PSEG Nuclear LLC
P.O. Box 236, Hancocks Bridge, New Jersey 08038-0236

PSEG
Nuclear LLC

LR-N06-0008
JAN 3 1 2006

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

CORE OPERATING LIMITS REPORT - CYCLE 13, REVISION 3
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

In accordance with section 6.9.1.9 of the Hope Creek Technical Specifications, PSEG Nuclear LLC submits Revision 3 of the Core Operating Limits Report (COLR) for Hope Creek Cycle 13 (NFS-0243, Rev. 3) in Attachment 1 to this letter.

Should you have any questions, please contact Mr. Paul Duke at (856) 339-1466.

Sincerely,

Michael J. Massaro

Michael J. Massaro
Plant Manager
Hope Creek Generating Station

Attachment

A001

C Mr. S. Collins, Administrator - Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. S. Bailey, Licensing Project Manager - Hope Creek
U. S. Nuclear Regulatory Commission
Mail Stop 08B1
Washington, DC 20555

USNRC Senior Resident Inspector - Hope Creek (X24)

Mr. K. Tosch, Manager IV
Bureau of Nuclear Engineering
PO Box 415
Trenton, NJ 08625

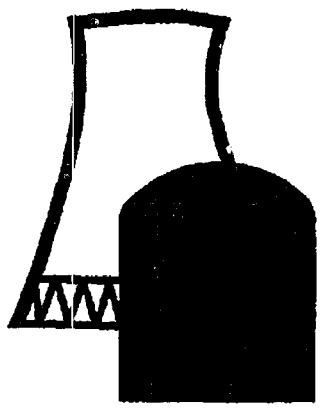
NFS-0243, Rev. 3

Hope Creek Generating Station

Core Operating Limits Report

Cycle 13/ Reload 12

Effective Date: 1/4/06



Prepared By: Steven G. Bier Date: 11/23/05
Steven G. Bier, Nuclear Fuels Staff Engineer

Reviewed By: Shie-Jeng Peng Date: 11/23/2005
Shie-Jeng Peng, Nuclear Fuels Senior Engineer

Concurrence By: Donald V. Notigan Date: 12/1/05
Donald V. Notigan, Supervisor
Hope Creek Reactor & Safety Analysis

Approved By: M M Mannion Date: 12/15/05
Michael M. Mannion, Manager
Nuclear Fuels/Reactor Engineering

Table of Contents

Section	Description	Page
1.0	INTRODUCTION	5
2.0	TECHNICAL SPECIFICATIONS THAT REFERENCE THE COLR	6
2.1	AVERAGE PLANAR LINEAR HEAT GENERATION RATE	7
2.2	MINIMUM CRITICAL POWER RATIO	12
2.3	LINEAR HEAT GENERATION RATE	20
2.4	OPRM TRIP SETPOINT	25
3.0	REFERENCES	26
Appendix A:	Method of Core Average Scram Speed Calculation	27

List of Tables

Table	Description	Page
Table 2.1- 1:	APLHGR Data for GE14 Fuel (Two Recirculation Loop Operation)	8
Table 2.1- 2:	APLHGR Data for GE14 Fuel (Single Recirculation Loop Operation)	8
Table 2.1- 3:	APLHGR Data for SVEA-96+ Fuel (Two Recirculation Loop Operation)	9
Table 2.1- 4:	APLHGR Data for SVEA-96+ Fuel (Single Recirculation Loop Operation)	9
Table 2.2- 1:	Cycle 13 MCPR Operating limits: Cycle Exposure ≤ 8693 *MWd/MTU*	13
Table 2.2- 2:	Cycle 13 MCPR Operating limits: Cycle Exposure > 8693 *MWd/MTU*	14
Table 2.2- 3:	K_f Multiplier Data	19
Table 2.3- 1:	LHGR Limit for GE14 (Two Recirculation Loop Operation)	21
Table 2.3- 2:	LHGR Limit for GE14 (Single Recirculation Loop Operation)	21
Table 2.3- 3:	LHGR Limit for SVEA-96+ (Two Recirculation Loop Operation)	22
Table 2.3- 4:	LHGR Limit for SVEA-96+ (Single Recirculation Loop Operation)	22

List of Figures

Figures	Description	Page
Figure 2.1- 1: APLHGR Limit for Fuel Bundle GE14		10
Figure 2.1- 2: APLHGR Limit for Fuel Bundle SVEA-96+		11
Figure 2.2-1: Rated Power MCPR Limit: GE14, Cycle Exposure ≤ 8693 MWD/MTU		15
Figure 2.2-2: Rated Power MCPR Limit: SVEA-96+, Cycle Exposure ≤ 8693 MWD/MTU		16
Figure 2.2-3: Rated Power MCPR Limit: GE14, Cycle Exposure > 8693 MWD/MTU		17
Figure 2.2-4: Rated Power MCPR Limit: SVEA-96+, Cycle Exposure > 8693 MWD/MTU		18
Figure 2.2-5 K_f Multiplier Curve		19
Figure 2.3- 1: LHGR Limit for GE14		23
Figure 2.3- 2: LHGR Limit for SVEA-96+		24

1.0 INTRODUCTION

The purpose of this report is to provide the Core Operating Limits for Hope Creek Generation Station Unit 1 Cycle 13/ Reload 12 operation. In addition, this report will provide information on Oscillation Power Range Monitor (OPRM) setpoint, single recirculation loop operation, average scram speed and determination of the Core Maximum Fraction of Limiting Power Density. Finally, this report also provides a reference to the most recent revision of the implemented approved methodology. The limits presented here correspond to the core thermal limits for Average Planar Linear Heat Generation Rate (APLHGR), Minimum Critical Power Ratio (MCPR), MCPR Flow Adjustment Factor (K_f) and Linear Heat Generation Rate (LHGR).

These operating limit values have been determined using NRC approved methods contained in GESTAR-II [1], NEDE-24011-P-A (Revision 14) and are established such that all applicable fuel thermal-mechanical, core thermal-hydraulic, ECCS, and nuclear limits such as shutdown margin, and transient and accident analysis limits are met.

Hope Creek Technical Specifications Section 3.2 references this report as the source for certain LIMITING CONDITIONS FOR OPERATION. These are included in Section 2 of this document. Hope Creek Technical Specification 6.9.1.9 also requires that this report, including any mid cycle revisions, shall be provided, upon issuance, to the NRC.

Revision 3 removes the conservative penalty applied to the operating limit LCO values for GE14 fuel in section 2.2 MINIMUM CRITICAL POWER RATIO. The conservative penalty for GE14 fuel was applied in revision 1 pending resolution of a non-conforming condition associated with the critical power calculation for GE14 fuel. The final resolution of the non-conforming condition in the critical power correlation for GE14 fuel is documented in corrective action order 70047609.

