

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.

February 19, 2021

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U. S. Nuclear Regulatory Commission
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Edwin I. Hatch Nuclear Plant – Unit 2
Cycle 27 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 2 Cycle 27.

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 Jamie Coleman at 205.992.6611.

Respectfully submitted,



Cheryl A. Gayheart
Regulatory Affairs Director

CAG/tle/cbg

- Enclosures: 1. HNP Unit 2 Cycle 27 Core Operating Limits Report Version 1
PROPRIETARY INFORMATION and Global Nuclear Fuel – Americas Affidavit
2. HNP Unit 2 Cycle 27 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 2
Cycle 27 Core Operating Limits Report Version 1

Enclosure 2

HNP Unit 2 Cycle 27 Core Operating Limits Report Version 1
NON-PROPRIETARY INFORMATION

Non-Proprietary Information
**SOUTHERN NUCLEAR OPERATING COMPANY
EDWIN I. HATCH NUCLEAR PLANT**

**Unit 2 Cycle 27
CORE OPERATING LIMITS REPORT**

Version 1

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1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 2 Cycle 27 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 includes GNF2, GNF3 Lead Test Assembly (LTA), and GNF3 fuel types (References 2 through 4). Results from the associated reload analyses for the fuel in Unit 2 Cycle 27 are documented in References 5 through 7.

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 which 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, configuration of the high pressure feedwater heaters, 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
Feedwater Heaters	For any 4 th stage feedwater heater configuration off-normal, High Pressure Feedwater Heaters Out of Service limits must be applied (unless the standard LFWH analysis is demonstrated to remain applicable by BWR Fuel Engineering)
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: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Core power must be \leq 2000 MWth • Core flow must be \leq 55% of rated
Main Turbine Bypass System Inoperable <u>OR</u> Main Turbine Pressure Regulator System in TLCO 3.3.13.c <u>OR</u> High Pressure Feedwater Heaters Out of Service	Dome pressure must be within +/- 10 psi of nominal, as defined in Figure 5-1
High Pressure Feedwater Heaters Out of Service and Main Turbine Pressure Regulator System in TLCO 3.3.13.c simultaneously	No core operating limits available (Technical Specifications RAS 3.2.2 and 3.2.3 must be entered)
High Worth Scram Rods In Service	<ul style="list-style-type: none"> • 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 <u>NOT</u> 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 - 5000 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 & GNF3 LTA 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

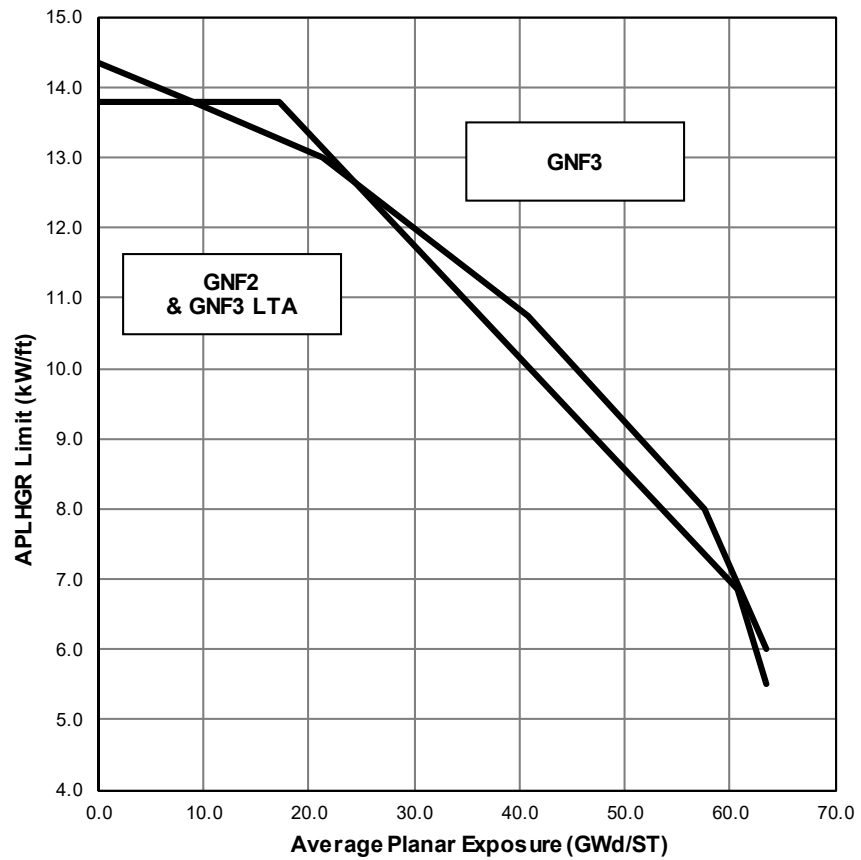


FIGURE 2-1

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 combination 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 $24\% \leq \text{core power} \leq 28\%$, 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. Individual credited HWSRs must meet the equipment requirements defined in Table 1-2 to be considered valid for thermal operating limit credit. Operating conditions which credit HWSRs provide MCPR operating limit improvements in the MOC2-EOC exposure interval relative to limits which do not credit HWSRs.

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 corresponds to 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:

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

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

$$\tau_B = \mu + 1.65 * \sigma * \left[\frac{N_1}{\sum_{i=1}^n N_i} \right]^{\frac{1}{2}}$$

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

$\sigma = 0.018$ sec (standard deviation of μ).

$N_1 =$ 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.

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

where: $\tau_i =$ 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:

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

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
1.07	1.09

TABLE 3-2

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

Equipment In/Out of Service					Figure #
<u>Main Turbine Bypass System Operable</u>	<u>EOC-RPT System Operable</u>	<u>Main Turbine Pressure Regulator System Status</u>	<u>High Pressure Feedwater Heaters In Service</u>	<u>High Worth Scram Rods In Service</u>	
Yes	Yes/No	TLCO 3.3.13.a or b	Yes/No	Yes/No	3-2A
		TLCO 3.3.13.c	Yes	No	
No	Yes/No	TLCO 3.3.13.a or b	Yes/No	Yes/No	3-2B
		TLCO 3.3.13.c	Yes	No	
Yes/No	Yes/No	TLCO 3.3.13.c	Yes	Yes	Non-HWSR Limits Apply *
			No	Yes/No	Not Licensed

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

Equipment In/Out of Service					Figure #
<u>Main Turbine Bypass System Operable</u>	<u>EOC-RPT System Operable</u>	<u>Main Turbine Pressure Regulator System Status</u>	<u>High Pressure Feedwater Heaters In Service</u>	<u>High Worth Scram Rods In Service</u>	
Yes/No	Yes/No	TLCO 3.3.13.a or b	Yes/No	Yes/No	3-3A
		TLCO 3.3.13.c	Yes	No	3-3B
				Yes	Non-HWSR Limits Apply *
			No	Yes/No	Not Licensed

* 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.

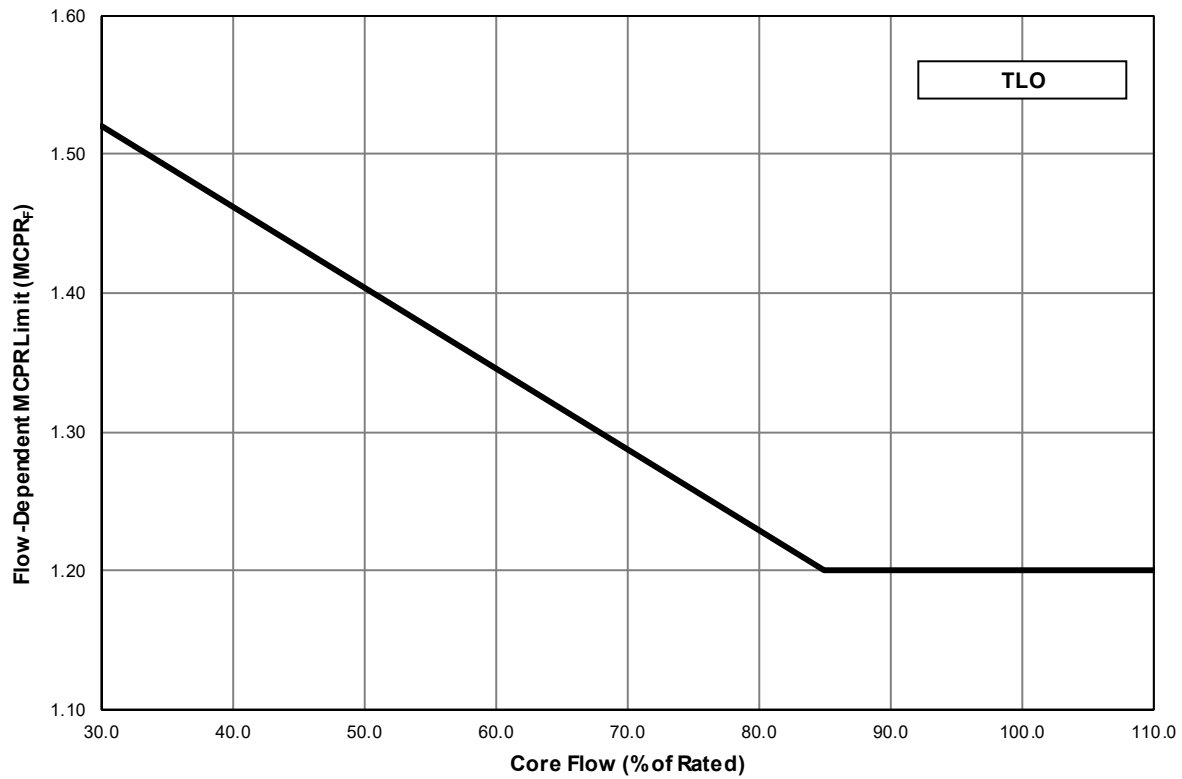
TABLE 3-4
Rated-Power OLMCPR Operating Flexibility Options

Equipment In/Out of Service		Figure #	
		<u>TLO</u>	<u>SLO</u>
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	<u>AND</u> 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	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 <u>AND</u> EOC-RPT System Inoperable	3-4A-4	3-4B-4
High Pressure Feedwater Heaters Out of Service		3-4A-1	3-4B-1
High Pressure Feedwater Heaters Out of Service	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 <u>AND</u> EOC-RPT System Inoperable	3-4A-4	3-4B-4

TABLE 3-4 (continued)

Rated-Power OLMCPR Operating Flexibility Options

Equipment In/Out of Service		Figure #	
		<u>TLO</u>	<u>SLO</u>
High Worth Scram Rods In Service		3-4A-5	3-4B-5
High Worth Scram Rods In Service	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 <u>AND</u> EOC-RPT System Inoperable	3-4A-8	3-4B-8
High Worth Scram Rods In Service <u>AND</u> High Pressure Feedwater Heaters Out of Service		3-4A-5	3-4B-5
High Worth Scram Rods In Service <u>AND</u> High Pressure Feedwater Heaters Out of Service	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 <u>AND</u> EOC-RPT System Inoperable	3-4A-8	3-4B-8

