Specification LCO 3.7.5, whenever the reactor power is at or above 23% RTP the main turbine bypass system shall be operable or the plant must operate with the TBVOOS penalties. The definition of operable is given in Table 7-1 below.

Table 7-1
Turbine Bypass Valve Response Time
(Reference 9 – Section 1.6)

Event	Response Time [sec]
Maximum delay time before start of bypass valve opening following initial turbine inlet valve movement	0.15
Maximum time after initial turbine inlet valve movement for bypass valve position to reach 80% of full flow (includes the above delay time)	0.30

8.0 Modes of Operation

The following conditions are supported by the Cycle 18 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 8-1 provides allowed modes of operation with thermal limit sets in the COLR. Table 8-2 provides allowed modes of operation that do not contain explicit thermal limit sets but are included in the BASE option. Note that per TS LCO 3.4.1, SLO in the MELLLA or MELLLA+ domains is prohibited.

Table 8-1
Modes of Operation
(Reference 2, Reference 10, Reference 12)

Options[3]	Allowed Operating Region
BASE	Yes
BASE SLO	Yes
TBVOOS[7]	Yes
TBVOOS SLO[7]	Yes
RPTOOS	Yes
RPTOOS SLO	Yes
PROOS	Yes

Table 8-2
EOOS Conditions Included under BASE Option
(Reference 2, Reference 13)

EOOS Condition[4]
SRVOOS
ADSOOS
MSIVOOS[5]
TCV/TSVOOS[6,7]

[3] The EOOS Options listed apply to both Option A and Option B
[4] Base includes 2 SRVOOS, 1 MSIVOOS (limited to 75% power), 1 TCV/TSVOOS (limited to 85% power), and 1 ADSOOS.
[5] 1 MSIVOOS limited to 75% rated thermal power
[6] 1 TCV/TSVOOS limited to 85% rated thermal power.
[7] TCV/TSVOOS not analyzed concurrent with TBVOOS

9.0 Stability Protection

Technical Specification Section 3.3.1.1

The OPRM Amplitude Discriminator Setpoint (S_{AD}) is 1.10 (Reference 2 – Section 15.1). Results have been validated with rated feedwater temperature ≥ 420.5°F as described by Reference 2. Per TS 5.6.5.a.4, the Backup Stability Protection (BSP) regions and values are as shown below in Tables 9-1 and 9-2. The manual BSP region boundary endpoints are connected using the Generic Shape Function. A graphical representation of the BSP regions can be found in Reference 2 – Figure 1.

Table 9-1
BSP Endpoints for Normal Feedwater Temperature[8,9]
(Reference 2 – Table 3)

Endpoint	Power [% of rated]	Flow [% of rated]	Definition
A1	69.1	43.6	Scram Region Boundary, HFCL
B1	39.7	29.5	Scram Region Boundary, NCL
A2	64.5	50.0	Controlled Entry Region Boundary, HFCL
B2	27.5	28.9	Controlled Entry Region Boundary, NCL
A3	100.0	88.3	BSP Boundary Intercept, HFCL
B3	68.7	55.0	BSP Boundary Intercept, MELLLA Boundary

Table 9-2
Automated BSP Setpoints[10]
(Reference 2 – Table 4)

Parameter	Symbol	Value
Slope of Automated BSP APRM flow-biased trip linear segment	m_{TRIP}	1.26
Automated BSP APRM flow-biased trip setpoint power intercept. Constant Power Line for Trip from zero Drive Flow to Flow Breakpoint value.	$P_{BSP-TRIP}$	39.7% RTP
Automated BSP APRM flow-biased trip setpoint drive flow intercept. Constant Flow Line for Trip.	$W_{BSP-TRIP}$	36.9% RDF
Flow Breakpoint value	$W_{BSP-BREAK}$	19.2% RDF

[8] Bounding for both DLO and SLO
[9] Station may elect to place additional administrative margin on the endpoints provided in Table 9-1
[10] Applicable to both DLO and SLO

10.0 Power Flow Operating Map

See Appendix A for a Power Flow Map (Reference 6).