This document is specific to Hope Creek Generating Station Unit 1 Cycle 13 / Reload 12 and shall not be applicable to any other core or cycle design. The thermal limits contained in this report are applicable whether the Crossflow™ correction factor is applied or not applied. This report is applicable for Cycle 13 operation from the date of issuance through the end of effective full power capability or a cycle exposure of 11938 *MWd/MTU* (10830 *MWd/STU*), whichever occurs first [2]. End of effective full power capability is reached when 100% rated power can no longer be maintained by increasing core flow (up to 105% of rated core flow), at rated feedwater temperatures, in the all-rods-out configuration.

2.0 TECHNICAL SPECIFICATIONS THAT REFERENCE THE COLR

The TECHNICAL SPECIFICATIONS THAT REFERENCE THE COLR presented in this section are referenced by the Hope Creek Technical Specifications.

Tech. Spec.	Title
2.1	Safety Limit Bases
3/4.2.1	Average Planar Linear Generation Rate
3/4.2.3	Minimum Critical Power Ratio
3/4.2.4	Linear Heat Generation Rate
3/4.3.11	Oscillation Power Range Monitor
3/4.4.1	Recirculation System Recirculation Loops
3/4.2.1 Bases	Average Planar Linear Heat Generation Rate
6.9.1.9	Administrative Controls, Core Operating Limits Report

2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE

LIMITING CONDITION FOR OPERATION:

All AVERAGE PLANAR LINEAR HEAT GENERATION RATES (APLHGRs) shall be less than or equal to the limits specified in Table 2.1-1 and Table 2.1-3.

When the Technical Specification Section 3/4.4.1 ACTION statement a.1.d is entered from that section's LCO, reduce the APLHGR limits to the values specified in Tables 2.1-2 and 2.1-4.

When hand calculations are required, all APLHGRs for each type of fuel as a function of AVERAGE EXPOSURE shall not exceed the limits specified in Figures 2.1-1 and 2.1-2.

Table 2.1- 1: APLHGR Data for GE14 Fuel
(Two Recirculation Loop Operation)

Bundle Types: GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757
GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758

Average Planar Exposure		APLHGR Limit
MWD/STU	MWD/MTU	Kw/ft
0.00	0.00	12.82
19130	21090	12.82
57610	63500	8.00
63500	70000	5.00

Table 2.1- 2: APLHGR Data for GE14 Fuel
(Single Recirculation Loop Operation)

Bundle Types: GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757
GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758

Average Planar Exposure		APLHGR Limit
MWD/STU	MWD/MTU	Kw/ft
0.00	0.00	10.25
19130	21090	10.25
57610	63500	6.40
63500	70000	4.00

Table 2.1- 3: APLHGR Data for SVEA-96+ Fuel
(Two Recirculation Loop Operation)

Bundle Types: SVEA96-P10CASB326-11GZ-568U-4WR-150-T6-2654
SVEA96-P10CASB326-11G4.5-568U-4WR-150-T6-2655
SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656
SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657
SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658
SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659

Average Planar Exposure		APLHGR Limit
MWD/STU	MWD/MTU	Kw/ft
0.00	0.00	12.85
3340	3680	12.85
14510	16000	10.97
58970	65000	7.24

Table 2.1- 4: APLHGR Data for SVEA-96+ Fuel
(Single Recirculation Loop Operation)

Bundle Types: SVEA96-P10CASB326-11GZ-568U-4WR-150-T6-2654
SVEA96-P10CASB326-11G4.5-568U-4WR-150-T6-2655
SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656
SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657
SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658
SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659

Average Planar Exposure		APLHGR Limit
MWD/STU	MWD/MTU	Kw/ft
0.00	0.00	10.28
3340	3680	10.28
14510	16000	8.77
58970	65000	5.79

