DUKE ENERGY®

Brunswick Nuclear Plant
8470 River Rd SE
Southport, NC 28461

March 29, 2022
Serial: RA-22-0095

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Brunswick Steam Electric Plant, Unit No. 1
Renewed Facility Operating License No. DPR-71
Docket No. 50-325
Unit 1 Cycle 24 Core Operating Limits Report (COLR)

Reference Letter from Mark R. DeWire (Duke Energy) to NRC Document Control Desk, Unit 1 Cycle 23 Core Operating Limits Report (COLR), Revision 3, dated June 23, 2021.

Ladies and Gentlemen:

Enclosed is a copy of the Core Operating Limits Report (COLR) for Brunswick Steam Electric Plant (BSEP), Unit 1 Cycle 24 operation. Duke Energy Progress, LLC (Duke Energy), is providing the enclosed COLR in accordance with Brunswick Unit 1 Technical Specification 5.6.5.d. The enclosed COLR supersedes the report previously submitted by letter dated June 23, 2021 (i.e., Reference).

This letter and the enclosed COLR contain no regulatory commitments.

Please refer any questions regarding this submittal to Mr. Stephen Yodersmith, Brunswick Regulatory Affairs, at (910) 832-2568.

Sincerely,

Mark R. DeWire
Manager – Nuclear Support Services
Brunswick Steam Electric Plant

Enclosure:

Brunswick Unit 1 Cycle 24 Core Operating Limits Report

cc (with enclosure):

Ms. Laura Dudes, NRC Regional Administrator, Region II
Mr. Luke Haeg, NRC Project Manager
Mr. Gale Smith, NRC Senior Resident Inspector
Chair - North Carolina Utilities Commission

Brunswick Unit 1 Cycle 24
Core Operating Limits Report

DUKE ENERGY®

Facility Code :	BNP
Applicable Facilities :	BNP
Document Number :	BNEI-0400-0051
Document Revision Number :	000
Document EC Number :	
Change Reason :	AD-NF-ALL-0807
Document Title :	B1C24 CORE OPERATING LIMITS REPORT

Evans, Steve	Originator	3/28/2022
Wells, Ryan E.	Verifier	3/29/2022
Butler, Allen P	Reviewer	3/28/2022
Lambert, Brad	Approver	3/29/2022

Notes :

BRUNSWICK UNIT 1, CYCLE 24

CORE OPERATING LIMITS REPORT

March 2022

Prepared by: [Signed Electronically]
Steve Evans
Brunswick Nuclear Design

Reviewed by: [Signed Electronically]
Ryan Wells
Brunswick Nuclear Design

Site Inspection by: [Signed Electronically]
Brunswick Reactor Engineering

Approved by: [Signed Electronically]
Brad Lambert
Manager, Brunswick Nuclear Design

Implementation Instructions for Revision 0

Revision Description

Design Calculation 1B21-2098 Revision 0 documents the initial generation of the B1C24 Core Operating Limits Report in support of the B1C24 Reload Core Design.

Implementation Requirements

Technical Specification Amendment 301 (TSTF-564) is required to be implemented prior to the issuance of the B1C24 COLR Revision 0.

Implementation Schedule

The B1C24 COLR Revision 0 must be issued prior to entering MODE 2 for startup following the Unit 1 Spring 2022 refueling outage.

LIST OF EFFECTIVE PAGES

Page(s)	Revision
1- 47	0

This document consists of 47 total pages.

TABLE OF CONTENTS

Subject	Page
Cover	1
Implementation Instructions for Revision 0	2
List of Effective Pages	3
Table of Contents	4
List of Tables	5
List of Figures	7
Nomenclature	8
Introduction and Summary	10
APLHGR Limits	11
MCPR Limits	11
LHGR Limits	12
CDA Setpoints	12
RBM Setpoints	13
Equipment Out-of-Service	14
Single Loop Operation	15
Inoperable Main Turbine Bypass System	15
Feedwater Temperature Reduction	16
References	17

CAUTION
References to COLR Figures or Tables should be made using titles only; Figure and Table numbers may change from cycle to cycle.

LIST OF TABLES

Table	Title	Page
Table 1:	RBM System Setpoints	19
Table 2:	RBM Operability Requirements	20
Table 3.1:	BSP Endpoints for Nominal Feedwater Temperature	21
Table 3.2:	BSP Endpoints for Reduced Feedwater Temperature	21
Table 3.3:	ABSP Setpoints for the Scram Region	21
Table 4:	Exposure Basis for Brunswick Unit 1 Cycle 24 Transient Analysis	22
Table 5:	Power-Dependent $MCPR_p$ Limits NSS Insertion Times - BOC to < NEOC	23
Table 6:	Power-Dependent $MCPR_p$ Limits ESS Insertion Times - BOC to < NEOC	24
Table 7:	Power-Dependent $MCPR_p$ Limits TSSS Insertion Times - BOC to < NEOC	25
Table 8:	Power-Dependent $MCPR_p$ Limits NSS Insertion Times - BOC to < EOCLB	26
Table 9:	Power-Dependent $MCPR_p$ Limits ESS Insertion Times - BOC to < EOCLB	27
Table 10:	Power-Dependent $MCPR_p$ Limits TSSS Insertion Times - BOC to < EOCLB	28
Table 11:	Power-Dependent $MCPR_p$ Limits NSS Insertion Times – BOC to < MCE (FFTR/Coastdown)	29
Table 12:	Power-Dependent $MCPR_p$ Limits ESS Insertion Times – BOC to < MCE (FFTR/Coastdown)	30
Table 13:	Power-Dependent $MCPR_p$ Limits TSSS Insertion Times – BOC to < MCE (FFTR/Coastdown)	31
Table 14:	Flow-Dependent $MCPR_f$ Limits	32
Table 15:	Framatome Fuel Steady-State $LHGR_{SS}$ Limits	33
Table 16:	Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers NSS Insertion Times - BOC to < EOCLB	34
Table 17:	Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers ESS Insertion Times - BOC to < EOCLB	35
Table 18:	Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers TSSS Insertion Times - BOC to < EOCLB	36
Table 19:	Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers NSS Insertion Times – BOC to < MCE (FFTR/Coastdown)	37

Table 20: Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers 38
ESS Insertion Times – BOC to < MCE (FFTR/Coastdown)

Table 21: Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers 39
TSSS Insertion Times – BOC to < MCE (FFTR/Coastdown)

Table 22: Framatome Fuel Flow-Dependent $LHGRFAC_f$ Multipliers 40

Table 23: Framatome Fuel Steady-State $MAPLHGR_{SS}$ Limits..... 41

CAUTION

References to COLR Figures or Tables should be made using titles only; Figure and Table numbers may change from cycle to cycle.

LIST OF FIGURES

Figure	Title or Description	Page
Figure 1:	MELLLA+ Power/Flow Map OPRM Operable, Two Loop Operation, 2923 MWt	42
Figure 2:	MELLLA+ Power/Flow Map OPRM Inoperable, Two Loop Operation, 2923 MWt	43
Figure 3:	MELLLA+ Power/Flow Map OPRM Operable, Single Loop Operation, 2923 MWt	44
Figure 4:	MELLLA+ Power/Flow Map OPRM Inoperable, Single Loop Operation, 2923 MWt	45
Figure 5:	MELLLA+ Power/Flow Map OPRM Operable, FWTR, 2923 MWt	46
Figure 6:	MELLLA+ Power/Flow Map OPRM Inoperable, FWTR, 2923 MWt	47

NOMENCLATURE

2PT	Two Recirculation Pump Trip
ΔW	SLO Flow Uncertainty
ABSP	Automated Backup Stability Protection
APLHGR	Average Planar Linear Heat Generation Rate
APRM	Average Power Range Monitor (Subsystem)
ARTS	APRM/RBM Technical Specification
BEO-III	Best-estimate Enhanced Option-III
BOC	Beginning of Cycle
BSP	Backup Stability Protection
BWROG	BWR Owners' Group
CAVEX	Core Average Exposure
CDA	Confirmation Density Algorithm
COLR	Core Operating Limits Report
CRWE	Control Rod Withdrawal Error
ECCS	Emergency Core Cooling System
EFPD	Effective Full Power Day
EOC	End of Cycle
EOCLB	End of Cycle Licensing Basis
EOFP	End of Full Power
EOOS	Equipment Out-of-Service
ESS	Extended SCRAM Speed
F	Flow (Total Core)
FHOOS	Feedwater Heater Out-of-Service
FFTR	Final Feedwater Temperature Reduction
FWTR	Feedwater Temperature Reduction
GE	General Electric
HFCL	High Flow Control Line
HPSP	High Power Set Point
HTSP	High Trip Set Point
ICF	Increased Core Flow
IPSP	Intermediate Power Set Point
ITSP	Intermediate Trip Set Point
LCO	Limiting Condition of Operation
LHGR	Linear Heat Generation Rate
$LHGR_{SS}$	Steady-State Maximum Linear Heat Generation Rate
LHGRFAC	Linear Heat Generation Rate Factor
$LHGRFAC_f$	Flow-Dependent Linear Heat Generation Rate Factor
$LHGRFAC_p$	Power-Dependent Linear Heat Generation Rate Factor
LOCA	Loss of Coolant Accident
LPRM	Local Power Range Monitor (Subsystem)
LPSP	Low Power Set Point
LTSP	Low Trip Set Point

NOMENCLATURE (continued)

MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
$MAPLHGR_{SS}$	Steady-State Maximum Average Planar Linear Heat Generation Rate
MAPFAC	Maximum Average Planar Linear Heat Generation Rate Factor
$MAPFAC_f$	Flow-Dependent Maximum Average Planar Linear Heat Generation Rate Factor
$MAPFAC_p$	Power-Dependent Maximum Average Planar Linear Heat Generation Rate Factor
$MAPFAC_{SLO}$	Maximum Average Planar Linear Heat Generation Rate Factor when in SLO
MCE	Maximum Core Exposure
MCPR	Minimum Critical Power Ratio
$MCPR_{99.9\%}$	Cycle-specific safety limit MCPR that ensures at least 99.9% of fuel rods are not susceptible to boiling transition
$MCPR_f$	Flow-Dependent Minimum Critical Power Ratio
$MCPR_p$	Power-Dependent Minimum Critical Power Ratio
MELLL	Maximum Extended Load Line Limit
MELLLA+	Maximum Extended Load Line Limit Analysis +
MEOD	Maximum Extended Operating Domain
MSIVOOS	Main Steam Isolation Valve Out-of-Service
N/A	Not Applicable
NCL	Natural Circulation Line
NEOC	Near End of Cycle
NFWT	Nominal Feedwater Temperature
NRC	Nuclear Regulatory Commission
NSS	Nominal SCRAM Speed
OLMCPR	Operating Limit Minimum Critical Power Ratio
OPRM	Oscillation Power Range Monitor
OOS	Out-of-Service
P	Power (Total Core Thermal)
PRNM	Power Range Neutron Monitoring (System)
RBM	Rod Block Monitor (Subsystem)
RDF	Rated Drive Flow
RFWT	Reduced Feedwater Temperature
RPT	Recirculation Pump Trip
RTP	Rated Thermal Power
S_{AD}	Amplitude Discriminator Setpoint
SLO	Single Loop Operation
SRV	Safety Relief Valve
SRVOOS	Safety Relief Valve Out-of-Service
SS	Steady-State
STP	Simulated Thermal Power
TBV	Turbine Bypass Valve
TBVINS	Turbine Bypass Valves In Service
TBVOOS	Turbine Bypass Valves Out-of-Service (all bypass valves OOS)
TIP	Traversing Incore Probe
TLO	Two Loop Operation
TS	Technical Specification
TSSS	Technical Specification SCRAM Speed

CAUTION
References to COLR Figures or Tables should be made using titles only; Figure and Table numbers may change from cycle to cycle.

Introduction and Summary

The Brunswick Unit 1, Cycle 24 COLR provides values for the core operation limits and setpoints required by Technical Specifications (TS) 5.6.5.a.

Required Core Operating Limit (TS 5.6.5.a)	NRC Approved Methodology (TS 5.6.5.b)	Related TS Items
1. The Average Planar Linear Heat Generation Rate (APLHGR) for TS 3.2.1.	1, 2, 6, 7,16, 17, 26	– TS 3.2.1 Limiting Condition for Operation (LCO) (APLHGR) – TS 3.4.1 LCO (Recirculation loops operating) – TS 3.7.6 LCO (Main Turbine Bypass out-of-service)
2. The Minimum Critical Power Ratio (MCPR) and $MCPR_{99.9\%}$ for TS 3.2.2.	1, 6, 7, 8, 9, 11, 12, 13, 19, 21, 22, 25	– TS 3.2.2 LCO (MCPR) – TS 3.4.1 LCO (Recirculation loops operating) – TS 3.7.6 LCO (Turbine bypass out-of-service)
3. The Linear Heat Generation Rate (LHGR) for TS 3.2.3.	3, 5, 6, 7, 8, 9, 12, 13, 20, 23, 24	– TS 3.2.3 LCO (LHGR) – TS 3.4.1 LCO (Recirculation loops operating) – TS 3.7.6 LCO (Turbine bypass out-of-service)
4. The Manual Backup Stability Protection (BSP) Scram Region (Region I), Manual BSP Controlled Entry Region (Region II), the modified Average Power Range Monitor (APRM) Simulated Thermal Power – High Scram setpoints used in the Automated BSP Scram Region, the BSP Boundary for TS 3.3.1.1.	18, 19, 22	– TS Table 3.3.1.1-1, Function 2.f (OPRM Upscale) – TS 3.3.1.1, Condition I and J (Alternate instability detection)
5. The Allowable Values and power range setpoints for Rod Block Monitor (RBM) Upscale Functions for TS 3.3.2.1.	6, 8	– TS Table 3.3.2.1-1, Function 1 (RBM upscale and operability requirements)
The required core operating limits and setpoints listed in TS 5.6.5.a are presented in the COLR, have been determined using Nuclear Regulatory Commission (NRC) approved methodologies (COLR References 1 through 26) in accordance with TS 5.6.5.b, have considered all fuel types utilized in B1C24, and are established such that all applicable limits of the plant safety analysis are met in accordance with TS 5.6.5.c.		

In addition to the TS required core operating limits and setpoints, this COLR also includes maps showing the allowable power/flow operating ranges including the stability ranges.
The generation of this COLR is documented in Reference 34 and is based on analysis results documented in References 31,32, and 33.

APLHGR Limits

Steady-state $MAPLHGR_{SS}$ limits are provided for Framatome Fuel (Table 23). These steady-state $MAPLHGR_{SS}$ limits must be modified as follows:

- Framatome Fuel MAPLHGR limits do not have a power, flow, or EOOS dependency.
- The applied MAPLHGR limit is dependent on the number of recirculation loops in operation. The steady-state MAPLHGR limit must be modified by a $MAPFAC_{SLO}$ multiplier when in SLO. $MAPFAC_{SLO}$ has a fuel design dependency as shown below.

The applied TLO and SLO MAPLHGR limits are determined as follows:

$$MAPLHGR\,Limit_{TLO} = MAPLHGR_{SS}$$

$$MAPLHGR\,Limit_{SLO} = MAPLHGR_{SS} \times MAPFAC_{SLO}$$

where $MAPFAC_{SLO} = 0.80$ for ATRIUM 10XM and
where $MAPFAC_{SLO} = 0.85$ for ATRIUM 11 fuel

Linear interpolation should be used to determine intermediate values between the values listed in the table.

MCPR Limits

The MCPR limits presented in Tables 5 through 14 are based on the TLO and SLO $MCPR_{99.9\%}$ values of 1.08 and 1.09, respectively, which meet the requirements of Technical Specification 2.1.1.2.

- MCPR limits have a core power and core flow dependency. Power-dependent $MCPR_p$ limits are presented in Tables 5 through 13 while flow-dependent $MCPR_f$ limits are presented in Table 14.
- Power-dependent $MCPR_P$ limits are dependent on CAVEX, SCRAM insertion speed, EOOS, fuel design, number of operating recirculation loops (i.e., TLO or SLO), core flow and core thermal power. Values for the CAVEX breakpoints are provided in Table 4. See COLR section titled “Equipment Out-of-Service” for a list of analyzed EOOS conditions. Care should be used when selecting the appropriate limits set.
- The MCPR limits are established such that they bound all pressurization and non-pressurization events.
- The power-dependent $MCPR_p$ limits (Tables 5-13) must be adjusted by an adder of +0.01 when in SLO.

The applied TLO and SLO MCPR limits are determined as follows:

$$MCPR\,Limit_{TLO} = (MCPR_p, MCPR_f)_{max}$$

$$MCPR\,Limit_{SLO} = (MCPR_p + 0.01, MCPR_f)_{max}$$

Linear interpolation should be used to determine intermediate values between the values listed in the tables. Some of the limits tables show step changes at 26.0%P and 50.0%P. **IF** performing a hand calculation of a limit **AND** the power is exactly on the breakpoint (i.e. 26.0 or 50.0), **THEN** select the most restrictive limit associated with the breakpoint.

LHGR Limits

Steady-state $LHGR_{SS}$ limits are provided for Framatome Fuel (Table 15). These steady-state $LHGR_{SS}$ limits must be modified as follows:

- Framatome Fuel LHGR limits have a core power and core flow dependency. Framatome Fuel power-dependent $LHGRFAC_p$ multipliers (Tables 16-21) and flow-dependent $LHGRFAC_f$ multipliers (Table 22) must be used to modify the steady-state $LHGR_{SS}$ limits (Table 15) for off-rated conditions.
- Framatome Fuel power-dependent $LHGRFAC_p$ multipliers are dependent on CAVEX, SCRAM insertion speed, EOOS, fuel design, core flow and core thermal power. Values for the CAVEX breakpoints are provided in Table 4. See COLR section titled “Equipment Out-of-Service” for a list of analyzed EOOS conditions. Care should be used when selecting the appropriate multiplier set.
- The applied LHGR limit is not dependent on the number of operating recirculation loops. No adjustment to the LHGR limit is necessary for SLO.

The applied LHGR limit is determined as follows:

$$\text{LHGR Limit} = LHGR_{SS} \times (LHGRFAC_p, LHGRFAC_f)_{min}$$

Linear interpolation should be used to determine intermediate values between the values listed in the tables. Some of the limits tables show step changes at 26.0%P and 50.0%P. **IF** performing a hand calculation of a limit **AND** the power is exactly on the breakpoint (i.e. 26.0 or 50.0), **THEN** select the most restrictive limit associated with the breakpoint.

The cycle-specific off-rated flow dependent LHGR set-down bounds those assumed in the MELLLA+ plant-specific ECCS-LOCA analyses.

CDA Setpoints

Brunswick has implemented the Best-estimate Enhanced Option-III (BEO-III) with the Confirmation Density Algorithm (CDA) stability solution using the Oscillation Power Range Monitor (OPRM) as described in References 19 and 22. The Detect and Suppress function of the BEO-III w/ CDA solution based on the OPRM system relies on the CDA, which constitutes the licensing basis. The Backup Stability Protection (BSP) solution described in Reference 22 may be used by the plant in the event the OPRM Upscale function is declared inoperable.

The safety evaluation (Reference 30) concluded that the BEO-III w/ CDA solution is acceptable subject to certain cycle-specific limitations and conditions (Reference 35). As described in Reference 33, these limitations and conditions are met for B1C24.

A reload BEO-III w/ CDA evaluation has been performed in accordance with References 19 and 22. The MCPR limits presented in Tables 5 through 14 bound the minimum stability MCPR values determined for B1C24 in the reload evaluation.

The S_{AD} setpoint value of 1.10 is applicable to TLO and SLO.

Reference 22 describes two BSP options that are based on selected elements from three distinct constituents: BSP Manual Regions, BSP Boundary, and Automated BSP (ABSP) setpoints.

