Exelon Generation®

Technical Specification 5.6.5

NMP2L 2678
May 15, 2018

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

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 4, for Nine Mile Point Unit 2, Cycle 17. 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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DMM/KJK

Enclosure: Core Operating Limits Report, Revision 4, for Nine Mile Point Unit 2, Cycle 17

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

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NRR

Enclosure

Core Operating Limits Report, Revision 4

For

Nine Mile Point Unit 2, Cycle 17

CORE OPERATING LIMITS REPORT

FOR

NINE MILE POINT UNIT 2 CYCLE 17

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

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Summary of Revisions

Revision	Description
Revision 4	New Issue for Cycle 17

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
BPV	Bypass Valve
BSP	Backup Stability Protection
COLR	Core Operating Limits Report
CRD	Control Rod Drive
DLO	Dual Loop Operation
ECCS	Emergency Core Cooling System
EIS	Equipment in Service
ELLLA	Extended Load Line Limit Analysis
EOC	End of Cycle
EOC-RPT	See RPTOOS
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to 100% rated (3988 MW_{th}), recirculation flow equal to 100% rated (108.5 Mlb/hr), and all control blades are fully withdrawn with equilibrium xenon.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
FWHOOS	Feedwater Heater(s) Out of Service
GEH	General Electric-Hitachi
GNF	Global Nuclear Fuel
GPM	Gallons Per Minute
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	OLMCPR Multiplier
LCO	Limiting Condition for Operation
LHGR	Linear Heat Generation Rate
$LHGRFAC_F$	ARTS LHGR thermal limit flow dependent adjustments and multipliers
$LHGRFAC_P$	ARTS LHGR thermal limit power dependent adjustments and multipliers

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
$MCPR_F$	ARTS MCPR thermal limit flow dependent adjustments and multipliers
$MCPR_P$	ARTS MCPR thermal limit power dependent adjustments and multipliers
MELLLA	Maximum Extended Load Line Limit Analysis
MELLLA+	Maximum Extended Load Line Limit Analysis Plus
MSIV	Main Steam Isolation Valve
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
RDF	Recirculation Drive Flow
RPTOOS	Recirculation Pump Trip Out of Service; also known as EOC-RPT
RTP	Rated Thermal Power (3988 MW_t)
RBM	Rod Block Monitor
RWE	Rod Withdraw Error
SLMCPR	Safety Limit MCPR
SLO	Single Loop Operation
SRV	Safety Relief Valve
SRVOOS	Safety Relief Valve Out of Service
TBV	Turbine Bypass Valve
TBVOOS	Turbine Bypass Valve Out of Service
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 17.

OPERATING LIMIT TECHNICAL SPECIFICATION REQUIREMENTS

Operating Limit	Requirement
APLHGR	TS LCO 3.2.1
MCPR	TS LCO 3.2.2
LHGR	TS LCO 3.2.3

This report provides the following cycle-specific parameter limits for Nine Mile Point Unit 2 Cycle 17 (Reload 16):

- 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) Analytical Limits, Allowable Values and MCPR Limits
- Turbine Bypass Valve (TBV) parameters
- Backup Stability Protection (BSP) parameters

Per TS 5.6.5, these values have been determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met. The limits specified in this COLR support both DLO and SLO as required by TS LCO 3.4.1 and Main Turbine Bypass System inoperable as required by TS LCO 3.7.5.

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%

3.0 MAPLHGR Limits

The MAPLHGR limits obtained from the ECCS analysis are provided in Table 3-1 and Table 3-2. 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 3-3.

The MAPLHGR multipliers, $MAPFAC_P$ and $MAPFAC_F$, are set to unity for all power and flow conditions per Reference 2 – Section 16.

Table 3-1
MAPLHGR Versus Average Planar Exposure
GE14C
(Reference 2 – Table 16.3-1)

Average 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 Versus Average Planar Exposure
GNF2
(Reference 2 – Table 16.3-2)

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 3-3
MAPLHGR SLO Multiplier
All Fuel Types
(Reference 2 – Table 16.3-3)

Fuel Type	SLO Multiplier
GE14C	0.78
GNF2	0.78

4.0 MCPR Limits

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 dependent thermal limits have been confirmed for operation with Equipment In-Service (EIS), Turbine Bypass Valves Out-Of-Service (TBVOOS), Recirculation Pump Trip Out-Of-Service (RPTOOS) and Pressure Regulator Out-Of-Service (PROOS).