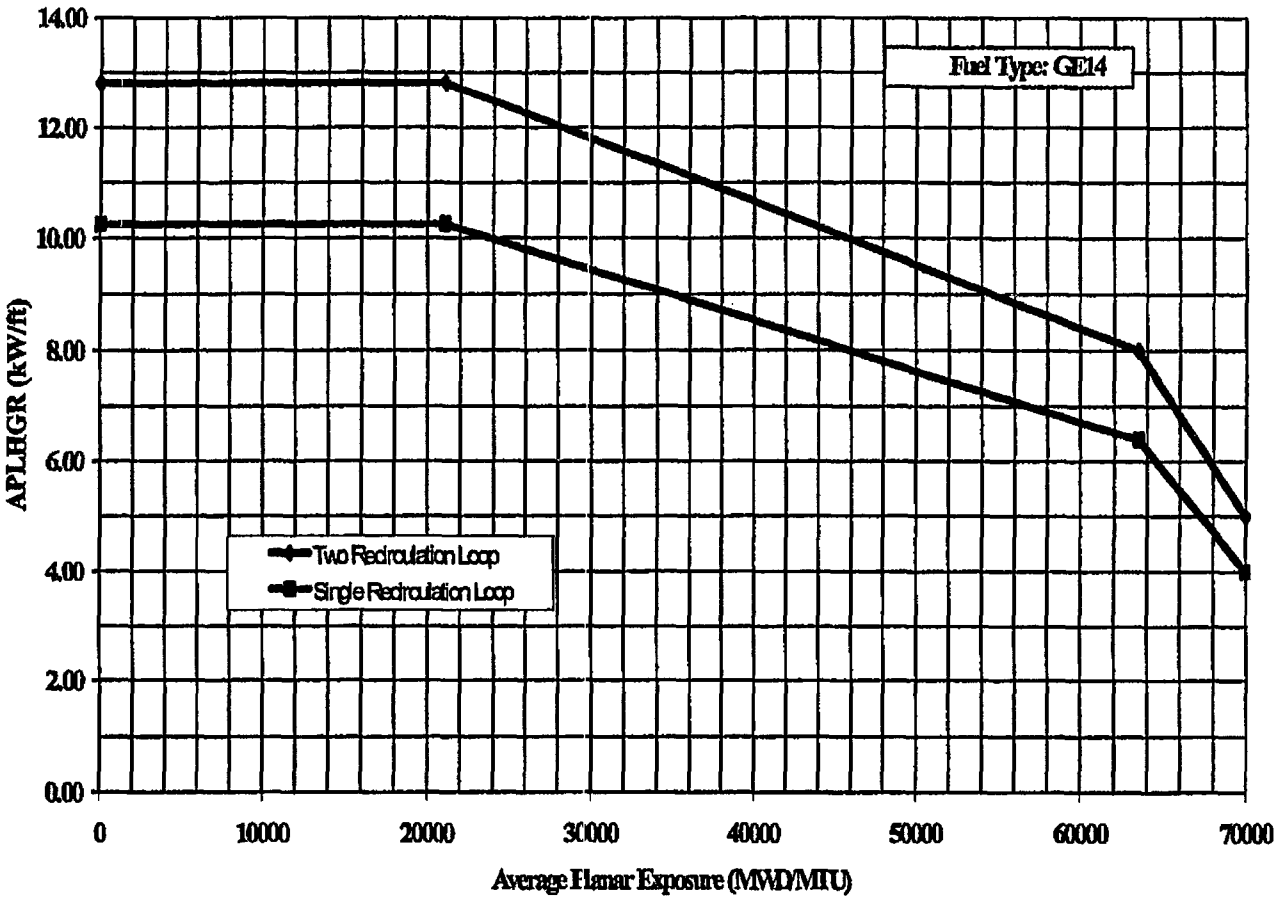


Figure 2.1- 1: APLHGR Limit for GE14 Fuel

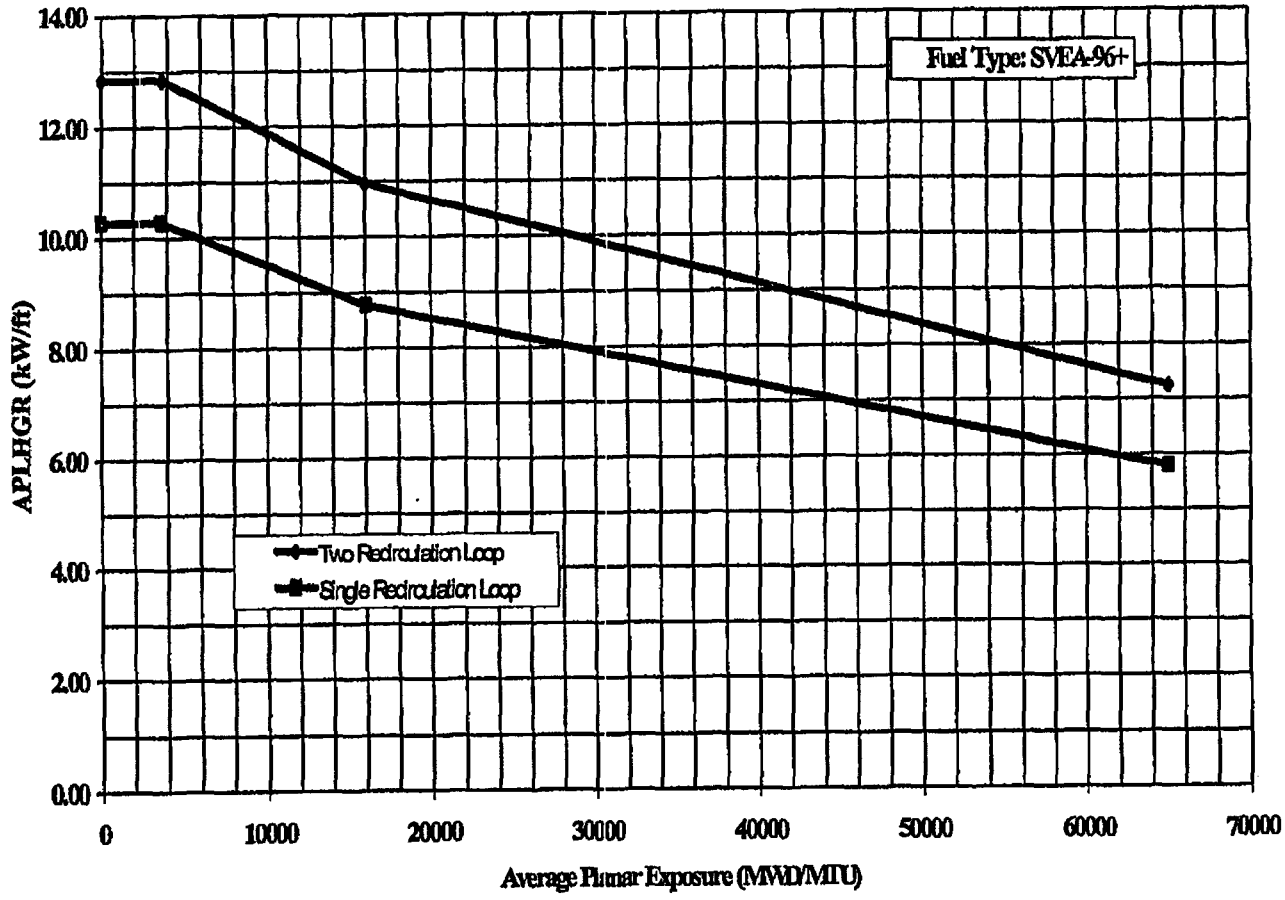


Figure 2.1- 2: APLHGR Limit for SVEA-96+ Fuel

2.2 MINIMUM CRITICAL POWER RATIO

LIMITING CONDITION FOR OPERATION

The MINIMUM CRITICAL POWER RATIO (MCPR) shall be equal to or greater than the MCPR limit as computed from the following steps:

1. Determine τ as defined in Appendix A.

2. Linearly interpolate a MCPR value as a function of τ from the MCPR value at $\tau = 0$ and the MCPR value at $\tau = 1$ as specified in Table 2.2-1 and Table 2.2-2. The obtained value shall be checked with the value as shown in Figures 2.2-1 to 2.2-4.

3. When in single loop operation, add 0.02 to the MCPR value obtained from Step 2.

4. For core flow correction, first obtain K_f value by linearly interpolating from Table 2.2-3 and check the result with the curve shown in Figure 2.2-5. Multiply the MCPR value obtained from Step 2 (or Step 3 as required) by the K_f value.

Note that the MCPR limit is a function of core average scram speed (τ), cycle exposure, EOC-RPT operability, reactor coolant recirculation loop operation condition and main turbine bypass operability.

EOC-RPT system operability is defined by Hope Creek Technical Specification 3.3.4.2.

Reactor coolant recirculation loop operation condition is defined by Hope Creek Technical Specification 3.4.1.1.

Main Turbine Bypass operability is defined by Hope Creek Technical Specification 3.7.7.