Reference 22 defines the BSP boundary as the MELLLA boundary. The Manual BSP region boundaries were validated for Brunswick Unit 1 Cycle 24 for nominal feedwater temperature operation and reduced feedwater temperature. The endpoints of the regions are defined in Table 3.1 and Table 3.2. The Manual BSP region boundary endpoints are calculated with the Reference 18 methodology and connected using the Generic Shape Function (GSF), which is described in Reference 29.

The ABSP Average Power Range Monitor (APRM) Simulated Thermal Power (STP) setpoints associated with the ABSP Scram Region are determined for Cycle 24 and are defined in Table 3.3. These ABSP setpoints are applicable to both TLO and SLO as well as nominal and reduced feedwater temperature operation.

The Manual Backup Stability Protection (BSP) Regions I and II are documented on the Power/Flow maps as is the modified APRM Simulated Thermal Power (STP) high SCRAM setpoints and the BSP Boundary.

The power/flow maps (Figures 1-6) were validated for B1C24 based on Reference 33 using the Reference 22 methodology to facilitate operation under BEO-III w/ CDA as implemented by Function 2.f of Table 3.3.1.1-1 and LCO Conditions I and J of Technical Specification 3.3.1.1. The generation of these maps is documented in Reference 32. All maps illustrate the region of the power/flow map above 23% RTP and below 75% drive flow (correlated to core flow) where the OPRM system is required to be enabled. Figures 1-6 were included in the COLR as an operator aid and not a licensing requirement. Figures 5 and 6 are the power/flow maps for use in FWTR.

The maps supporting an operable OPRM (Figures 1, 3 and 5) show a Scram Avoidance Region, which is not a licensing requirement but is an operator aid to illustrate where there is increased probability the OPRM system may generate a scram to avoid an instability event. Figures 2, 4, and 6 support an inoperable OPRM and highlight the Manual Backup Stability Regions I and II, the modified APRM STP high SCRAM setpoints, and the BSP Boundary. Note that the STP scram and rod block limits are defined in Technical Specifications, the Technical Requirements Manual, and/or Plant procedures, and are included in the COLR as an operator aid rather than a licensing requirement.

Figures 3 and 4 implement the corrective action for AR-217345 which restricts reactor power to no more than 50% RTP when in SLO with OPRM operable or inoperable. This operator aid is intended to mitigate a spurious OPRM trip signal which could result from APRM noise while operating at high power levels.

RBM Setpoints

The nominal trip setpoints and allowable values of the control rod withdrawal block instrumentation are presented in Table 1 and were determined to be consistent with the bases of the ARTS program (Reference 27). These setpoints will ensure the power-dependent MCPR limits will provide adequate protection against violation of the $MCPR_{99.9\%}$ during a postulated CRWE event. Reference 31 revised these setpoints to reflect changes associated with the installation of the NUMAC PRNM system. RBM operability requirements, consistent with Notes (a) through (e) of Technical Specification Table 3.3.2.1-1, are provided in Table 2.

Equipment Out-of-Service

Brunswick Unit 1, Cycle 24 is analyzed for the following operating conditions with applicable MCPR, APLHGR and LHGR limits.

- Base Case Operation
- SLO
- TBVOOS
- FHOOS
- Combined TBVOOS and FHOOS

Base Case Operation as well as the above-listed EOOS conditions assume all the items OOS below. These conditions are general analysis assumptions used to ensure conservative analysis results and were not meant to define specific EOOS conditions beyond those already defined in Technical Specifications.

- Any 1 inoperable SRV
- 1 inoperable TBV (Note that for TBVOOS, TBVOOS/FHOOS, all 4 TBVs are assumed inoperable)
- Up to 40% of the TIP channels OOS
- Up to 50% of the LPRMs OOS

Please note that during FFTR/Coastdown, FHOOS is included in Base Case Operation, and TBVOOS.

Single Loop Operation

Brunswick Unit 1, Cycle 24 may operate in SLO up to a maximum core flow of 45 Mlbm/hr which corresponds to a maximum power level of 71.1% RTP with applicable MCPR, APLHGR and LHGR limits. These power and flow limitations also apply when operating with jet pump loop flow mismatch conditions (LCO 3.4.1). The following must be considered when operating in SLO:

- SLO is not permitted with RFWT (FHOOS/FFTR).
- SLO is not permitted with TBVOOS.
- SLO is not permitted with MSIVOOS.
- SLO is not permitted within the MELLLA+ operating domain.

Various indicators on the Power/Flow Maps are provided not as operating limits but rather as a convenience for the operators. The purposes for some of these indicators are as follows:

- The SLO Entry Rod Line is shown on the TLO maps to avoid regions of instability in the event of a pump trip.
- A maximum core flow line is shown on the SLO maps to avoid vibration problems.
- APRM STP Scram and Rod Block nominal trip setpoint limits are shown at the estimated core flow corresponding to the actual drive flow-based setpoints to indicate where the Operator may encounter these setpoints (See LCO 3.3.1.1, Reactor Protection System Instrumentation Function 2.b: Average Power Range Monitors Simulated Thermal Power - High Allowable Value).
- When in SLO, Figures 3 and 4 implement the corrective action for AR-217345 which restricts reactor power to no more than 50% RTP with OPRM operable or inoperable. This operator aid is intended to mitigate a spurious OPRM trip signal which could result from APRM noise while operating at high power levels.
- If OPRMs are inoperable in SLO, the expansion of the ABSP region results in power being restricted to 39% RTP as shown in Figure 4.

Inoperable Main Turbine Bypass System

Brunswick Unit 1, Cycle 24 may operate with an inoperable Main Turbine Bypass System over the entire MEOD range and in the MELLLA+ domain for all cycle exposures with applicable APLHGR, MCPR and LHGR limits as specified in the COLR. An operable Main Turbine Bypass System with only one inoperable bypass valve was assumed in the development of the Base Case Operation limits. Base Case Operation is synonymous with TBVINS. The following must be considered when operating with TBVOOS:

- Two or more inoperable bypass valves renders the entire Main Turbine Bypass System inoperable requiring the use of TBVOOS limits. The TBVOOS analysis supports operation with all bypass valves inoperable.
- Prior to reaching the EOCLB exposure breakpoint, operation with FWTR >10˚F and reactor power ≥ 23% RTP requires use of the combined TBVOOS/FHOOS limits.
- TBVOOS operation coincident with FHOOS is supported using the combined TBVOOS/FHOOS limits.
- SLO is not permitted with TBVOOS.

Feedwater Temperature Reduction

Brunswick Unit 1, Cycle 24 may operate with RFWT over the entire MEOD range and cycle with applicable APLHGR, MCPR and LHGR limits as specified in the COLR. NFWT is defined as the range of feedwater temperatures from NFWT to NFWT - 10˚F. NFWT and its allowable variation were assumed in the development of the Base Case Operation limits. The FHOOS limits and FFTR/Coastdown limits were developed for a maximum feedwater temperature reduction of 110.3˚F. The following must be considered when operating with RFWT:

- Although the acronyms FWTR, FHOOS, RFWT and FFTR all involve reduced feedwater temperature, the use of FFTR is reserved for cycle energy extension using reduced feedwater temperature at and beyond a core average exposure of EOCLB using FFTR/Coastdown limits.
- Prior to reaching the EOCLB exposure breakpoint, operation with FWTR >10˚F and reactor power ≥ 23% RTP requires use of the FHOOS limits.
- Until a core average exposure of EOCLB is reached, implementation of the FFTR/Coastdown limits is not required even if coastdown begins early.
- When operating with RFWT, the appropriate MELLLA+ Power/Flow Maps (Figures 5 and 6) must be used.
- FHOOS operation coincident with TBVOOS is supported using the combined TBVOOS/FHOOS limits.
- SLO is not permitted with RFWT.
- FWTR operation within the MELLLA+ operating domain is not allowed.
- NFWT limits have **not** been conservatively adjusted to eliminate the need to use RFWT limits below 50% RTP.

References

In accordance with Brunswick Unit 1 Technical Specification 5.6.5.b, the analytical methods for determining Brunswick Unit 1 core operating limits have been specifically reviewed and approved by the NRC and are listed as References 1 through 26.

1. NEDE-24011-P-A, "GESTAR II - General Electric Standard Application for Reactor Fuel," and US Supplement, Revision 15, September 2005.
2. XN-NF-81-58(P)(A) and Supplements 1 and 2, “RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model,” Revision 2, March 1984.
3. XN-NF-85-67(P)(A), “Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel,” Revision 1, September 1986.
4. EMF-85-74(P) Supplement 1(P)(A) and Supplement 2(P)(A), “RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model,” Revision 0, February 1998.
5. ANF-89-98(P)(A), “Generic Mechanical Design Criteria for BWR Fuel Designs,” Revision 1, May 1995.
6. XN-NF-80-19(P)(A) Volume 1 and Volume 1 Supplements 1 and 2, “Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis,” March 1983.
7. XN-NF-80-19(P)(A) Volume 4, “Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads,” Revision 1, June 1986.
8. EMF-2158(P)(A), “Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2,” Revision 0, October 1999.
9. XN-NF-80-19(P)(A) Volume 3, “Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description,” Revision 2, January 1987.
10. ANP-10333P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Control Rod Drop Accident (CRDA)”, Revision 0, March 2018.
11. ANP-10307PA, “AREVA MCPR Safety Limit Methodology for Boiling Water Reactors,” Revision 0, June 2011.
12. ANP-10300P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios”, Revision 1, January 2018.
13. ANF-1358(P)(A), “The Loss of Feedwater Heating Transient in Boiling Water Reactors,” Revision 3, September 2005.
14. EMF-2209(P)(A), “SPCB Critical Power Correlation,” Revision 3, September 2009.
15. EMF-2245(P)(A), “Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel,” Revision 0, August 2000.
16. EMF-2361(P)(A), “EXEM BWR-2000 ECCS Evaluation Model,” Revision 0, May 2001.
17. EMF-2292(P)(A), “ATRIUM™-10: Appendix K Spray Heat Transfer Coefficients,” Revision 0, September 2000.
18. EMF-CC-074(P)(A) Volume 4, “BWR Stability Analysis - Assessment of STAIF with Input from MICROBURN-B2,” Revision 0, August 2000.
19. ANP-3703P, “BEO-III Analysis Methodology for Brunswick Using RAMONA5-FA”, Revision 0, August 2018.
20. BAW-10247PA, “Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors,” Revision 0, April 2008.
21. ANP-10298P-A, “ACE/ATRIUM 10XM Critical Power Correlation,” Revision 1, March 2014.