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

EOOS Combination	SCRAM Time Option	Cycle Exposure	
		<EOR-2017 MWD/ST	≥EOR-2017 MWD/ST
BASE	A	1.65	1.67
	B	1.45	1.47
BASE SLO	A	1.67	1.69
	B	1.48	1.49
TBVOOS	A	1.72	1.72
	B	1.49	1.49
TBVOOS SLO	A	1.74	1.74
	B	1.51	1.51
RPTOOS	A	1.69	1.71
	B	1.45	1.47
RPTOOS SLO	A	1.71	1.73
	B	1.48	1.49
PROOS	A	1.65	1.67
	B	1.45	1.47

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	2.70	2.70	2.61					
BASE SLO	>75				1.218	1.180	1.150	1.056	1.000
	≤75	2.72	2.72	2.63					
TBVOOS	>75				1.218	1.180	1.150	1.056	1.000
	≤75	3.57	3.57	3.28					
TBVOOS SLO	>75				1.218	1.180	1.150	1.056	1.000
	≤75	3.59	3.59	3.30					
RPTOOS	>75				1.218	1.180	1.150	1.056	1.000
	≤75	2.70	2.70	2.61					
RPTOOS SLO	>75				1.218	1.180	1.150	1.056	1.000
	≤75	2.72	2.72	2.63					
PROOS	>75				1.218	1.180	1.172	1.056	1.000
	≤75	2.70	2.70	2.61					

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	2.04
30.0	1.81
96.8	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	2.06
30.0	1.83
96.8	1.31
112.0	1.31

5.0 LHGR Limits

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]
GE14C	See Reference 5 – Table D-2
GNF2	See Reference 11 – Table B-1

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

Fuel Type	LHGR Limit [KW/ft]
GE14C	See Reference 5 – Table D-4
GNF2	See Reference 11 – Table B-2

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	52.7	85	112
DLO	0.420	0.625		1.000	1.000
SLO	0.420	0.625	0.780	0.780	0.780

6.0 Rod Block Monitor Setpoints

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, Reference 4 – Attachment 1 Table 4-5). The RBM operability requirements have been evaluated and shown to be sufficient to ensure that the SLMCPR and cladding 1% plastic strain criteria will not be exceeded in the event of a Rod Withdraw Error.

The ARTS RWE analysis validated the MCPR values in Table 6-2 below for use in Cycle 17. The RWE MCPR values have been analyzed at discrete setpoint values and unblocked (continuous withdraw) conditions.

Table 6-1
Rod Block Monitor Setpoints[1]
(Reference 2 – Section 10, Reference 6 – Section 5.1.3, 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%
INOP	N/A	N/A	N/A

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

Power Level [% Rated]	MCPR
<90%	≥1.86
≥90%	≥1.53

[1] See Reference 8 for filtered values.

7.0 Turbine Bypass Valve Parameters

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 17 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[2]	Allowed Operating Region
BASE	Yes
BASE SLO	Yes
TBVOOS[5]	Yes
TBVOOS SLO[5]	Yes
RPTOOS	Yes
RPTOOS SLO	Yes
PROOS	Yes

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

EOOS Condition
SRVOOS
ADSOOS
MSIVOOS[3]
TCV/TSVOOS[4,5]

[2] The EOOS Options listed apply to both Option A and Option B
[3] 1 MSIVOOS limited to 75% rated thermal power
[4] 1 TCV/TSVOOS limited to 85% rated thermal power
[5] TCV/TSVOOS not analyzed concurrent with TBVOOS

9.0 Stability Protection

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 25.

Table 9-1
BSP Endpoints for Normal Feedwater Temperature[6,7]
(Reference 2 – Table 15-2)

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	92.7	BSP Boundary Intercept, HFCL
B3	79.4	69.6	BSP Boundary Intercept, MELLLA Boundary

Table 9-2
Automatic BSP Setpoints[8]
(Reference 2 – Table 15-3)

Parameter	Symbol	Value
Slope of Automatic BSP APRM flow-biased trip linear segment	m_{TRIP}	1.26
Automatic 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
Automatic 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