Table 2.2- 1: Cycle 13 MCPR Operating limits:
Cycle Exposure ≤ 8693 *MWd/MTU*

Main Turbine Bypass Operable **Cycle Exposure ≤ 8693 *MWd/MTU* (7886 *MWd/STU*)**			
Conditions	**Limit**	**GE14[1]**	**SVEA-96+[2]**
Option A ($\tau = 1$) EOC-RPT Operable	Rated Power	1.45	1.47
Option B ($\tau = 0$) EOC-RPT Operable	Rated Power	1.34	1.36
Option A ($\tau = 1$) EOC-RPT Inoperable	Rated Power	1.47	1.48
Option B ($\tau = 0$) EOC-RPT Inoperable	Rated Power	1.36	1.37

1. GE14 fuel design:
   GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757
   GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758

2. SVEA-96+ fuel design:
   SVEA96-P10CASB326-11GZ-568U-4WR-150-T6-2654
   SVEA96-P10CASB326-11G4.5-568U-4WR-150-T6-2655
   SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656
   SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657
   SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658
   SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659

Table 2.2- 2: Cycle 13 MCPR Operating limits:
Cycle Exposure > 8693 *MWd/MTU*

Main Turbine Bypass Operable **Cycle Exposure > 8693 *MWd/MTU* (7886 *MWd/STU*)**			
Conditions	**Limit**	**GE14[1]**	**SVEA-96+[2]**
Option A ($\tau = 1$) EOC-RPT Operable	Rated Power	1.56	1.60
Option B ($\tau = 0$) EOC-RPT Operable	Rated Power	1.39	1.43
Option A ($\tau = 1$) EOC-RPT Inoperable	Rated Power	1.59	1.60
Option B ($\tau = 0$) EOC-RPT Inoperable	Rated Power	1.42	1.43

1. GE14 fuel design:
   GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757
   GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758

2. SVEA-96+ fuel design:
   SVEA96-P10CASB326-11GZ-568U-4WR-150-T6-2654
   SVEA96-P10CASB326-11G4.5-568U-4WR-150-T6-2655
   SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656
   SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657
   SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658
   SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659