22. DPC-NE-1009-P, “Brunswick Nuclear Plant Implementation of Best-estimate Enhanced Option-III”, Revision 0, September 2018
23. BAW-10247P-A, Supplement 2P-A, “Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors Supplement 2: Mechanical Methods”, Revision 0, August 2018
24. ANP-10340P-A, “Incorporation of Chromia-Doped Fuel Properties in AREVA Approved Methods”, Revision 0, May 2018
25. ANP-10335P-A, “ACE/ATRIUM 11 Critical Power Correlation”, Revision 0, May 2018
26. ANP-10332P-A, “AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios”, Revision 0, March 2019.
27. NEDC-31654P, “Maximum Extended Operating Domain Analysis for Brunswick Steam Electric Plant,” February 1989.
28. Not Used.
29. OG02-0119-260, “Backup Stability Protection (BSP) for Inoperable Option III Solution”, July 2002.
30. NRC Letter to Duke Energy Progress, LLC, “Brunswick Steam Electric Plant, Units 1 and 2 – Issuance of Amendment Nos. 299 and 327 to Revise Technical Specification 5.6.5b to Allow Application of Advanced Framatome ATRIUM 11 Fuel Methodologies (EPID L-2018-LLA-0273),” dated March 6, 2020 (ADAMS Accession No. ML20073F186).
31. BNP Design Calculation 1C51-0001, “Power Range Neutron Monitoring System Setpoint Uncertainty and Scaling Calculation (1-C51-APRM-1 through 4 Loops and 1-C51 RBM-A and B Loops),” Revision 4, September 2018.
32. BNP Design Calculation 0B21-2045, “BNP Power/Flow Maps for MELLLA+,” Revision 2, January 2020.
33. ANP-3978P, “Brunswick Unit 1 Cycle 24 Reload Safety Analysis,” Revision 0, February 2022.
34. BNP Design Calculation 1B21-2098, “Preparation of the B1C24 Core Operating Limits Report,” Revision 0, March 2022.
35. NRC E-mail Capture, “Request for Additional Information – Brunswick ATRIUM 11 LAR,” (ADAMS Accession Number ML19283C829), October 9, 2019.

Table 1

RBM System Setpoints[1]

Setpoint [a]	Setpoint Value	Allowable Value
Lower Power Setpoint (LPSP[b])	$\leq$ 27.7	$\leq$ 29.0
Intermediate Power Setpoint (IPSP[b])	$\leq$ 62.7	$\leq$ 64.0
High Power Setpoint (HPSP[b])	$\leq$ 82.7	$\leq$ 84.0
Low Trip Setpoint (LTSP[c,d])	$\leq$ 120.1	$\leq$ 120.6
Intermediate Trip Setpoint (ITSP[c,d])	$\leq$ 115.1	$\leq$ 115.6
High Trip Setpoint (HTSP[c,d])	$\leq$ 110.3	$\leq$ 110.8
RBM Time Delay (t_{d2})	0 seconds	< 2.0 seconds

a See Table 2 for RBM Operability Requirements.

b Setpoints in percent of Rated Thermal Power.

c Setpoints relative to a full scale reading of 125. For example, $\leq$ 120.1 means $\leq$ 120.1/125.0 of full scale.

d Trip setpoints and allowable values are based on a HTSP Analytical Limit of 113.2 with RBM filter.

[1] This table is referred to by Technical Specification 3.3.2.1 (Table 3.3.2.1-1) and 5.6.5.a.5.

Table 2

RBM Operability Requirements[2]

IF the following conditions are met, **THEN**
RBM Not Required Operable

Thermal Power (% rated)	MCPR
≥ 29% and < 90%	≥ 1.65 TLO ≥ 1.68 SLO
≥ 90%	≥ 1.49 TLO

[2] Requirements valid for all fuel designs, all SCRAM insertion times and all core average exposure ranges.

Table 3.1

BSP Endpoints for Nominal Feedwater Temperature[3,4]

Endpoint	Power (%)	Flow (%)	Definition
A1	57.0	40.6	Scram Region Boundary, HFCL
B1	42.0	31.7	Scram Region Boundary, NCL
A2	64.5	50.0	Controlled Entry Region Boundary, HFCL
B2	28.9	31.9	Controlled Entry Region Boundary, NCL

Table 3.2

BSP Endpoints for Reduced Feedwater Temperature[3,4]

Endpoint	Power (%)	Flow (%)	Definition
A1	65.9	51.8	Scram Region Boundary, HFCL
B1	36.5	31.9	Scram Region Boundary, NCL
A2	69.8	56.8	Controlled Entry Region Boundary, HFCL
B2	28.9	31.9	Controlled Entry Region Boundary, NCL

Table 3.3

ABSP Setpoints for the Scram Region[3,5]

Parameter	Symbol	Value
Slope of ABSP APRM flow-biased trip linear segment.	m_{TRIP}	2.00 %RTP/%RDF
ABSP APRM flow-biased trip setpoint power intercept. Constant Power Line for Trip from zero Drive Flow to Flow Breakpoint value.	$P_{BSP-TRIP}$	42.0 %RTP
ABSP APRM flow-biased trip setpoint drive flow intercept. Constant Flow Line for Trip.	$W_{BSP-TRIP}$	≥37.5 %RDF
Flow Breakpoint value	$W_{BSP-BREAK}$	25.0 %RDF

[3] These tables are referred to by Technical Specification 3.3.1.1 (Table 3.3.1.1-1) and 5.6.5.a.4.

[4] The BSP Boundary for Nominal and Reduced Feedwater Temperature is defined by the MELLLA boundary line and extends from the natural circulation boundary to rated power.

[5] When in SLO the ABSP STP Scram is modified by the applied SLO ΔW as shown in Figure 4.

Table 4

Exposure Basis[6] for Brunswick Unit 1 Cycle 24 Transient Analysis

Core Average Exposure (MWd/MTU)	Comments
33,084	Breakpoint for exposure dependent $MCPR_p$ limits (NEOC)
36,117	Design basis rod patterns to EOFP + 15 EFPD (EOCLB)
37,908	End of cycle with FFTR/Coastdown - Maximum Core Exposure (MCE)

[6] The exposure basis for the defined break points is the core average exposure (CAVEX) values shown above regardless of the actual BOC CAVEX value of the As-Loaded Core.

Table 5

Power-Dependent $MCPR_p$ Limits[7]

NSS Insertion Times
BOC to < NEOC

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
Base case operation	100.0	1.36		1.34	
	90.0	1.40		1.36	
	50.0	1.72		1.63	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.27	2.26	2.31	2.26
	23.0	2.33	2.33	2.38	2.26
TBVOOS	100.0	1.37		1.36	
	90.0	1.40		1.43	
	50.0	1.72		1.83	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.18	3.18	2.83	2.55
	23.0	3.27	3.27	3.03	2.74
FHOOS	100.0	1.36		1.34	
	90.0	1.40		1.39	
	50.0	1.72		1.70	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.37	2.30	2.42	2.26
	23.0	2.50	2.43	2.51	2.31
TBVOOS FHOOS	100.0	1.40		1.40	
	90.0	1.43		1.51	
	50.0	1.72		1.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.91	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.23	3.23	2.96	2.65
	23.0	3.30	3.30	3.03	2.74

[7] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 6

Power-Dependent $MCPR_p$ Limits[8]

ESS Insertion Times
BOC to < NEOC

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
Base case operation	100.0	1.36		1.35	
	90.0	1.40		1.36	
	50.0	1.72		1.63	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.27	2.26	2.31	2.26
	23.0	2.33	2.33	2.38	2.26
TBVOOS	100.0	1.37		1.36	
	90.0	1.40		1.43	
	50.0	1.72		1.83	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.18	3.18	2.83	2.55
	23.0	3.27	3.27	3.03	2.74
FHOOS	100.0	1.36		1.35	
	90.0	1.40		1.39	
	50.0	1.72		1.70	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.37	2.30	2.42	2.26
	23.0	2.50	2.43	2.51	2.31
TBVOOS FHOOS	100.0	1.40		1.40	
	90.0	1.43		1.51	
	50.0	1.72		1.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.91	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.23	3.23	2.96	2.65
	23.0	3.30	3.30	3.03	2.74

[8] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 7

Power-Dependent $MCPR_p$ Limits[9]

TSSS Insertion Times
BOC to < NEOC

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
Base case operation	100.0	1.46		1.40	
	90.0	1.46		1.49	
	50.0	1.72		1.76	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.86	1.76	1.86	1.69
	26.0	2.22	2.07	2.18	1.98
	26.0	2.29	2.28	2.31	2.26
	23.0	2.35	2.35	2.38	2.26
TBVOOS	100.0	1.54		1.46	
	90.0	1.54		1.56	
	50.0	1.76		1.99	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.90	1.80	1.99	1.69
	26.0	2.26	2.11	2.18	2.04
	26.0	3.24	3.24	2.83	2.55
	23.0	3.33	3.33	3.03	2.74
FHOOS	100.0	1.46		1.42	
	90.0	1.46		1.53	
	50.0	1.72		1.80	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.86	1.76	1.86	1.69
	26.0	2.22	2.07	2.18	1.98
	26.0	2.39	2.32	2.42	2.26
	23.0	2.52	2.45	2.51	2.31
TBVOOS FHOOS	100.0	1.54		1.53	
	90.0	1.56		1.66	
	50.0	1.78		2.00	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.90	1.80	2.00	1.79
	26.0	2.26	2.11	2.18	2.16
	26.0	3.29	3.29	2.96	2.65
	23.0	3.36	3.36	3.03	2.74

[9] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 8

Power-Dependent $MCPR_p$ Limits[10]

