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Enclosure 1 to this letter contains Proprietary Information to be withheld from public disclosure per 10 CFR 2.390. When separated from Enclosure 1 this transmittal document is decontrolled.

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Edwin I. Hatch Nuclear Plant – Unit 1
Cycle 31 Core Operating Limits Report Version 1

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5.d., Southern Nuclear Operating Company (SNC) submits the enclosed Core Operating Limits Report (COLR), for Edwin I. Hatch Nuclear Plant (HNP) Unit 1 Cycle 31.

The enclosed documentation contains proprietary information as defined by 10 CFR 2.390. Global Nuclear Fuel (GNF), as the owner of the proprietary information, has executed the enclosed affidavit, which identifies that the enclosed proprietary information has been handled and classified as proprietary, is customarily held in confidence, and has been withheld from public disclosure. The proprietary information was provided to SNC in a GNF transmittal that is referenced by the affidavit. The proprietary information has been faithfully reproduced in the enclosed documentation, such that the affidavit remains applicable. GNF hereby requests that the proprietary information provided in Enclosure 1 to this letter be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. A non-proprietary version of the COLR is provided as Enclosure 2 to this letter. The affidavit is also provided in Enclosure 1 to this letter and identifies that the designated information has been handled and classified as proprietary to GNF.

This letter contains no NRC commitments. If you have any questions, please contact Ryan Joyce at 205.992.6468.

Respectfully submitted,

Cheryl A. Gayheart
Regulatory Affairs Director

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Enclosures: 1. HNP Unit 1 Cycle 31 Core Operating Limits Report Version 1
PROPRIETARY INFORMATION and Global Nuclear Fuel – Americas Affidavit

2. HNP Unit 1 Cycle 31 Core Operating Limits Report Version 1
NON-PROPRIETARY INFORMATION

Cc: Regional Administrator, Region II
NRR Project Manager – Hatch
Senior Resident Inspector – Hatch
RTYPE: CHA02.004

Edwin I. Hatch Nuclear Plant – Unit 1
Cycle 31 Core Operating Limits Report Version 1

Enclosure 2

HNP Unit 1 Cycle 31 Core Operating Limits Report Version 1
NON-PROPRIETARY INFORMATION

Non-Proprietary Information

SOUTHERN NUCLEAR OPERATING COMPANY
EDWIN I. HATCH NUCLEAR PLANT

Unit 1 Cycle 31
CORE OPERATING LIMITS REPORT

Version 1

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1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 1 Cycle 31 is prepared in accordance with the requirements of Technical Specification 5.6.5. The core operating limits presented herein were developed using NRC-approved methods (Reference 1). This reload contains GNF2 and GNF3 fuel types (Reference 2 and Reference 3). Results from the associated reload analyses for the fuel in Unit 1 Cycle 31 are documented in References 4 through 6.

The GNF2 limits in this report are applicable to the IronClad Lead Test Assembly (Reference 7 and Reference 8).

The following core operating limits are included in this report:

a. Average Planar Linear Heat Generation Rate (APLHGR) – Technical Specification 3.2.1

b. Minimum Critical Power Ratio (MCPR) – Technical Specification 3.2.2

c. Linear Heat Generation Rate (LHGR) – Technical Specification 3.2.3

This report also includes limits on the Maximum Fraction of Limiting Critical Power Ratio (MFLCPR) and Maximum Fraction of Limiting Power Density (MFLPD) thermal limit ratios, which may be used in conjunction with the standard core operating limits to allow operation with dome pressure down to 40 psi below nominal.

Related system operability requirements are defined in Table 1-1. Other equipment requirements that must be satisfied for operating limits included in this report to remain applicable are defined in Table 1-2.

Operating limit flexibility options are provided for various equipment in/out of service conditions, dependent on the number of operating recirculation loops, operability of the main turbine bypass system, operability of the End-of-Cycle Recirculation Pump Trip (EOC-RPT) system, status of the main turbine pressure regulator system, and configuration of High Worth Scram Rods (HWSRs). Plant operational limitations associated with specific equipment in/out of service combinations are defined in Table 1-3.

Operating limits are presented in this report as a function of fuel type, core power, core flow, average scram time, and exposure. These limits are not a function of feedwater temperature. Cycle exposure intervals used in the presentation of limits in this report are defined in Table 1-4.

Operating limits between tabulated values presented in this report are based on linear interpolation.

TABLE 1-1

System Operability Requirements

System	Operability Requirement
Main Turbine Bypass System Operable (Technical Specification 3.7.7)	At least two bypass valves must be operable

TABLE 1-2

Equipment Requirements

Equipment	Requirement
Recirculation Flow Control System	The maximum achievable core flow on the highest licensed rod line must be limited to less than 107% of rated core flow
Turbine Power/Load Unbalance Trip Logic	When operating at greater than 55% core thermal power, the turbine Power/Load Unbalance (PLU) trip logic must be functional
APRM System	The Oscillation Power Range Monitor (OPRM) Period Based Detection Algorithm (PBDA) amplitude trip setpoint must be set equal to 1.15
High Worth Scram Rod (HWSR)	An individual High Worth Scram Rod must satisfy the following conditions to be valid for thermal operating limit improvements: • Correspond to a licensed HWSR pattern, as defined in Figure 3-5. • Control rod is inserted to a licensed HWSR notch location, as defined in Figure 3-5. • All diagonal-adjacent and face-adjacent control rods are fully withdrawn as defined by the Figure 3-5 exclusion regions. • Control rod scram time is not "slow," in accordance with Technical Specification Table 3.1.4-1.

TABLE 1-3

Equipment Condition In/Out of Service Limitations

Condition	Limitation
Single-Loop Operation (SLO)	• Core power must be ≤ 2000 MWth • Core flow must be ≤ 55% of rated
Main Turbine Bypass System Inoperable OR Main Turbine Pressure Regulator System in TLCO 3.3.13.c	Dome pressure must be within +/- 10 psi of nominal, as defined in Figure 5-1
High Worth Scram Rods In Service	• The core must be operating with a set of four (4) valid High Worth Scram Rods (as defined in Table 1-2) • The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b
Main Turbine Pressure Regulator System in TLCO 3.3.13.c	High Worth Scram Rods In Service core operating limits are NOT applicable

TABLE 1-4

Exposure Definitions

Exposure Label	Definition	Cycle Exposure
BOC	Beginning of Cycle Exposure	0 MWd/ST
MOC1	First Middle of Cycle Exposure	EOR - 6000 MWd/ST
MOC2	Second Middle of Cycle Exposure	EOR - 3500 MWd/ST
EOR	End of Rated Exposure	Projected exposure at end of rated power with all control rods out, rated core flow, and rated feedwater temperature
EOC	End of Cycle Exposure	Exposure at cycle shutdown

2.0 APLHGR OPERATING LIMITS (Technical Specification 3.2.1)

For both two loop operation (TLO) and single loop operation (SLO), the APLHGR operating limit for each six inch axial segment of each fuel assembly in the core is the applicable fuel-type-specific APLHGR limit defined in Figure 2-1.

No flow-dependent or power-dependent APLHGR limit multipliers ($MAPFAC_F$ or $MAPFAC_P$) are required. For SLO, no unique limit on $MAPFAC_F$ or $MAPFAC_P$ is required.

These limits apply to operation over the full range of licensed dome pressure regions shown in Figure 5-1.

Average Planar Exposure (GWd/ST)	GNF2 APLHGR Limit (kW/ft)
0.00	13.78
17.15	13.78
60.78	6.87
63.50	5.50

Average Planar Exposure (GWd/ST)	GNF3 APLHGR Limit (kW/ft)
0.00	14.36
9.07	13.78
21.22	13.01
40.82	10.75
57.60	8.00
63.50	6.00

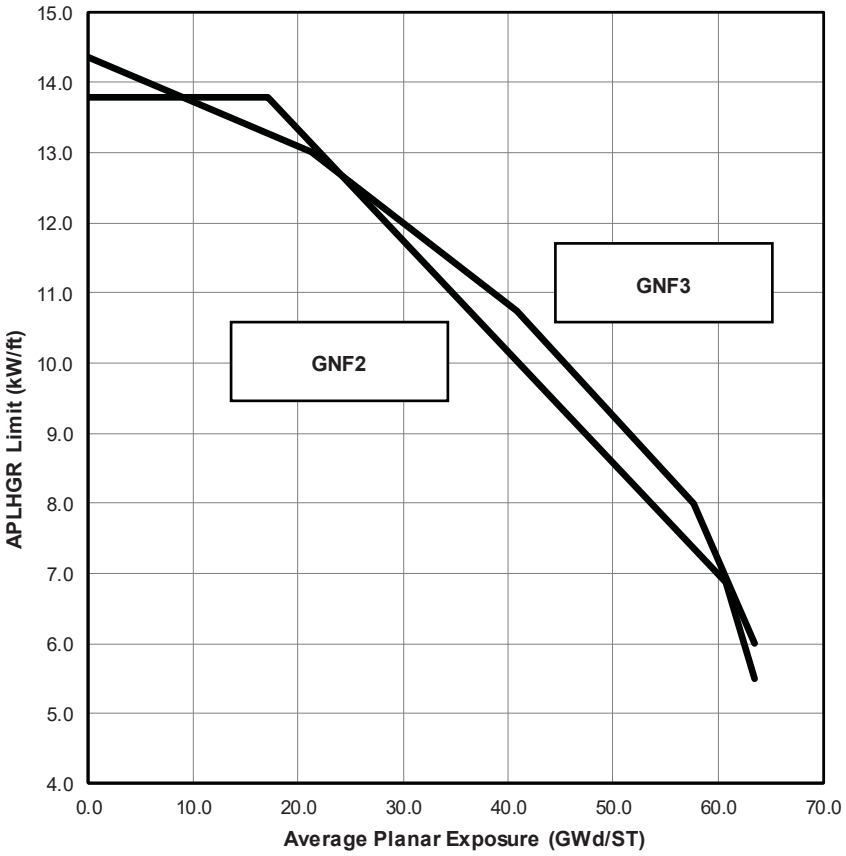


FIGURE 2-1

APLHGR Limits versus Average Planar Exposure

3.0 MCPR OPERATING LIMITS (Technical Specification 3.2.2)

The MCPR operating limit (OLMCPR) for each licensed equipment in or out of service operating flexibility option is independent of fuel type and is a function of core power, core flow, average scram time, and cycle exposure.

The cycle-specific MCPR safety limits (SLMCPRs) are specified in Table 3-1.

For both two loop operation (TLO) and single loop operation (SLO), the OLMCPR is determined as follows:

a. For 24% ≤ core power ≤ 28%, the greater of either:

   1) The flow-dependent MCPR limit, $MCPR_F$, as determined by Figure 3-1,

      OR

   2) The power-dependent MCPR limit, $MCPR_P$, as determined by Table 3-2.

b. For core power > 28%, the greater of either:

   1) $MCPR_F$, as determined by Figure 3-1,

      OR

   2) The product of the power-dependent MCPR limit multiplier (K_P), as determined by Table 3-3, and the scram-time dependent rated-power OLMCPR, as determined by Table 3-4.

The scram-time dependent value of τ used to determine the rated-power OLMCPR is calculated in accordance with Section 3.1. For High Worth Scram Rods In Service operation, Section 3.2 is also applicable to determine the value of τ.

Limits for operation with High Worth Scram Rods In Service apply to operation with four valid individual High Worth Scram Rods (HWSRs), as defined in Table 1-3. The licensed sets of HWSRs are defined in the Figure 3-5 series. Each individual credited HWSR must meet the equipment requirements defined in Table 1-2 to be considered valid for thermal operating limit credit.

The limits presented in this section apply to operation with vessel dome pressure within +/- 10 psi of nominal pressure, as defined by the Region I pressure band shown in Figure 5-1. With Standard Equipment In Service, with the EOC-RPT System Inoperable, and/or with High Worth Scram Rods In Service, operation with vessel dome pressure down to 40 psi below nominal is licensed provided the additional restrictions identified in Section 5.0 are applied with the OLMCPR defined in this section.

3.1 AVERAGE SCRAM TIME REQUIREMENTS

In the 3-4A and 3-4B figures, Option A scram time rated-power OLMCPRs correspond to $\tau = 1.0$, where τ is determined from scram time measurements performed in accordance with Technical Specifications Surveillance Requirements 3.1.4.1 and 3.1.4.2. Option B values correspond to $\tau = 0.0$. For scram times between Option A and Option B, the rated-power OLMCPR is linearly dependent on τ. If τ has not been determined, Option A limits must be used.

The average scram time of the control rods, τ, is defined as:

$$\tau = 0, \quad \text{OR} \quad \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B}, \text{ whichever is greater.}$$

where: τ_A = 1.08 sec (Technical Specification 3.1.4, Table 3.1.4-1, scram time limit to notch 36).

$$\tau_B = \mu + 1.65 * \sigma * \left[\frac{N_l}{\sum_{i=1}^{n} N_i} \right]^{\frac{1}{2}}$$

where: μ = 0.822 sec (mean scram time to notch 36 used in the transient analysis).

σ = 0.018 sec (standard deviation of μ).

N_l = total number of active rods measured in Technical Specifications Surveillance Requirement 3.1.4.1.

n = number of surveillance tests performed to date in the cycle.

N_i = number of active control rods measured in the i^{th} surveillance test.

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

where: τ_i = average scram time to notch 36 of all rods in the i^{th} surveillance test.

3.2 HIGH WORTH SCRAM ROD SCRAM TIME REQUIREMENTS

For High Worth Scram Rods In Service operation, the value of τ used to determine the MCPR limit is the greater of either:

a. The average scram time of the control rods, τ, as defined in Section 3.1,

   OR

b. The maximum of the individually calculated values of τ for the credited High Worth Scram Rods.

If individually calculated values of τ for all credited High Worth Scram Rods have not been determined, then non-HWSR limits must be used.

The value of τ for an individual High Worth Scram Rod is defined as:

$$\tau = 0, \quad \text{OR} \quad \frac{\tau_{HWSR} - \tau_B}{\tau_A - \tau_B}, \text{ whichever is greater.}$$

where: τ_A = 1.08 sec (Technical Specification 3.1.4, Table 3.1.4-1, scram time limit to notch 36).

τ_B = 0.822 sec (mean scram time to notch 36 used in the transient analysis).

τ_{HWSR} = most recent measurement of the individual rod scram time from notch 48 to notch 36 (in seconds).

