Edwin I. Hatch Nuclear Plant – Unit 1
Cycle 27 Core Operating Limits Report,
Information Letter on NSF Channel Lead Test Assemblies (LTAs), and
Information Letter on GNF-Ziron Cladding Material and Water Rod Material LTAs

Enclosure 3

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

# SOUTHERN NUCLEAR OPERATING COMPANY
# EDWIN I. HATCH NUCLEAR PLANT

## Unit 1 Cycle 27
## CORE OPERATING LIMITS REPORT

**Version 1**

Southern Nuclear Operating Company
Post Office Box 1295
Birmingham, Alabama 35201

*Non-Proprietary Information*

Edwin I. Hatch Nuclear Plant
Unit 1 Cycle 27 Core Operating Limits Report

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TABLES

## FIGURES

## 1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 1 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 (References 1 through 6). Results from the reload analyses for the fuel in Unit 1 Cycle 27 are documented in References 3 through 5.

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

Also included in this report is the maximum allowable scram setpoint for the Period Based Detection Algorithm (PBDA) in the Oscillation Power Range Monitor (OPRM).

Based upon the reload analysis for this cycle, the following operability requirement is defined for Unit 1 operation.

**TABLE 1-1**

**Main Turbine Bypass System Operability**

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

From a fuel thermal limits perspective, the following limitations are placed on Unit 1 Cycle 27 operation.

**TABLE 1-2**

**Equipment-Out-of-Service Limitations**

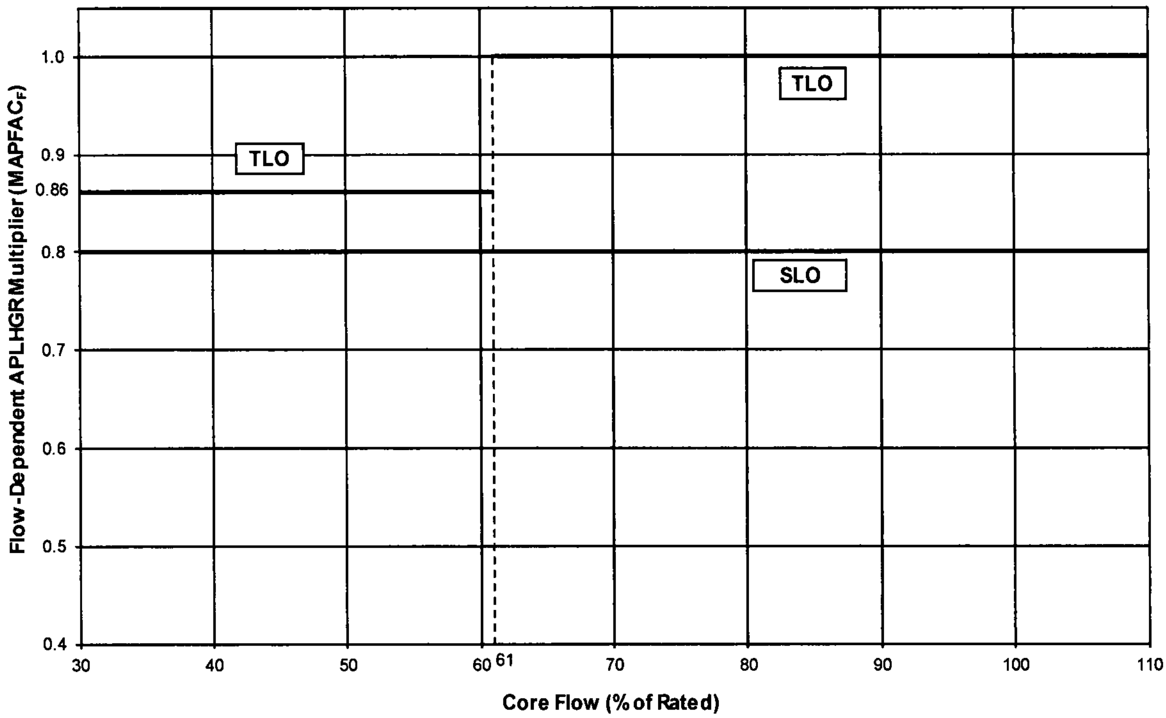
| Equipment / Condition | Limitation |
|---|---|
| EOC-RPT Out of Service and Main Turbine Bypass System Inoperable simultaneously | Option B scram speeds must be met (in place) at CTP ≥ 45% RTP |
| Main Turbine Pressure Regulator System in TLCO 3.3.13.c | Option B scram speeds must be met (in place) at CTP ≥ 45% RTP |
| Single-Loop Operation (SLO) | • CTP must be ≤ 2000 MWth<br>• Core Flow must be ≤ 56% of Rated |

**NOTE:**

The power distribution limits in this report apply to plant operation with all equipment in service, unless otherwise specified.