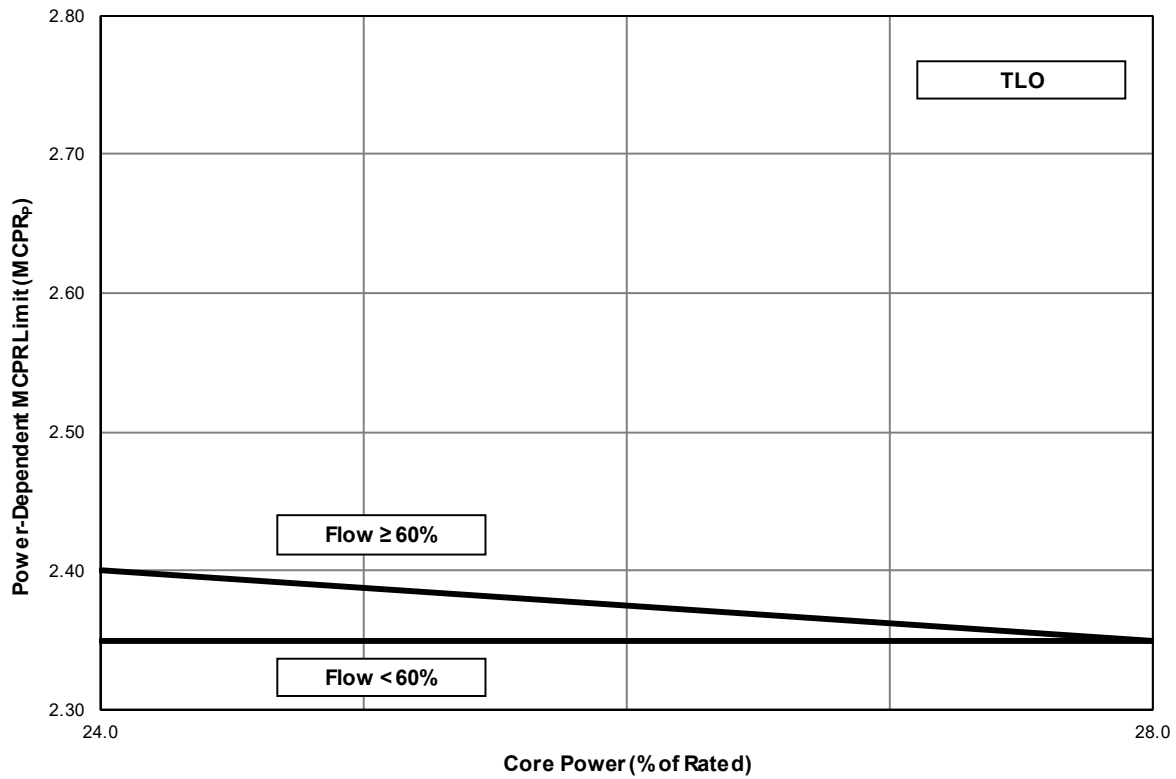


Flow (% of Rated)	MCPR _F (TLO)
30.0	1.52
85.0	1.20
110.0	1.20

$$\text{MCPR}_F(\text{SLO}) = \text{MCPR}_F(\text{TLO}) + 0.03$$

FIGURE 3-1

Flow-Dependent MCPR Limit (MCPR_F) versus Core Flow

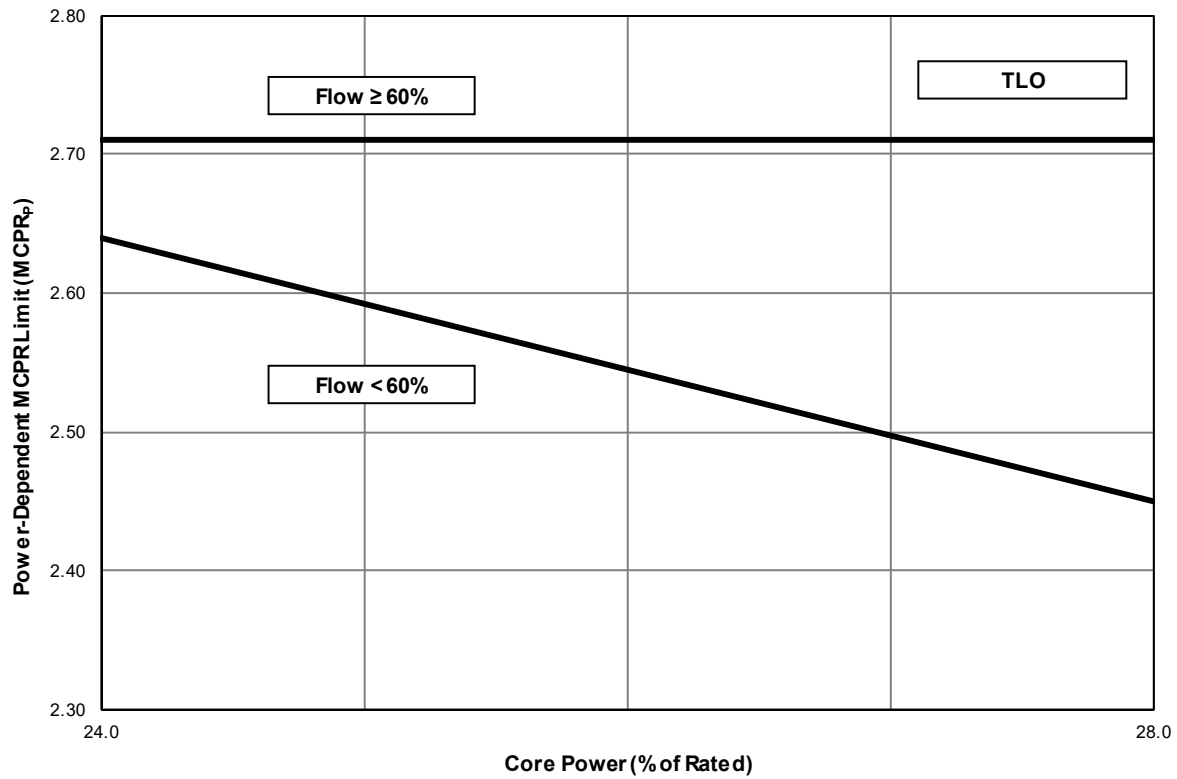


Flow (% of Rated)	Power (% of Rated)	MCPR _p (TLO)
≥ 60.0	24.0	2.40
	≤ 28.0	2.35
< 60.0	24.0	2.35
	≤ 28.0	2.35

$$\text{MCPR}_p(\text{SLO}) = \text{MCPR}_p(\text{TLO}) + 0.03$$

FIGURE 3-2A

Power-Dependent MCPR Limit (MCPR_p) versus Core Power

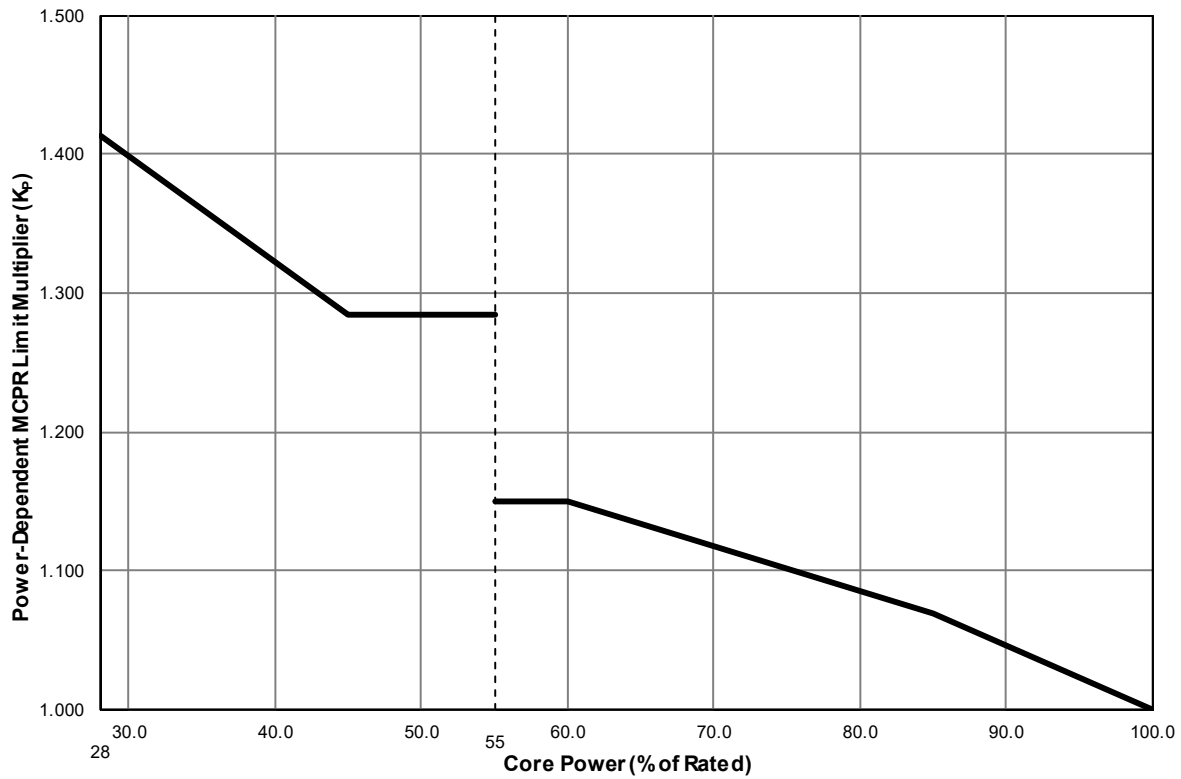


Flow (% of Rated)	Power (% of Rated)	MCPR _p (TLO)
≥ 60.0	24.0	2.71
	≤ 28.0	2.71
< 60.0	24.0	2.64
	≤ 28.0	2.45

$$\text{MCPR}_p(\text{SLO}) = \text{MCPR}_p(\text{TLO}) + 0.03$$

FIGURE 3-2B

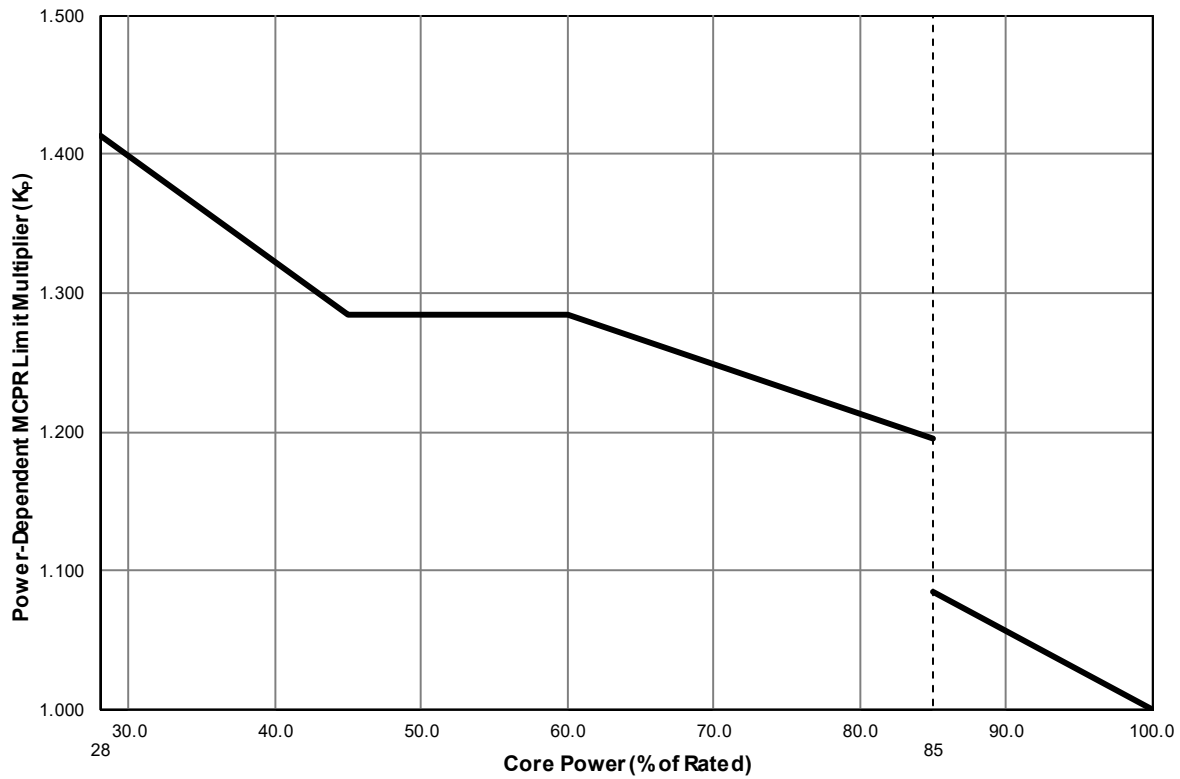
Power-Dependent MCPR Limit (MCPR_p) versus Core Power
(Main Turbine Bypass System Inoperable)



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

FIGURE 3-3A

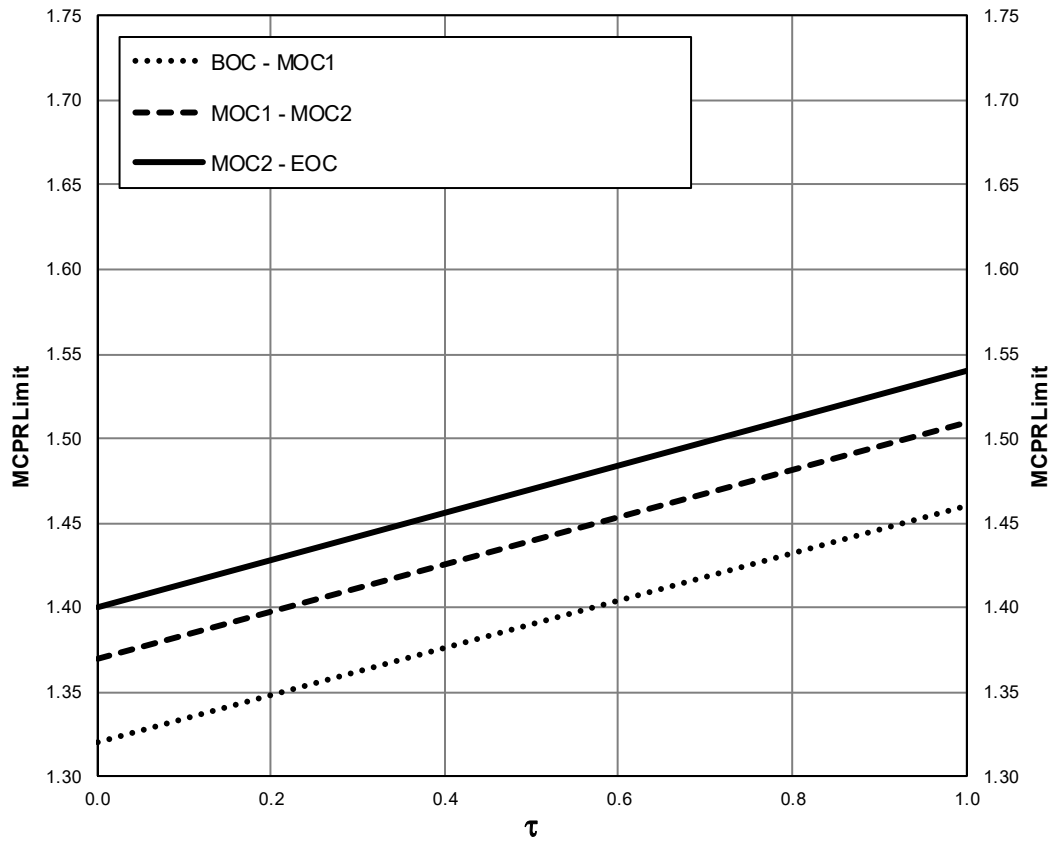
Power-Dependent MCPRLimit Multiplier (K_p) versus Core Power