TABLE 3-1

Cycle Specific MCPR Safety Limit

Two Loop Operation	Single Loop Operation
1.08	1.11

TABLE 3-2

Power-Dependent MCPR Limit ($MCPR_P$) Operating Flexibility Options (for Core Power ≤ 28% of Rated)

Equipment In/Out of Service				Figure #
Main Turbine Bypass System Operable	***EOC-RPT System Operable***	***Main Turbine Pressure Regulator System Status***	***High Worth Scram Rods In Service***	
Yes	Yes/No	TLCO 3.3.13.a or b	Yes/No	3-2A
		TLCO 3.3.13.c	N/A *	
No	Yes/No	TLCO 3.3.13.a or b	Yes/No	3-2B
		TLCO 3.3.13.c	N/A *	

* The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b for High Worth Scram Rods to be considered In Service, as described in Table 1-3.

TABLE 3-3

Power-Dependent MCPR Limit Multiplier (K_P) Operating Flexibility Options (for Core Power > 28% of Rated)

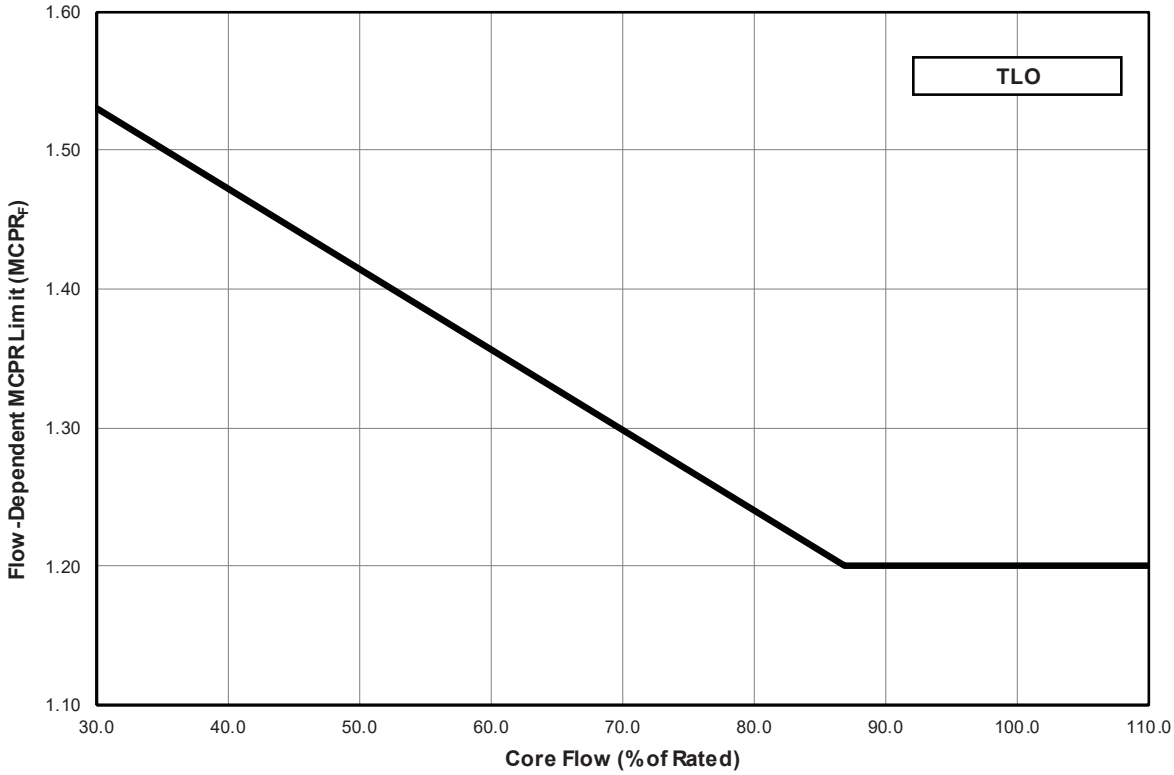
Equipment In/Out of Service				Figure #
Main Turbine Bypass System Operable	***EOC-RPT System Operable***	***Main Turbine Pressure Regulator System Status***	***High Worth Scram Rods In Service***	
Yes/No	Yes/No	TLCO 3.3.13.a or b	Yes/No	3-3A
		TLCO 3.3.13.c	N/A *	3-3B

* The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b for High Worth Scram Rods to be considered In Service, as described in Table 1-3.

TABLE 3-4

Rated-Power OLMCPR Operating Flexibility Options

Equipment In/Out of Service			Figure #	
			TLO	***SLO***
Standard Equipment In Service			3-4A-1	3-4B-1
Main Turbine Bypass System Inoperable			3-4A-2	3-4B-2
EOC-RPT System Inoperable			3-4A-3	3-4B-3
Main Turbine Bypass System Inoperable	AND	EOC-RPT System Inoperable	3-4A-4	3-4B-4
Main Turbine Pressure Regulator System in TLCO 3.3.13.c			3-4A-1	3-4B-1
Main Turbine Pressure Regulator System in TLCO 3.3.13.c	AND	Main Turbine Bypass System Inoperable	3-4A-2	3-4B-2
		EOC-RPT System Inoperable	3-4A-3	3-4B-3
		Main Turbine Bypass System Inoperable AND EOC-RPT System Inoperable	3-4A-4	3-4B-4
High Worth Scram Rods In Service			3-4A-5	3-4B-5
High Worth Scram Rods In Service	AND	Main Turbine Bypass System Inoperable	3-4A-6	3-4B-6
		EOC-RPT System Inoperable	3-4A-7	3-4B-7
		Main Turbine Bypass System Inoperable AND EOC-RPT System Inoperable	3-4A-8	3-4B-8

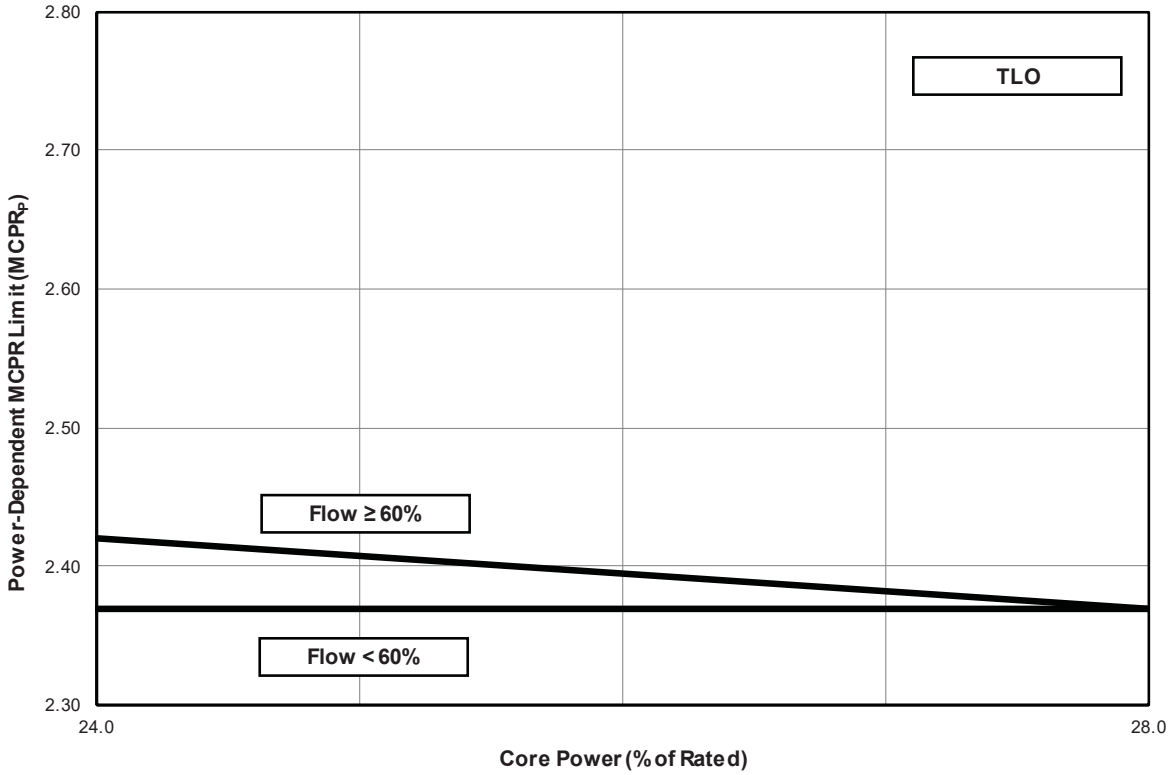


Flow (% of Rated)	MCPR$_F$ (TLO)
30.0	1.53
87.0	1.20
110.0	1.20

MCPR$_F$(SLO) = MCPR$_F$(TLO) + 0.03

FIGURE 3-1

Flow-Dependent MCPR Limit (MCPR$_F$) versus Core Flow

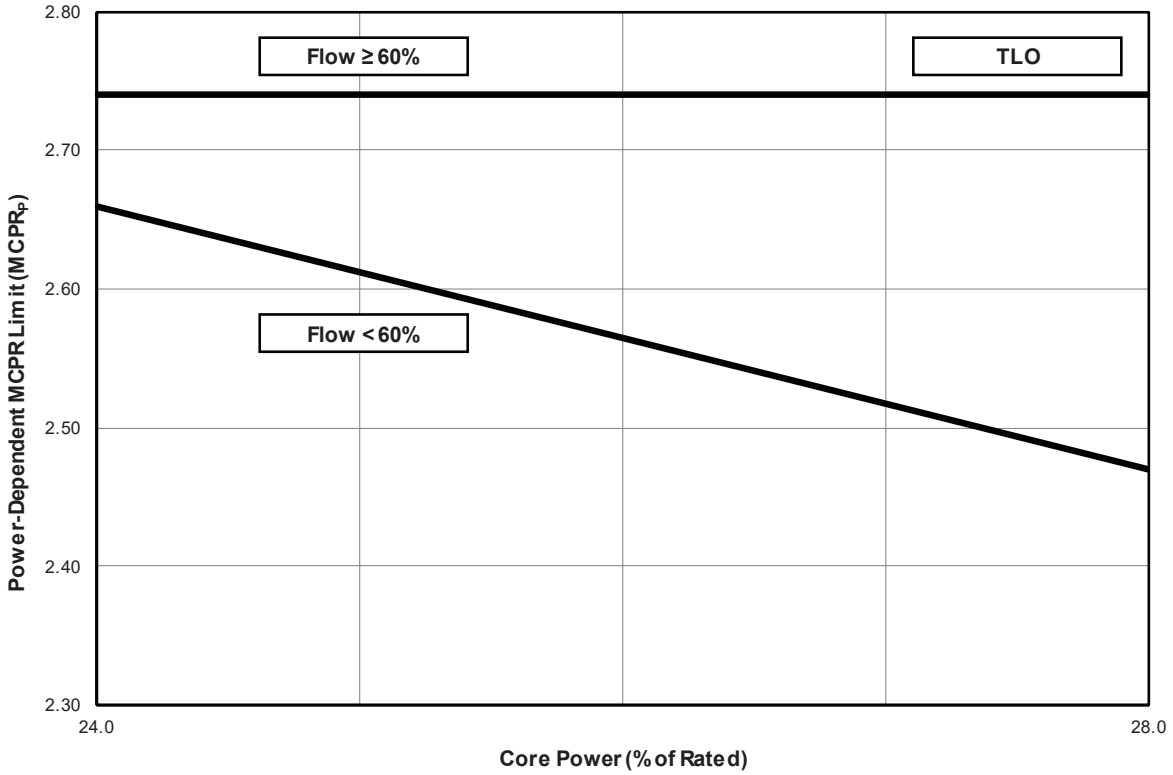


Flow (% of Rated)	Power (% of Rated)	$MCPR_P$ (TLO)
≥ 60.0	24.0	2.42
	≤ 28.0	2.37
< 60.0	24.0	2.37
	≤ 28.0	2.37

$MCPR_P(SLO) = MCPR_P(TLO) + 0.03$

FIGURE 3-2A

Power-Dependent MCPR Limit ($MCPR_P$) versus Core Power

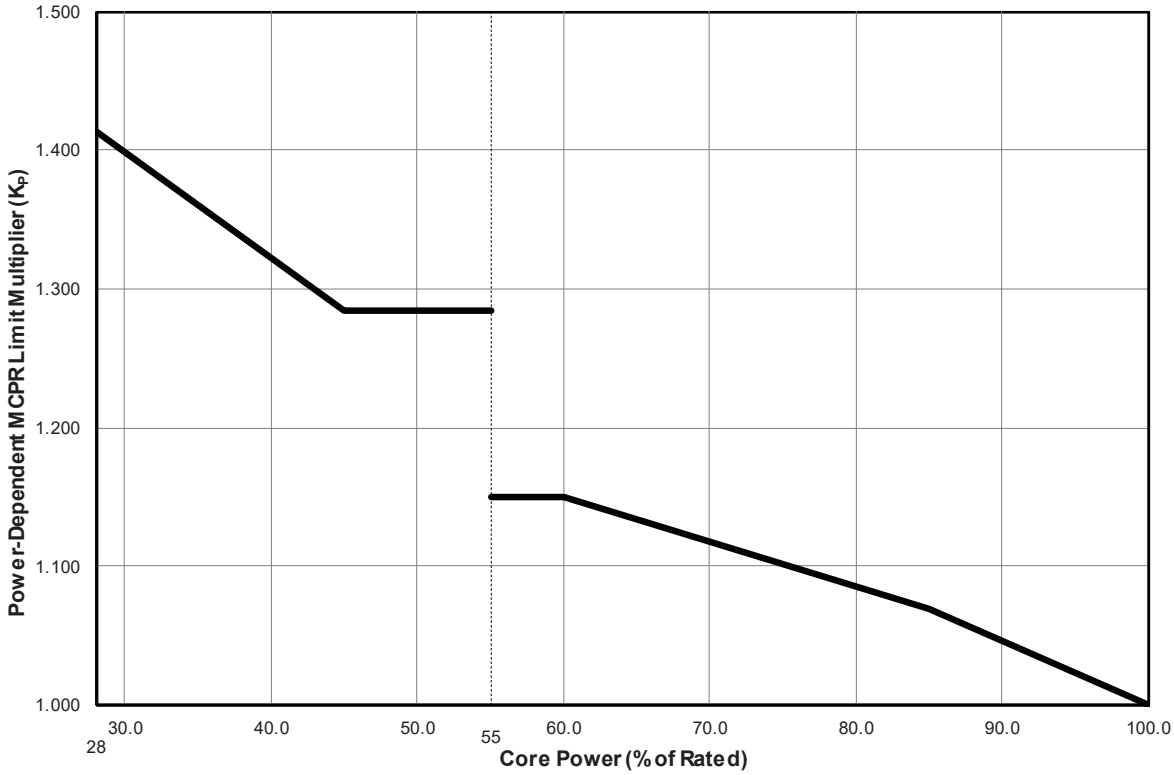


Flow (% of Rated)	Power (% of Rated)	$MCPR_P$ (TLO)
≥ 60.0	24.0	2.74
	≤ 28.0	2.74
< 60.0	24.0	2.66
	≤ 28.0	2.47