## 2.0 APLHGR LIMITS (Technical Specification 3.2.1)

The APLHGR limit for each six inch axial segment of each fuel assembly in the core is the applicable APLHGR limit taken from Figure 2-2 multiplied by the flow-dependent multiplier, $MAPFAC_F$, from Figure 2-1.




| Operating Conditions | | MAPFAC$_F$ |
|---|---|---|
| F | SLO / TLO | |
| $30 \leq F \leq 61$ | TLO | 0.86 |
| $61 < F$ | TLO | 1.00 |
| $30 \leq F$ | SLO | 0.80 |

F = Percent of Rated Core Flow

**FIGURE 2-1**

**Flow-Dependent APLHGR Multiplier (MAPFAC$_F$) versus Core Flow**

| Average Planar Exposure (GWd/st) | APLHGR Limit (kW/ft) |
|---|---|
| 0.00 | 12.82 |
| 14.51 | 12.82 |
| 19.13 | 12.82 |
| 57.61 | 8.00 |
| 63.50 | 5.00 |

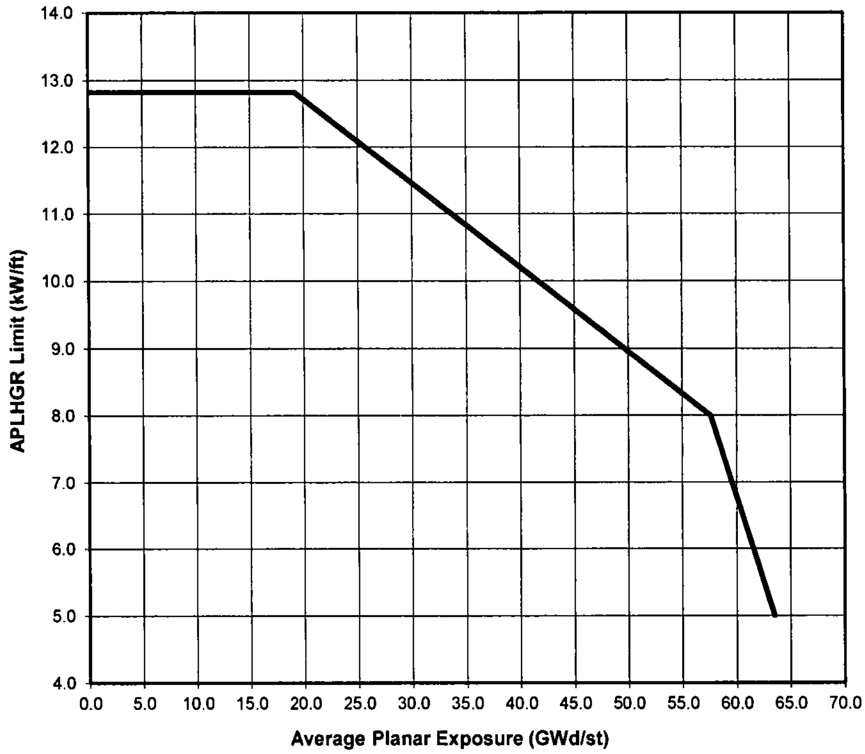



**FIGURE 2-2**

**APLHGR Limit versus Average Planar Exposure**

## 3.0 MCPR OPERATING LIMITS (Technical Specification 3.2.2)

The MCPR operating limit (OLMCPR) is a function of core power, core flow, average scram time, number of operating recirculation loops, EOC-RPT system status, operability of the main turbine bypass system, the status of the main turbine pressure regulator system, and cycle exposure. Cycle exposures are defined in Table 3-1.

With both recirculation pumps in operation (TLO), the OLMCPR is determined as follows:

a. For 24% ≤ power < 45%, the power-dependent MCPR limit, $MCPR_P$, as determined by Table 3-2.

b. For power ≥ 45%, the OLMCPR is the greater of either:

1) The flow-dependent MCPR limit, $MCPR_F$, from Figure 3-2,

or

2) The product of the power-dependent multiplier, $K_P$, and the rated-power OLMCPR, as determined by Table 3-2.

As shown on the figures for absolute MCPR, the OLMCPR with only one recirculation pump in operation (SLO) is equal to the two loop (TLO) OLMCPR plus 0.02.