NSS Insertion Times
BOC to < EOCLB

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
Base case operation	100.0	1.37		1.36	
	90.0	1.40		1.40	
	50.0	1.72		1.63	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.27	2.26	2.31	2.26
	23.0	2.33	2.33	2.38	2.26
TBVOOS	100.0	1.40		1.44	
	90.0	1.43		1.48	
	50.0	1.72		1.83	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.18	3.18	2.83	2.55
	23.0	3.27	3.27	3.03	2.74
FHOOS	100.0	1.37		1.36	
	90.0	1.40		1.41	
	50.0	1.72		1.70	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.37	2.30	2.42	2.26
	23.0	2.50	2.43	2.51	2.31
TBVOOS FHOOS	100.0	1.41		1.48	
	90.0	1.43		1.52	
	50.0	1.72		1.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.91	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.23	3.23	2.96	2.65
	23.0	3.30	3.30	3.03	2.74

[10] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 9

Power-Dependent $MCPR_p$ Limits[11]

ESS Insertion Times
BOC to < EOCLB

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
Base case operation	100.0	1.37		1.38	
	90.0	1.40		1.40	
	50.0	1.72		1.63	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.27	2.26	2.31	2.26
	23.0	2.33	2.33	2.38	2.26
TBVOOS	100.0	1.41		1.46	
	90.0	1.43		1.49	
	50.0	1.72		1.83	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.18	3.18	2.83	2.55
	23.0	3.27	3.27	3.03	2.74
FHOOS	100.0	1.37		1.38	
	90.0	1.40		1.41	
	50.0	1.72		1.70	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.86	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	2.37	2.30	2.42	2.26
	23.0	2.50	2.43	2.51	2.31
TBVOOS FHOOS	100.0	1.42		1.50	
	90.0	1.43		1.52	
	50.0	1.72		1.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.84	1.74	1.91	1.69
	26.0	2.20	2.05	2.18	1.98
	26.0	3.23	3.23	2.96	2.65
	23.0	3.30	3.30	3.03	2.74

[11] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 10

Power-Dependent $MCPR_p$ Limits[12]

TSSS Insertion Times
BOC to < EOCLB

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
Base case operation	100.0	1.52		1.52	
	90.0	1.52		1.56	
	50.0	1.73		1.79	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.89	1.79	1.86	1.69
	26.0	2.25	2.10	2.18	1.98
	26.0	2.32	2.31	2.31	2.26
	23.0	2.38	2.38	2.38	2.26
TBVOOS	100.0	1.58		1.60	
	90.0	1.58		1.66	
	50.0	1.78		1.99	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.92	1.82	1.99	1.69
	26.0	2.28	2.13	2.18	2.04
	26.0	3.26	3.26	2.83	2.55
	23.0	3.35	3.35	3.03	2.74
FHOOS	100.0	1.52		1.52	
	90.0	1.52		1.57	
	50.0	1.73		1.82	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.89	1.79	1.86	1.69
	26.0	2.25	2.10	2.18	1.98
	26.0	2.42	2.35	2.42	2.26
	23.0	2.55	2.48	2.51	2.31
TBVOOS FHOOS	100.0	1.58		1.60	
	90.0	1.58		1.66	
	50.0	1.80		2.00	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	1.92	1.82	2.00	1.79
	26.0	2.28	2.13	2.18	2.16
	26.0	3.31	3.31	2.96	2.65
	23.0	3.38	3.38	3.03	2.74

[12] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 11

Power-Dependent $MCPR_p$ Limits[13]

NSS Insertion Times
BOC to < MCE (FFTR/Coastdown)

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
	100.0	1.37		1.36	
Base case	90.0	1.40		1.41	
Operation	50.0	1.72		1.70	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
(FFTR/FHOOS	50.0	1.84	1.74	1.86	1.69
Included)	26.0	2.20	2.05	2.18	1.98
	26.0	2.37	2.30	2.42	2.26
(Bounds	23.0	2.50	2.43	2.51	2.31
operation with NFWT)					
	100.0	1.42		1.48	
TBVOOS	90.0	1.43		1.52	
	50.0	1.72		1.91	
(FFTR/FHOOS		> 65%F	≤ 65%F	> 65%F	≤ 65%F
Included)	50.0	1.84	1.74	1.91	1.69
	26.0	2.20	2.05	2.18	1.98
(Bounds	26.0	3.23	3.23	2.96	2.65
operation with NFWT)	23.0	3.30	3.30	3.03	2.74

[13] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 12

Power-Dependent $MCPR_p$ Limits[14]

ESS Insertion Times
BOC to < MCE (FFTR/Coastdown)

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
	100.0	1.38		1.38	
Base case	90.0	1.40		1.41	
Operation	50.0	1.72		1.70	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
(FFTR/FHOOS	50.0	1.84	1.74	1.86	1.69
Included)	26.0	2.20	2.05	2.18	1.98
	26.0	2.37	2.30	2.42	2.26
(Bounds operation with NFWT)	23.0	2.50	2.43	2.51	2.31
	100.0	1.42		1.50	
TBVOOS	90.0	1.43		1.52	
	50.0	1.72		1.91	
(FFTR/FHOOS		> 65%F	≤ 65%F	> 65%F	≤ 65%F
Included)	50.0	1.84	1.74	1.91	1.69
	26.0	2.20	2.05	2.18	1.98
(Bounds	26.0	3.23	3.23	2.96	2.65
operation with NFWT)	23.0	3.30	3.30	3.03	2.74

[14] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 13

Power-Dependent $MCPR_p$ Limits[15]

TSSS Insertion Times
BOC to < MCE (FFTR/Coastdown)

EOOS Condition	Power (% rated)	ATRIUM 10XM $MCPR_p$		ATRIUM 11 $MCPR_p$	
	100.0	1.56		1.60	
Base case	90.0	1.56		1.64	
Operation	50.0	1.73		1.85	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
(FFTR/FHOOS	50.0	1.91	1.81	1.86	1.69
Included)	26.0	2.27	2.12	2.18	1.98
	26.0	2.44	2.37	2.42	2.26
(Bounds	23.0	2.57	2.50	2.51	2.31
operation with NFWT)					
	100.0	1.62		1.66	
TBVOOS	90.0	1.62		1.72	
	50.0	1.82		2.01	
(FFTR/FHOOS		> 65%F	≤ 65%F	> 65%F	≤ 65%F
Included)	50.0	1.94	1.84	2.01	1.79
	26.0	2.30	2.15	2.18	2.16
(Bounds	26.0	3.33	3.33	2.96	2.65
operation with NFWT)	23.0	3.40	3.40	3.03	2.74

[15] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. For single-loop operation, the TLO MCPRp limits shown above must be adjusted by adding 0.01. SLO not permitted for FHOOS, TBVOOS or MSIVOOS. FHOOS not permitted in the MELLLA+ domain.

Table 14

Flow-Dependent $MCPR_f$ Limits[16, 17]

Core Flow	ATRIUM 10XM	ATRIUM 11
(% of rated)	$MCPR_f$	$MCPR_f$
0.0	1.66	1.68
31.0	1.66	1.68
60.0	1.50	--
77.0	--	1.33
81.0	1.30	1.33
100.0	1.30	1.33
107.0	1.30	1.33

[16] Limits valid for all SCRAM insertion times, all core average exposure ranges, all EOOS scenarios, and both TLO & SLO.

[17] "--" indicates that the fuel limit has no breakpoint at this exposure.

Table 15

Framatome Fuel Steady-State $LHGR_{SS}$ Limits[18]

Peak Pellet Exposure (GWd/MTU)	ATRIUM 10XM LHGR (kW/ft)	ATRIUM 11 LHGR (kW/ft)
0.0	14.1	13.6
6.0	14.1	--
18.9	14.1	--
21.0	--	13.6
53.0	--	10.2
54.0	10.6	--
74.4	5.4	--
80.0	N/A	3.5

[18] "--" indicates that the fuel limit has no breakpoint at this exposure.

Table 16

Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers[19]

NSS Insertion Times
BOC to < EOCLB

EOOS Condition	Power (% rated)	ATRIUM 10XM $LHGRFAC_p$		ATRIUM 11 $LHGRFAC_p$	
Base case operation	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.98	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.49	0.51	0.45	0.46
	23.0	0.49	0.51	0.45	0.46
TBVOOS	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.96	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.45	0.51	0.40	0.46
	23.0	0.41	0.50	0.37	0.43
FHOOS	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.93	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.47	0.49	0.43	0.44
	23.0	0.46	0.49	0.42	0.43
TBVOOS FHOOS	100.0	1.00		1.00	
	90.0	1.00		0.99	
	50.0	0.96		0.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.42	0.49	0.37	0.44
	23.0	0.38	0.47	0.34	0.41

[19] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. FHOOS not permitted in the MELLLA+ domain.

Table 17

Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers[20]

ESS Insertion Times
BOC to < EOCLB

EOOS Condition	Power (% rated)	ATRIUM 10XM $LHGRFAC_p$		ATRIUM 11 $LHGRFAC_p$	
Base case operation	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.98	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.49	0.51	0.45	0.46
	23.0	0.49	0.51	0.45	0.46
TBVOOS	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.96	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.45	0.51	0.40	0.46
	23.0	0.41	0.50	0.37	0.43
FHOOS	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.93	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.47	0.49	0.43	0.44
	23.0	0.46	0.49	0.42	0.43
TBVOOS FHOOS	100.0	1.00		1.00	
	90.0	1.00		0.99	
	50.0	0.96		0.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.42	0.49	0.37	0.44
	23.0	0.38	0.47	0.34	0.41

[20] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. FHOOS not permitted in the MELLLA+ domain.

Table 18

Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers[21, 22]

TSSS Insertion Times
BOC to < EOCLB

EOOS Condition	Power (% rated)	ATRIUM 10XM $LHGRFAC_p$		ATRIUM 11 $LHGRFAC_p$	
Base case operation	100.0	1.00		1.00	
	90.0	1.00		--	
	50.0	1.00		0.95	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.49	0.51	0.45	0.46
	23.0	0.49	0.51	0.45	0.46
TBVOOS	100.0	1.00		1.00	
	90.0	1.00		--	
	50.0	0.95		0.89	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.45	0.51	0.40	0.46
	23.0	0.41	0.50	0.37	0.43
FHOOS	100.0	1.00		0.99	
	90.0	1.00		--	
	50.0	0.96		0.90	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.47	0.49	0.43	0.44
	23.0	0.46	0.49	0.42	0.43
TBVOOS FHOOS	100.0	1.00		0.96	
	90.0	1.00		--	
	50.0	0.90		0.87	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.90	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.42	0.49	0.37	0.44
	23.0	0.38	0.47	0.34	0.41

[21] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. FHOOS not permitted in the MELLLA+ domain.