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

FIGURE 3-3B

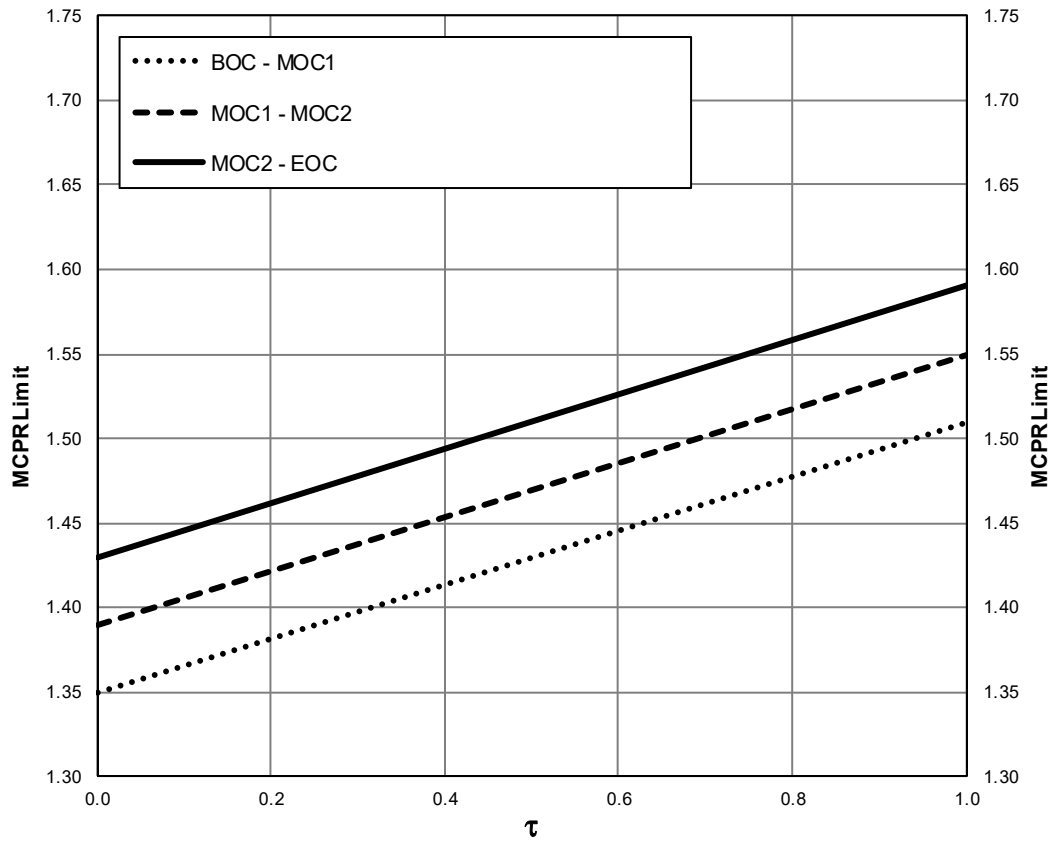
Power-Dependent MCPRLimit Multiplier (K_P) versus Core Power
(Main Turbine Pressure Regulator System in TLCO 3.3.13.c)



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.32	1.46
MOC1 - MOC2	1.37	1.51
MOC2 - EOC	1.40	1.54

FIGURE 3-4A-1

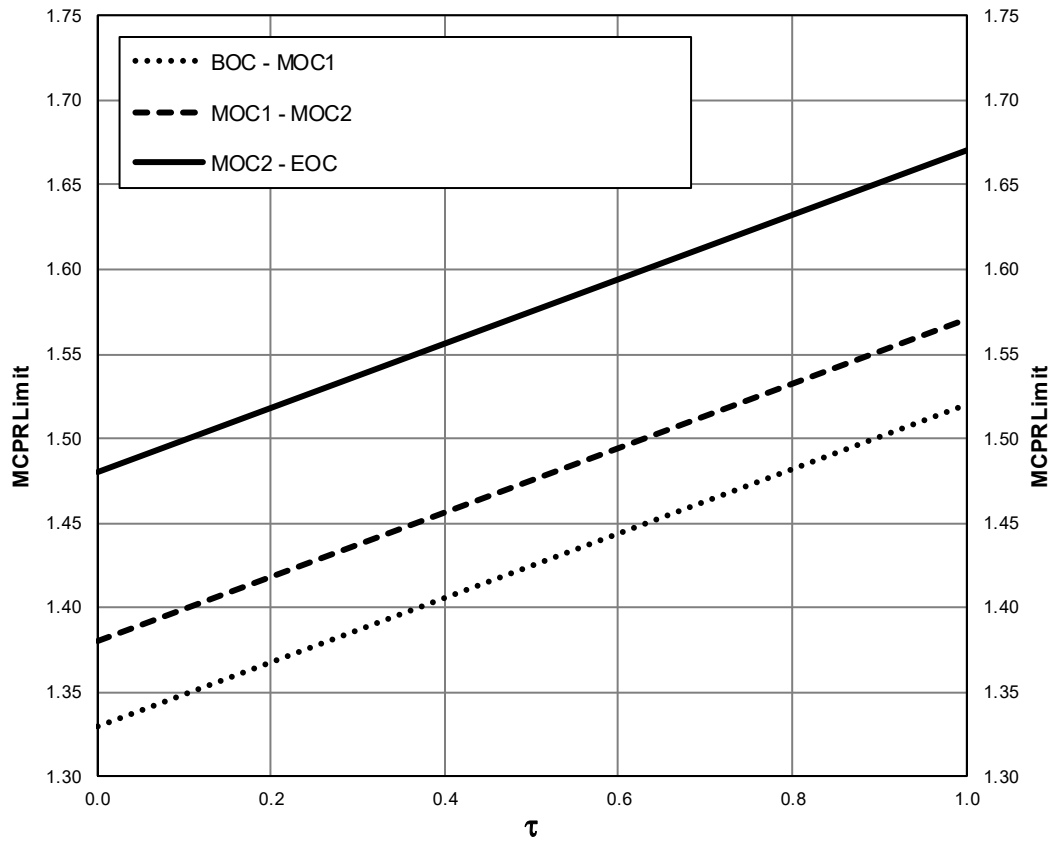
Rated-Power TLO MCPRLimits versus Average SCRAM Time



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.35	1.51
MOC1 - MOC2	1.39	1.55
MOC2 - EOC	1.43	1.59

FIGURE 3-4A-2

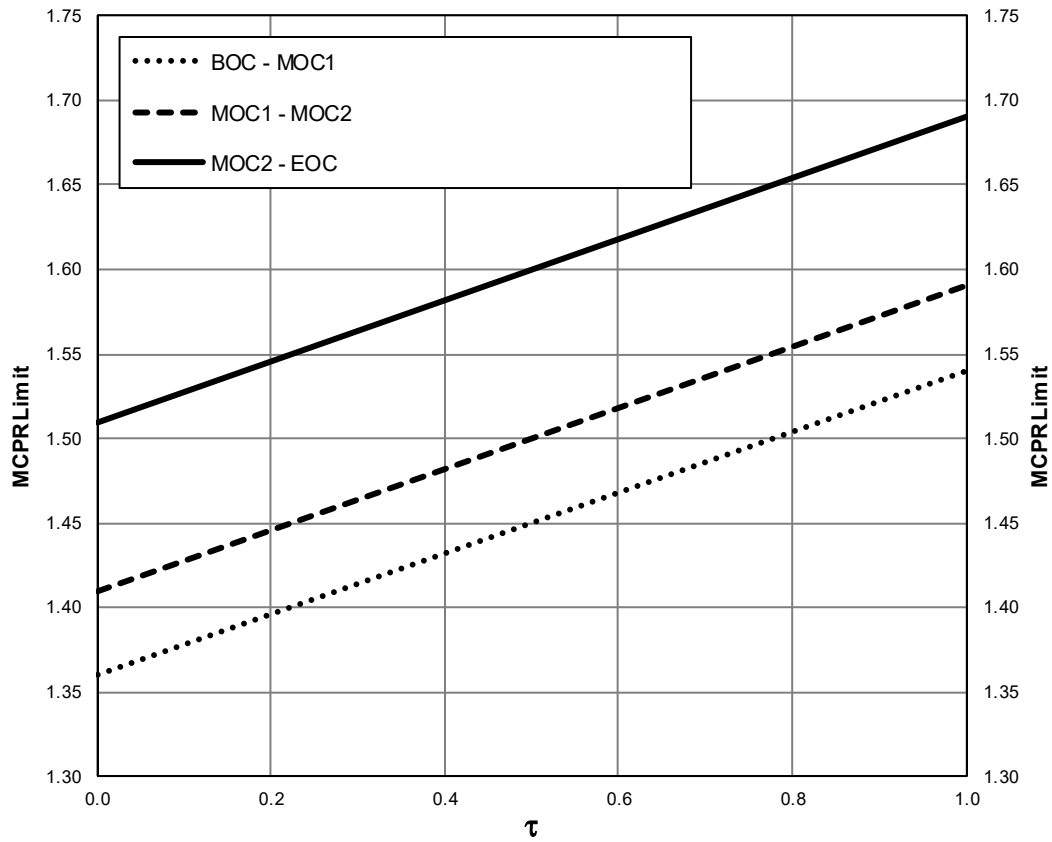
**Rated-Power TLO MCPRLimits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable)**



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.33	1.52
MOC1 - MOC2	1.38	1.57
MOC2 - EOC	1.48	1.67

FIGURE 3-4A-3

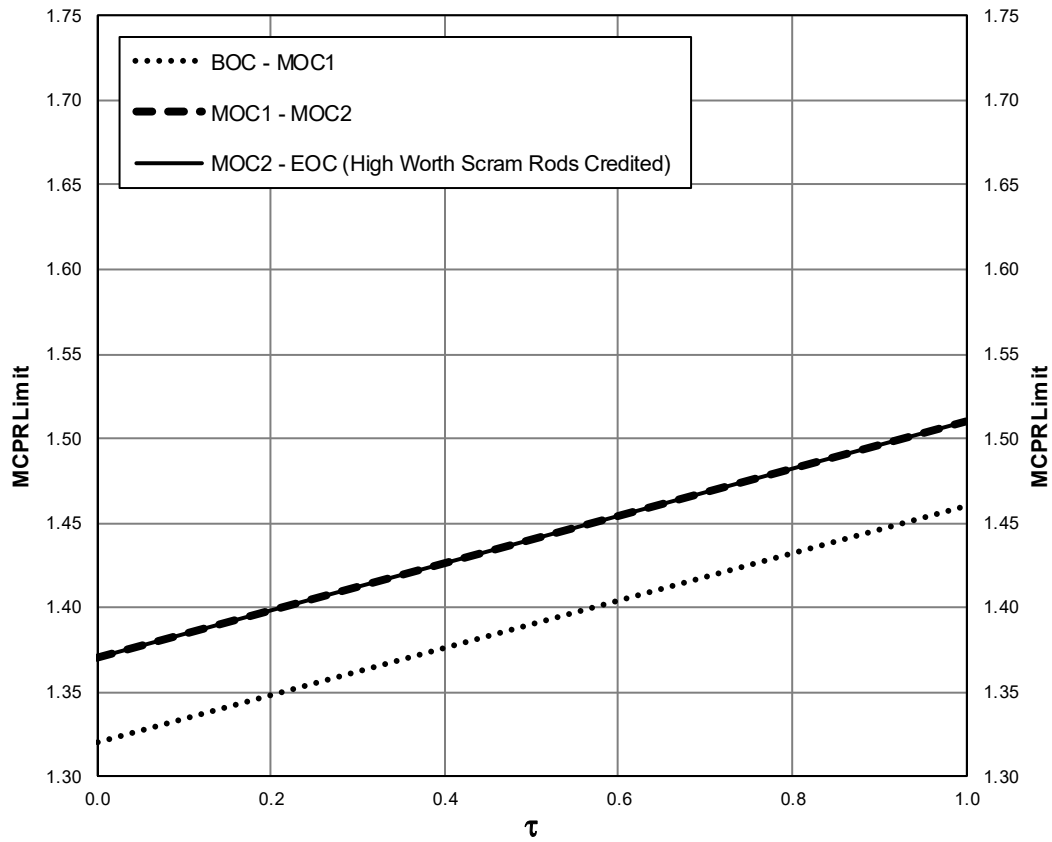
Rated-Power TLO MCPRLimits versus Average SCRAM Time
(EOC-RPT System Inoperable)



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.36	1.54
MOC1 - MOC2	1.41	1.59
MOC2 - EOC	1.51	1.69