These limits apply to all modes of operation with feedwater temperature reduction, as well as operation with normal feedwater temperatures.

In Figures 3-4A, 3-4B, and 3-4C, Option A scram time OLMCPRs correspond to $\tau = 1.0$, where $\tau$ 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 $\tau$. If $\tau$ has not been determined, Option A limits must be used.

The average scram time of the control rods, $\tau$, is defined as:

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

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

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

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

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

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

$N_1$ = total number of active rods measured in Technical Specifications Surveillance Requirement 3.1.4.1.

$N_i$ = 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: $\tau_i$ = average scram time to notch 36 of all rods in the $i^{th}$ surveillance test.

**TABLE 3-1**

**Exposure Definitions**

| Exposure Label | Cycle Exposure | Definition |
|---|---|---|
| BOC | Beginning of Cycle Exposure | 0 MWd/st |
| MOC1 | First Middle of Cycle Exposure | EOR - 6062 MWd/st |
| MOC2 | Second Middle of Cycle Exposure | EOR - 1062 MWd/st |
| EOR | End of Rated Exposure | Projected end of rated power with all operable control rods out at rated core flow and rated feedwater temperature |
| EOC | End of Cycle Exposure | Exposure at cycle shutdown |

**TABLE 3-2**

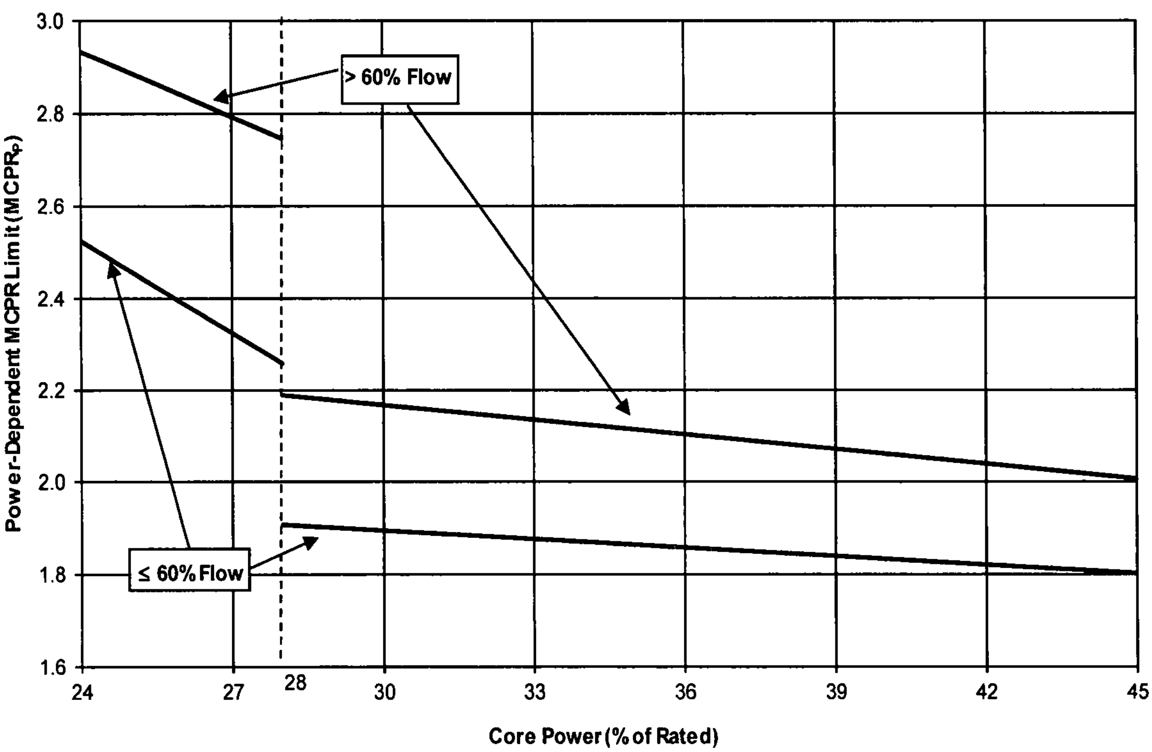
**MCPR Operating Flexibility Options**

| Rated-power OLMCPRs | |
|---|---|
| Cycle Exposure | |
| BOC to MOC1 | Figure 3-4A |
| MOC1 to MOC2 | Figure 3-4B |
| MOC2 to EOC | Figure 3-4C |

