Exelon Generation®

Technical Specification 5.6.5

NMP2L 2598
October 7, 2015

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, Cycle 15 for Nine Mile Point Unit 2 (NMP2). The COLR has been revised as a result of MELLLA+ implementation and 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 me at (315) 349-5219.

Sincerely,

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

Enclosure: Core Operating Limits Report for Nine Mile Point Unit 2 Cycle 15

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

A001
NRR

Enclosure

Core Operating Limits Report

For

Nine Mile Point Unit 2 Cycle 15

CORE OPERATING LIMIT REPORT

FOR

NINE MILE POINT UNIT 2 CYCLE 15

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Table of Contents

Revision History

Revision	Description
Revision 1	**Revised to reflect MELLLA+ Implementation**
Revision 0	**New Issue for Cycle 15**

Since this COLR will be the first Nine Mile Point Unit 2 (NMP2) COLR in the Exelon standard formatting and documentation style, it is listed as a new document in records management. This is revising the originally issued NMP2 Cycle 15 (C15) COLR.

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
DLO	Dual Loop Operation
DSS-CD	Detect and Suppress Solution – Confirmation Density
ECCS	Emergency Core Cooling System
EIS	Equipment In Service
ELLLA	Extended Load Line Limit Analysis
EOC	End of Cycle
EOOS	Equipment Out of Service
EOR	End of Rated. The cycle exposure at which reactor power is equal to 3988 MW_{th} with recirculation flow equal to 100% rated, all control blades fully withdrawn, and equilibrium xenon.
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 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
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
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
RBM	Rod Block Monitor
RWE	Rod Withdraw Error
SLMCPR	Safety Limit MCPR
SLO	Single Loop Operation
SRVOOS	Safety Relief Valve Out of Service
TBVOOS	Turbine Bypass Valve Out of Service
TS	Technical Specification

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 for intermediate values.

This report provides the values of the power distribution limits, control rod withdraw block instrumentation setpoints and stability protection setpoints for Nine Mile Point Unit 2 Cycle 15.

OPERATING LIMIT TECHNICAL SPECIFICATION REQUIREMENTS

Operating Limit	Requirement
APLHGR	Technical Specification LCO 3.2.1
MCPR	Technical Specification LCO 3.2.2
LHGR	Technical Specification LCO 3.2.3

This report provides the following cycle-specific parameter limits for Nine Mile Point Unit 2 CYCLE 15 (RELOAD 14):

- 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 Parameters
- EOC Recirculation Pump Trip (EOC-RPT) Parameters
- Backup Stability Protection 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 supports 2 SRVOOS and ICF for operational flexibility.

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 to a minimum core flow of 85% of rated.
- Increased Core Flow up to 105% rated.
- Extended Power Uprate to 3988 $MW_{th.}$

Note that no revision bars are used as this is a complete rewrite.

3.0 MAPLHGR Limits

The Maximum Average Planar Linear Heat Generation Rate limits, in $\frac{KW}{ft}$, 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. Since NMP2 Cycle 15 employs solely GE14 fuel, these values are applicable to all the bundles in the NMP2C15 core. For SLO, a multiplier is used as shown in Table 3-2.

Table 3-1
MAPLHGR Versus Average Planar Exposure
All Fuel Types
(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 SLO Multiplier
All Fuel Types
(Reference 2 – Table 16.3-2)

Fuel Type	SLO Multiplier
GE14C	0.78

Note that per TS LCO 3.4.1.d, Single Loop Operation in the MELLLA or MELLLA+ domains is prohibited.

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

4.0 MCPR Limits

The Operating Limit MCPRs listed in Table 4-1 cover all conditions listed in Section 8.0, Modes of Operation. ARTS provides for power and flow dependent thermal limits adjustments, which allow for a more reliable administration of the MCPR thermal limit. Note that SLO and DLO OLMCPR values are identical. The OLMCPRs for PROOS, ADSOOS, MSIVOOS, and ADSOOS+MSIVOOS are the same as the BASE OLMCPRs.

Control rod scram time verification is required as per TS 3.1.4, "Control Rod Scram Times". Tau (τ), a measure of scram time performance to notch position 39 throughout the cycle, is determined based on the cumulative scram time test results. The calculation of Tau shall be performed in accordance with site procedures. Linear interpolation shall be used to calculate the OLMCPR value if Tau is between 0.0 (Tau Option B) and 1.0 (Tau Option A). Tau is defined as:

$$\tau = \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B}$$

Where:

$$\tau_A = 0.866 \text{ seconds}$$

$$\tau_B = 0.672 + 1.65 \cdot \sqrt{\frac{N_1}{\sum_{i=1}^{n} N_i}} \cdot 0.016 \text{ seconds}$$

$$\tau_{ave} = \frac{\sum_{i=1}^{n} N_i \tau_i}{\sum_{i=1}^{n} N_i} \text{ seconds}$$

n is the number of surveillance tests performed in the cycle; N_i is the number of active control rods measured in surveillance test i; N_1 is the total number of active rods measured; τ_i is the average scram time to notch 39 for rods in surveillance test i.