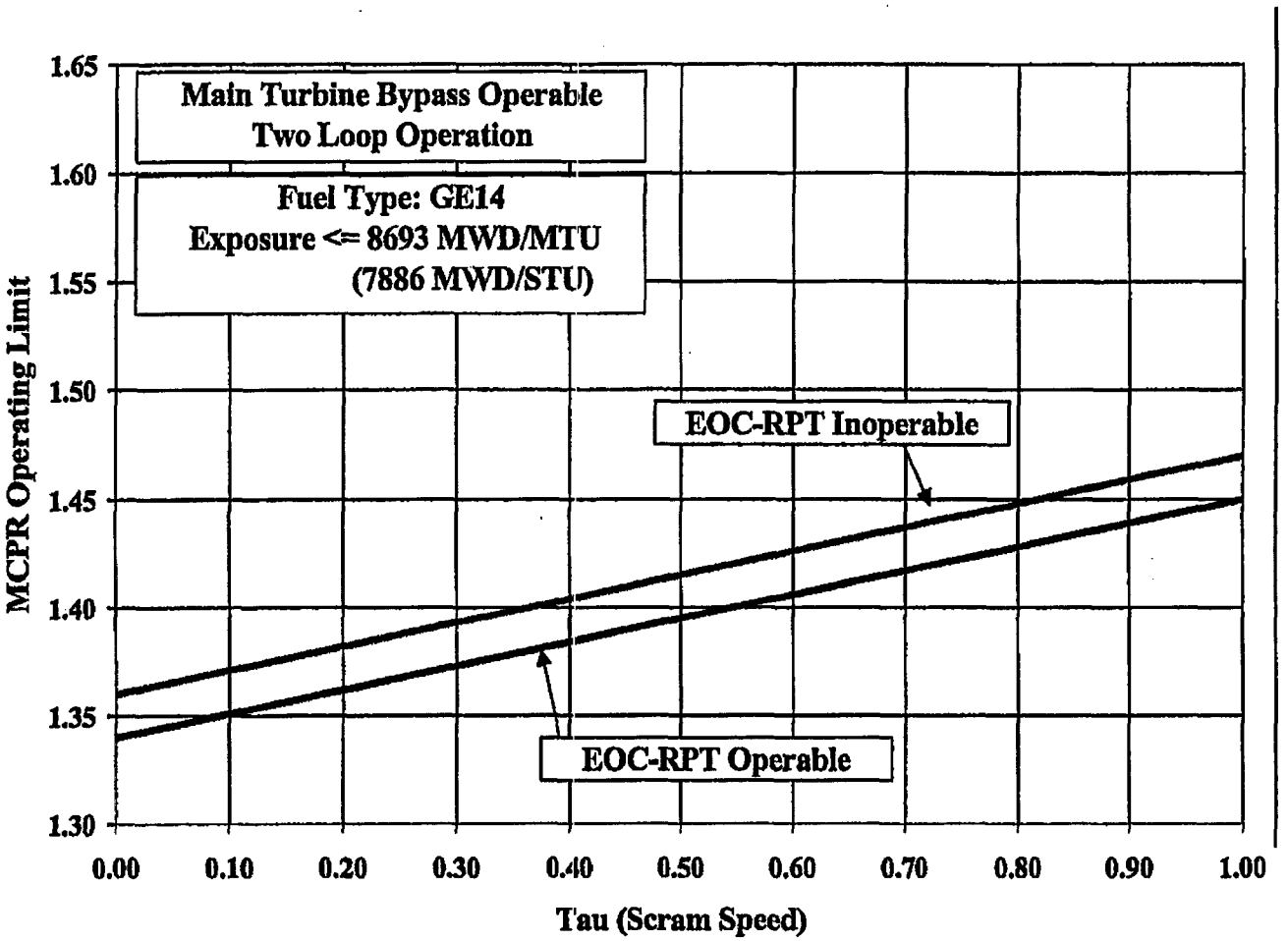


Figure 2.2-1: Rated Power MCPR Limit: GE14, Cycle Exposure ≤ 8693 MWD/MTU

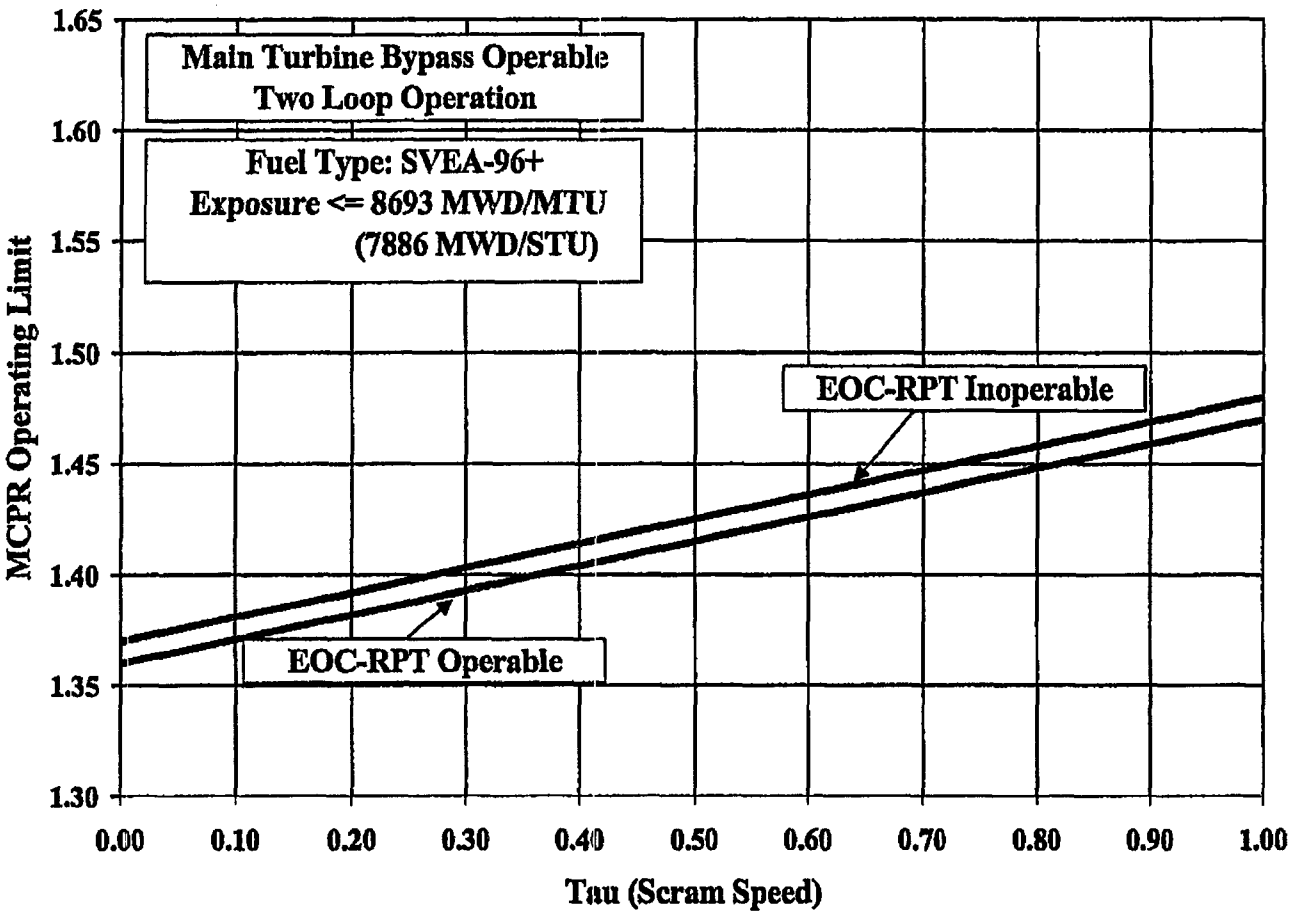


Figure 2.2-2: Rated Power MCPR Limit: SVEA-96+, Cycle Exposure ≤ 8693 MWD/MTU

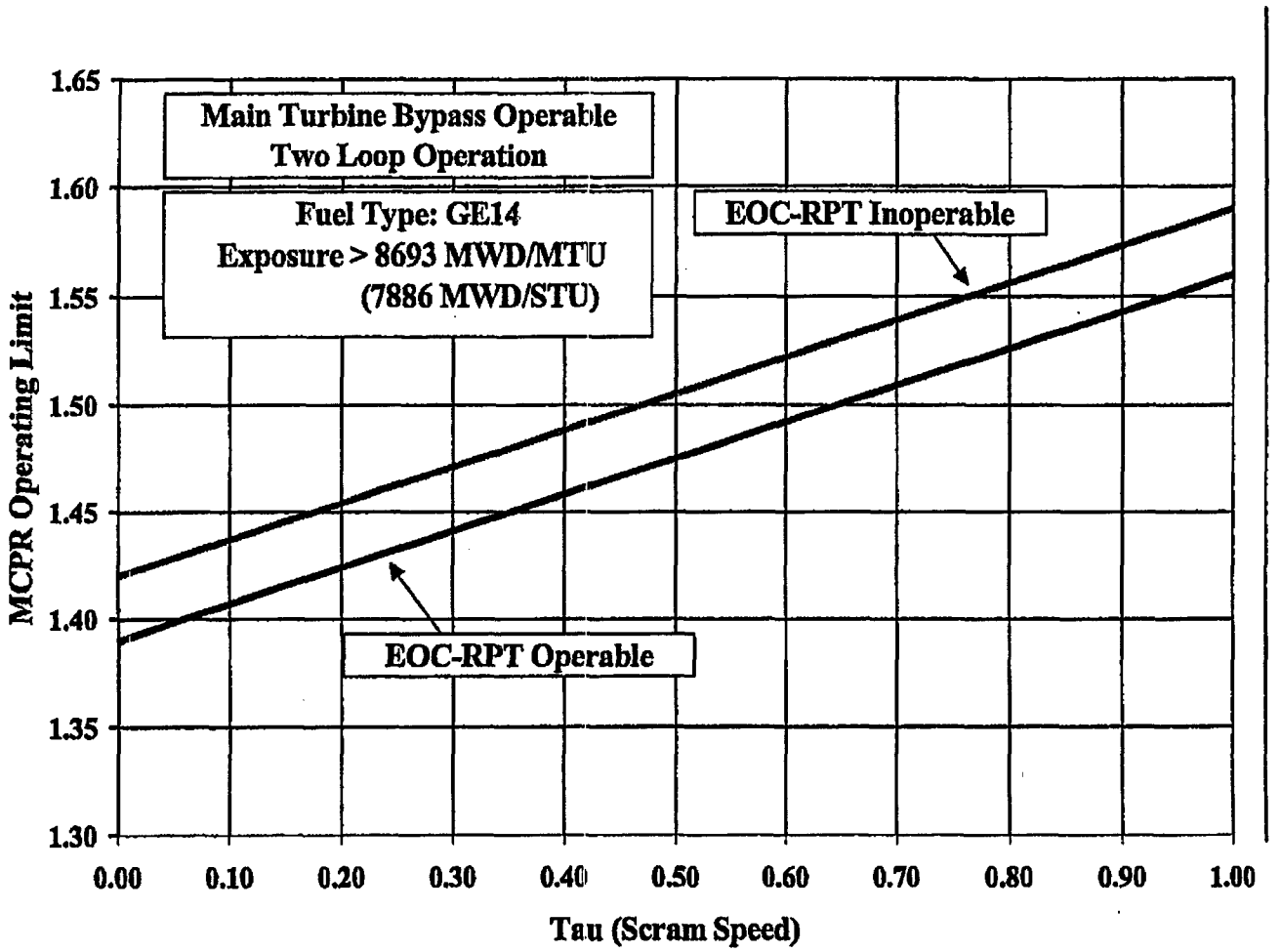
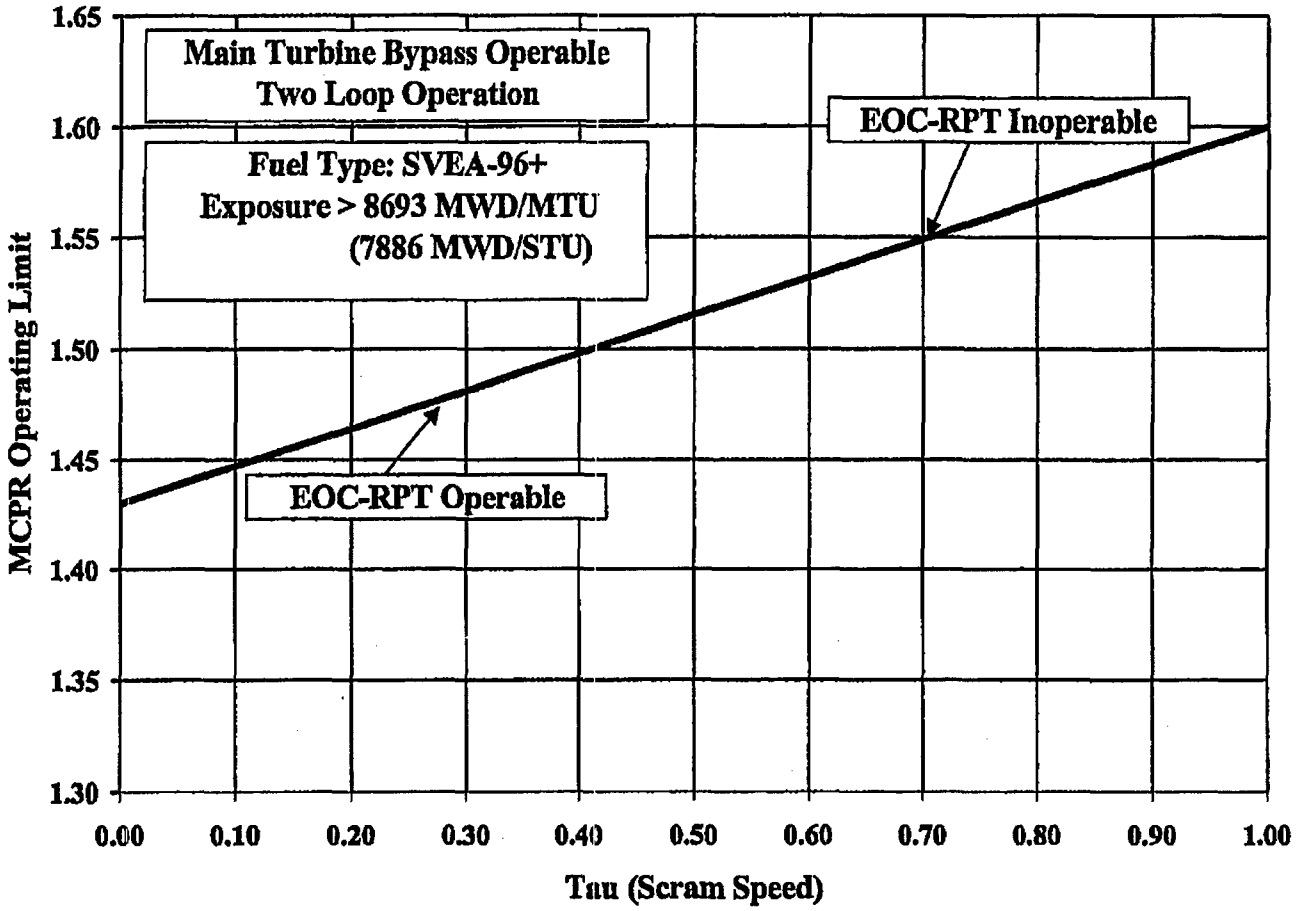


Figure 2.2-3: Rated Power MCPR Limit: GE14, Cycle Exposure > 8693 MWD/MTU



Note

The same rated power MCPR operating limit is applied to both EOC-RPT Operable and EOC-RPT Inoperable for SVEA-96+ under the condition of Cycle Exposure > 8693 MWD/MTU, Main Turbine Bypass Operable and Two Loop Operation.

Figure 2.2-4: Rated Power MCPR Limit: SVEA-96+, Cycle Exposure > 8693 MWD/MTU

Table 2.2- 3: K_f Multiplier Data

Initial Flow (% Rated Flow)	K_f Multiplier
25.00	1.2532
82.404	1.0000
105.00	1.0000