FIGURE 3-4A-4

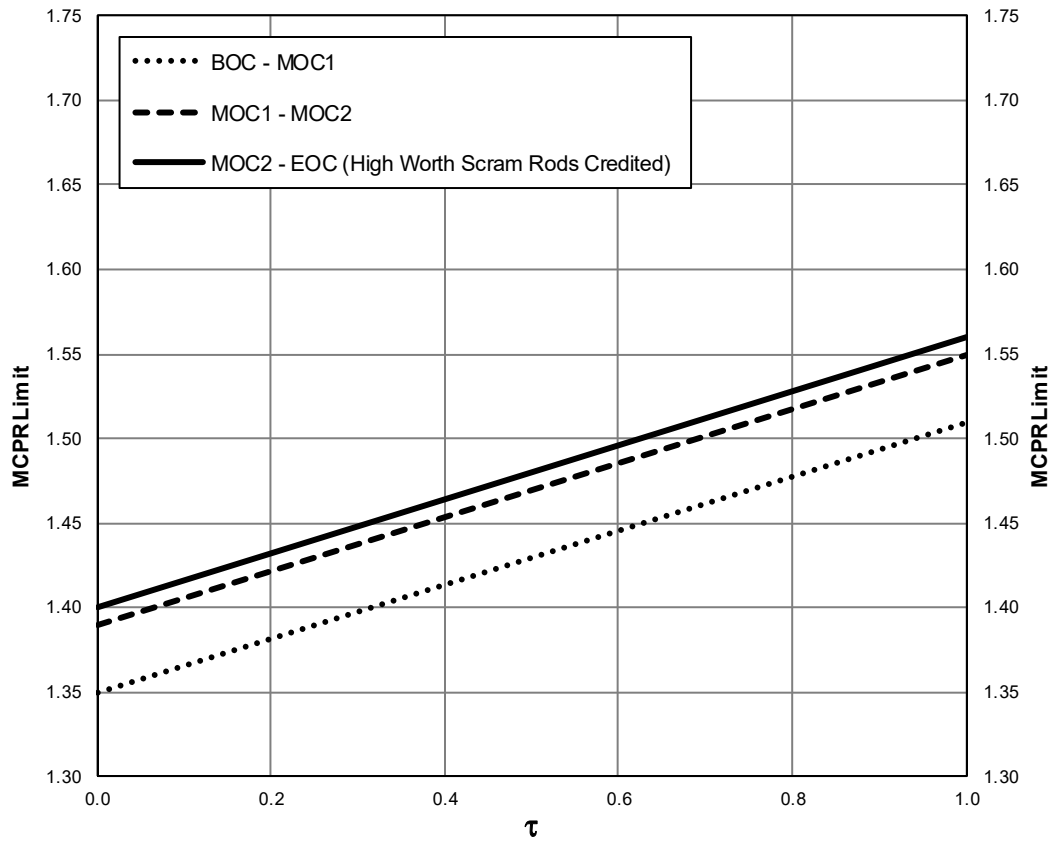
**Rated-Power TLO MCPRLimits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable
& EOC-RPT System Inoperable)**



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.32	1.46
MOC1 - MOC2	1.37	1.51
MOC2 - EOC	1.37	1.51

FIGURE 3-4A-5

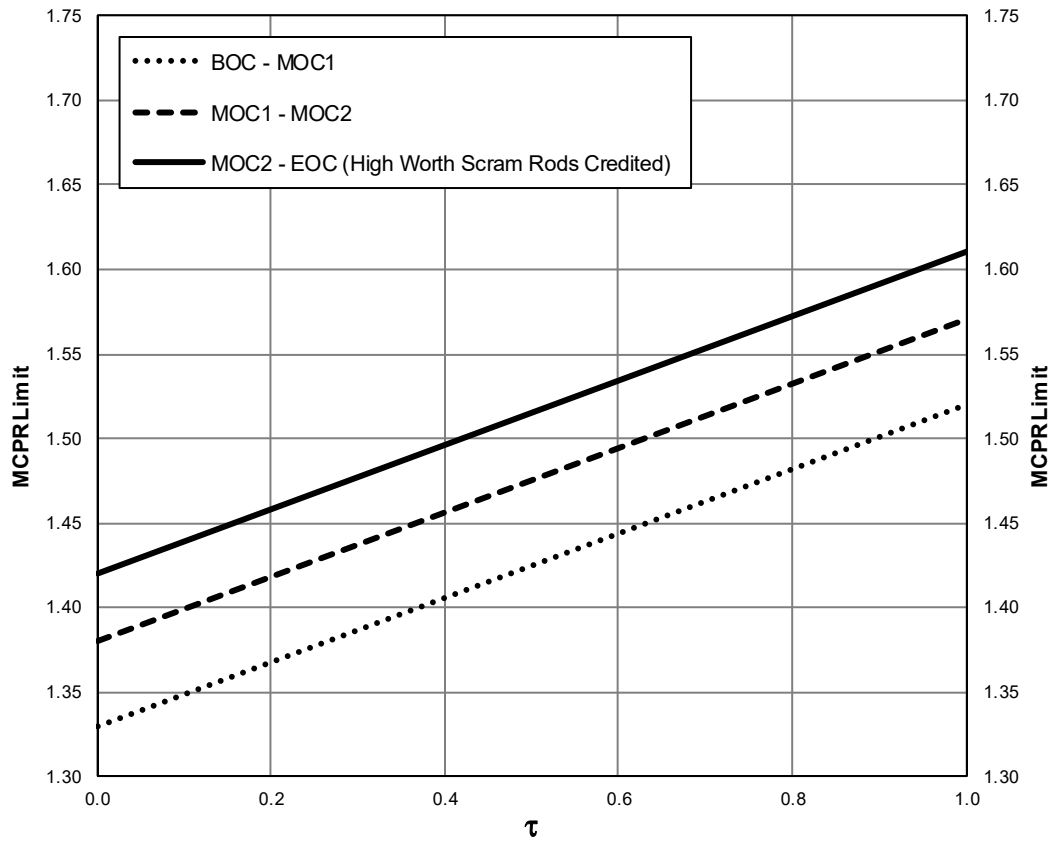
**Rated-Power TLO MCPRLimits versus Average SCRAM Time
(High Worth Scram Rods In Service)**



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.35	1.51
MOC1 - MOC2	1.39	1.55
MOC2 - EOC	1.40	1.56

FIGURE 3-4A-6

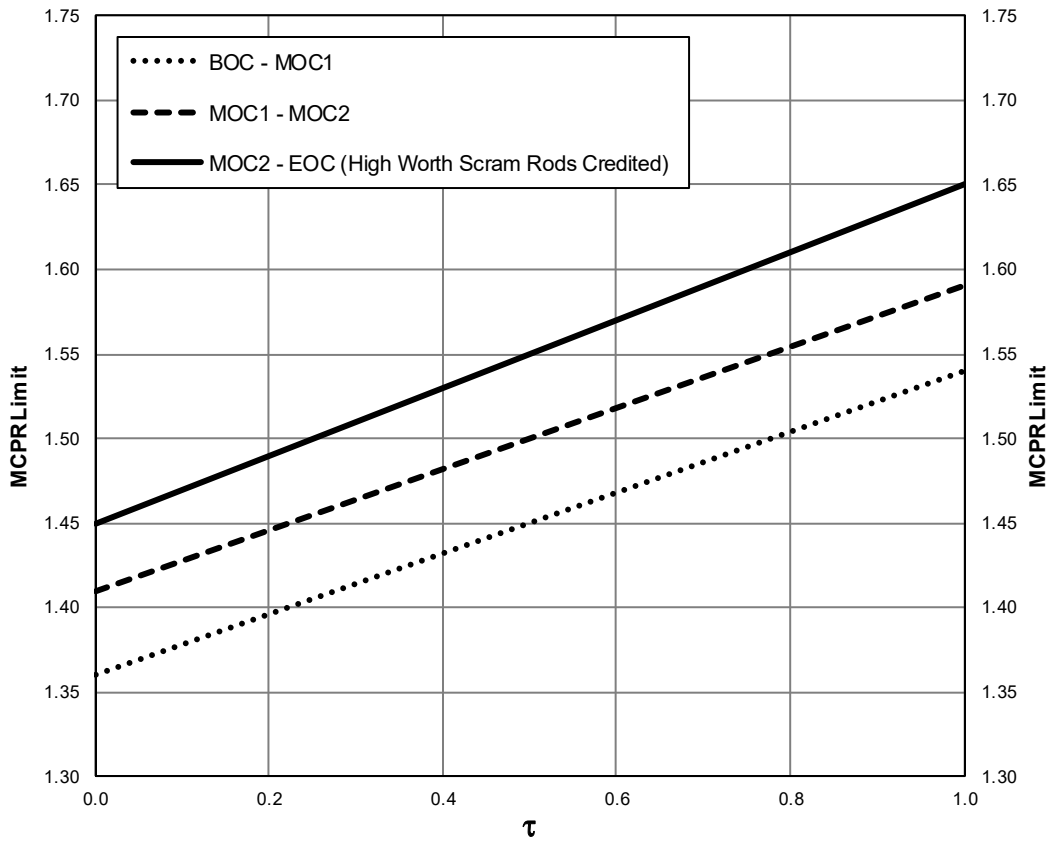
**Rated-Power TLO MCPRLimits versus Average SCRAM Time
(High Worth Scram Rods In Service
& Main Turbine Bypass System Inoperable)**



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.33	1.52
MOC1 - MOC2	1.38	1.57
MOC2 - EOC	1.42	1.61

FIGURE 3-4A-7

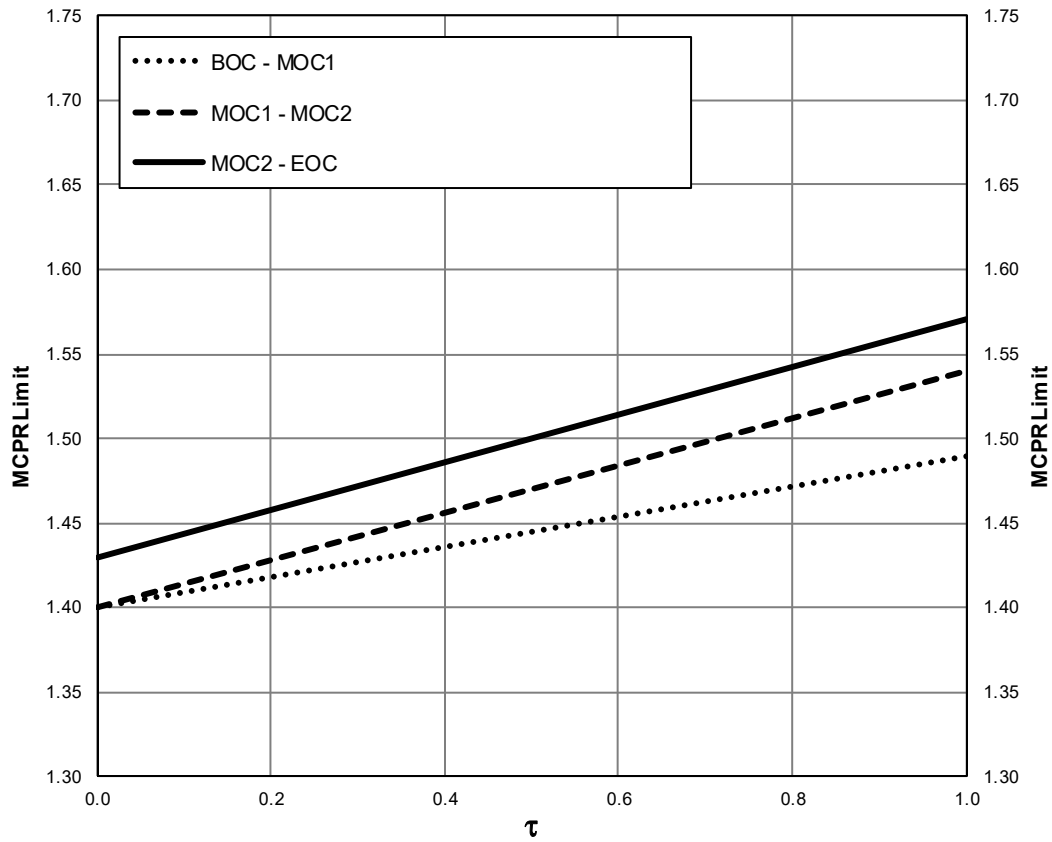
Rated-Power TLO MCPRLimits versus Average SCRAM Time
*(High Worth Scram Rods In Service
& EOC-RPT System Inoperable)*



Exposure Range	Rated OLMCPR _(TLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.36	1.54
MOC1 - MOC2	1.41	1.59
MOC2 - EOC	1.45	1.65