$MCPR_P(SLO) = MCPR_P(TLO) + 0.03$

FIGURE 3-2B

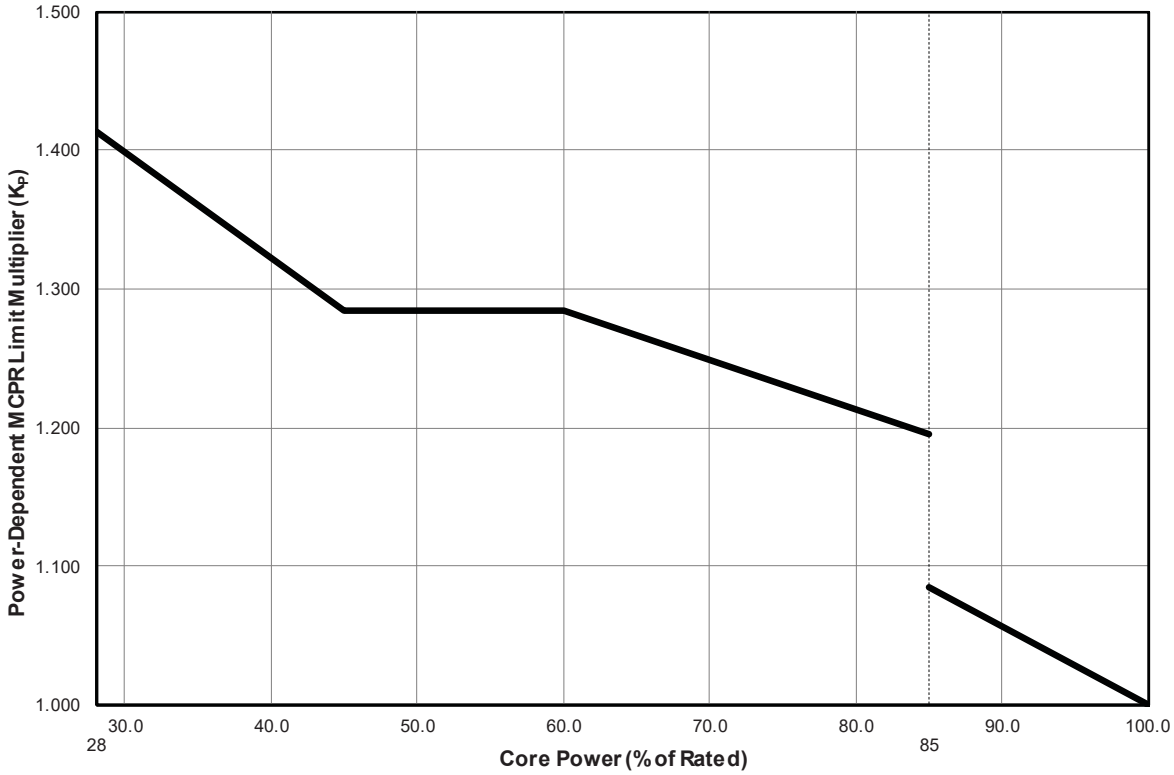
Power-Dependent MCPR Limit ($MCPR_P$) versus Core Power
(Main Turbine Bypass System Inoperable)



Power (% of Rated)	K_P (TLO/SLO)
> 28.0	1.413
45.0	1.285
≤ 55.0	1.285
> 55.0	1.150
60.0	1.150
85.0	1.070
100.0	1.000

FIGURE 3-3A

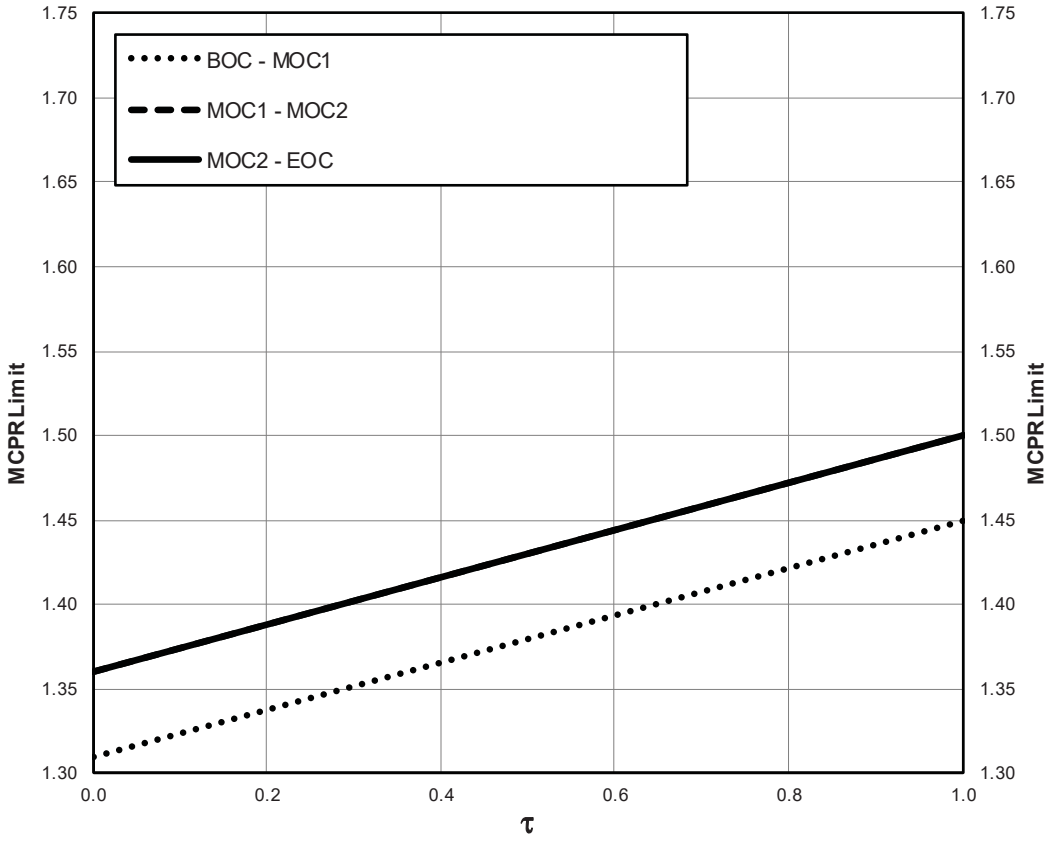
Power-Dependent MCPR Limit Multiplier (K_P) versus Core Power



Power (% of Rated)	K_P (TLO/SLO)
> 28.0	1.413
45.0	1.285
60.0	1.285
≤ 85.0	1.196
> 85.0	1.085
100.0	1.000

FIGURE 3-3B

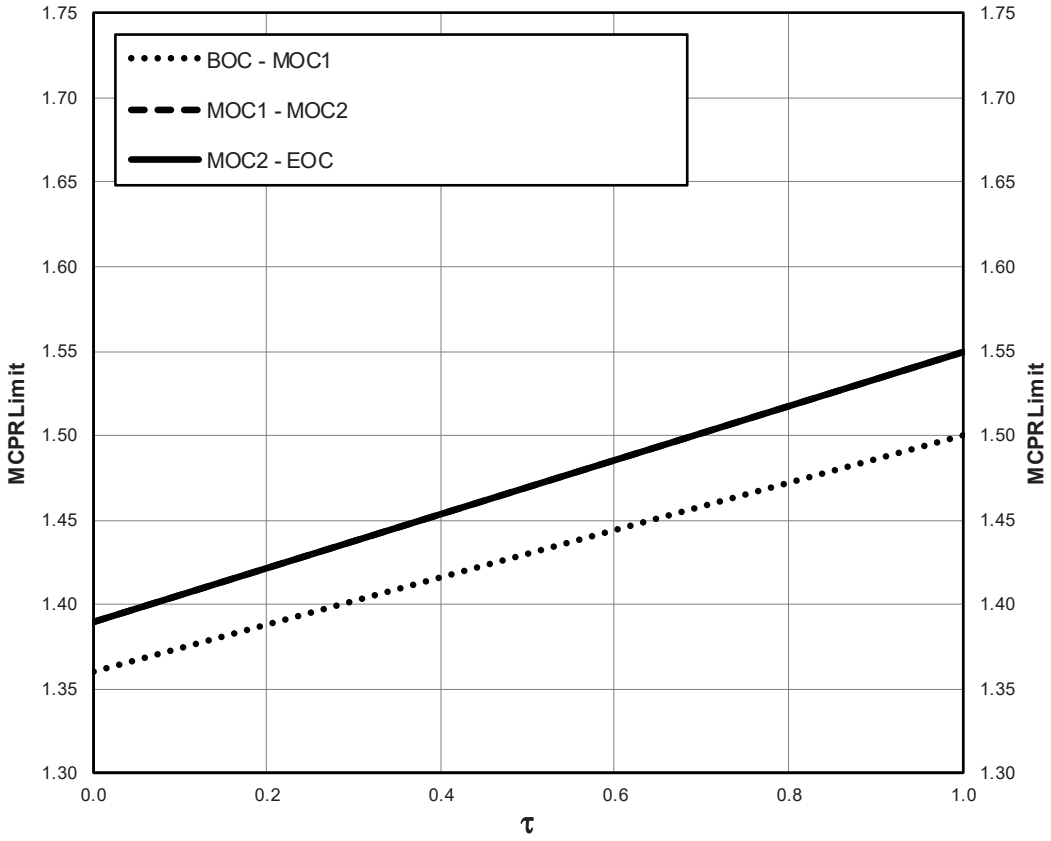
Power-Dependent MCPR Limit Multiplier (K_P) versus Core Power
(Main Turbine Pressure Regulator System in TLCO 3.3.13.c)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.31	1.45
MOC1 - MOC2	1.36	1.50
MOC2 - EOC	1.36	1.50

FIGURE 3-4A-1

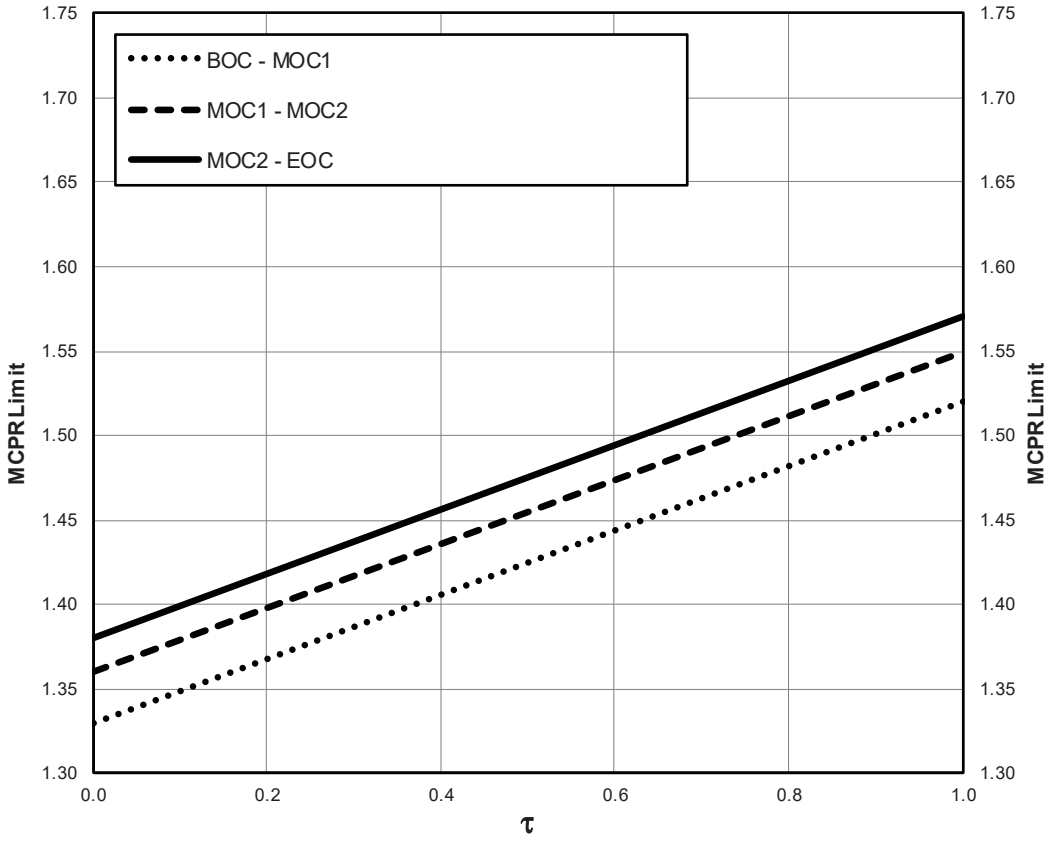
Rated-Power TLO MCPR Limits versus Average SCRAM Time



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.36	1.50
MOC1 - MOC2	1.39	1.55
MOC2 - EOC	1.39	1.55