[22] "--" indicates that the fuel limit has no breakpoint at this exposure.

Table 19

Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers[23]

NSS Insertion Times
BOC to < MCE (FFTR/Coastdown)

EOOS Condition	Power (% rated)	ATRIUM 10XM $LHGRFAC_p$		ATRIUM 11 $LHGRFAC_p$	
Base case operation (FFTR/FHOOS included)	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.93	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
(Bounds operation with NFWT)	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.47	0.49	0.43	0.44
	23.0	0.46	0.49	0.42	0.43
TBVOOS (FFTR/FHOOS included)	100.0	1.00		1.00	
	90.0	1.00		0.99	
	50.0	0.96		0.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
(Bounds operation with NFWT)	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.42	0.49	0.37	0.44
	23.0	0.38	0.47	0.34	0.41

[23] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. FHOOS not permitted in the MELLLA+ domain.

Table 20

Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers[24]

ESS Insertion Times
BOC to < MCE (FFTR/Coastdown)

EOOS Condition	Power (% rated)	ATRIUM 10XM $LHGRFAC_p$		ATRIUM 11 $LHGRFAC_p$	
Base case operation (FFTR/FHOOS included) (Bounds operation with NFWT)	100.0	1.00		1.00	
	90.0	1.00		1.00	
	50.0	1.00		0.93	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.47	0.49	0.43	0.44
	23.0	0.46	0.49	0.42	0.43
TBVOOS (FFTR/FHOOS included) (Bounds operation with NFWT)	100.0	1.00		1.00	
	90.0	1.00		0.99	
	50.0	0.96		0.91	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.42	0.49	0.37	0.44
	23.0	0.38	0.47	0.34	0.41

[24] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. FHOOS not permitted in the MELLLA+ domain.

Table 21

Framatome Fuel Power-Dependent $LHGRFAC_p$ Multipliers[25, 26]

TSSS Insertion Times
BOC to < MCE (FFTR/Coastdown)

EOOS Condition	Power (% rated)	ATRIUM 10XM $LHGRFAC_p$		ATRIUM 11 $LHGRFAC_p$	
Base case operation (FFTR/FHOOS included) (Bounds operation with NFWT)	100.0	1.00		0.99	
	90.0	1.00		--	
	50.0	0.96		0.90	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.92	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.47	0.49	0.43	0.44
	23.0	0.46	0.49	0.42	0.43
TBVOOS (FFTR/FHOOS included) (Bounds operation with NFWT)	100.0	1.00		0.96	
	90.0	1.00		--	
	50.0	0.90		0.87	
		> 65%F	≤ 65%F	> 65%F	≤ 65%F
	50.0	0.90	1.00	0.85	0.93
	26.0	0.75	0.86	0.66	0.79
	26.0	0.42	0.49	0.37	0.44
	23.0	0.38	0.47	0.34	0.41

[25] Limits support operation with any combination of any 1 inoperable SRV, 1 inoperable TBV, up to 40% of the TIP channels out-of-service, and up to 50% of the LPRMs out-of-service. FHOOS not permitted in the MELLLA+ domain.

[26] "--" indicates that the fuel limit has no breakpoint at this exposure.

Table 22

Framatome Fuel Flow-Dependent $LHGRFAC_f$ Multipliers[27]

Core Flow (% of rated)	ATRIUM 10XM and ATRIUM 11 $LHGRFAC_f$
0.0	0.52
31.0	0.52
75.0	1.00
107.0	1.00

[27] Multipliers valid for all SCRAM insertion times and all core average exposure ranges.

Table 23

Framatome Fuel Steady-State $MAPLHGR_{SS}$ Limits[28, 29, 30]

Average Planar Exposure (GWd/MTU)	ATRIUM 10XM MAPLHGR (kW/ft)	ATRIUM 11 MAPLHGR (kW/ft)
0.0	13.1	12.0
15.0	13.1	--
20.0	--	12.0
60.0	--	9.0
67.0	7.7	--
69.0	N/A	7.2

[28] Framatome Fuel MAPLHGR limits do not have a power, flow, or EOOS dependency.

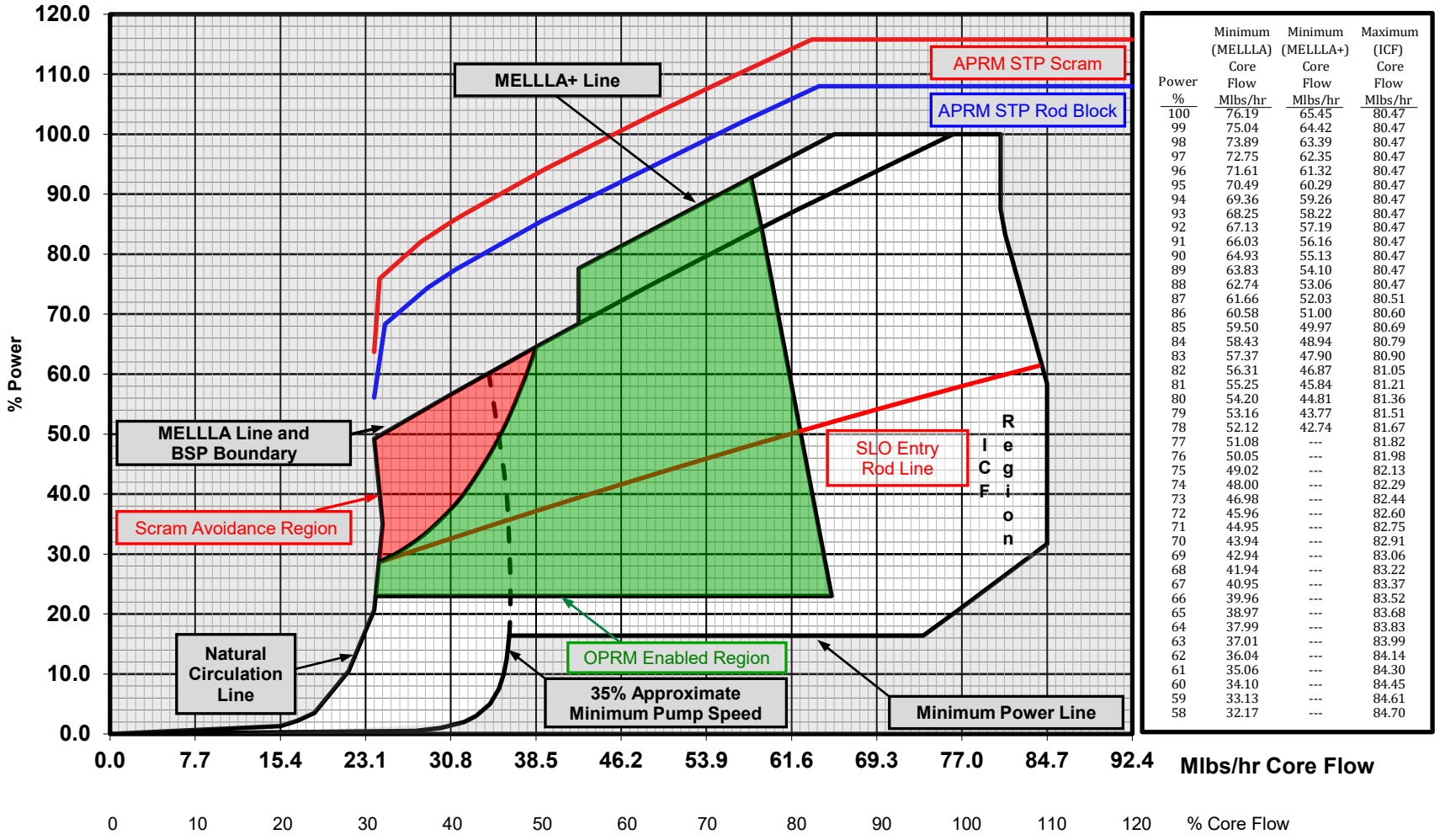
[29] ATRIUM 10XM MAPLHGR limits must be adjusted by a 0.80 multiplier when in SLO. ATRIUM 11 MAPLHGR limits must be adjusted by a 0.85 multiplier when in SLO. SLO not permitted for FHOOS, TBVOOS or MSIVOOS.

[30] "--" indicates that the fuel limit has no breakpoint at this exposure.