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

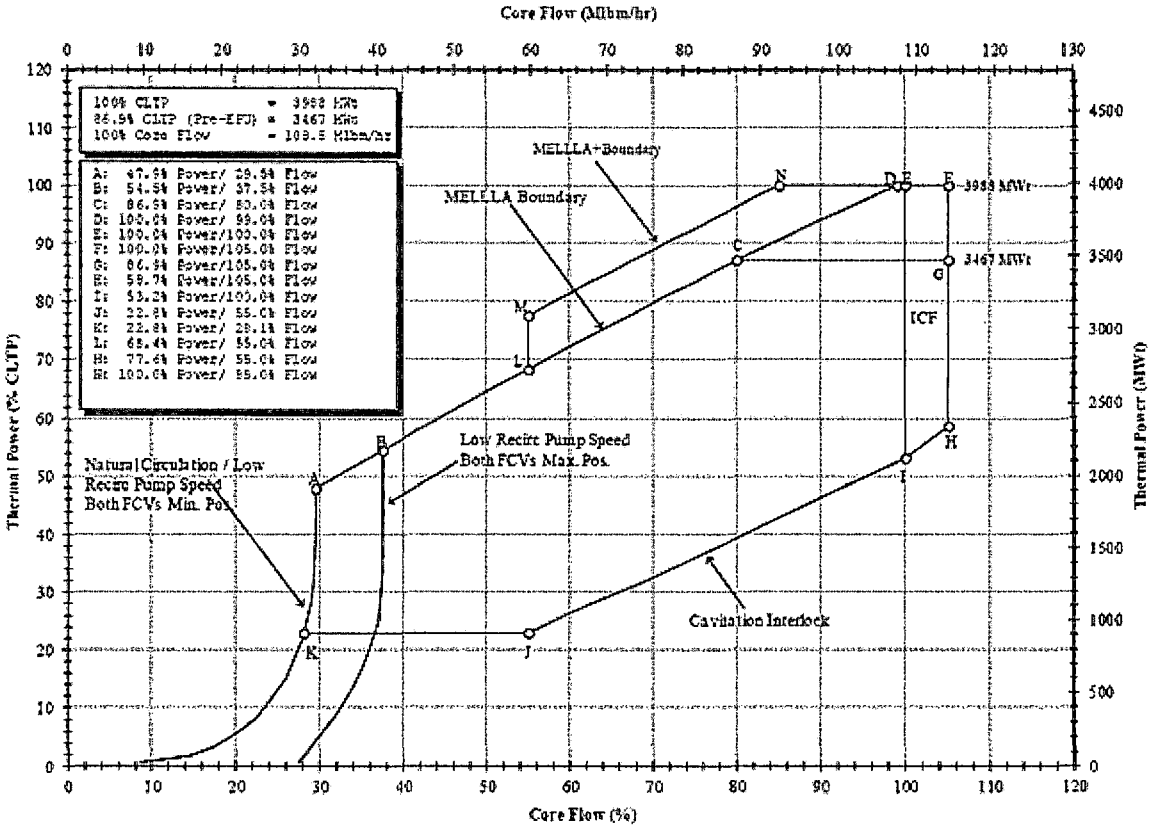
The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the Nuclear Regulatory Commission, particularly those described in the following documents:

1. "General Electric Standard Application for Reactor Fuel (GESTAR II)", NEDE-24011-P-A-26, January 2018.
2. "General Electric Standard Application for Reactor Fuel (GESTAR II) (Supplement for United States)", NEDE-24011-P-A-26-US, January 2018.

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, Revision 20180111.01, January 2018.
2. "Supplemental Reload Licensing Report for Nine Mile Point Unit 2 Reload 16 Cycle 17", Global Nuclear Fuel Document, No. 003N8948, Revision 0, January 2018.
3. "Fuel Bundle Information Report for Nine Mile Point Unit 2 Reload 16 Cycle 17", GNF Document, No. 003N8949, Revision 0, January 2018.
4. "Nine Mile Point Nuclear Station Unit 2 ARTS/MELLLA, Task T0900: Transient Analysis", GE Energy Document, No. GE-NE-0000-0055-2373-R0, Revision 0, February 2007.
5. "GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II), NEDC-32868P, Revision 6, March 2016," GNF Document, No. MFN 16-015, March 2016.
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 C17", Exelon Document, ENSAF ID No. ES1700015, Revision 1, September 2017.
10. "Nine Mile Point 2 GNF2 NFI T0900 Coincident Equipment Out-of-Service (EOOS) Report", GEH Document, No. 003N2077-R0 Revision 0, February 2016.
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 3, September 2017.
13. "Nine Mile Point Unit 2 Option B' Scram Speed Implementation", GEH Document, No. 004N0521-R0, September 2017.

Appendix A



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