FIGURE 3-4A-2

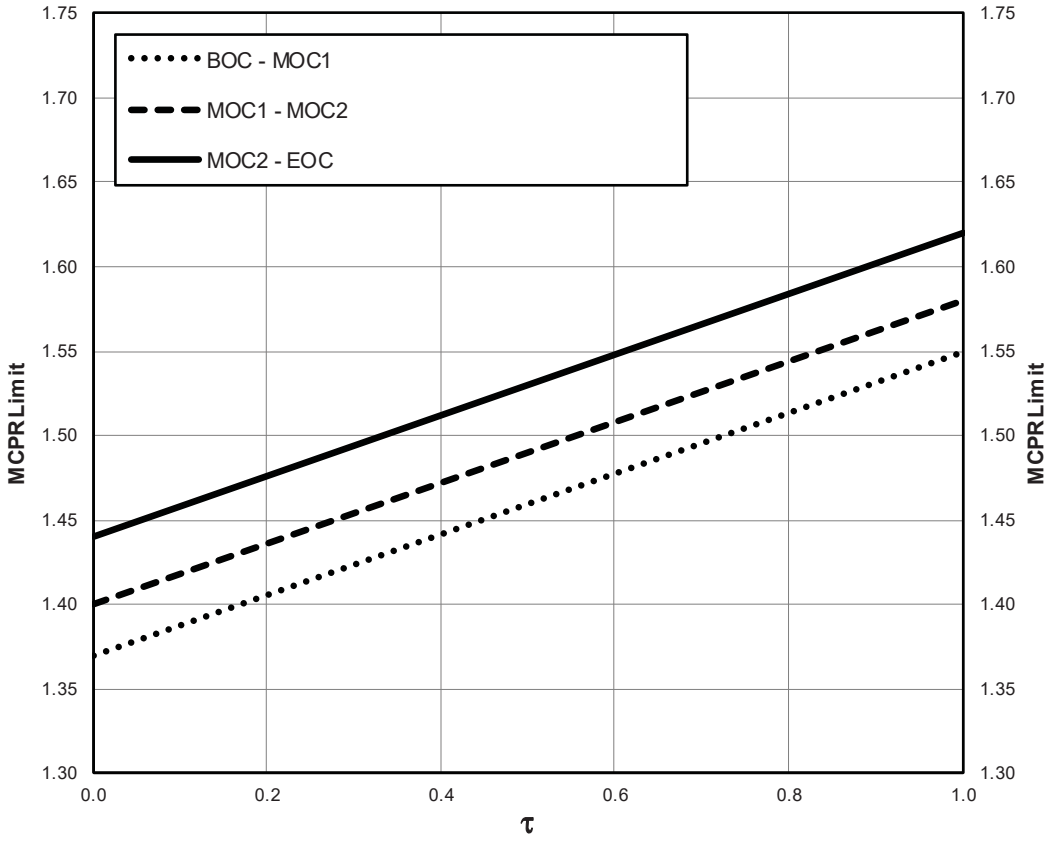
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.33	1.52
MOC1 - MOC2	1.36	1.55
MOC2 - EOC	1.38	1.57

FIGURE 3-4A-3

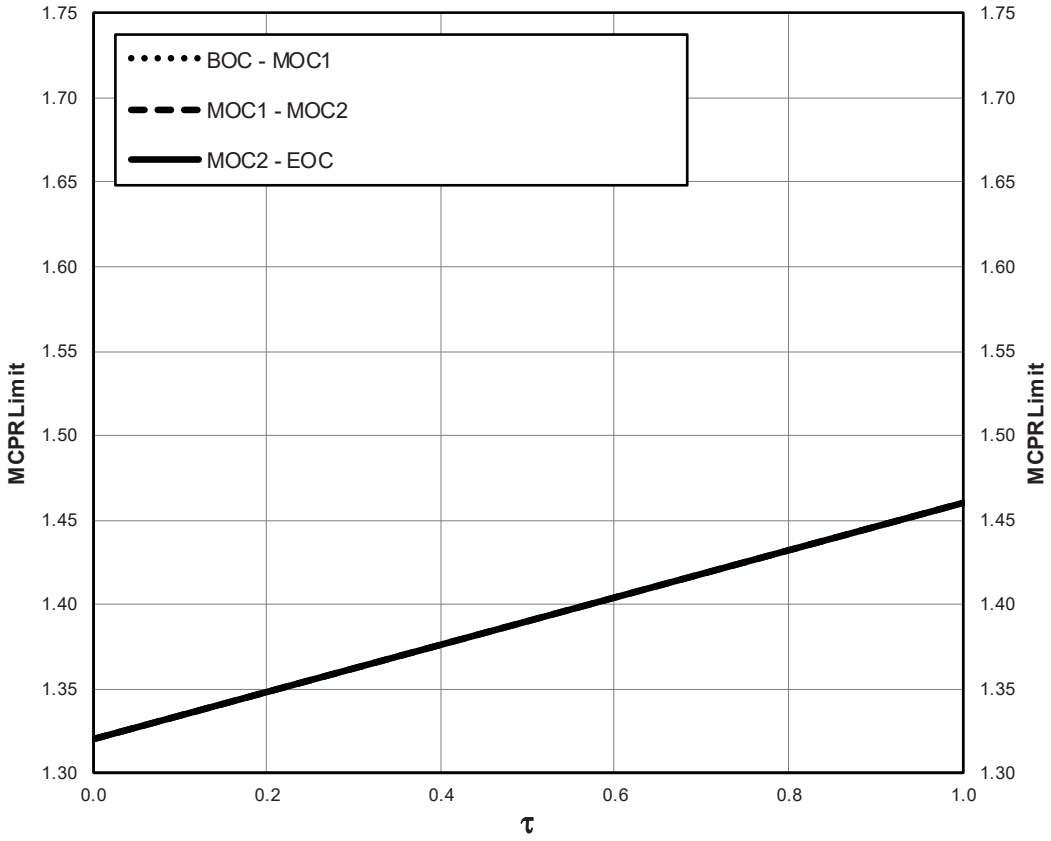
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(EOC-RPT System Inoperable)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.37	1.55
MOC1 - MOC2	1.40	1.58
MOC2 - EOC	1.44	1.62

FIGURE 3-4A-4

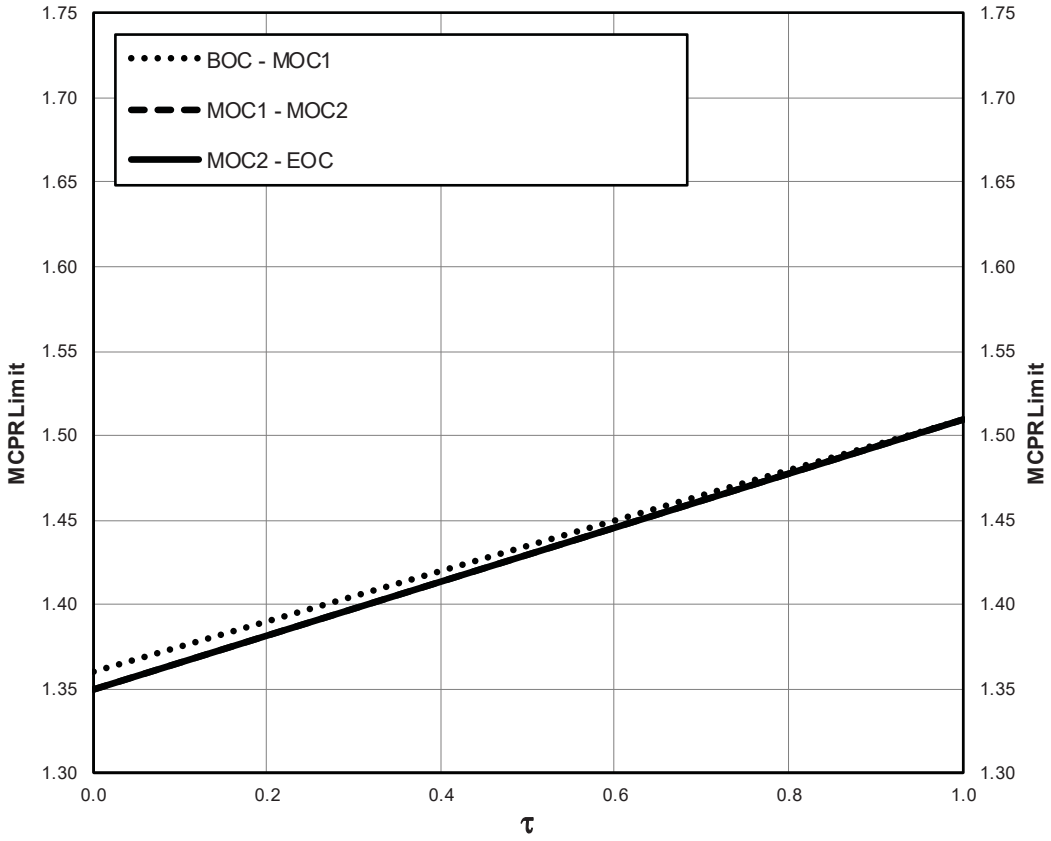
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable &
EOC-RPT System Inoperable)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.32	1.46
MOC1 - MOC2	1.32	1.46
MOC2 - EOC	1.32	1.46

FIGURE 3-4A-5

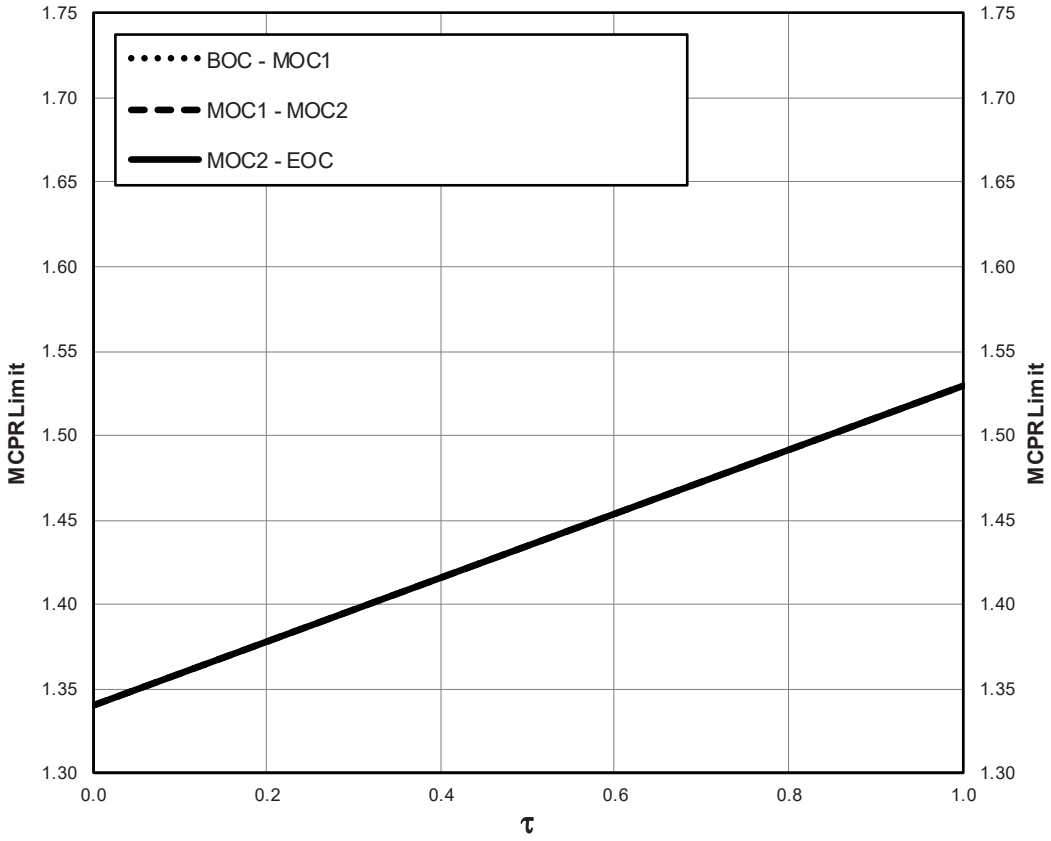
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.36	1.51
MOC1 - MOC2	1.35	1.51
MOC2 - EOC	1.35	1.51

FIGURE 3-4A-6

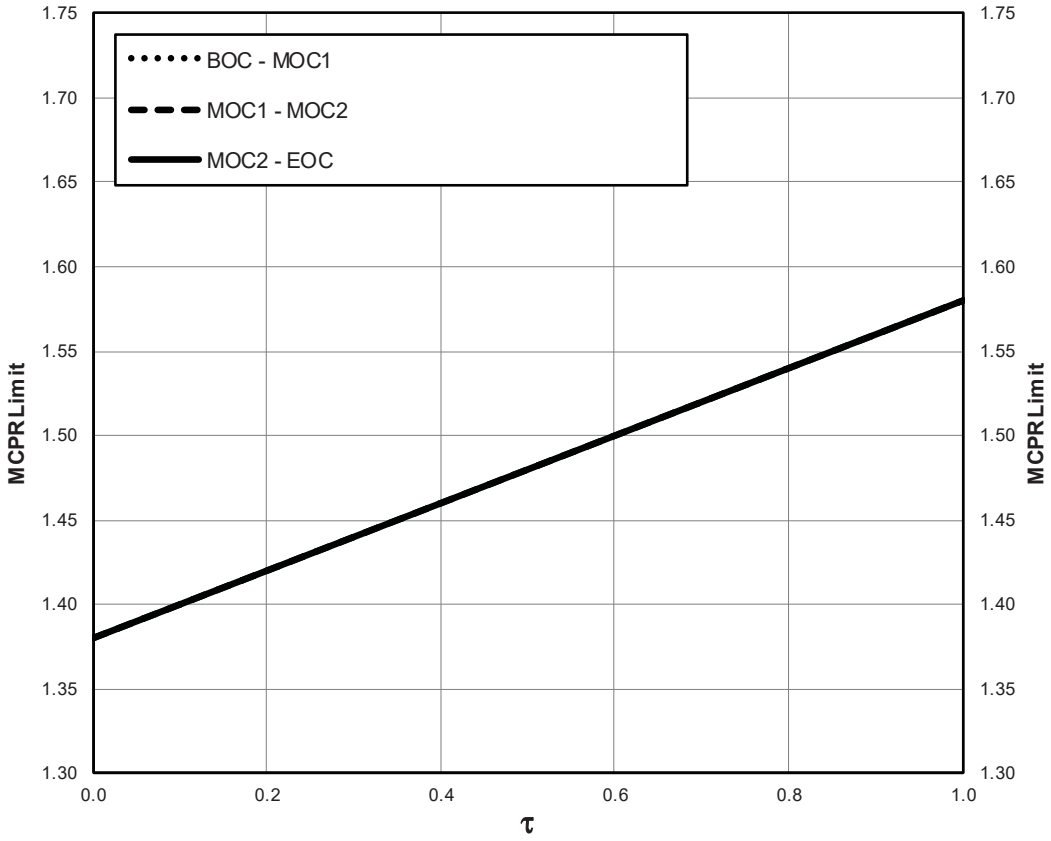
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service &
Main Turbine Bypass System Inoperable)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.34	1.53
MOC1 - MOC2	1.34	1.53
MOC2 - EOC	1.34	1.53