Figure 1
MELLLA+ Power/Flow Map

OPRM Operable, Two Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3



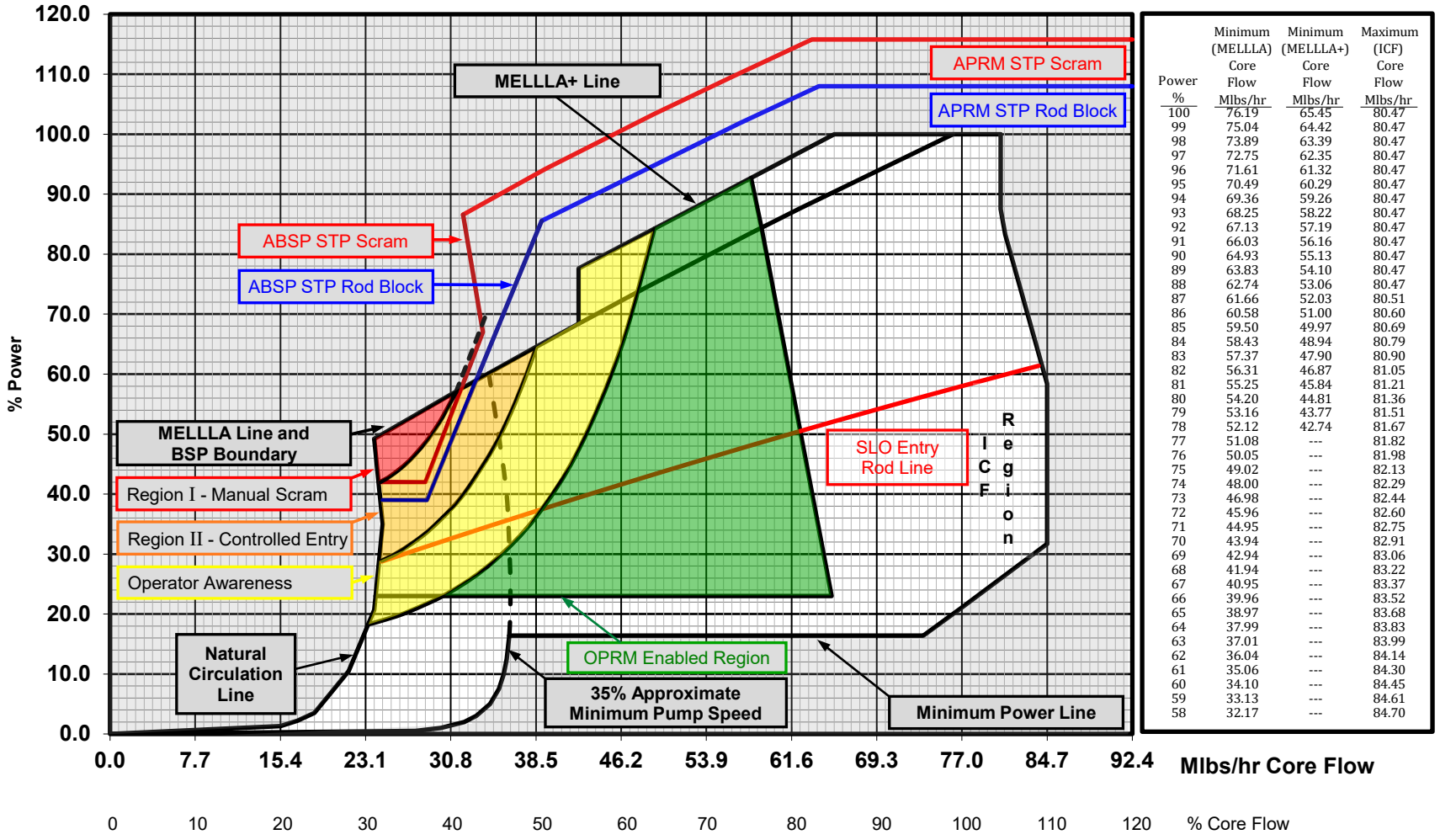
Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

Reference: 0B21-2045, Revision 2

Figure 2
MELLLA+ Power/Flow Map

OPRM Inoperable, Two Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3



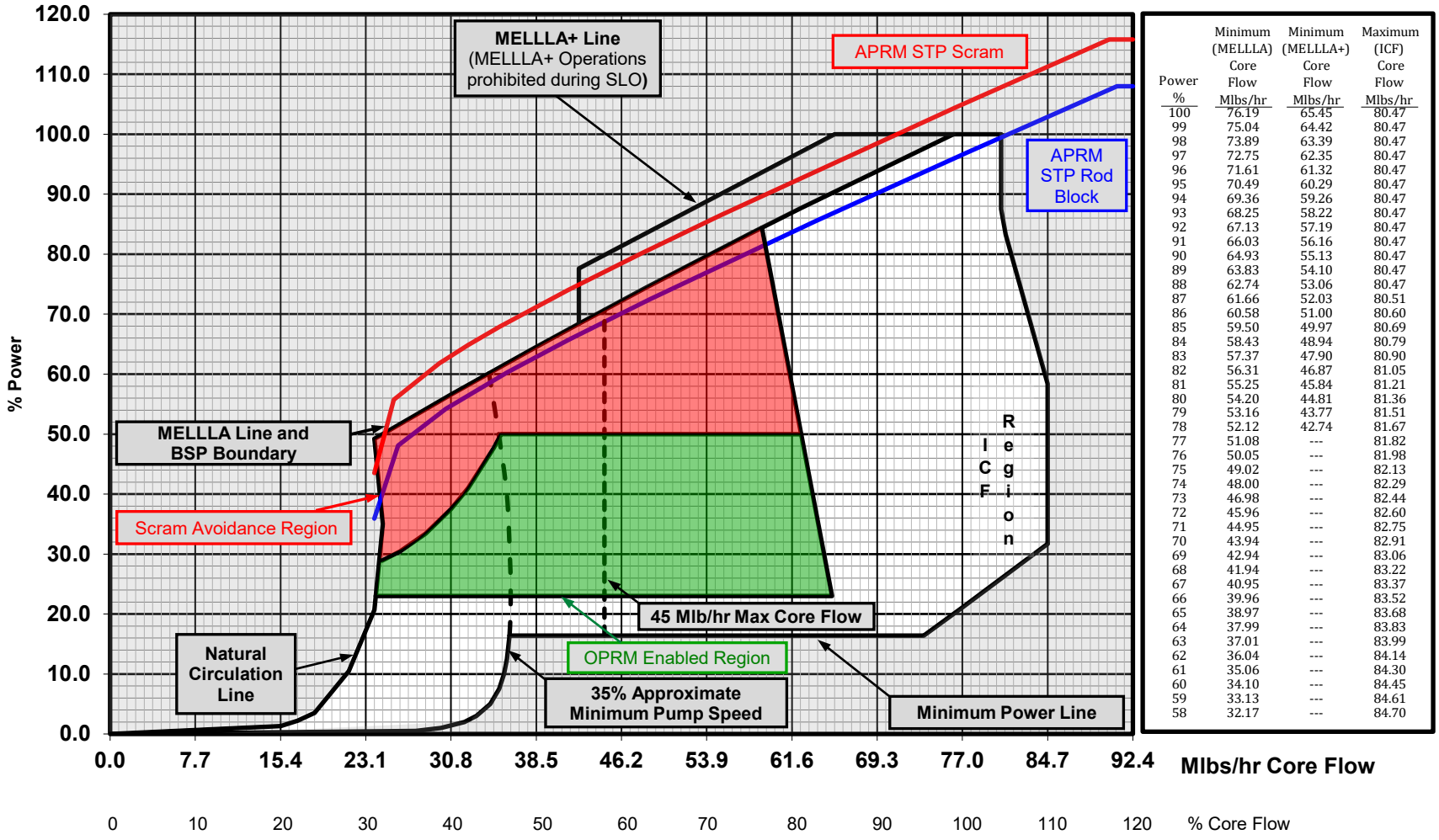
Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

Reference: 0B21-2045, Revision 2

Figure 3
MELLLA+ Power/Flow Map

OPRM Operable, Single Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3



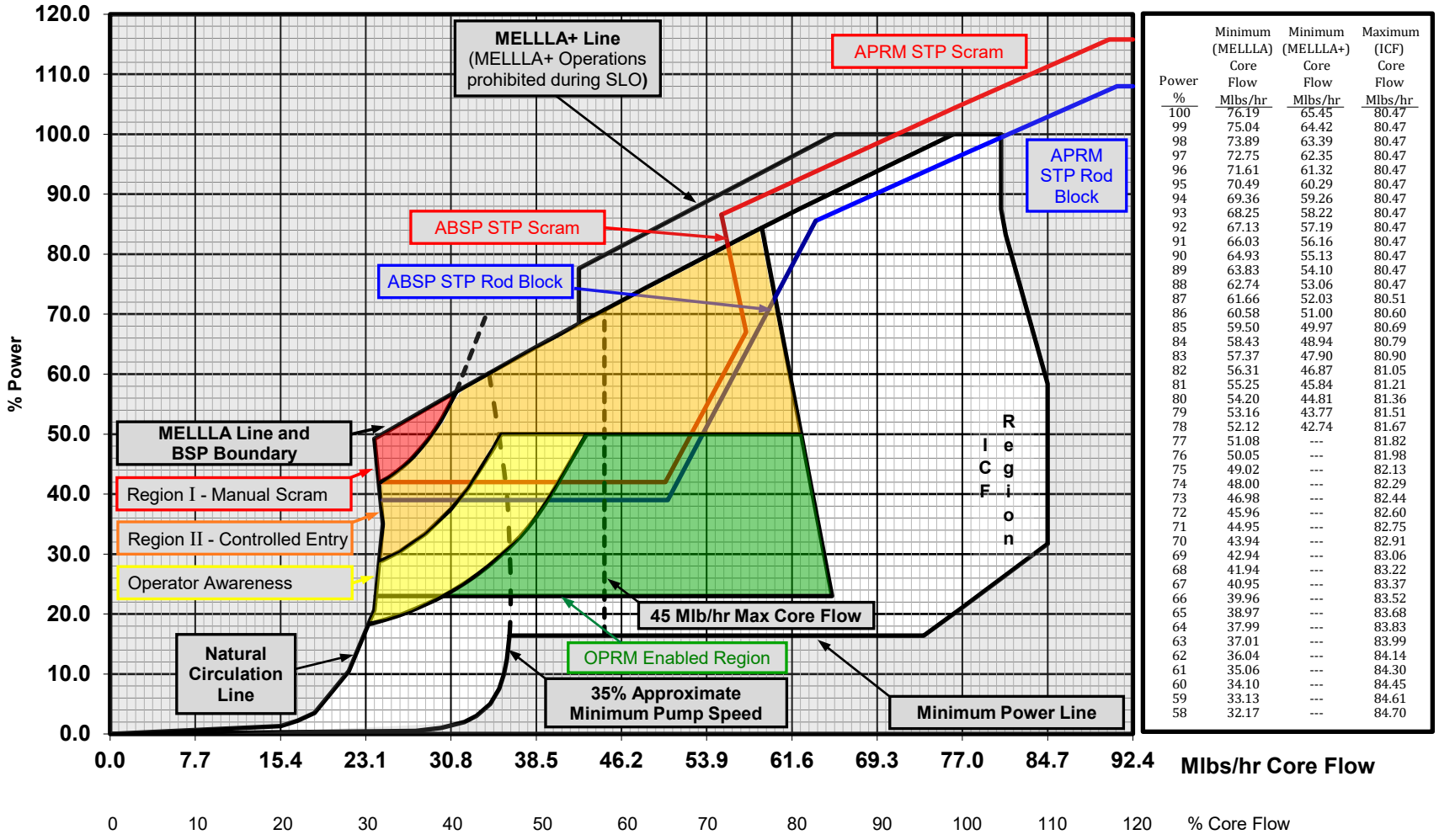
Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