FIGURE 3-4A-8

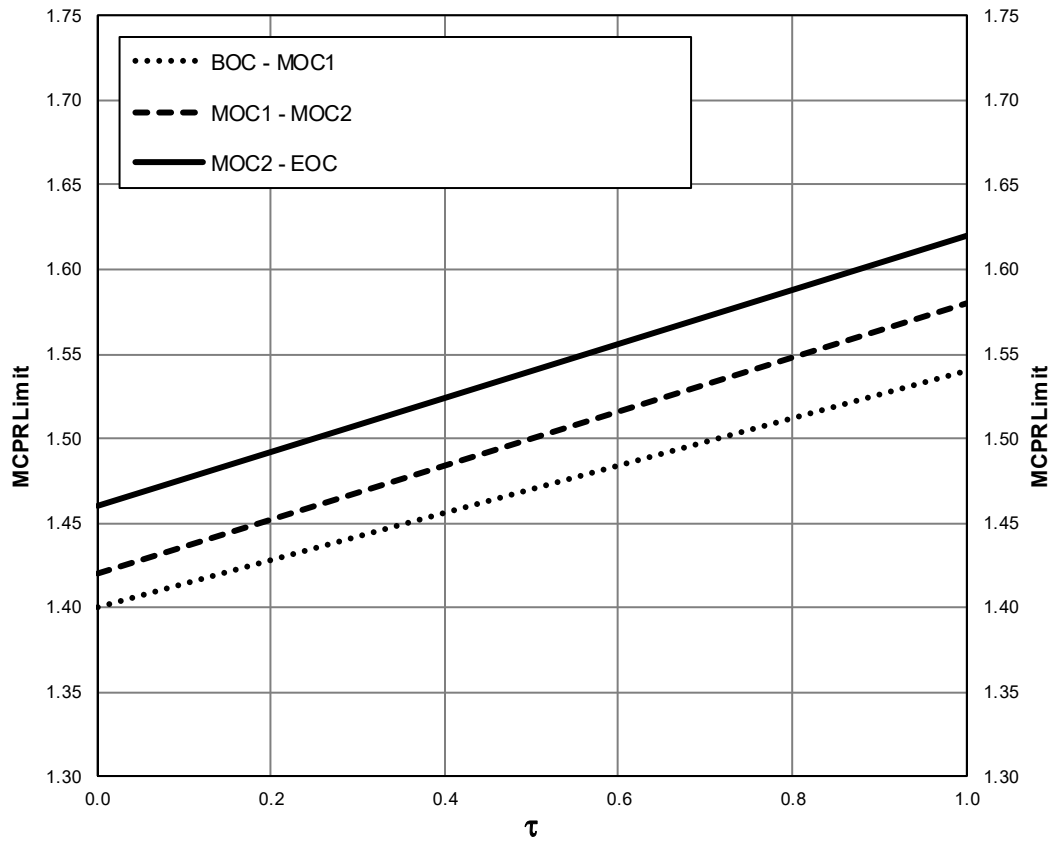
Rated-Power TLO MCPRLimits versus Average SCRAM Time
*(High Worth Scram Rods In Service
 & Main Turbine Bypass System Inoperable
 & EOC-RPT System Inoperable)*



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.49
MOC1 - MOC2	1.40	1.54
MOC2 - EOC	1.43	1.57

FIGURE 3-4B-1

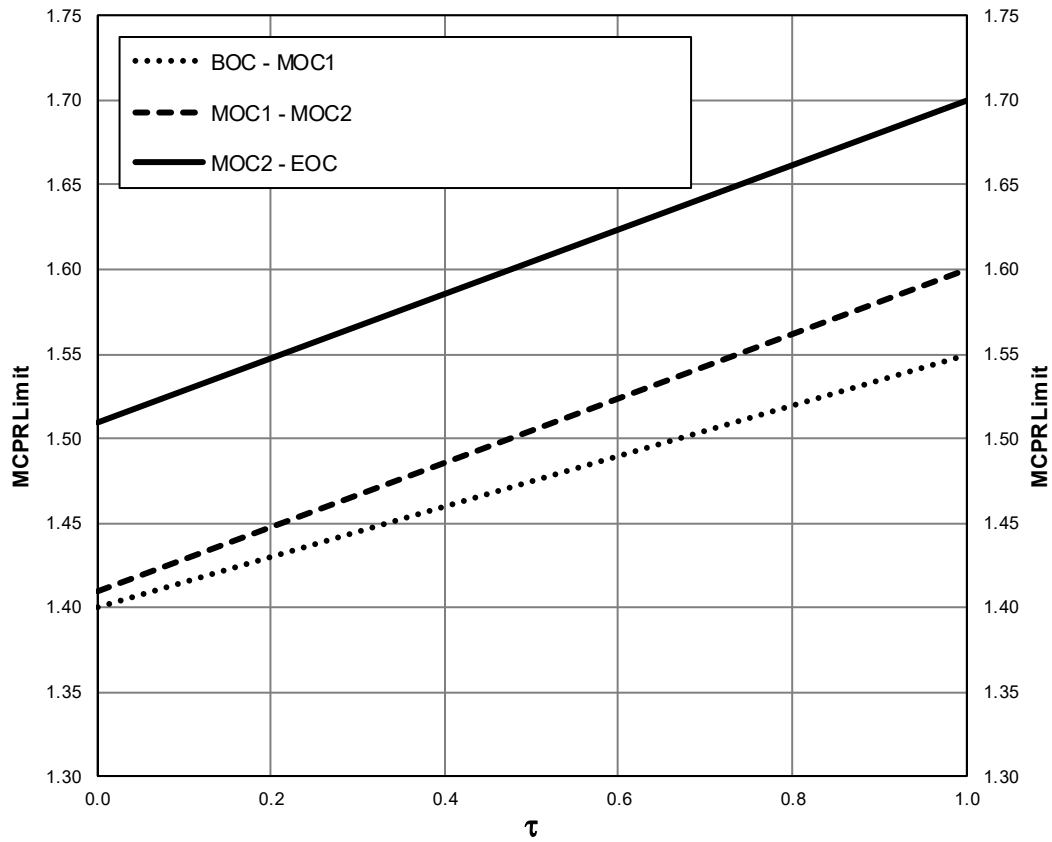
Rated-Power SLO MCPRLimits versus Average SCRAM Time



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.54
MOC1 - MOC2	1.42	1.58
MOC2 - EOC	1.46	1.62

FIGURE 3-4B-2

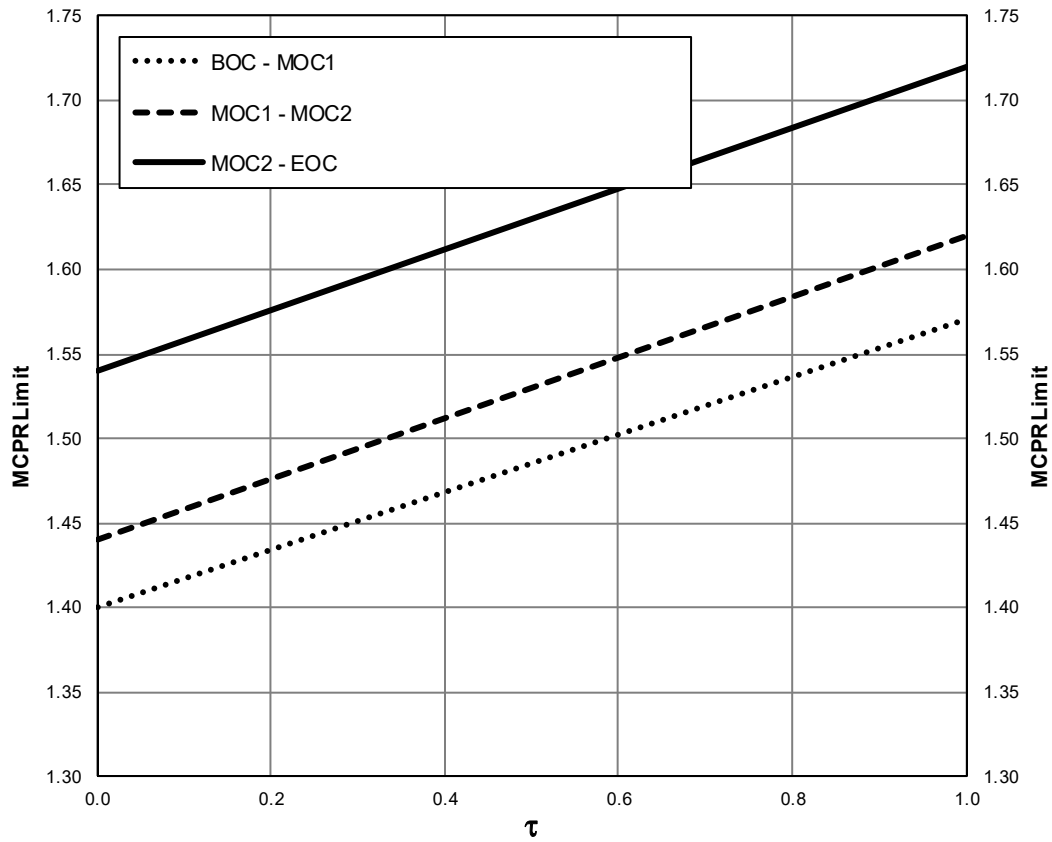
**Rated-Power SLO MCPRLimits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable)**



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.55
MOC1 - MOC2	1.41	1.60
MOC2 - EOC	1.51	1.70

FIGURE 3-4B-3

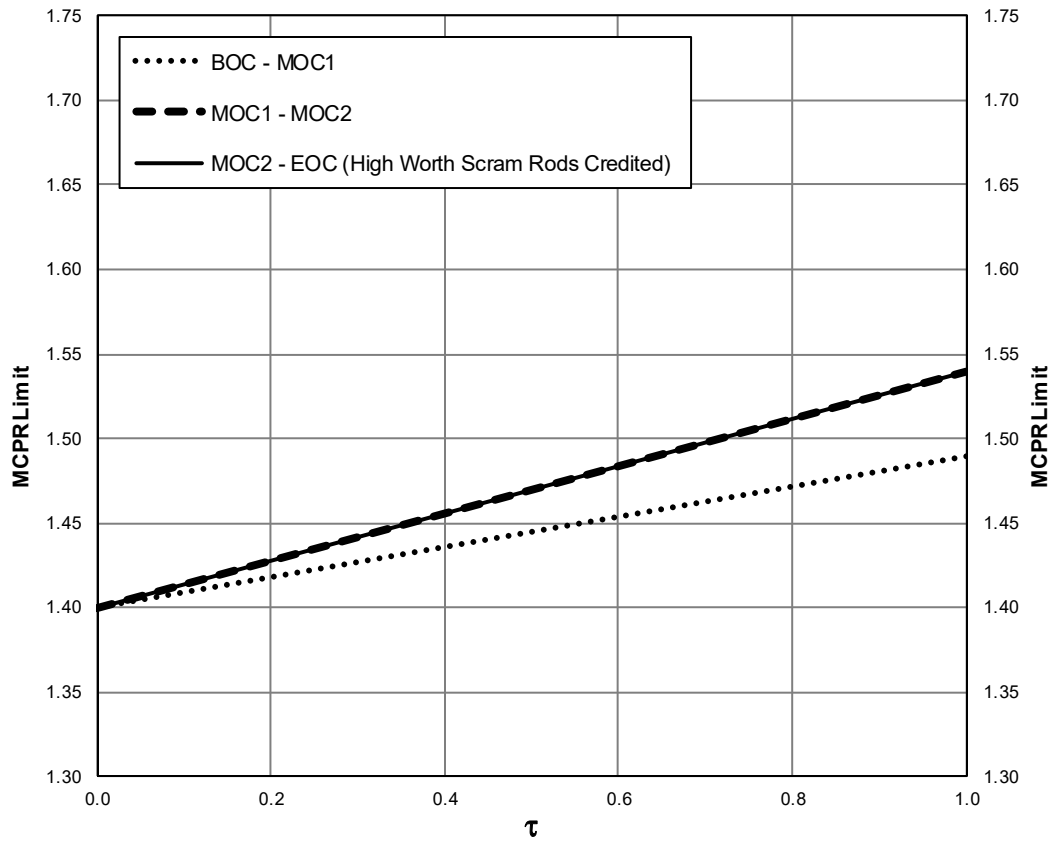
**Rated-Power SLO MCPRLimits versus Average SCRAM Time
(EOC-RPT System Inoperable)**



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.57
MOC1 - MOC2	1.44	1.62
MOC2 - EOC	1.54	1.72

FIGURE 3-4B-4

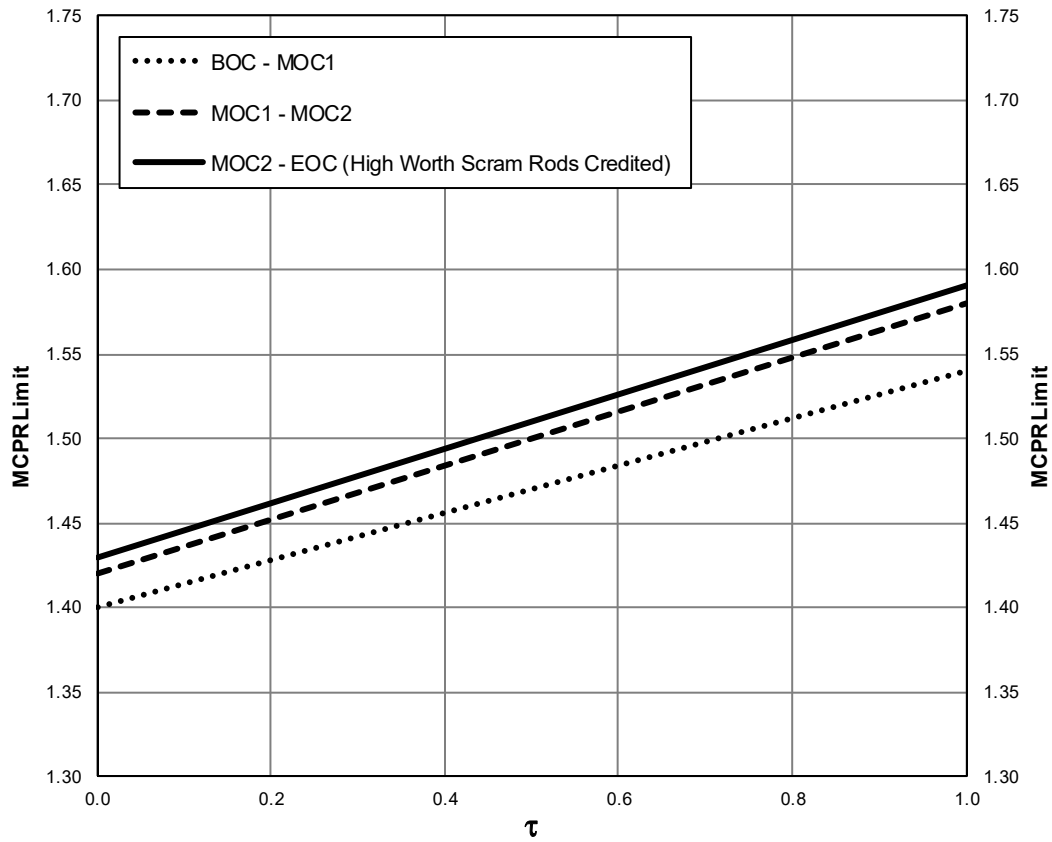
**Rated-Power SLO MCPRLimits versus Average SCRAM Time
(Main Turbine Bypass System Inoperable
& EOC-RPT System Inoperable)**