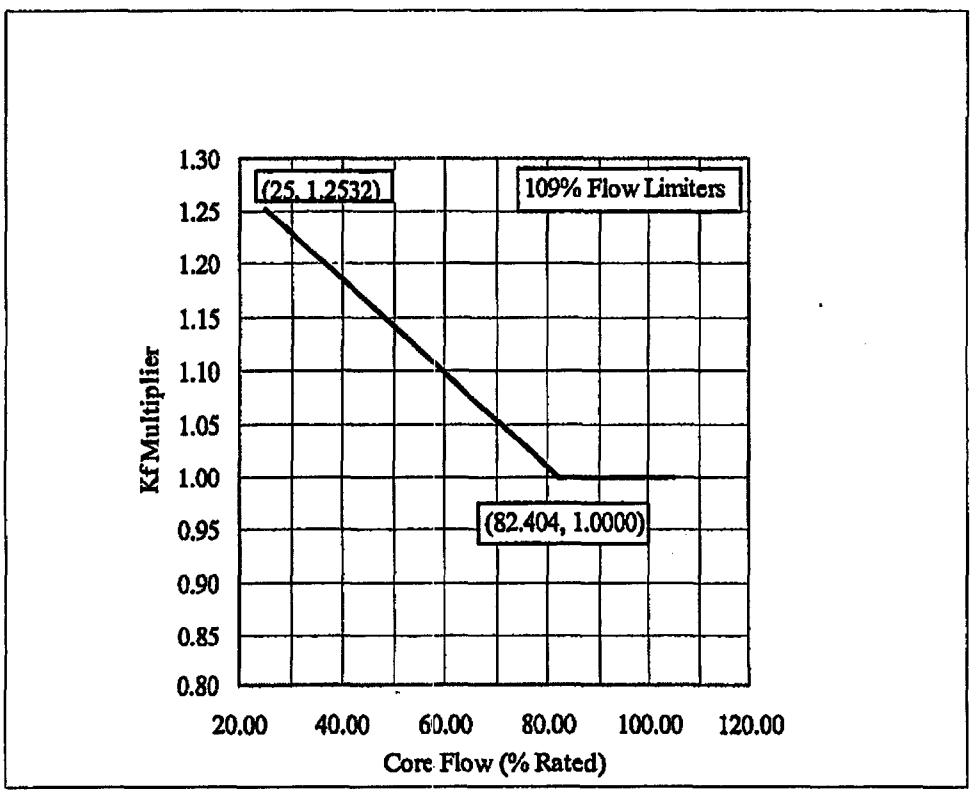


Figure 2.2-5 K_f Multiplier Curve

2.3 LINEAR HEAT GENERATION RATE

LIMITING CONDITION FOR OPERATION

The LINEAR HEAT GENERATION RATE (LHGR) shall not exceed the limit specified in Table 2.3-1 and Table 2.3-3.

When the Technical Specification Section 3/4.4.1 ACTION statement a.1.e is entered from that section's LCO, reduce the LHGR limits to a value specified in Table 2.3-2 and Table 2.3-4.

When hand calculations are required, all LHGRs for each type of fuel as a function of Peak Pellet Exposure shall not exceed the limits specified in Figure 2.3-1 and Figure 2.3-2.

The CORE MAXIMUM FRACTION OF LIMITING POWER DENSITY as implemented in Technical Specification Section 3/4.2.2 shall use a FRACTION OF LIMITING POWER DENSITY that is based on a specified LHGR equal to the exposure dependent LHGR in Table 2.3-1 through Table 2.3-4 for both GE14 and SVEA-96+ fuel assemblies.

Table 2.3- 1: LHGR Limit for GE14 (Two Recirculation Loop Operation)

Peak Pellet Exposure MWD/MTU (MWD/STU)	LHGR Limit (kW / ft)
	GE14
0 (0)	13.4
16000 (14510)	13.4
63500 (57610)	8.0
70000 (63500)	5.0

Table 2.3- 2: LHGR Limit for GE14 (Single Recirculation Loop Operation)

Peak Pellet Exposure MWD/MTU (MWD/STU)	LHGR Limit (kW / ft)
	GE14
0 (0)	10.7
16000 (14510)	10.7
63500 (57610)	6.4
70000 (63500)	4.0

Table 2.3- 3: LHGR Limit for SVEA-96+ (Two Recirculation Loop Operation)

Peak Pellet Exposure MWD/MTU (MWD/STU)	LHGR Limit (kW / ft)
	SVEA-96+
0 (0)	13.4
16000 (14510)	10.9
65000 (58970)	7.2

Table 2.3- 4: LHGR Limit for SVEA-96+ (Single Recirculation Loop Operation)

Peak Pellet Exposure MWD/MTU (MWD/STU)	LHGR Limit (kW / ft)
	SVEA-96+
0 (0)	10.7
16000 (14510)	8.7
65000 (58970)	5.7