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-2816 MWD/ST	≥EOR-2816 MWD/ST
BASE	A	1.65	1.66
	B	1.41	1.42
BASE SLO	A	1.65	1.66
	B	1.41	1.42
TBVOOS	A	1.66	1.66
	B	1.44	1.44
TBVOOS SLO	A	1.66	1.66
	B	1.44	1.44
RPTOOS	A	1.75	1.81
	B	1.42	1.48
RPTOOS SLO	A	1.75	1.81
	B	1.42	1.48

Table 4-2
Power Dependent MCPR Limit Adjustments and Multipliers ($MCPR_P$)
All Fuel Types
(Reference 2 – Appendix D, Reference 3 – Section 4.3)

EOOS Combination	Core Flow [% of rated]	Core Thermal Power [% of rated]										
		0	23	<26	≥26	<55	≥55	60	85	<90	≥90	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier (K_p)							
BASE	>75				1.511	1.336	1.193	1.150	1.056			1.000
	≤75	2.52	2.52	2.43								
BASE SLO	>75				1.511	1.336	1.193	1.150	1.056			1.000
	≤75	2.52	2.52	2.43								
RPTOOS	>75				1.511	1.336	1.193	1.150	1.062			1.000
	≤75	2.52	2.52	2.43								
RPTOOS SLO	>75				1.511	1.336	1.193	1.150	1.062			1.000
	≤75	2.52	2.52	2.43								
TBVOOS	>75				1.511	1.336	1.193	1.150	1.056			1.000
	≤75	3.33	3.33	3.06								
TBVOOS SLO	>75				1.511	1.336	1.193	1.150	1.056			1.000
	≤75	3.33	3.33	3.06								
PROOS	>75				1.511					1.122	1.038	1.000
	≤75	2.52	2.52	2.43								
PROOS SLO	>75				1.511					1.122	1.038	1.000
	≤75	2.52	2.52	2.43								

ARTS power dependent thermal limits have been confirmed for operation with Equipment In-Service, Turbine Bypass Valves Out-Of-Service (TBVOOS), Recirculation Pump Trip Out-Of-Service (RPTOOS) and Pressure Regulator Out-Of-Service (PROOS). The $K_p/MCPR_p$ and $LHGRFAC_p$ thermal limits applicable to the Equipment In-Service, TBVOOS and RPTOOS conditions are documented in Reference 3. The $K_p/MCPR_p$ and $LHGRFAC_p$ thermal limits applicable to the PROOS condition are documented in References 3 and 4.

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

Flow [% rated]	$MCPR_F$ Limit
0.0	1.91
30.0	1.69
87.3	1.27
112.0	1.27

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 $LHGRFAC_F$.

Table 5-1
LHGR Limits for UO_2 Fuel
(Reference 5, Reference 6 – Table D2)

Fuel Type	LHGR Limit [KW/ft]
GE14C	See Reference 6 – Table D2

Table 5-2
LHGR Limits for Gadolinia Rods
(Reference 5, Reference 6 – Table D4)

Fuel Type	LHGR Limit [KW/ft]
GE14C	See Reference 6 – Table D4

Table 5-3
Power Dependent LHGR Multiplier $LHGRFAC_P$
All Fuels Types
(Reference 2 – Appendix D, Reference 4 – Section 4)

EOOS Combination	Core Flow [% of rated]	Core Thermal Power [% of rated]						
		0	23	<26	≥26	<90	≥90	100
BASE	>75				0.613			1.000
	≤75	0.597	0.597	0.613				
BASE SLO	>75				0.613			1.000
	≤75	0.597	0.597	0.613				
RPTOOS	>75				0.613			1.000
	≤75	0.597	0.597	0.613				
RPTOOS SLO	>75				0.613			1.000
	≤75	0.597	0.597	0.613				
TBVOOS	>75				0.613			1.000
	≤75	0.535	0.535	0.556				
TBVOOS SLO	>75				0.613			1.000
	≤75	0.535	0.535	0.556				
PROOS	>75				0.613	0.850	0.948	1.000
	≤75	0.597	0.597	0.613				
PROOS SLO	>75				0.613	0.850	0.948	1.000
	≤75	0.597	0.597	0.613				

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

EOOS Condition	Core Flow [% of rated]				
	0	30	52.8	85	112
	$LHGRFAC_F$ Multiplier				
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 9 – 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.