FIGURE 3-4A-7

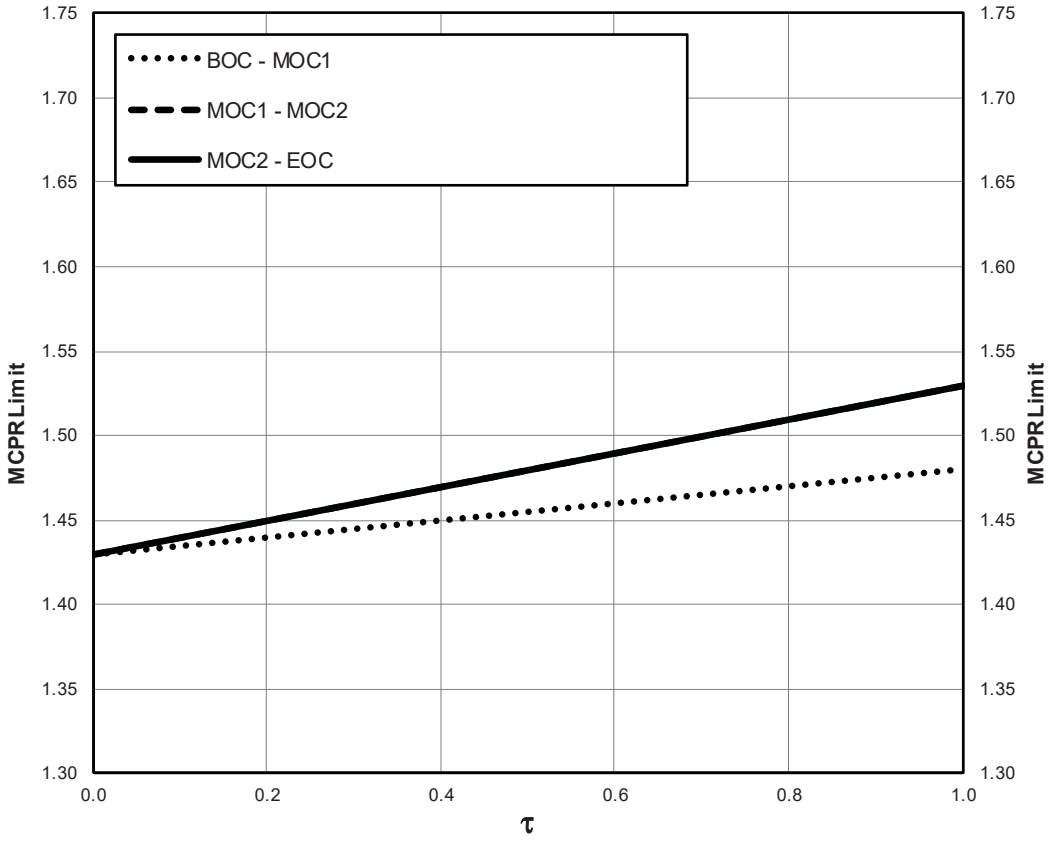
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service &
EOC-RPT System Inoperable)



Exposure Range	Rated $OLMCPR_{(TLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.38	1.58
MOC1 - MOC2	1.38	1.58
MOC2 - EOC	1.38	1.58

FIGURE 3-4A-8

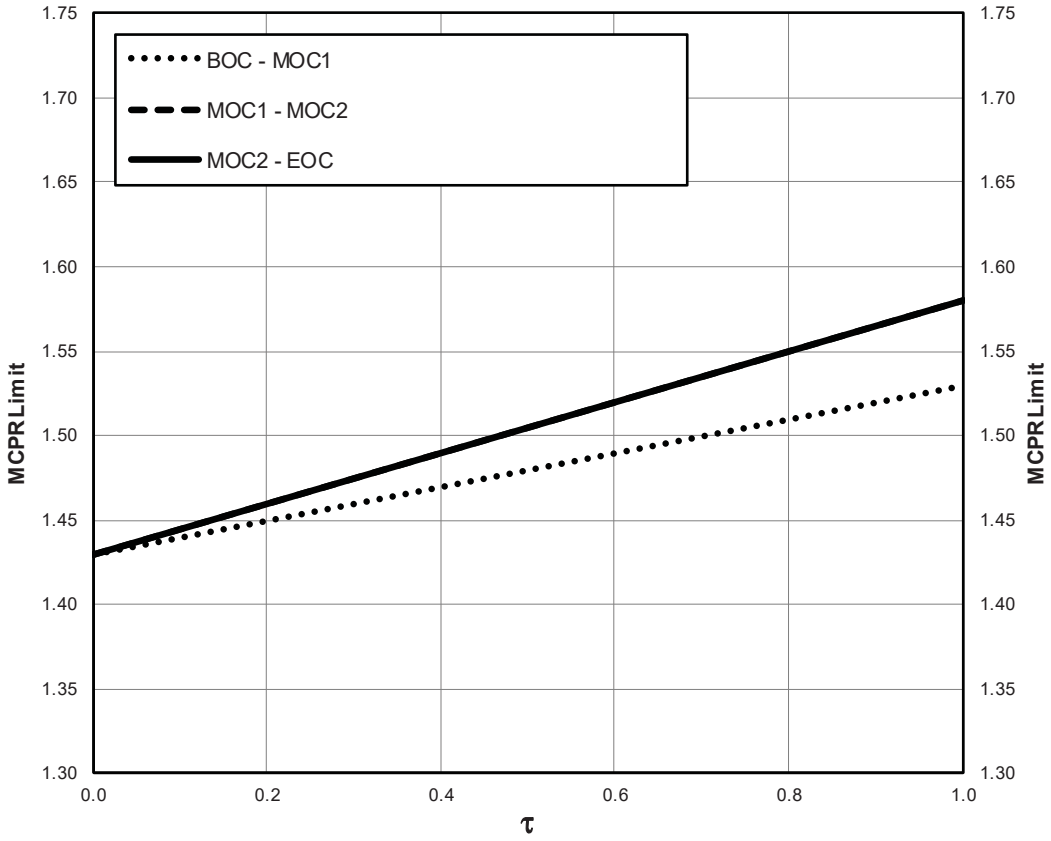
Rated-Power TLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service &
Main Turbine Bypass System Inoperable &
EOC-RPT System Inoperable)



Exposure Range	Rated $OLMCPR_{(SLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.43	1.48
MOC1 - MOC2	1.43	1.53
MOC2 - EOC	1.43	1.53

FIGURE 3-4B-1

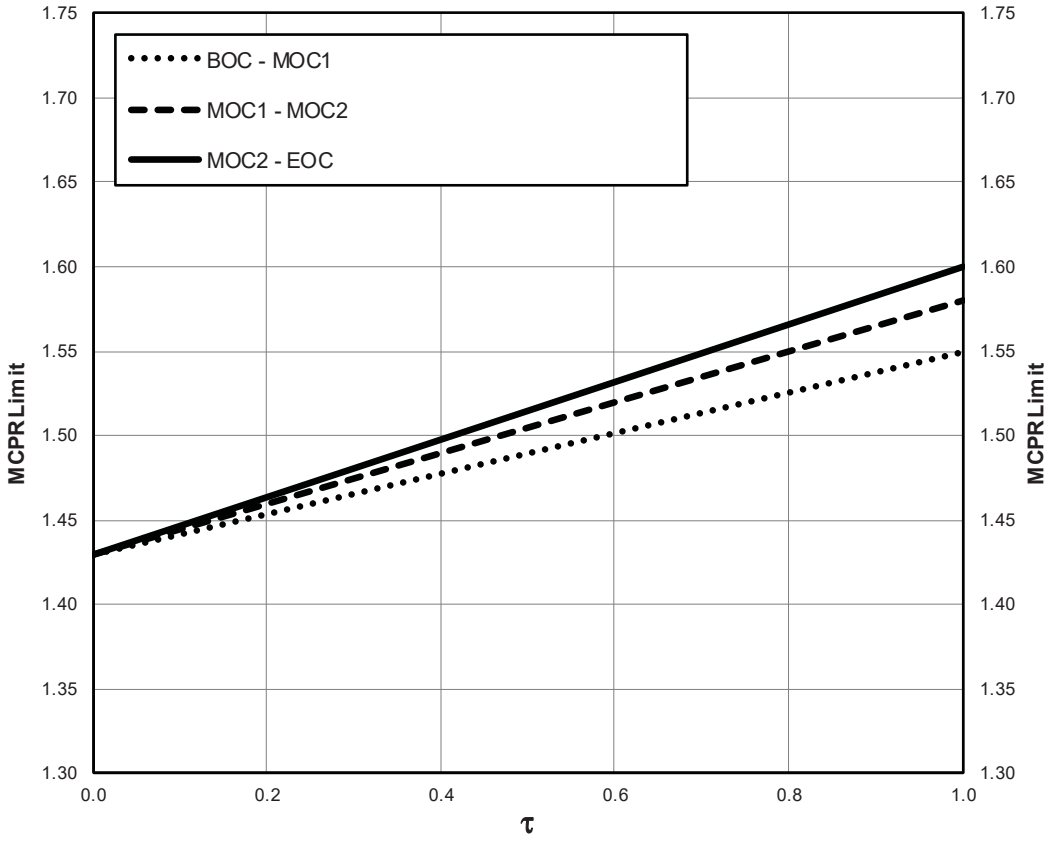
Rated-Power SLO MCPR Limits versus Average SCRAM Time



Exposure Range	Rated $OLMCPR_{(SLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.43	1.53
MOC1 - MOC2	1.43	1.58
MOC2 - EOC	1.43	1.58

FIGURE 3-4B-2

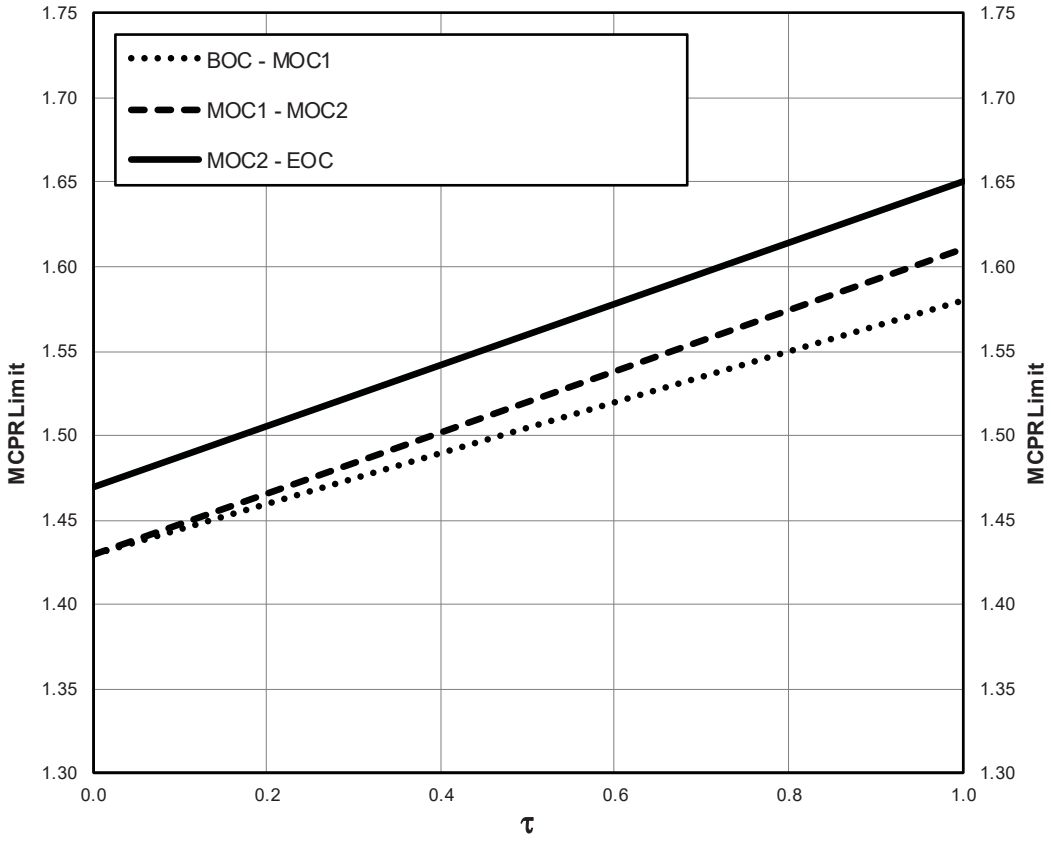
Rated-Power SLO MCPR Limits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable)



Exposure Range	Rated OLMCPR$_{(SLO)}$	
	τ = 0.0	τ = 1.0
BOC - MOC1	1.43	1.55
MOC1 - MOC2	1.43	1.58
MOC2 - EOC	1.43	1.60

FIGURE 3-4B-3

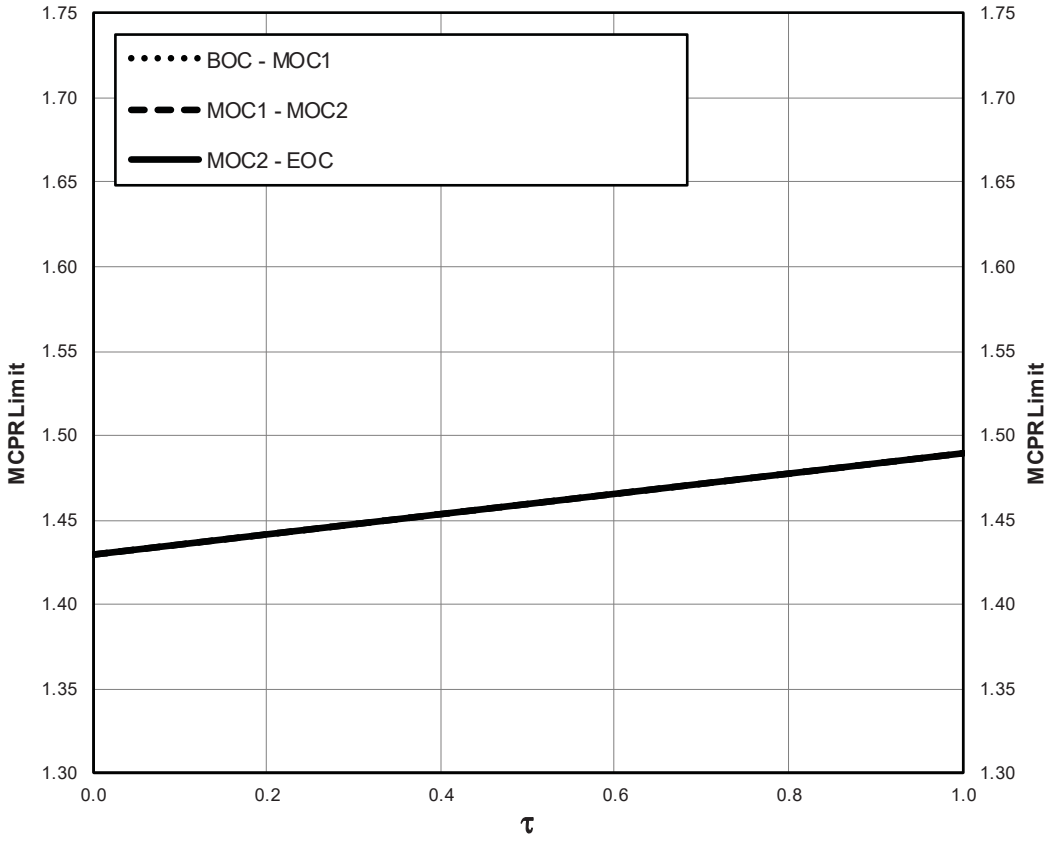
Rated-Power SLO MCPR Limits versus Average SCRAM Time
(EOC-RPT System Inoperable)