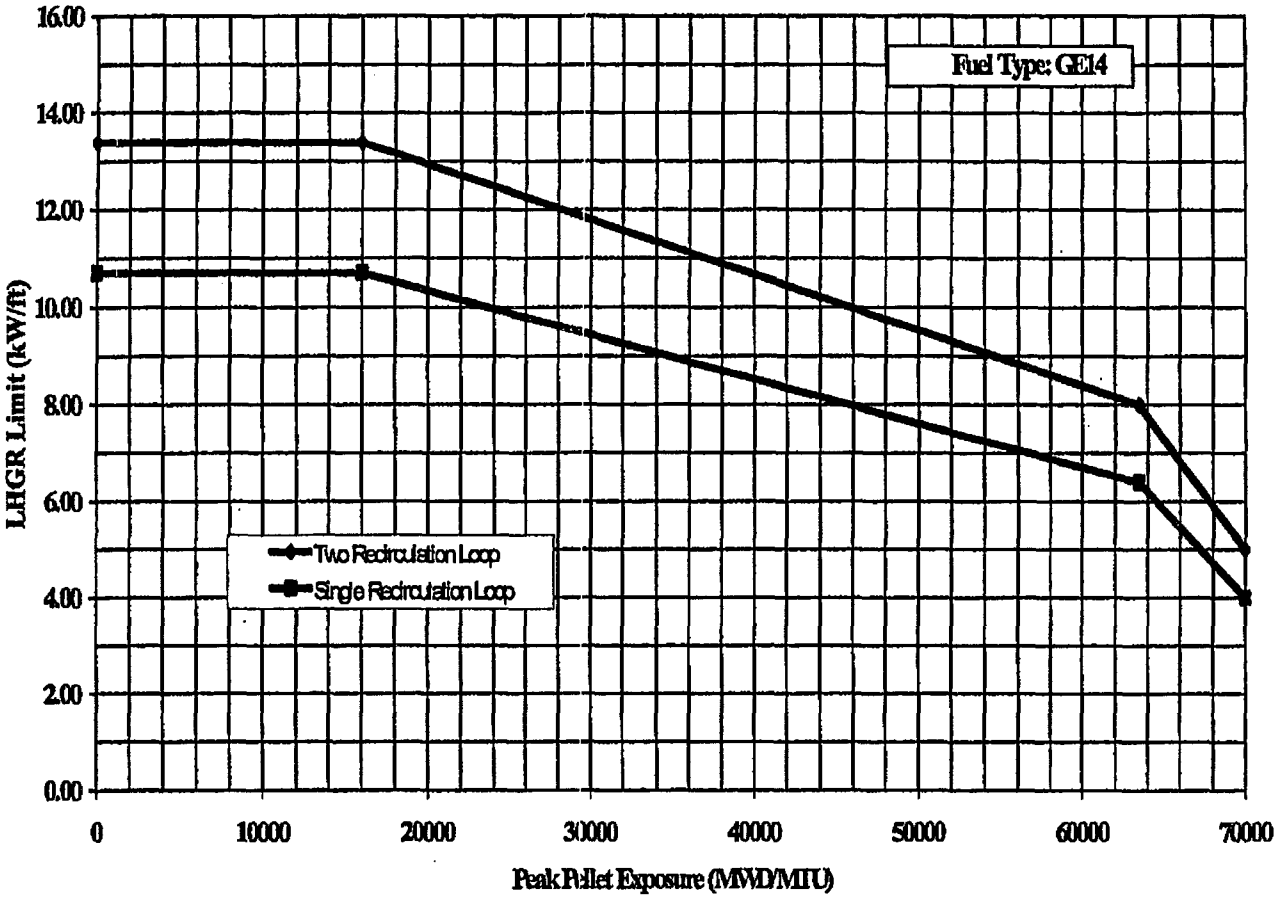


Figure 2.3- 1: LHGR Limit for GE14

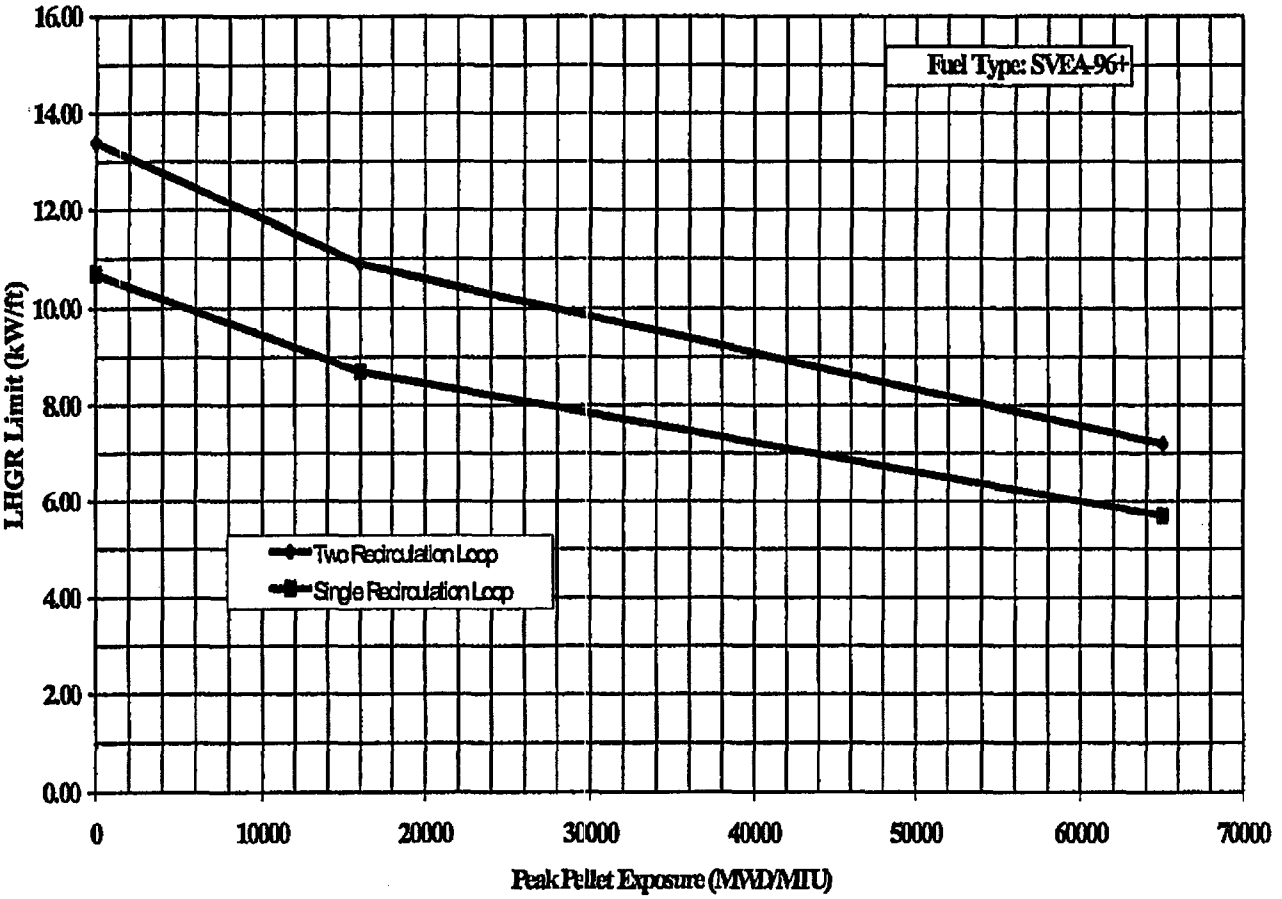


Figure 2.3- 2: LHGR Limit for SVEA-96+

2.4 OPRM TRIP SETPOINT

LIMITING CONDITION FOR OPERATION

Four channels of the OPRM instrumentation shall be OPERABLE. Each OPRM channel period based algorithm amplitude trip setpoint (Sp) shall be less than or equal to the Allowable Value of 1.09.

3.0 REFERENCES

1. Nuclear Fuel Section Design Input File HCG.5-0002,"General Electric Standard Application for Reactor Fuel," General Electric Company, NEDE-24011-P-A-14, and the U.S. Supplement NEDE-24011-P-A-14-US.

2. Nuclear Fuel Section Vendor Technical Document, NFVD-GE-2004-009-01, "Supplemental Reload Licensing Report for Hope Creek Unit 1 Reload 12 Cycle 13" GE Nuclear Energy 0000-0031-0596-SRLR, Rev. 1, December 2004.

3. Nuclear Fuel Section Design Input File HCG.5-0020, "Fuel Bundle Information Report for Hope Creek Unit 1 Reload 12 Cycle 13," 0000-0031-0596-FBIR, December 2004.

4. Nuclear Fuel Section Design Input File HCG.5-0024, "Cycle 13 Attachment to NC.NF-AP.ZZ-6004(Q) OPRM Setpoint," December 2004.

Appendix A: Method of Core Average Scram Speed Calculation

Method of Core Average Scram Speed, τ, Calculation

τ is defined as

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

where:

τ_A = 0.86 seconds, control rod average scram insertion time limit to notch 39 per Specification 3.1.3.3

$$\tau_B = 0.672 + 1.65\left[\frac{N_1}{\sum_{i=1}^{n} N_i}\right]^{1/2} (0.016)$$

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

n = number of surveillance tests performed to date in cycle,
N_i = number of active control rods measured in the i^{th} surveillance test,
τ_i = average scram time to notch 39 of all rods measured in the i^{th} surveillance test, and
N_1 = total number of active rods measured in Specification 4.1.3.2.a.

If $\tau_{ave} \leq \tau_B$, set $\tau = 0$ to apply Option B OLMCPR.

τ shall be 1.0 ($\tau = 1.0$) prior to performance of the initial scram time measurements for the cycle in accordance with Specification 4.1.3.2.