Table 6-1
Rod Block Monitor Setpoints[1]
(Reference 2 – Section 10, Reference 7 – Section 5.1.3, Reference 8 – Section 4, Reference 10 – Section 3)

Power Level	Allowable Value	Nominal Trip Setpoint	Analytical Limit
LTSP	124.6%	124.2%	127.0%
ITSP	119.6%	119.2%	122.0%
HTSP	114.6%	114.2%	117.0%
INOP	N/A	N/A	N/A

The ARTS RWE analysis validated the MCPR values in Table 6-2 below for use in Cycle 15. The RWE MCPR values have been analyzed at discrete setpoint values and unblocked (continuous withdraw) conditions. The most limiting RBM OLMCPR of 1.38 is still less than minimum cycle OLMCPRs.

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

Power Level [% Rated]	MCPR
<90%	≥1.70
≥90%	≥1.40

[1] Values given are unfiltered; for filtered values see Reference 10.

7.0 Turbine Bypass Valve Parameters

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

Table 7-1
Turbine Bypass Valve Response Time
(Reference 11 – Section 2.6)

Event	Response Time [sec]
Total Response Time Of BPV (80% of rated BPV flow)	0.30
Maximum Bypass Valve Delay From Event Initiation To Start Of BPV Opening	0.15

8.0 Modes of Operation

Table 8-1
Modes of Operation
(Reference 2, Reference 12 – Table 15.0-6)

Options[2]	Allowed Operating Region
BASE	Yes
BASE SLO	Yes
TBVOOS	Yes
TBVOOS SLO	Yes
RPTOOS	Yes
RPTOOS SLO	Yes
PROOS	Yes
MSIVOOS	Yes
MSIVOOS SLO	Yes
ADSOOS	Yes
ADSOOS SLO	Yes
MSIVOOS + ADSOOS	Yes
MSIVOOS + ADSOOS SLO	Yes

For Main Steam Isolation Valve (MSIV) Out of Service, only one MSIV may be inoperable and, per Reference 14 – Section 15.22.0, reactor power must be maintained ≤ 75% rated power.

[2] The EOOS Options listed are for Option A or Option B

Note that there are no thermal limit penalties or differences for operating with up to two Safety Relief Valves Out of Service (SRVOOS) and all conditions also support 2 SRVOOS.

There are no thermal limit penalties or differences for operating with up to two ADS valves out of service and all conditions also support 2 ADSOOS.

Maximum power in SLO operation is restricted by two parameters, namely recirculation flow and rod line. The maximum allowable SLO recirculation drive flow is 41,800 GPM due to recirculation piping vibration limitations and the maximum SLO rod line is 89% (original ELLLA boundary). These restrictions are also described in the SLO Loop Power-to-Flow Maps (Reference 16). Where these two parameters intersect on the Power-to-Flow Maps restricts SLO maximum power.

Operation with EOC RPTOOS was justified for Nine Mile Point Unit 2 in Reference 13.

There is no formally analyzed option for FWHOOS, however per Reference 7 – Section 1.2.4 there is a 20°F decrease from the rated temperature within analyzed conditions.

9.0 Stability Protection

Per References 15 and 2 the OPRM Upscale Setpoint requirement has been replaced by the DSS-CD solution. The Amplitude Discriminator Setpoint is 1.10 (Reference 2 Section 15.2). Results have been validated with feedwater temperature ≥ 420.5°F in accordance with Reference 7.

Per TS 5.6.5.a.4, the BSP regions and values are as shown below in Table 9-1, and Table 9-2. A graphical representation of these values can be found in Appendix A

Table 9-1
BSP Endpoints for Normal Feedwater Temperature
(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	89.9	71.4	BSP Boundary Intercept, HFCL
B3	74.0	55.0	BSP Boundary Intercept, MELLLA+ Boundary Minimum Flow

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

Parameter	Symbol	Value
Slope of Automatic BSP APRM flow-biased trip linear segment	$m_{BSP-TRIP}$	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	$W_{BSP-BREAK}$	16.4% RDF

10.0 Power/Flow Operating Map

See Appendix B for a Power/Flow Map.

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-21, May 2015
2. "General Electric Standard Application for Reactor Fuel (GESTAR II) (Supplement for United States)", NEDE-24011-P-A-21-US, May 2015

[3] Bounding for both DLO and SLO.