Reference: 0B21-2045, Revision 2

Figure 4
MELLLA+ Power/Flow Map

OPRM Inoperable, Single Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3



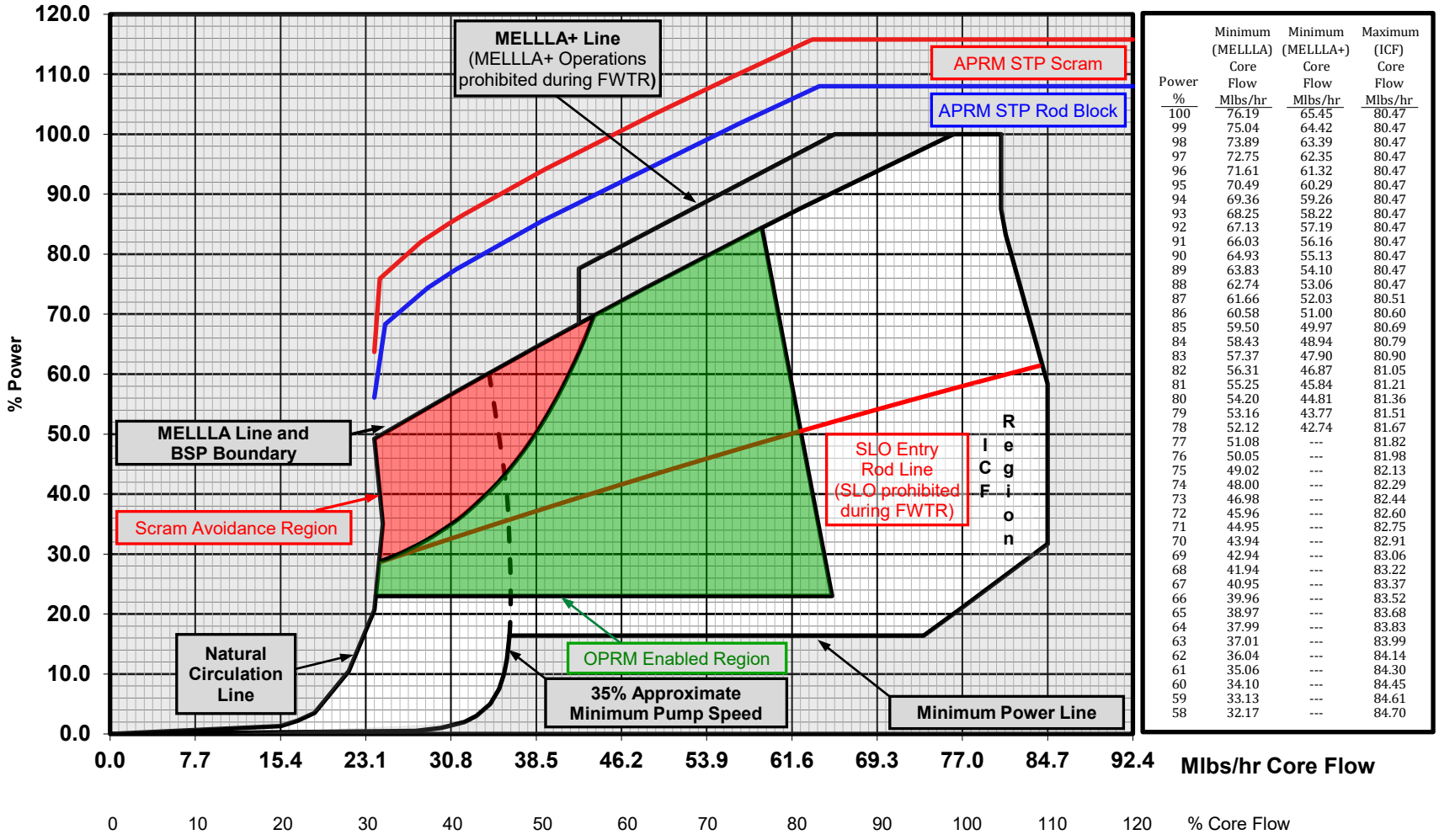
Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

Reference: 0B21-2045, Revision 2

Figure 5
MELLLA+ Power/Flow Map

OPRM Operable, FWTR, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3



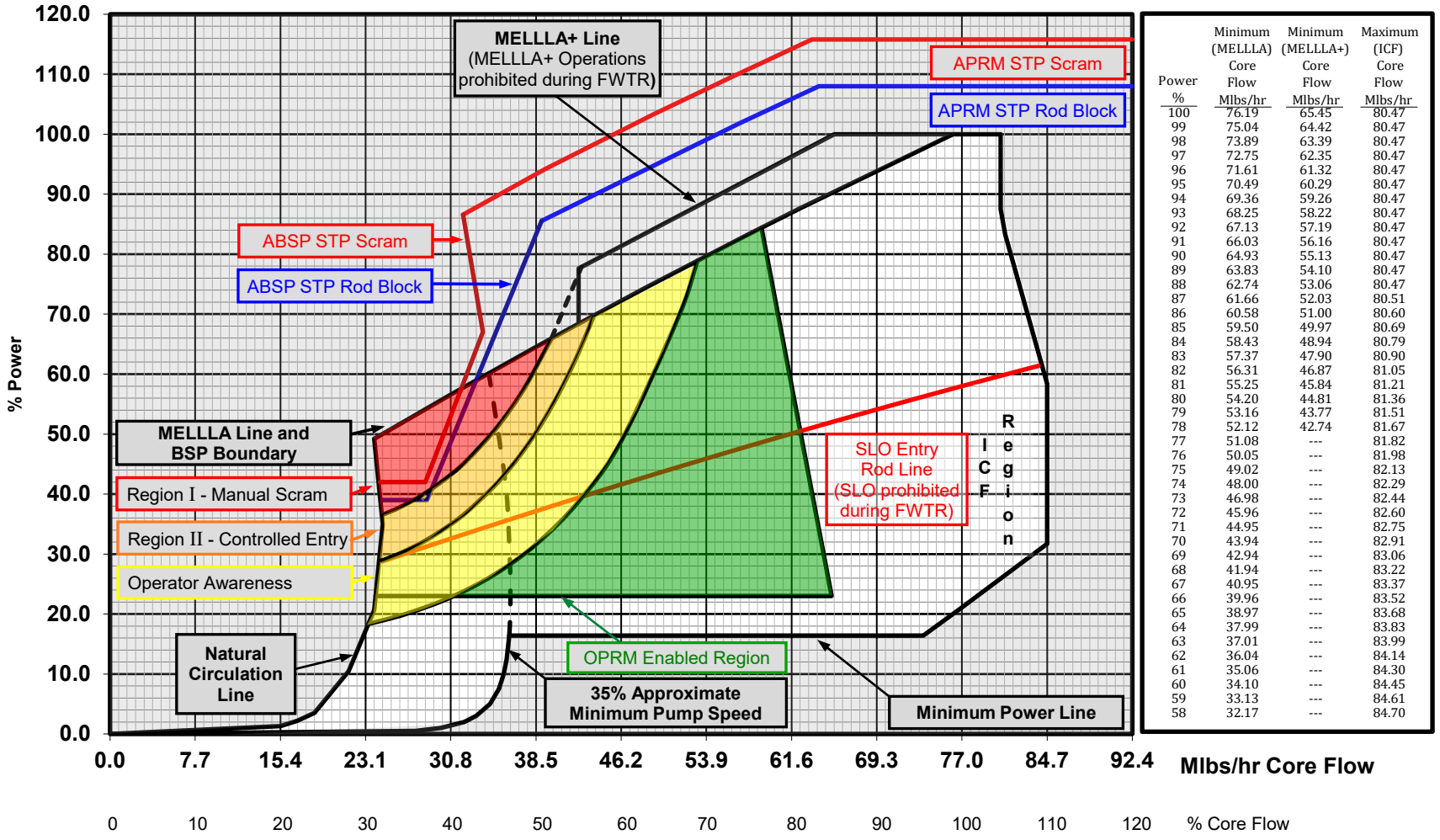
Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

Reference: 0B21-2045, Revision 2

Figure 6
MELLLA+ Power/Flow Map

OPRM Inoperable, FWTR, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3



Power %	Minimum (MELLLA) Core Flow Mlbs/hr	Minimum (MELLLA+) Core Flow Mlbs/hr	Maximum (ICF) Core Flow Mlbs/hr
100	76.19	65.45	80.47
99	75.04	64.42	80.47
98	73.89	63.39	80.47
97	72.75	62.35	80.47
96	71.61	61.32	80.47
95	70.49	60.29	80.47
94	69.36	59.26	80.47
93	68.25	58.22	80.47
92	67.13	57.19	80.47
91	66.03	56.16	80.47
90	64.93	55.13	80.47
89	63.83	54.10	80.47
88	62.74	53.06	80.47
87	61.66	52.03	80.51
86	60.58	51.00	80.60
85	59.50	49.97	80.69
84	58.43	48.94	80.79
83	57.37	47.90	80.90
82	56.31	46.87	81.05
81	55.25	45.84	81.21
80	54.20	44.81	81.36
79	53.16	43.77	81.51
78	52.12	42.74	81.67
77	51.08	---	81.82
76	50.05	---	81.98
75	49.02	---	82.13
74	48.00	---	82.29
73	46.98	---	82.44
72	45.96	---	82.60
71	44.95	---	82.75
70	43.94	---	82.91
69	42.94	---	83.06
68	41.94	---	83.22
67	40.95	---	83.37
66	39.96	---	83.52
65	38.97	---	83.68
64	37.99	---	83.83
63	37.01	---	83.99
62	36.04	---	84.14
61	35.06	---	84.30
60	34.10	---	84.45
59	33.13	---	84.61
58	32.17	---	84.70

Reference: 0B21-2045, Revision 2