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.49
MOC1 - MOC2	1.40	1.54
MOC2 - EOC	1.40	1.54

FIGURE 3-4B-5

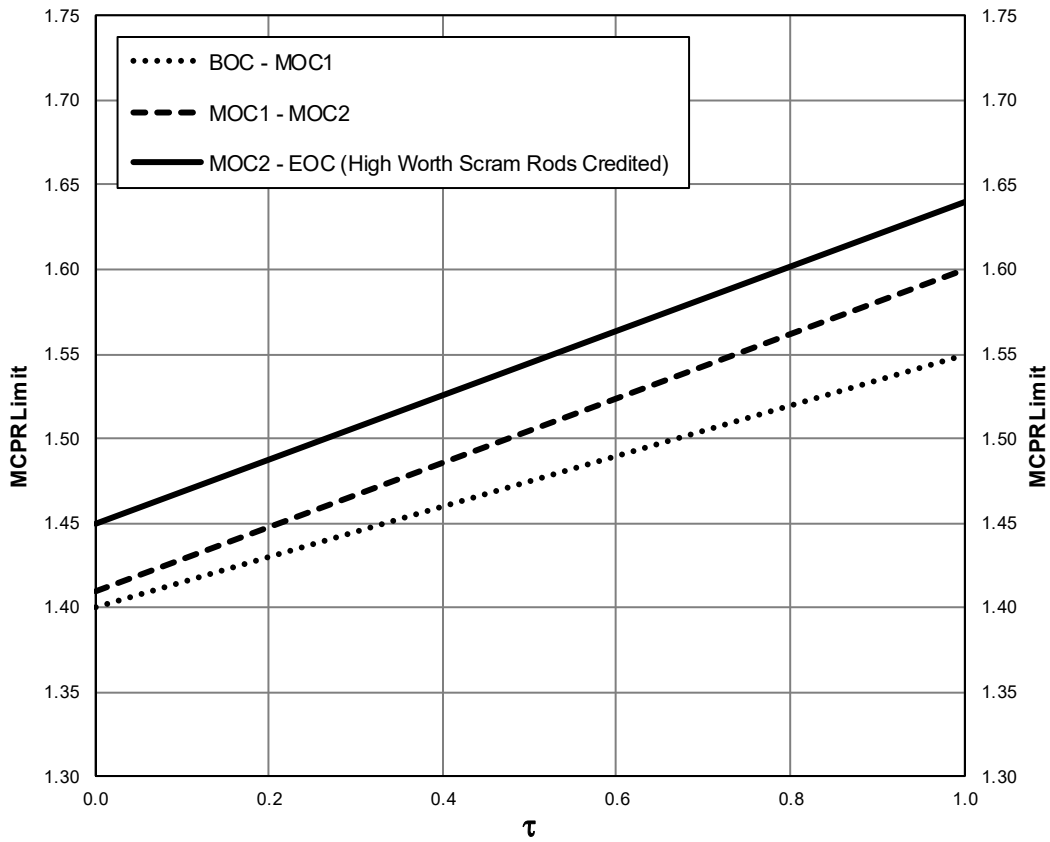
**Rated-Power SLO MCPRLimits versus Average SCRAM Time
(High Worth Scram Rods In Service)**



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.54
MOC1 - MOC2	1.42	1.58
MOC2 - EOC	1.43	1.59

FIGURE 3-4B-6

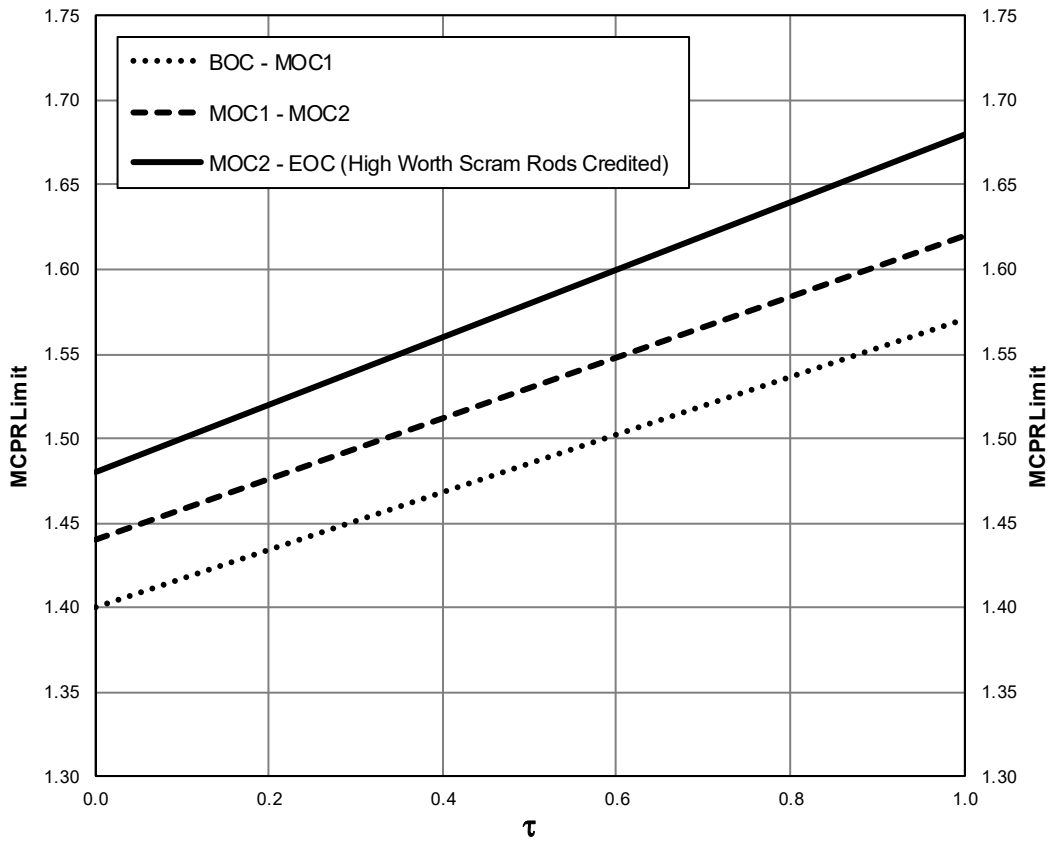
**Rated-Power SLO MCPRLimits versus Average SCRAM Time
(High Worth Scram Rods In Service
& Main Turbine Bypass System Inoperable)**



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.55
MOC1 - MOC2	1.41	1.60
MOC2 - EOC	1.45	1.64

FIGURE 3-4B-7

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



Exposure Range	Rated OLMCPR _(SLO)	
	$\tau = 0.0$	$\tau = 1.0$
BOC - MOC1	1.40	1.57
MOC1 - MOC2	1.44	1.62
MOC2 - EOC	1.48	1.68