12.0 References

1. "Nine Mile Point Nuclear Station Unit 2 Renewed Facility Operating License", Docket No. 50-410, Renewed License No. NPF-69, Exelon Document.
2. "Supplemental Reload Licensing Report for Nine Mile Point 2 (NMP2) Reload 14 Cycle 15 Extended Power Uprate (EPU)/Maximum Extended Load Line Limit Plus (MELLLA+)", August 2015, Global Nuclear Fuels Document No. 000N0123-SRLR, Revision 3.
3. "Nine Mile Point Nuclear Power Plant, Unit 2, TRACG Implementation for Reload Licensing Transient Analysis (T1309)", GEH Document No. 0000-0157-9895-R1, Rev. 1, October 2013.
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. "Fuel Bundle Information Report for Nine Mile Point 2 Reload 14 Cycle 15", GNF Document No. 000N0123-FIBR-P Revision 0, December 2013.
6. Letter from B. R. Moore (GNF) to Document Control Desk (NRC), Subject: "GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II), NEDC-32868P, Revision 5, May 2013," GNF Document No. MFN13-028, May 24, 2013.
7. "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.
8. "Nine Mile Point Nuclear Station Unit 2 APRM/RBM/Technical Specifications/Maximum Extended Load Line Limit Analysis (ARTS/MELLLA)", GE Energy Document No. NEDC-33286P Revision 0, March 2007.
9. "Revise 22A2843AM", Engineering Change Notice for NSSS161405000 "Design Spec Data Sheet, Neutron Monitoring System", Exelon Document Number 007242, Rev. 1, April 2008.
10. "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.
11. "OPL 3 – Fuel Analysis Parameters", Nine Mile Point Nuclear Station Calculation No. A10.1-AE-001 Revision 02, October 2003.
12. "Nine Mile Point Nuclear Station Unit 2 Updated Safety Analysis Report", U.S. Nuclear Regulatory Commission Docket 50-410 License NPF-69, Revision 20, October 2012, Exelon Document.
13. "Project Task Report, Constellation Energy Nuclear Group, Nine Mile Point Nuclear Station Unit 2 MELLLA+, Task T0900: Transient Analysis", GEH Document No. 0000-0130-0603-R3, Revision 3, July 2013.
14. "FRED Nine Mile Point Unit 2 Reload 14 Cycle 15 MELLLA+", Technical Information Letter between Nine Mile Point Nuclear Station and GNF, Revision 4, August 2013.

15. "License Amendment Request Pursuant to 10 CFR 50.90: Maximum Extended Load Line Limit Analysis Plus", Nine Mile Point Nuclear Station, Unit 2 Renewed Facility Operating License No. NPF-69 Docket No. 50-410, November 2013.
16. "Power Flow Operating Map 1 Recirculation Loop in Operation", Engineering Change Notice No. ECP-12-000448-CN-043 EM-950B-17.01, Revision 0000.00, August 2015, Exelon Document.