Exposure Range	Rated $OLMCPR_{(SLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.43	1.58
MOC1 - MOC2	1.43	1.61
MOC2 - EOC	1.47	1.65

FIGURE 3-4B-4

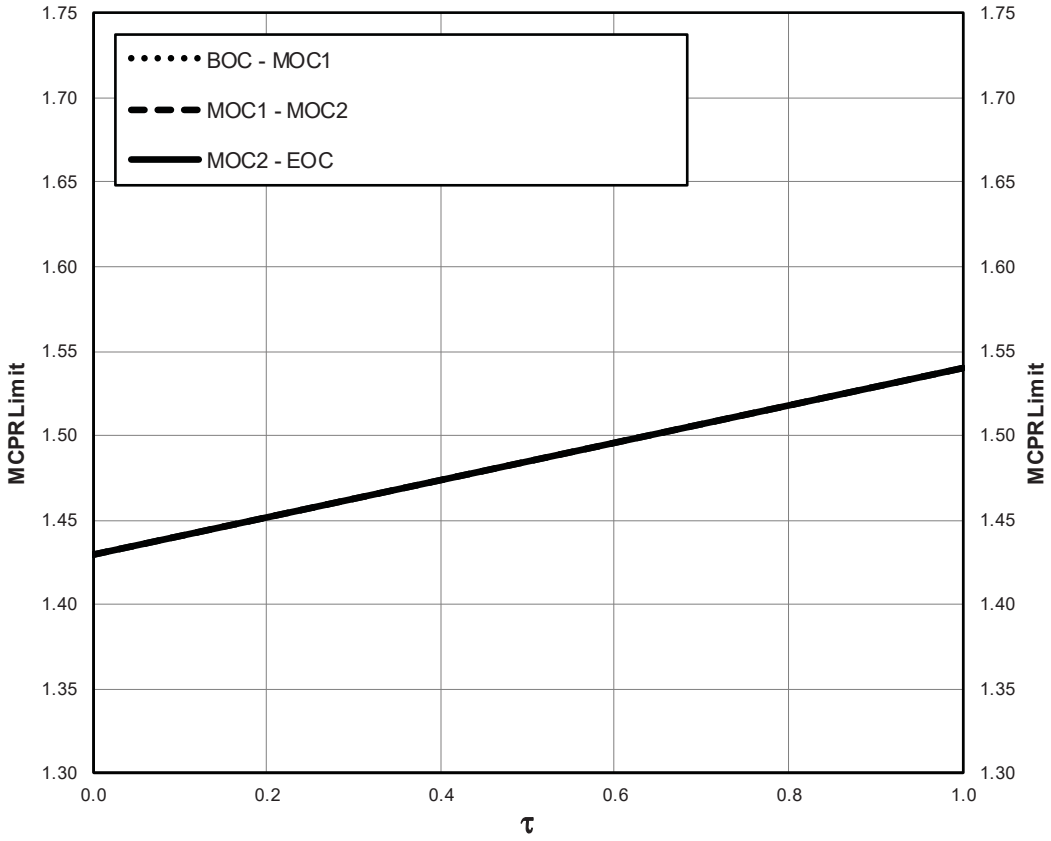
Rated-Power SLO MCPR Limits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable &
EOC-RPT System Inoperable)



Exposure Range	Rated $OLMCPR_{(SLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.43	1.49
MOC1 - MOC2	1.43	1.49
MOC2 - EOC	1.43	1.49

FIGURE 3-4B-5

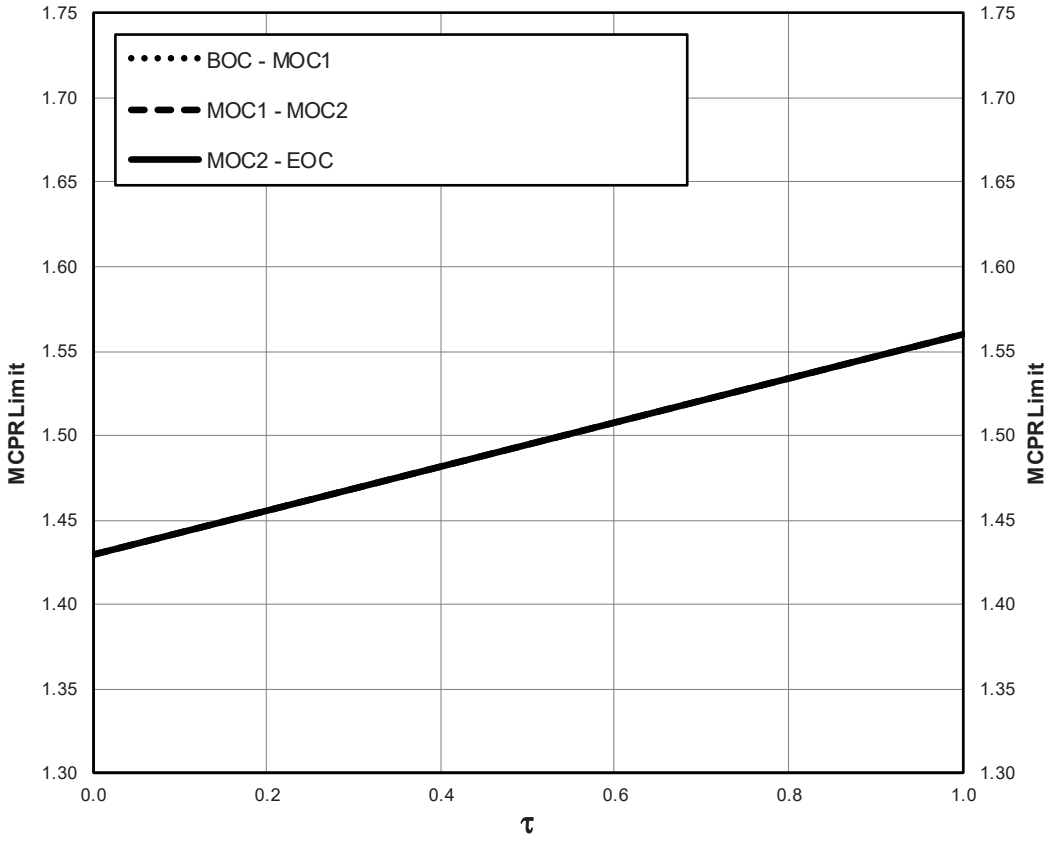
Rated-Power SLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service)



Exposure Range	Rated $OLMCPR_{(SLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.43	1.54
MOC1 - MOC2	1.43	1.54
MOC2 - EOC	1.43	1.54

FIGURE 3-4B-6

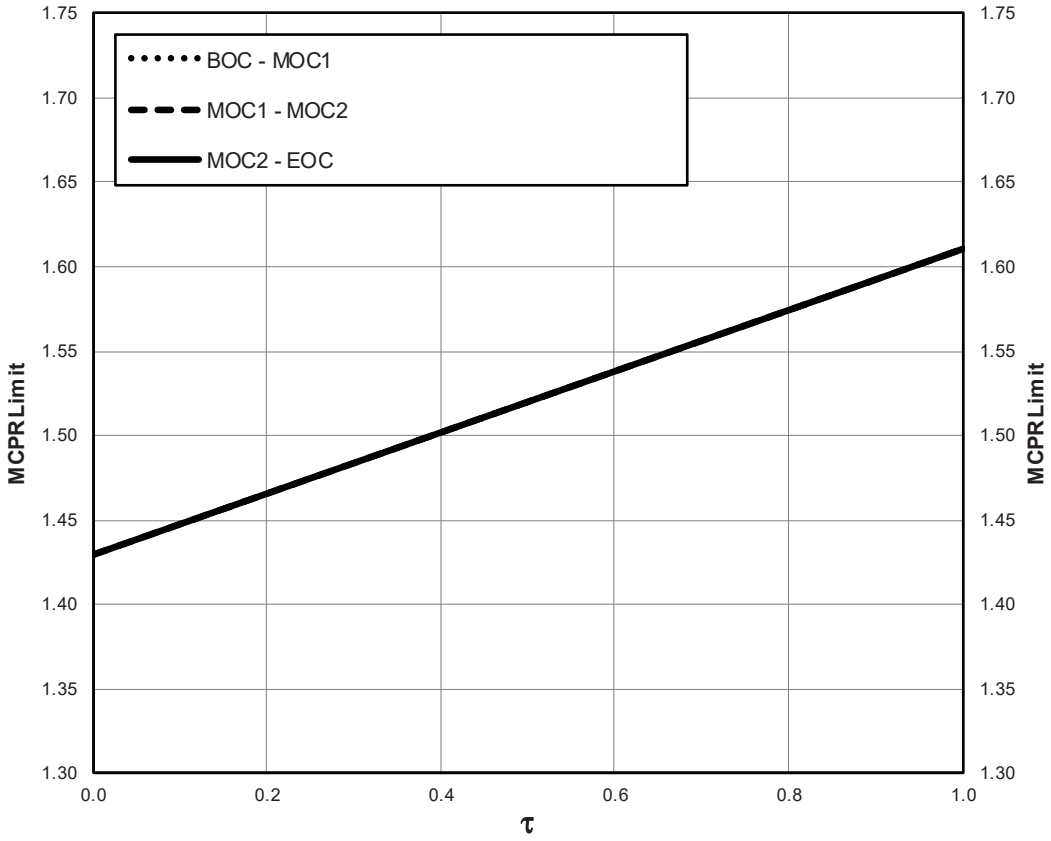
Rated-Power SLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service &
Main Turbine Bypass System Inoperable)



Exposure Range	Rated $OLMCPR_{(SLO)}$	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.43	1.56
MOC1 - MOC2	1.43	1.56
MOC2 - EOC	1.43	1.56

FIGURE 3-4B-7

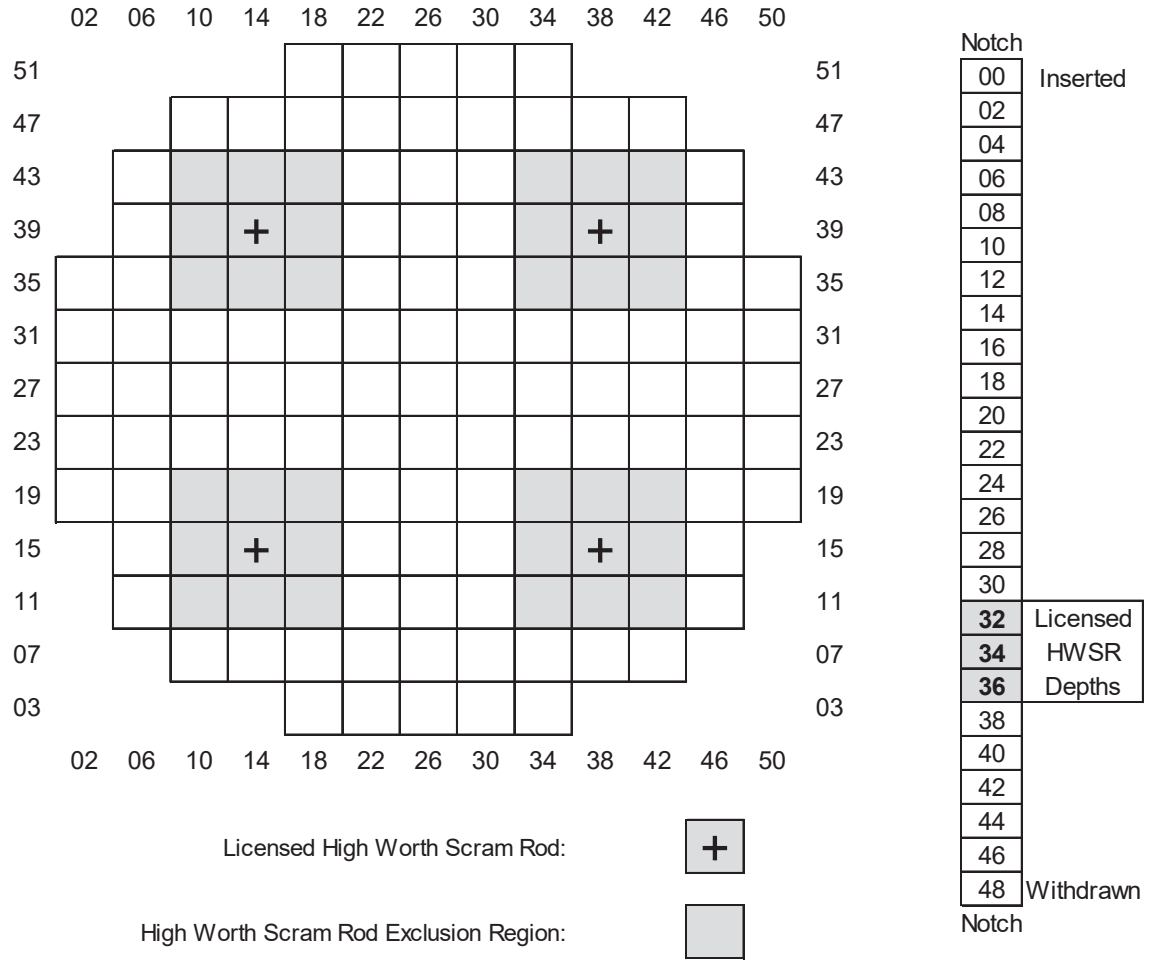
Rated-Power SLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service &
EOC-RPT System Inoperable)