FIGURE 3-4B-8

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

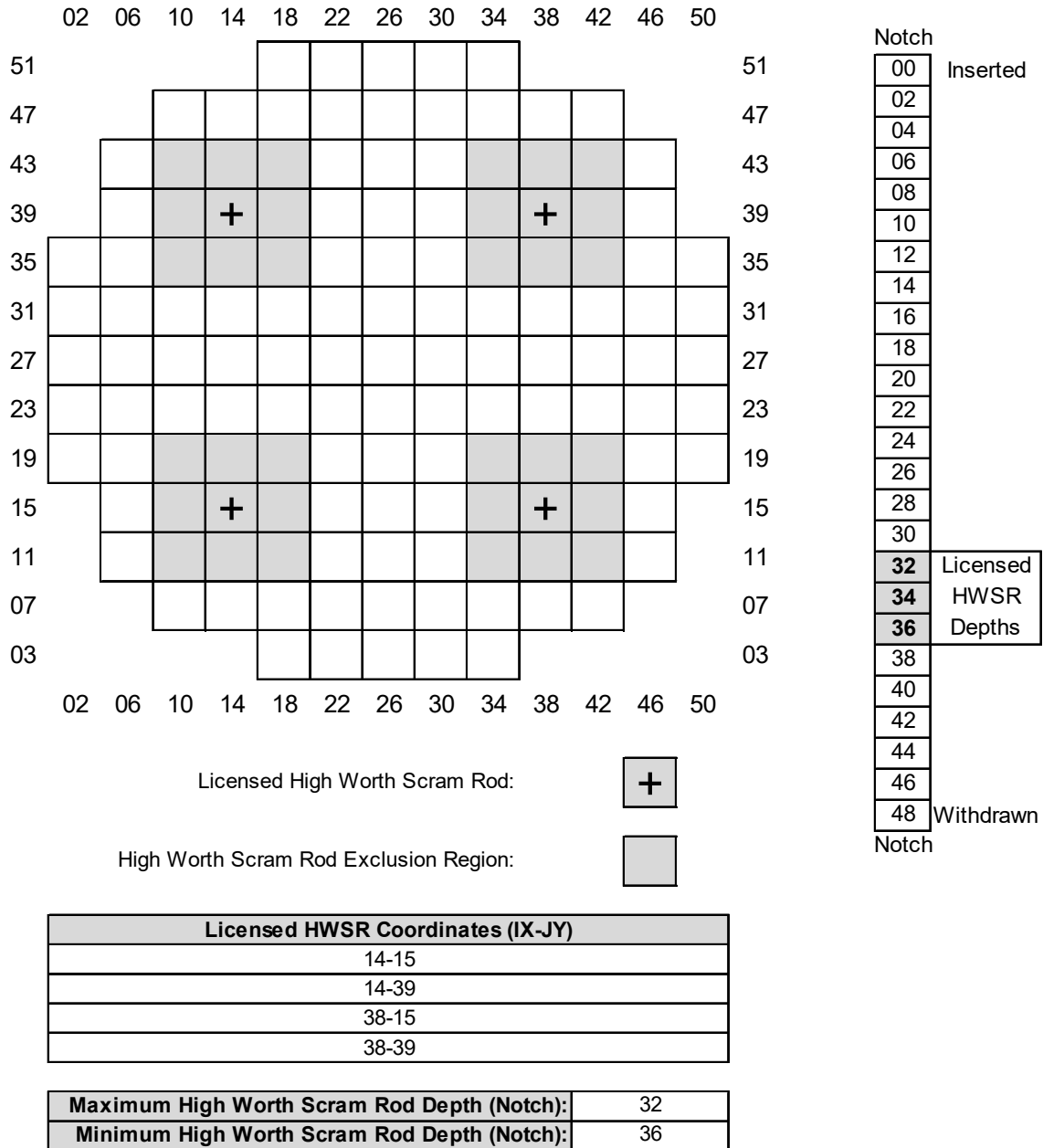


FIGURE 3-5A

High Worth Scram Rod Set – A1 Configuration

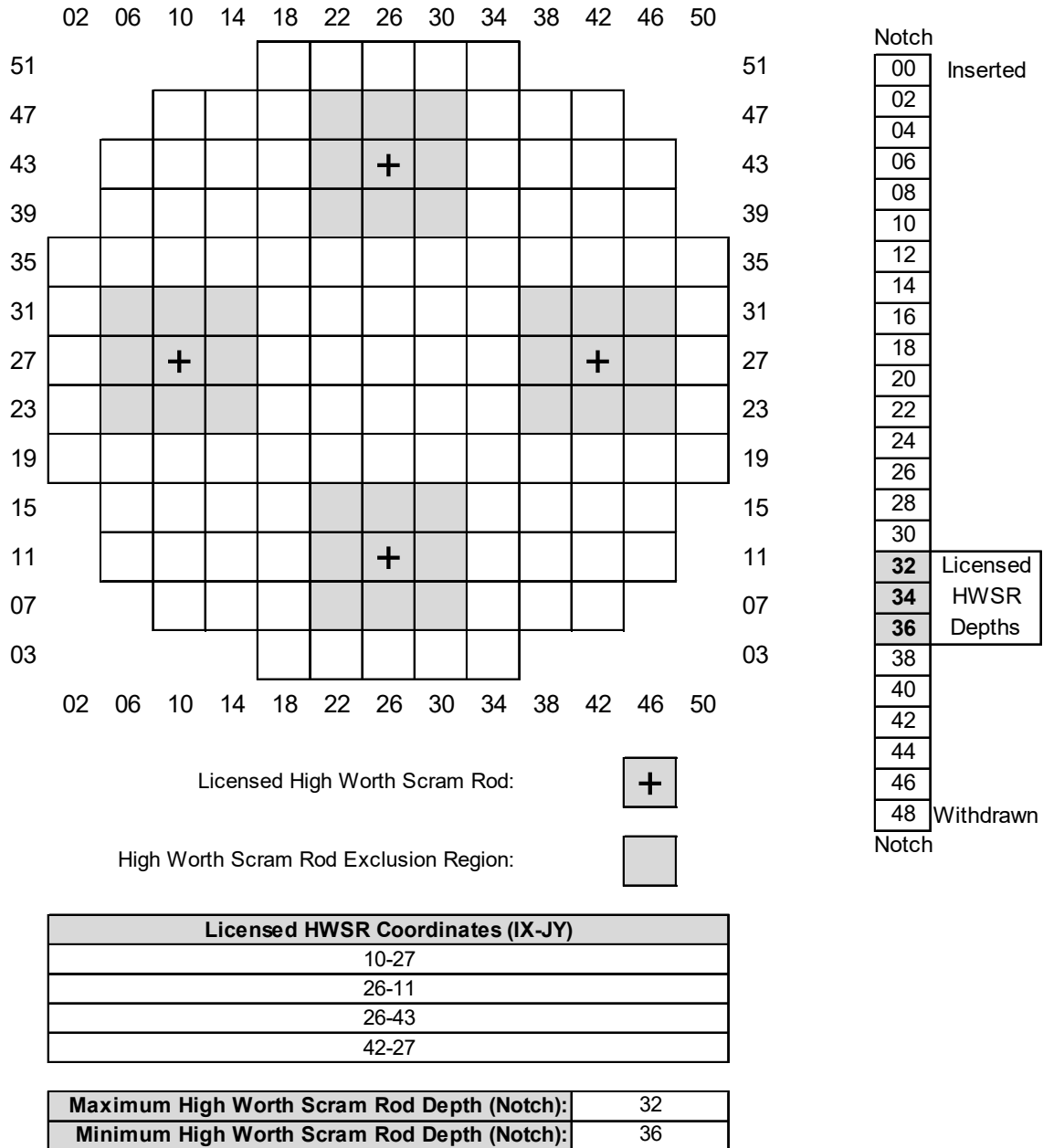


FIGURE 3-5B

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 combination is independent of average scram time, and is a function of fuel bundle type, fuel rod type, core power, core flow, cycle exposure, 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 Table 4-3.

Table 4-1 shows the exposure-dependent LHGR limits for all fuel types in the core, as a function of initial gadolinium 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.

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 LHGRFAC_F Limit Multiplier Operating Flexibility Options

Fuel Type	Equipment In/Out of Service					Figure #
	<u>Main Turbine Bypass System Operable</u>	<u>EOC-RPT System Operable</u>	<u>Main Turbine Pressure Regulator System Status</u>	<u>High Pressure Feedwater Heaters In Service</u>	<u>High Worth Scram Rods In Service</u>	
GNF2 & GNF3 LTA	Yes	Yes/No	TLCO 3.3.13.a or b	Yes/No	Yes/No	4-1A
			TLCO 3.3.13.c	Yes	No	
	No		TLCO 3.3.13.a or b	Yes/No	Yes/No	4-1B
			TLCO 3.3.13.c	Yes	No	
GNF3	Yes/No	Yes/No	TLCO 3.3.13.a or b	Yes/No	Yes/No	4-1C
			TLCO 3.3.13.c	Yes	No	
ALL	Yes/No	Yes/No	TLCO 3.3.13.c	Yes	Yes	Non-HWSR Limits Apply *
				No	Yes/No	Not Licensed

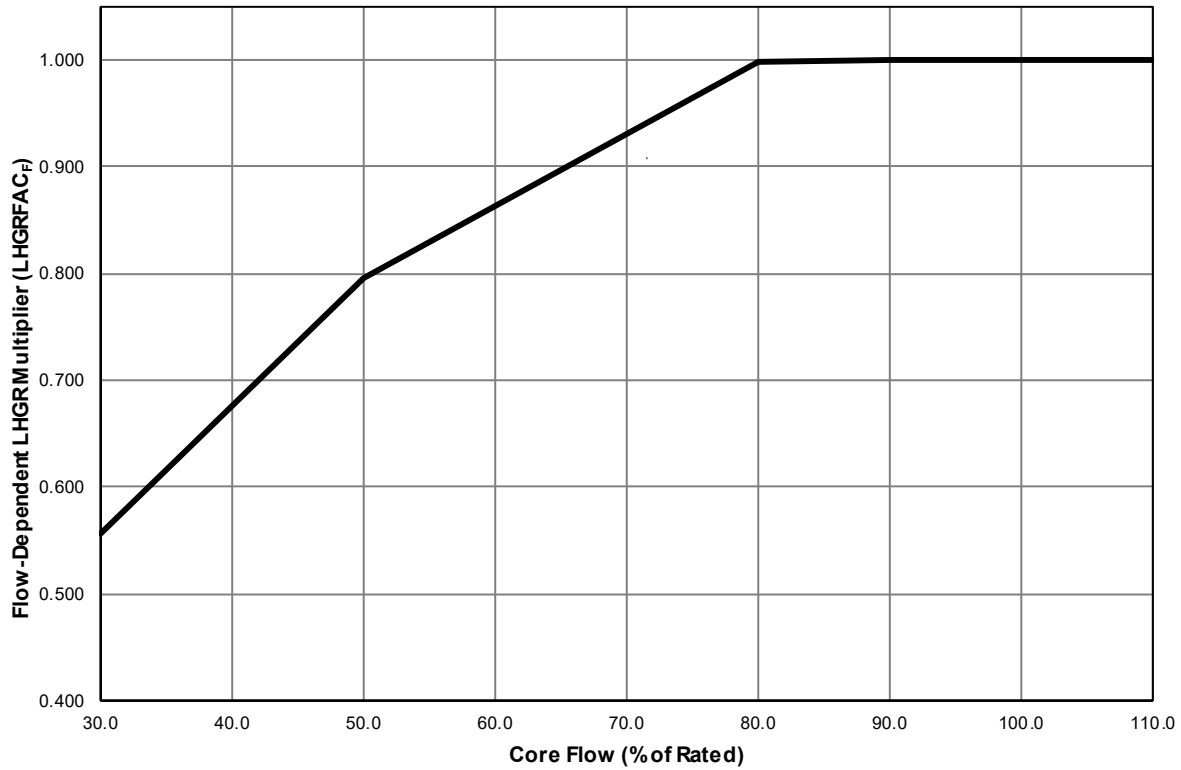
* The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b for High Worth Scram Rods to be considered In Service, as described in Table 1-3.

TABLE 4-3

Power-Dependent LHGRFAC_p Limit Multiplier Operating Flexibility Options

Fuel Type	Equipment In/Out of Service					Figure #
	<u>Main Turbine Bypass System Operable</u>	<u>EOC-RPT System Operable</u>	<u>Main Turbine Pressure Regulator System Status</u>	<u>High Pressure Feedwater Heaters In Service</u>	<u>High Worth Scram Rods In Service</u>	
ALL	Yes/No	Yes/No	TLCO 3.3.13.a or b	Yes	Yes/No	4-2A
				No	Yes/No	4-2B
			TLCO 3.3.13.c	Yes	No	4-2A
					Yes	Non-HWSR Limits Apply *
				No	Yes/No	Not Licensed

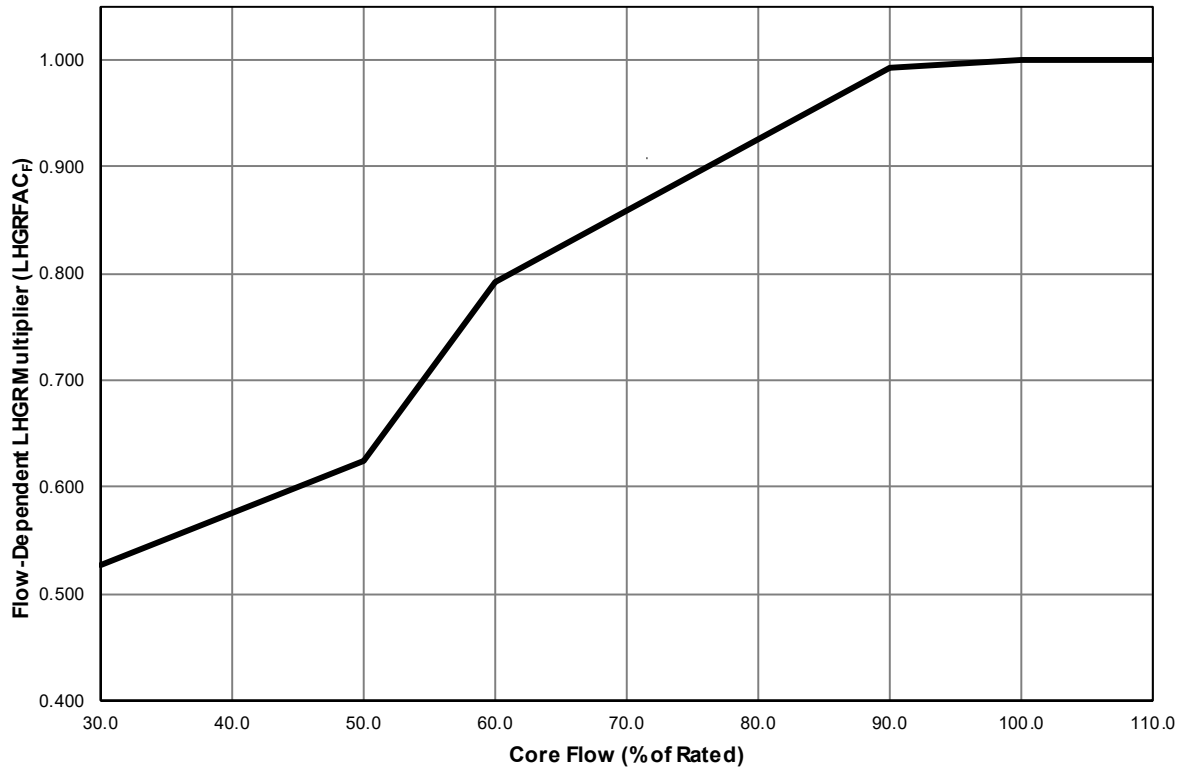
* The Main Turbine Pressure Regulator System must be in TLCO 3.3.13.a or b for High Worth Scram Rods to be considered In Service, as described in Table 1-3.



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

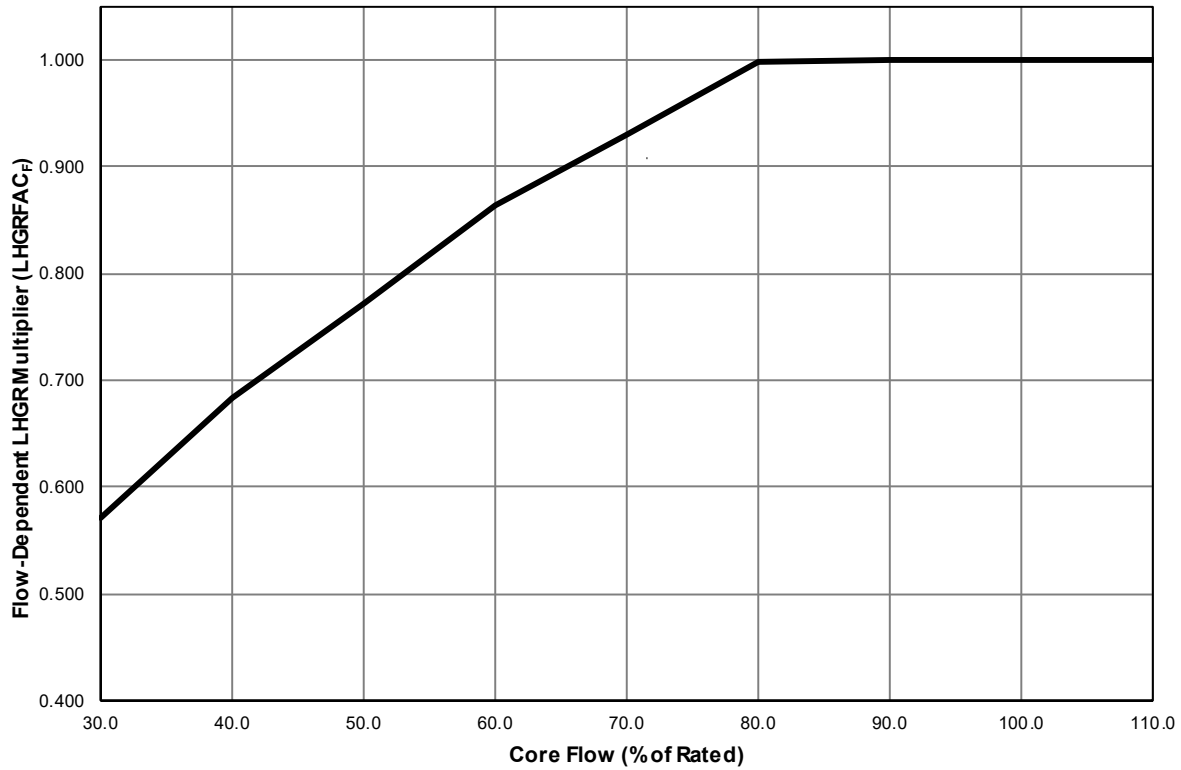
GNF2 & GNF3 LTA Flow-Dependent LHGR Limit Multiplier (LHGRFAC_F) versus Core Flow