Appendix A

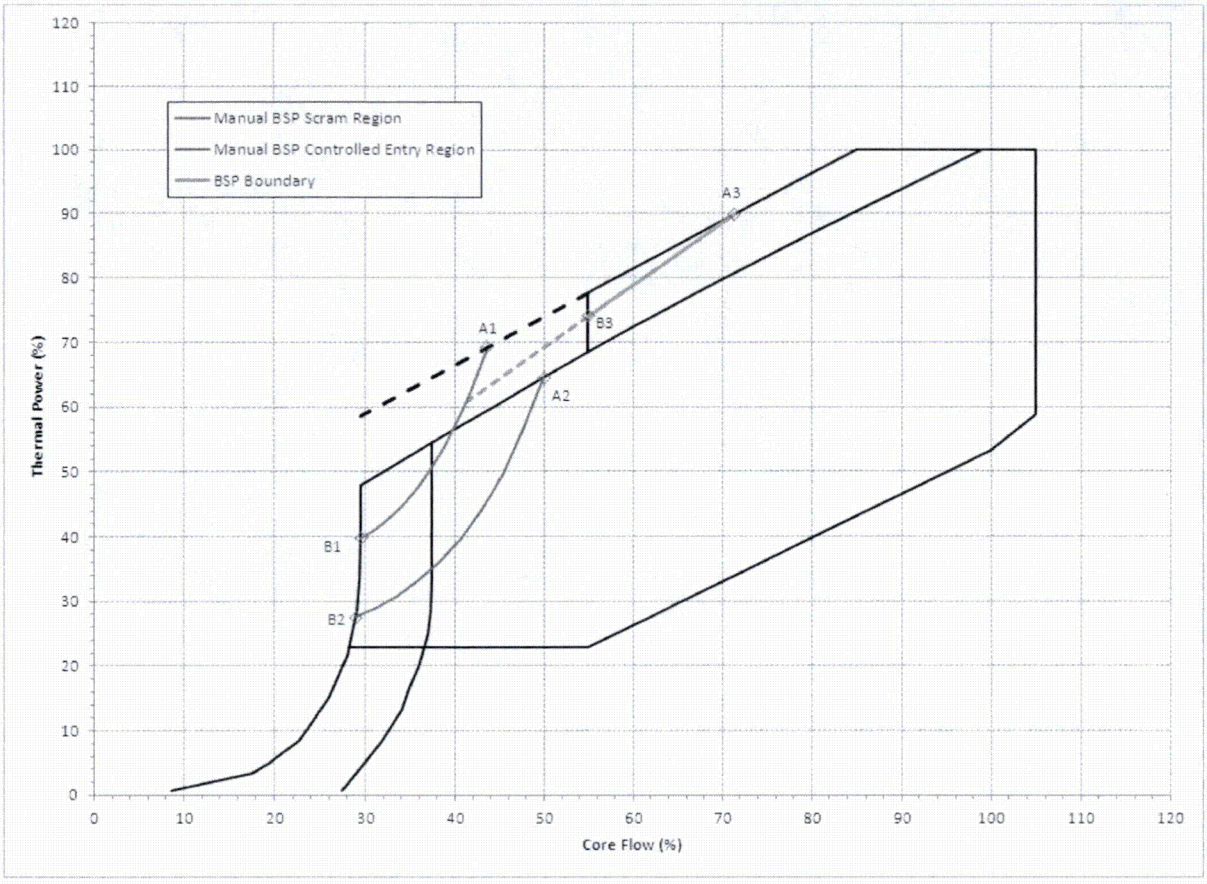

Figure 22 Manual BSP Regions and BSP Boundary for Normal Feedwater Temperature Operation

Appendix B

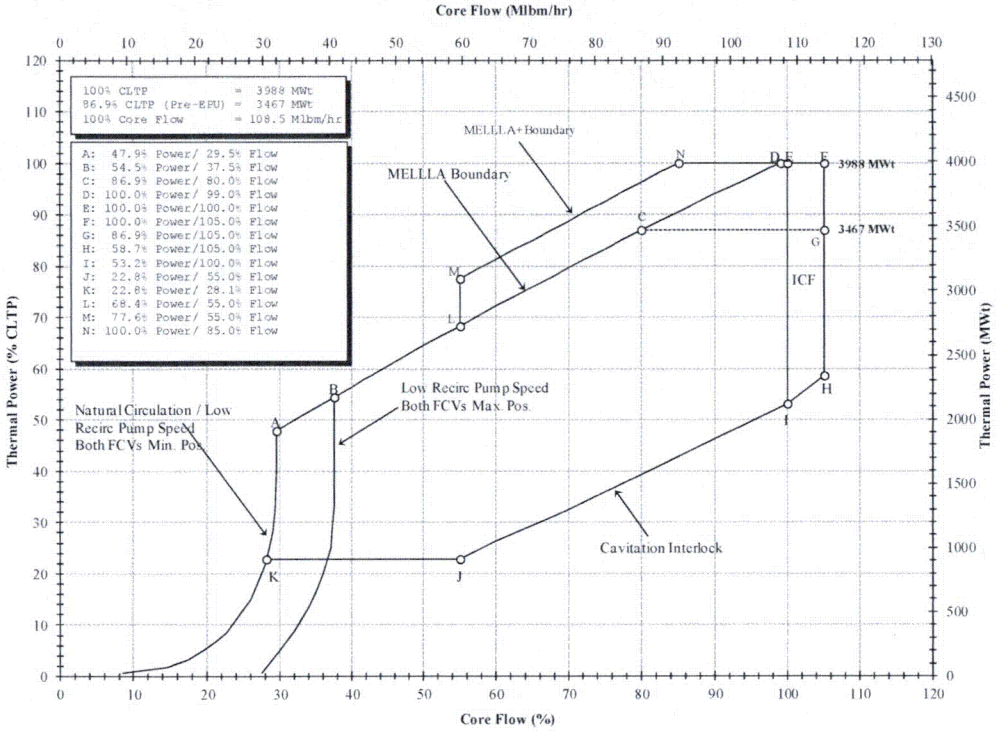

Figure 1-1 Power/Flow Operating Map for MELLLA+