Exposure Range	Rated OLMCPR$_{(SLO)}$	
	τ = 0.0	τ = 1.0
BOC - MOC1	1.43	1.61
MOC1 - MOC2	1.43	1.61
MOC2 - EOC	1.43	1.61

FIGURE 3-4B-8

Rated-Power SLO MCPR Limits versus Average SCRAM Time
(High Worth Scram Rods In Service &
Main Turbine Bypass System Inoperable &
EOC-RPT System Inoperable)

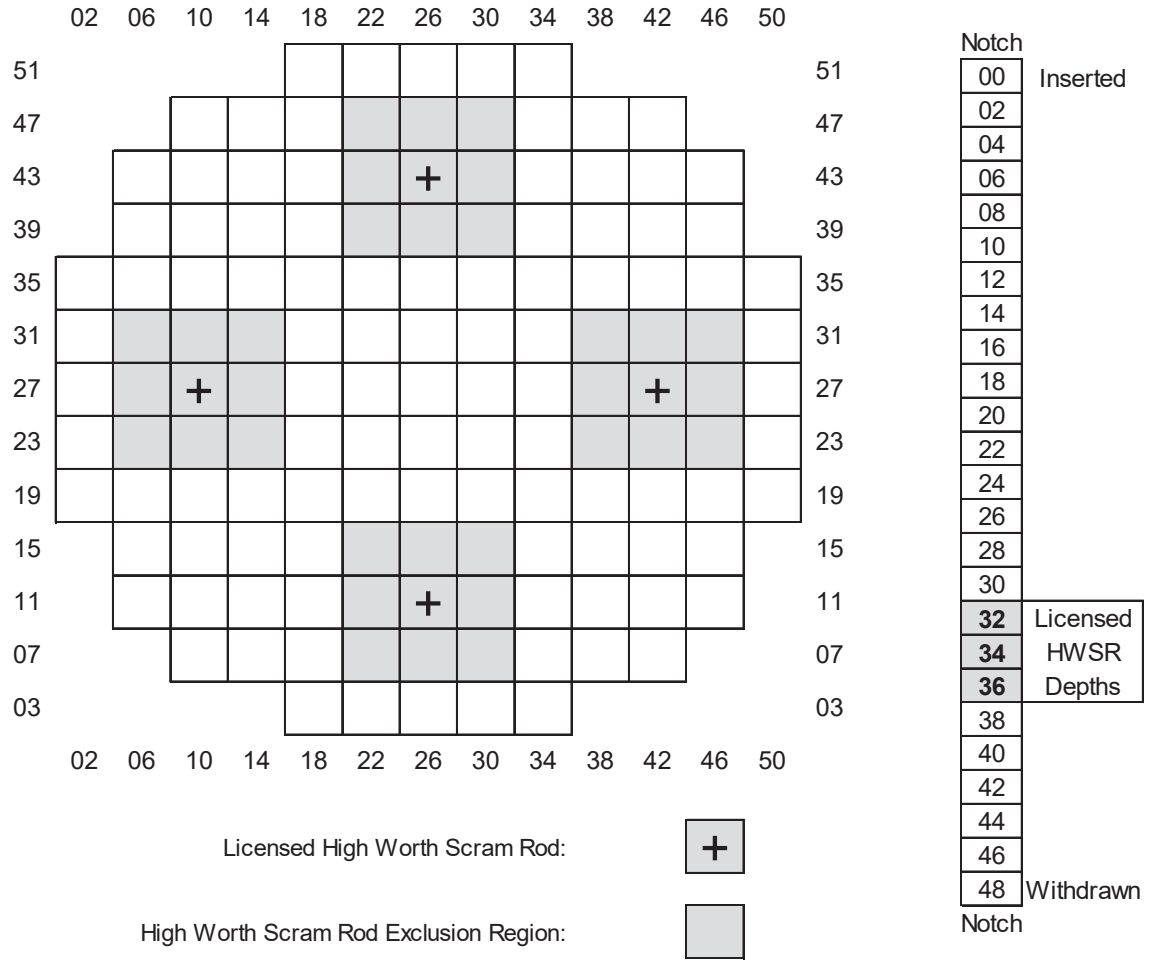


Licensed HWSR Coordinates (IX-JY)
14-15
14-39
38-15
38-39

Maximum High Worth Scram Rod Depth (Notch):	32
Minimum High Worth Scram Rod Depth (Notch):	36

FIGURE 3-5A

High Worth Scram Rod Set – A1 Configuration



Licensed HWSR Coordinates (IX-JY)
10-27
26-11
26-43
42-27

Maximum High Worth Scram Rod Depth (Notch):	32
Minimum High Worth Scram Rod Depth (Notch):	36

FIGURE 3-5B

High Worth Scram Rod Set – A2 Configuration

4.0 LHGR OPERATING LIMITS (Technical Specification 3.2.3)

The LHGR operating limit for each licensed equipment in or out of service operating flexibility option is independent of average scram time and is a function of fuel bundle type, fuel rod type, core power, core flow, and pellet exposure.

For both two loop operation (TLO) and single loop operation (SLO), the LHGR operating limit for each six inch axial segment of each fuel rod in the core is the applicable rated-power, rated-flow LHGR limit taken from Table 4-1 multiplied by the smaller of either:

a. The flow-dependent LHGR limit multiplier, $LHGRFAC_F$, as determined by Table 4-2,

   OR

b. The power-dependent LHGR limit multiplier, $LHGRFAC_P$, as determined by Figure 4-2.

Table 4-1 shows the exposure-dependent LHGR limits for all fuel types in the core as a function of initial gadolinia concentration in a six inch segment of a fuel rod. Figures 4-3A and 4-3B show the LHGR limits for both UO_2 fuel segments and for fuel segments with the highest initial Gd (Gd_2O_3) concentrations for the GNF2 and GNF3 fuel types, respectively.

These limits apply to operation with vessel dome pressure within +/- 10 psi of nominal pressure, as defined by the Region I pressure band shown in Figure 5-1. With Standard Equipment In Service, with the EOC-RPT System Inoperable, and/or with High Worth Scram Rods In Service, operation with vessel dome pressure down to 40 psi below nominal is licensed provided the additional restrictions identified in Section 5.0 are applied with the LHGR operating limit defined in this section.

TABLE 4-1

Rated-Power LHGR Limits versus Peak Pellet Exposure

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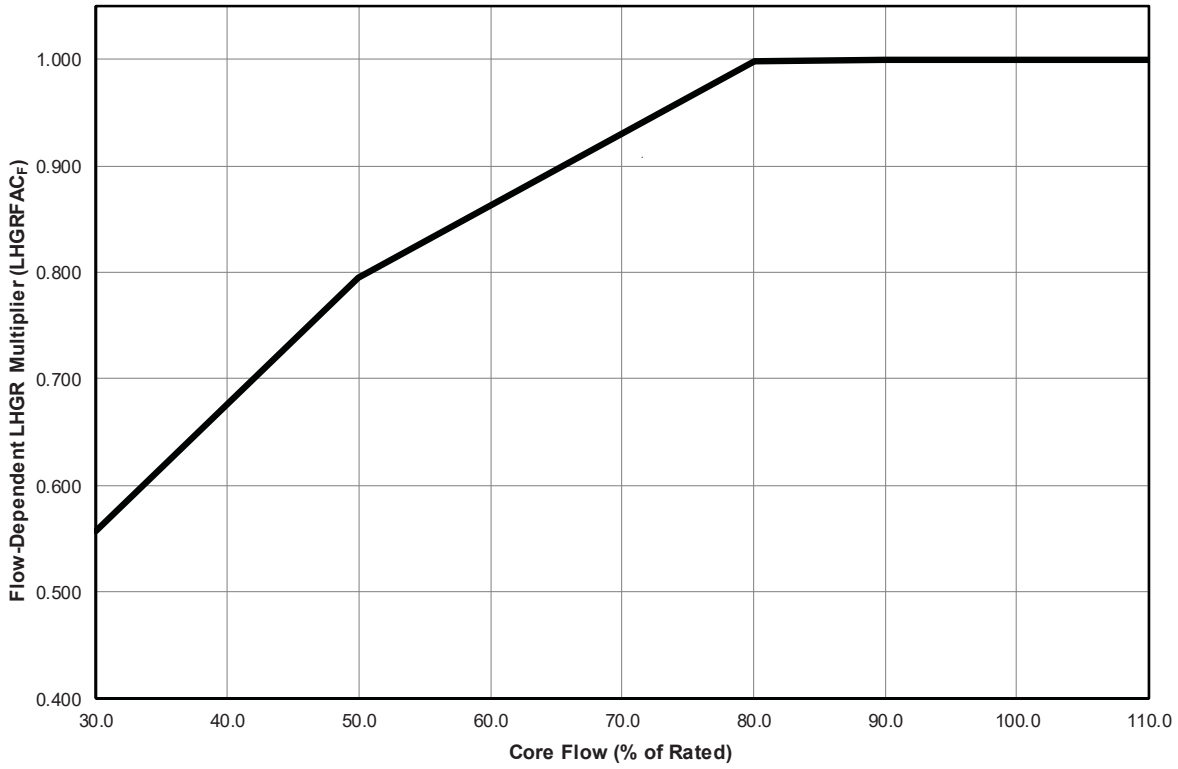
TABLE 4-2

Flow-Dependent LHGR Limit Multiplier ($LHGRFAC_F$) Operating Flexibility Options

Fuel Type	Equipment In/Out of Service				Figure #
	Main Turbine Bypass System Operable	***EOC-RPT System Operable***	***Main Turbine Pressure Regulator System Status***	***High Worth Scram Rods In Service***	
GNF2	Yes	Yes/No	TLCO 3.3.13.a or b	Yes/No	4-1A
			TLCO 3.3.13.c	N/A *	
	No		TLCO 3.3.13.a or b	Yes/No	4-1B
			TLCO 3.3.13.c	N/A *	
GNF3	Yes/No	Yes/No	TLCO 3.3.13.a or b	Yes/No	4-1C
			TLCO 3.3.13.c	N/A *	

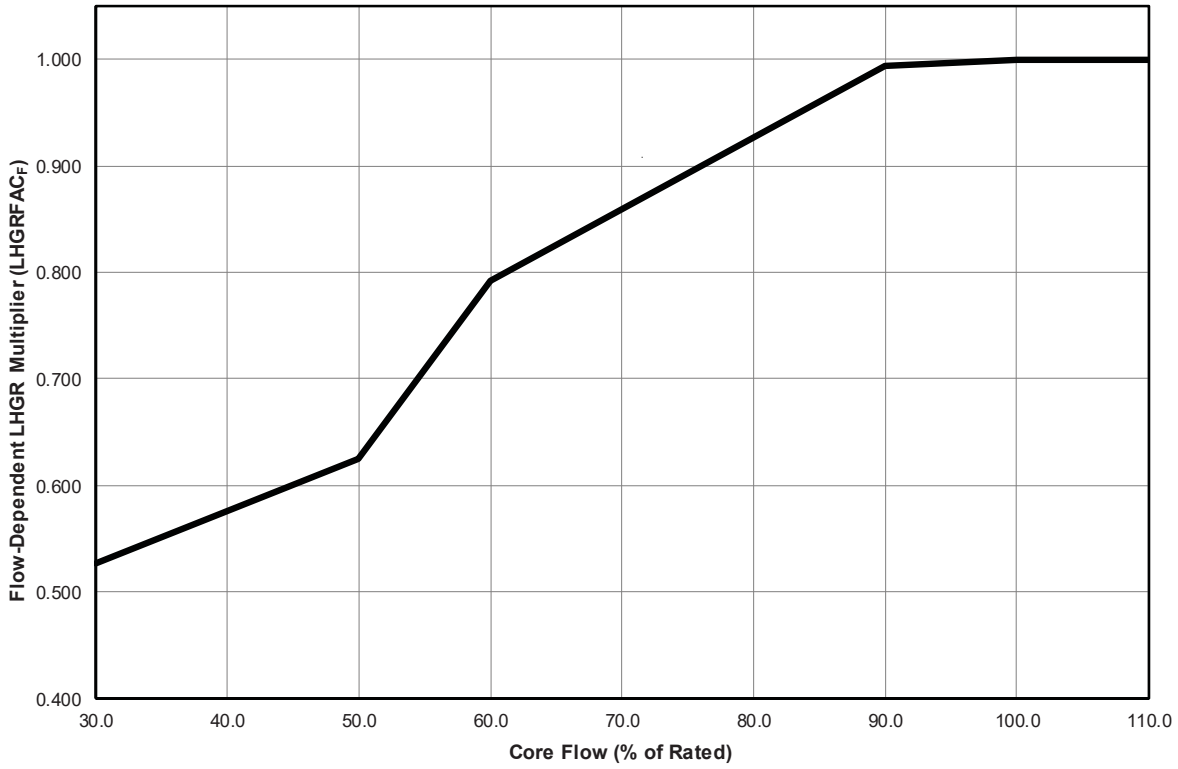
* The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b for High Worth Scram Rods to be considered In Service, as described in Table 1-3.