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

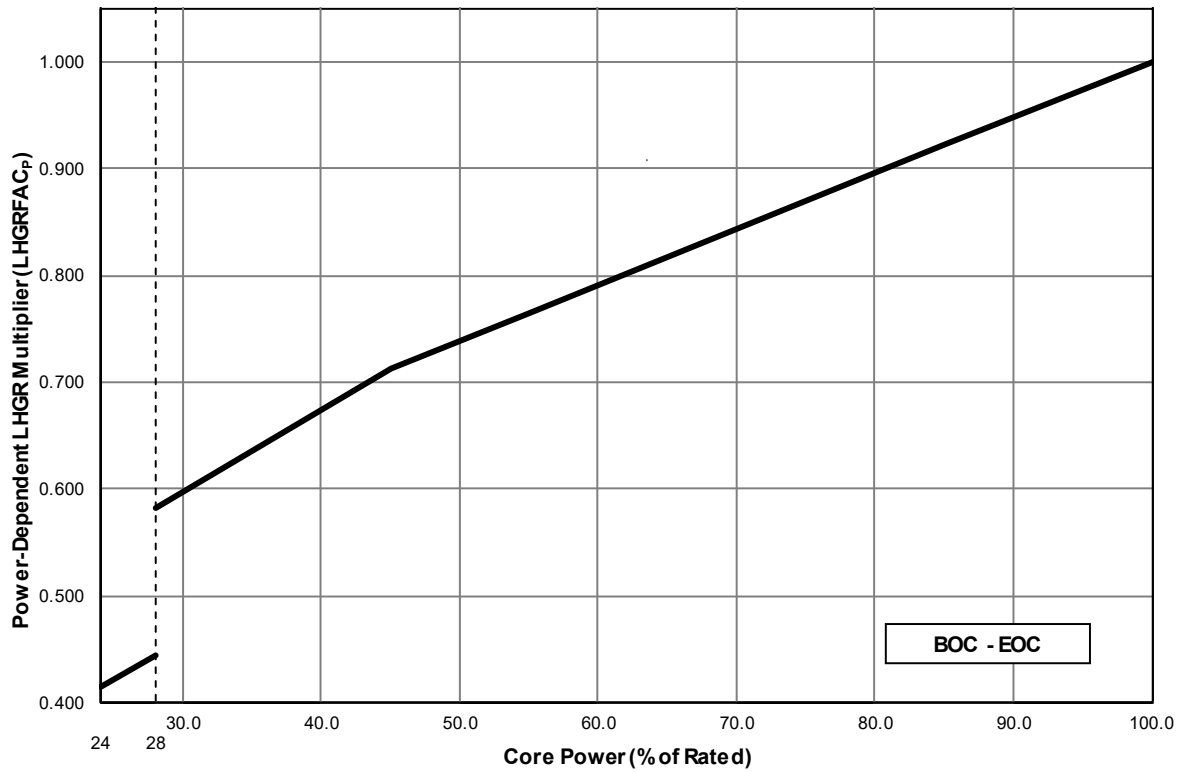
**GNF2 & GNF3 LTA Flow-Dependent LHGR Limit Multiplier (LHGRFAC_F) versus Core Flow
(Main Turbine Bypass System Inoperable)**



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

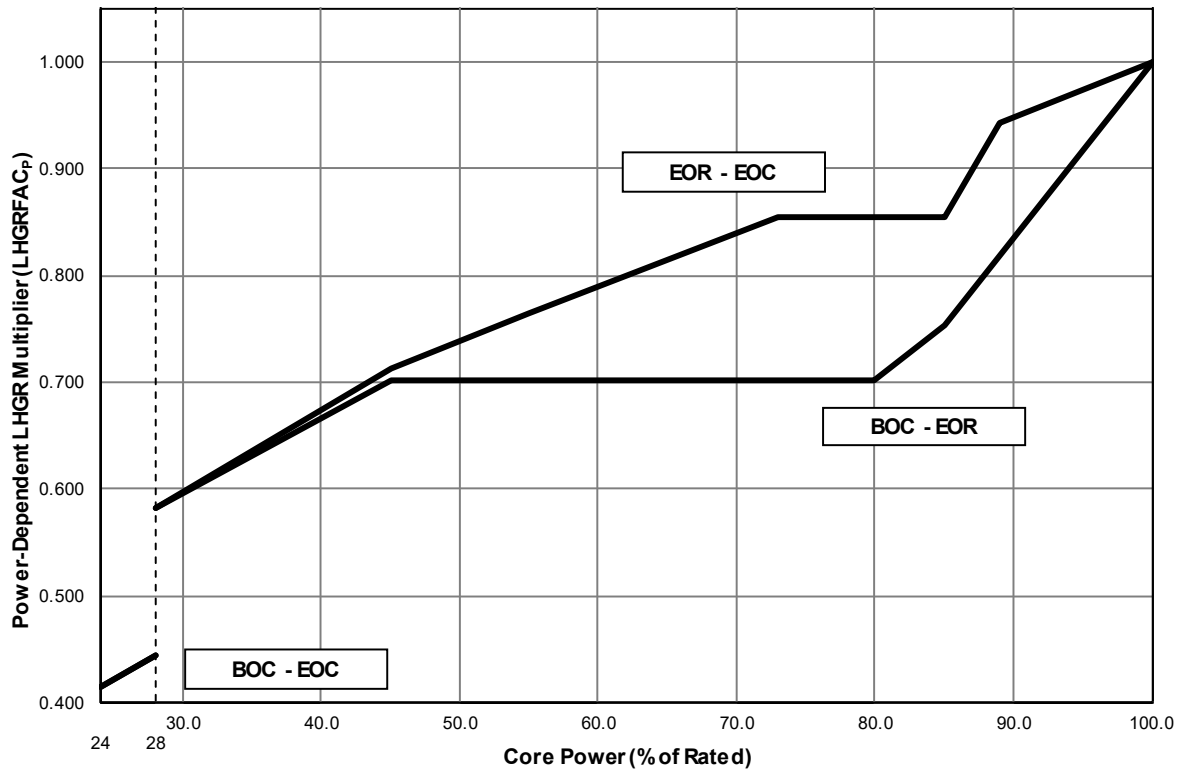
GNF3 Flow-Dependent LHGR Limit Multiplier (LHGRFAC_F) versus Core Flow



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 4-2A

GNF2, GNF3 LTA, & GNF3 Power-Dependent LHGR Limit Multiplier (LHGRFAC_p)
versus Core Power



BOC - EOR	
Power (% of Rated)	LHGRFAC _p (TLO/SLO)
24.0	0.415
≤ 28.0	0.445
> 28.0	0.583
45.0	0.702
80.0	0.702
85.0	0.754
100.0	1.000

EOR - EOC	
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
73.0	0.855
85.0	0.855
89.0	0.943
100.0	1.000

FIGURE 4-2B

**GNF2, GNF3 LTA, & GNF3 Power-Dependent LHGR Limit Multiplier (LHGRFAC_p)
versus Core Power
(High Pressure Feedwater Heaters Out of Service)**

[[

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FIGURE 4-3A

GNF2 & GNF3 LTA 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.

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:

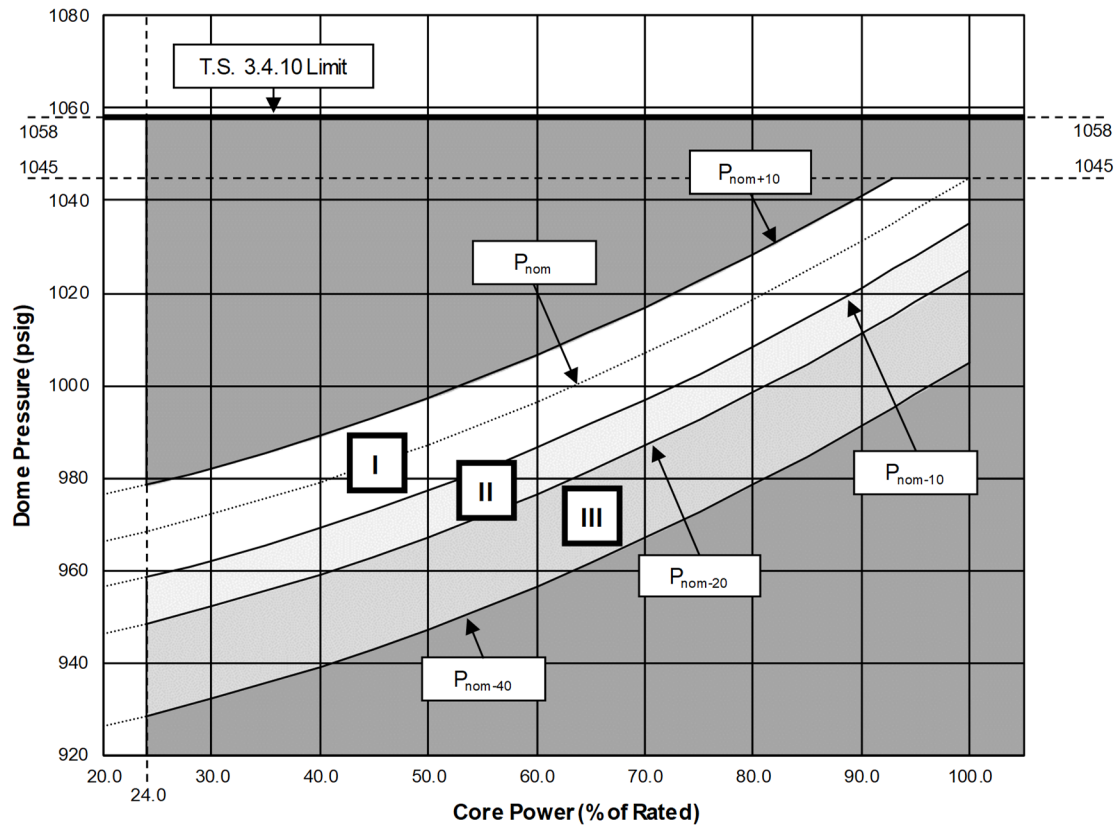
$$\text{FLCPR} = \frac{\text{MCPR}_{\text{Limit}}}{\text{Fuel Assembly Minimum Critical Power Ratio}}$$

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



$$P = A + 0.30 * CP + 0.0057 * CP^2$$

Dome Pressure Curves	Core Power	A
Nominal Dome Pressure (P _{nom})	24 ≤ CP ≤ 100	958
Region I Upper Boundary (P _{nom+10})	24 ≤ CP ≤ 100	968
Region I Lower Boundary (P _{nom-10})	24 ≤ CP ≤ 100	948
Region II Lower Boundary (P _{nom-20})	24 ≤ CP ≤ 100	938
Region III Lower Boundary (P _{nom-40})	24 ≤ CP ≤ 100	918

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 #
<u>Main Turbine Bypass System Operable</u>	<u>EOC-RPT System Operable</u>	<u>Main Turbine Pressure Regulator System Status</u>	<u>High Pressure Feedwater Heaters In Service</u>	<u>High Worth Scram Rods In Service</u>	
Yes	Yes/No	TLCO 3.3.13.a or b	Yes	Yes/No	5-2
No	Yes/No	TLCO 3.3.13.a or b	Yes	Yes/No	Reduced-Pressure Flexibility Option Not Licensed
Yes/No	Yes/No	TLCO 3.3.13.c	Yes	Yes/No	
Yes/No	Yes/No	TLCO 3.3.13.a or b	No	Yes/No	

TABLE 5-2

MFLCPR and MFLPD Limits versus Operating Pressure Regions

Operating Pressure Region	Max Allowable Thermal Limit Ratio	
	<u>MFLCPR Limit</u>	<u>MFLPD Limit</u>
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-30, "*General Electric Standard Application for Reactor Fuel (GESTAR II)*," April 2020, and the US Supplement, NEDE-24011-P-A-30-US, April 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 003N5312, "*Technical Evaluation to Support Introduction of GNF3 Lead Use Assemblies (LUAs) in Hatch Nuclear Plant, Unit 2*," Revision 0, October 2016.
4. Global Nuclear Fuel Report NEDC-33879P, "*GNF3 Generic Compliance with NEDE-24011-P-A (GESTAR II)*," Revision 4, August 2020.
5. Southern Nuclear Operating Company Report NFD-H-20-236 "*Hatch-2 Cycle 27 Reload Licensing Analysis Report*," Version 1.0, November 2020.
6. Global Nuclear Fuel Report 006N3297, "*Supplemental Reload Licensing Report for Hatch 2 Reload 26 Cycle 27*," Revision 0, November 2020.
7. Global Nuclear Fuel Report 005N2010, "*Fuel Bundle Information Report for Hatch 2 Reload 26 Cycle 27*," Revision 0, October 2020.