11.0 Methodology

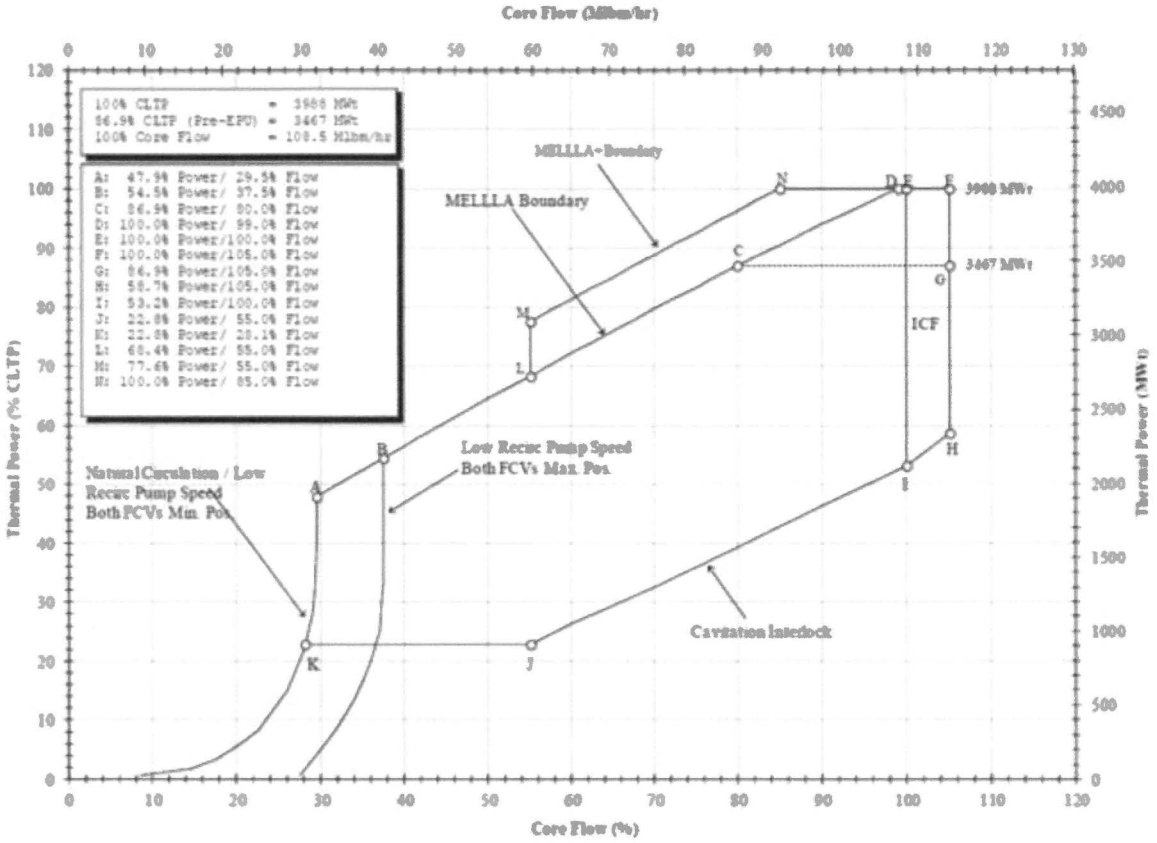
The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the Nuclear Regulatory Commission, particularly those described in the following documents:

1. "General Electric Standard Application for Reactor Fuel (GESTAR II) (Supplement for United States)", NEDE-24011-P-A-29-US, October 2019.

12.0 References

1. "Nine Mile Point Nuclear Station, Unit 2 Renewed Facility Operating License", Exelon Document, Docket No. 50-410, Renewed License No. NPF-69.
2. "Supplemental Reload Licensing Report for Nine Mile Point Unit 2 Reload 17 Cycle 18", Global Nuclear Fuel Document, No. 004N8624, Revision 0, January 2020.
3. "Fuel Bundle Information Report for Nine Mile Point Unit 2 Reload 17 Cycle 18", GNF Document, No. 004N8625, Revision 0, January 2020.
4. "Nine Mile Point Unit 2 Revised TMOL Application Evaluation" Global Nuclear Fuel Document, No 005N5463, Revision 0, January 2020.
5. "Revised GNF2 Thermal Mechanical Operating Limits for Nine Mile Point Unit 2" Global Nuclear Fuel Document, No 005N5546, Revision 1, January 2020.
6. "Safety Analysis Report for Nine Mile Point Unit 2 Maximum Extended Load Line Limit Analysis Plus", GEH Document, No. NEDC-33576P, Revision 0, October 2013.
7. "Revise 22A2843AM", Engineering Change Notice for NSSS161405000 "Design Spec Data Sheet, Neutron Monitoring System", Exelon Document, No. 007242, Revision 1, April 2008.
8. "Instrumentation Limits Calculation Constellation Generation Group Nine Mile Point Nuclear Station Unit 2 Rod Block Monitor (NUMAC ARTS-MELLLA)", GEH Document, No. 0000-0053-1006 NMP2 A-M-T506-RBM-Calc-2006, Revision 1, March 2008.
9. "Final resolved OPL-3 parameters for NMP2 C18", Exelon Document, ENSAF ID No. ES1900009, Revision 0, September 2019.
10. "Nine Mile Point 2 GNF2 NFI T0900 Coincident Equipment Out-of-Service (EOOS) Report", GEH Document, No. 003N2077-R0 Revision 0, February 2016.Searchable in FCMS as 003N2077.
11. "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)", GNF Document, No. NEDC-33270P, Revision 9, December 2017.
12. "GNF2 Fuel Design Cycle-Independent Analyses for Exelon Nine Mile Point Nuclear Station Unit 2", GEH Document, No. 003N2003 Revision 5, August 2019.
13. "Nine Mile Point Unit 2 Option B' Scram Speed Implementation", GEH Document, No. 004N0521-R0, September 2017.
14. "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.

Appendix A



Power/Flow Operating Map for MELLLA+ in Dual Loop Operation (Reference 6)