Flow (% of Rated)	LHGRFAC$_F$ (TLO/SLO)
30.0	0.557
50.0	0.795
80.0	0.998
90.0	1.000
110.0	1.000

FIGURE 4-1A

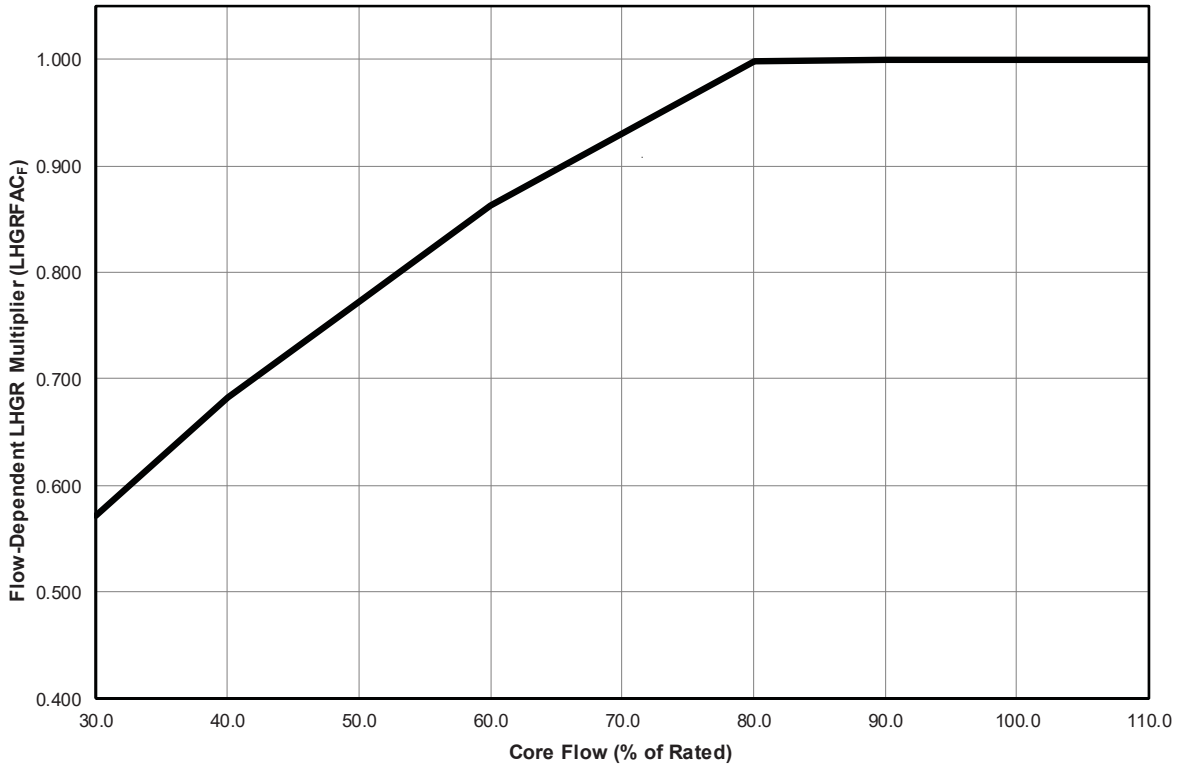
GNF2 Flow-Dependent LHGR Limit Multiplier (LHGRFAC$_F$) versus Core Flow



Flow (% of Rated)	LHGRFAC$_F$ (TLO/SLO)
30.0	0.527
50.0	0.625
60.0	0.792
90.0	0.993
100.0	1.000
110.0	1.000

FIGURE 4-1B

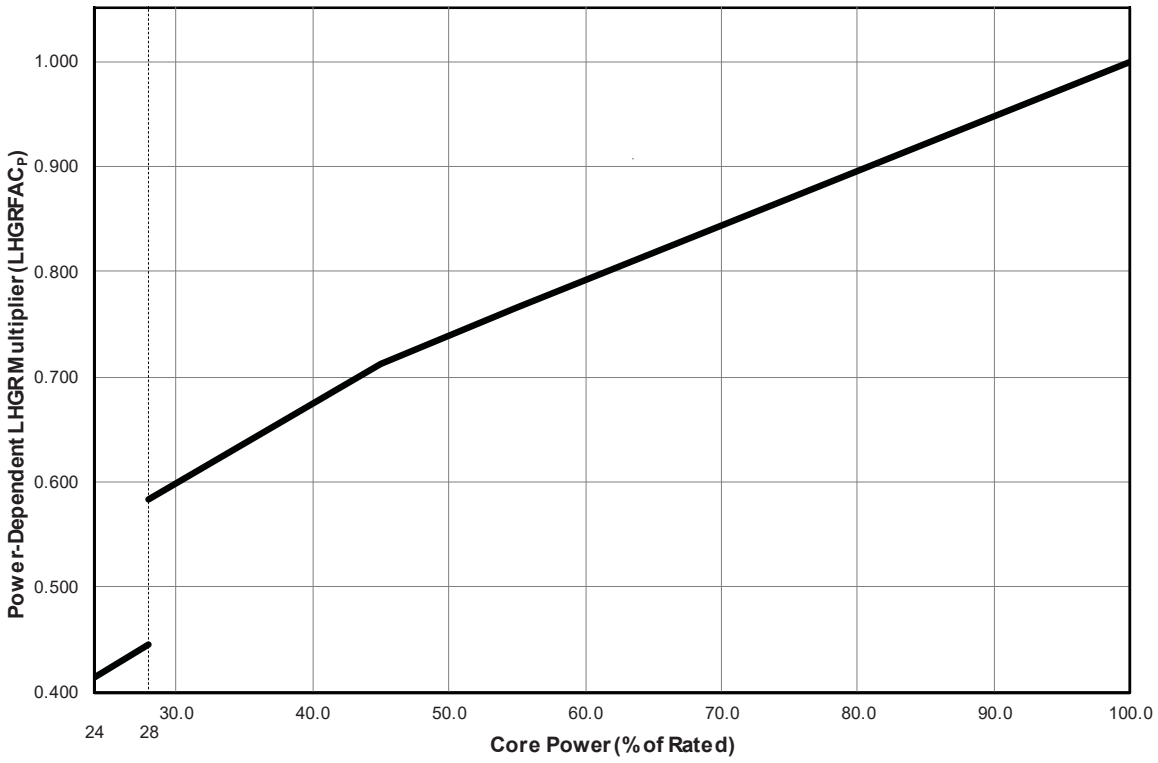
GNF2 Flow-Dependent LHGR Limit Multiplier (LHGRFAC$_F$) versus Core Flow
(Main Turbine Bypass System Inoperable)



Flow (% of Rated)	LHGRFAC$_F$ (TLO/SLO)
30.0	0.572
40.0	0.683
50.0	0.772
60.0	0.863
70.0	0.930
80.0	0.998
90.0	1.000
110.0	1.000

FIGURE 4-1C

GNF3 Flow-Dependent LHGR Limit Multiplier (LHGRFAC$_F$) versus Core Flow



Power (% of Rated)	LHGRFAC$_P$ (TLO/SLO)
24.0	0.415
≤ 28.0	0.445
> 28.0	0.583
45.0	0.713
55.0	0.765
85.0	0.922
100.0	1.000

FIGURE 4-2

GNF2 & GNF3 Power-Dependent LHGR Limit Multiplier (LHGRFAC$_P$) versus Core Power

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FIGURE 4-3A

GNF2 Rated-Power LHGR Limit versus Peak Pellet Exposure

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FIGURE 4-3B

GNF3 Rated-Power LHGR Limit versus Peak Pellet Exposure

5.0 OPERATING PRESSURE LIMITS

The operating limits presented within this report require that reactor dome pressure be maintained within the licensed pressure bands defined by Figure 5-1. For operation in each of these regions, the following pressure-dependent restrictions apply:

a. For Region I operation:

   The core operating limits from Sections 2.0 through 4.0 are applicable.

b. For Region II and Region III operation:

   1) The core operating limits from Sections 2.0 through 4.0 are applicable

      AND

   2) The MFLCPR and MFLPD thermal limit ratios must remain below the maximum values determined by Table 5-1.

These restrictions are independent of core power, core flow, cycle exposure, feedwater temperature, the number of operating recirculation loops, and average scram time.

The pressure-dependent MFLPD and MFLCPR limits defined in this section constitute redefinitions of the conditions for entry into Technical Specifications Required Action Statements 3.2.2 and 3.2.3. Thus, any additional applicable administrative limits beyond those discussed in this section must be applied in combination (via multiplication) so as to maintain margin to the COLR-based thermal limit ratio limits instead of margin to MFLCPR and/or MFLPD thermal limit ratio values of 1.000.

5.1 THERMAL LIMIT RATIO DEFINITIONS

The MFLCPR and MFLPD thermal limit ratios are defined in terms of the core operating limits defined in Section 3.0 and Section 4.0.

The MFLCPR thermal limit ratio is the most limiting (maximum) value of the Fraction of Limiting Critical Power Ratio (FLCPR) in the core. The FLCPR is defined for each fuel assembly in the core as:

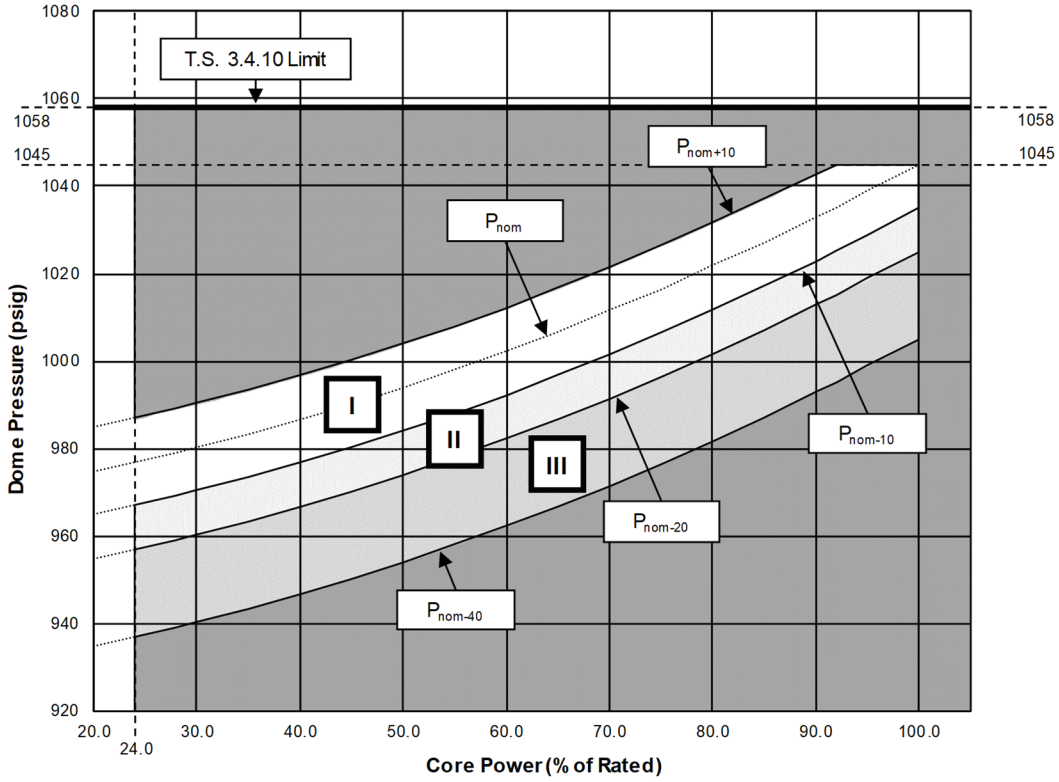
$$\text{FLCPR} = \frac{\text{MCPR}_{\text{Limit}}}{\text{Fuel Assembly Critical Power Ratio}}$$

where: $\text{MCPR}_{\text{Limit}}$ = MCPR operating limit defined in Section 3.0

The MFLPD thermal limit ratio is the most limiting (maximum) value of the Fraction of Limiting Power Density (FLPD) in the core. The FLPD is defined for each six inch axial segment of each fuel rod in the core as:

$$\text{FLPD} = \frac{\text{Peak kW/ft power generated in a fuel rod segment}}{\text{LHGR}_{\text{Limit}}}$$

where: $\text{LHGR}_{\text{Limit}}$ = LHGR operating limit defined in Section 4.0



$$P = A + 0.30 * CP + 0.0048 * CP^2$$

Dome Pressure Curves	Core Power	A
Nominal Dome Pressure (P_{nom})	**24 ≤ CP ≤ 100**	**967**
Region I Upper Boundary (P_{nom+10})	24 ≤ CP ≤ 100	977
Region I Lower Boundary (P_{nom-10})	24 ≤ CP ≤ 100	957
Region II Lower Boundary (P_{nom-20})	24 ≤ CP ≤ 100	947
Region III Lower Boundary (P_{nom-40})	24 ≤ CP ≤ 100	927

CP = Percent of Rated Core Power

P = Reactor Dome Pressure (psig)

FIGURE 5-1

Licensed Regions of Operating Dome Pressure versus Core Power

TABLE 5-1

Pressure-Dependent Operating Flexibility Options

Equipment In/Out of Service				Table #
Main Turbine Bypass System Operable	***EOC-RPT System Operable***	***Main Turbine Pressure Regulator System Status***	***High Worth Scram Rods In Service***	
Yes	Yes/No	TLCO 3.3.13.a or b	Yes/No	5-2
No	Yes/No	TLCO 3.3.13.a or b	Yes/No	Reduced-Pressure Flexibility Option Not Licensed
Yes/No	Yes/No	TLCO 3.3.13.c	N/A *	

* The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b for High Worth Scram Rods to be considered In Service, as described in Table 1-3.

TABLE 5-2

MFLCPR and MFLPD Limits versus Operating Pressure Regions

Operating Pressure Region	Max Allowable Thermal Limit Ratio	
	MFLCPR Limit	***MFLPD Limit***
I	1.000	1.000
II	0.977	0.985
III	0.954	0.912

6.0 REFERENCES

1. Global Nuclear Fuel Report NEDE-24011-P-A-31, "*General Electric Standard Application for Reactor Fuel (GESTAR II)*," November 2020, and the US Supplement, NEDE-24011-P-A-31-US, November 2020.

2. Global Nuclear Fuel Report NEDC-33270P, "*GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)*," Revision 11, August 2020.

3. Global Nuclear Fuel Report NEDC-33879P, "*GNF3 Generic Compliance with NEDE-24011-P-A (GESTAR II)*," Revision 4, August 2020.

4. Southern Nuclear Operating Company Report NFD-H-21-220, "*Hatch-1 Cycle 31 Reload Licensing Analysis Report*," Version 1, December 2021.

5. Global Nuclear Fuel Report 006N0332, "*Supplemental Reload Licensing Report for Hatch 1 Reload 30 Cycle 31*," Revision 0, November 2021.

6. Global Nuclear Fuel Report 006N0333, "*Fuel Bundle Information Report for Hatch 1 Reload 30 Cycle 31*," Revision 0, November 2021.

7. Global Nuclear Fuel Report 004N5426, "*Technical Evaluation to Support Introduction of GNF FeCrAl (ATF) Unfueled Lead Test Rods (LTRs) in Four (4) GNF2 Reload Assemblies at Hatch Nuclear Plant, Unit 1,*" Revision 0, November 2017.

8. Global Nuclear Fuel Report 005N4842, "*Application of ARMOR and IronClad LTA Technical Evaluations to Hatch 1, Beyond Cycle 29*," Revision 0, November 2019.