| **$MCPR_P$ from ≥ 24% to < 45% Power** | |
|---|---|
| Main Turbine Bypass System Operable* | Figure 3-1A |
| Main Turbine Bypass System Inoperable | Figure 3-1B |

| **$K_P$ for Power ≥ 45% of Rated** | | | |
|---|---|---|---|
| EOC-RPT System In Service | Main Turbine Bypass System Operable* | Main Turbine Pressure Regulator System Status | |
| Yes | Yes | TLCO 3.3.13.a or b | Figure 3-3A |
| No | Yes | TLCO 3.3.13.a or b | Figure 3-3A |
| Yes | No | TLCO 3.3.13.a or b | Figure 3-3A |
| No | No | TLCO 3.3.13.a or b | Figure 3-3B** |
| Yes/No | Yes/No | TLCO 3.3.13.c | Figure 3-3C** |

* At least two bypass valves must be operable
** Option B scram speeds must be met (in place) at CTP ≥ 45% RTP



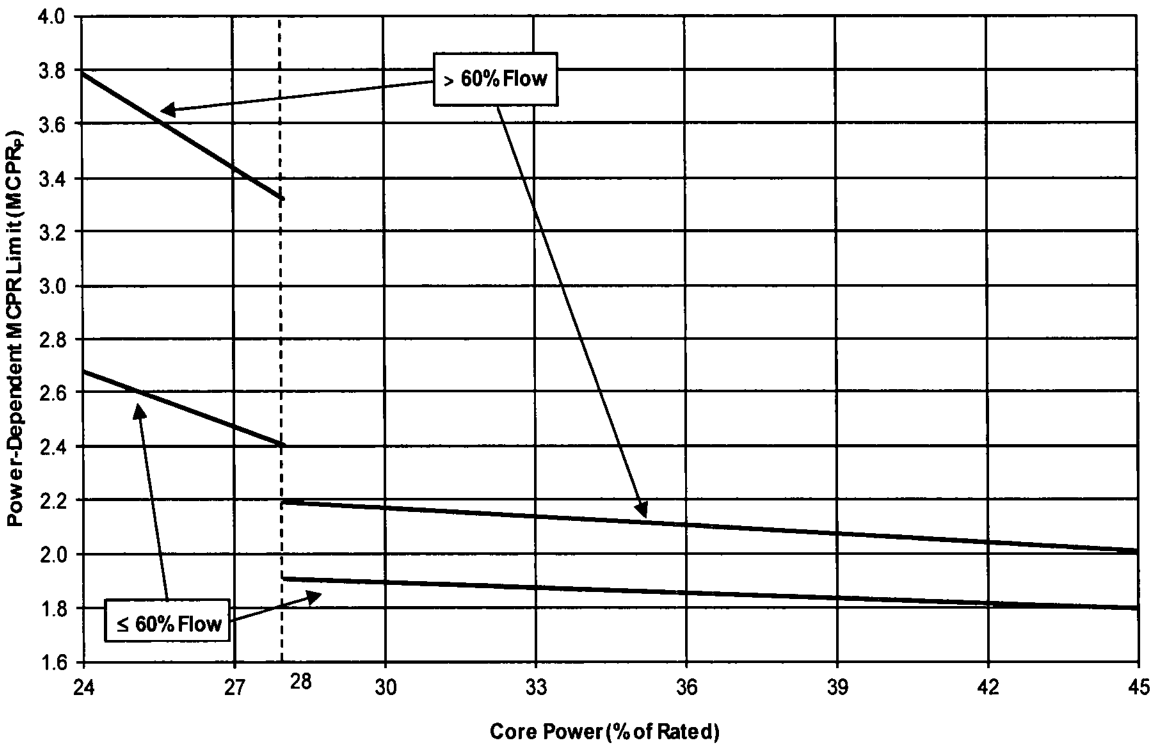

**$MCPR_P(TLO) = A + B*P$**
**$MCPR_P(SLO) = MCPR_P(TLO) + 0.02$**

| F | P | A | B |
|---|---|---|---|
| ≤ 60 | 24 ≤ P < 28 | 4.1235 | -0.06673 |
| > 60 | 24 ≤ P < 28 | 4.0635 | -0.04708 |
| ≤ 60 | 28 ≤ P < 45 | 2.0810 | -0.00624 |
| > 60 | 28 ≤ P < 45 | 2.4861 | -0.01067 |

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

**FIGURE 3-1A**

**Power-Dependent MCPR Limit ($MCPR_P$) versus Core Power from 24% to 45% of Rated Core Power**



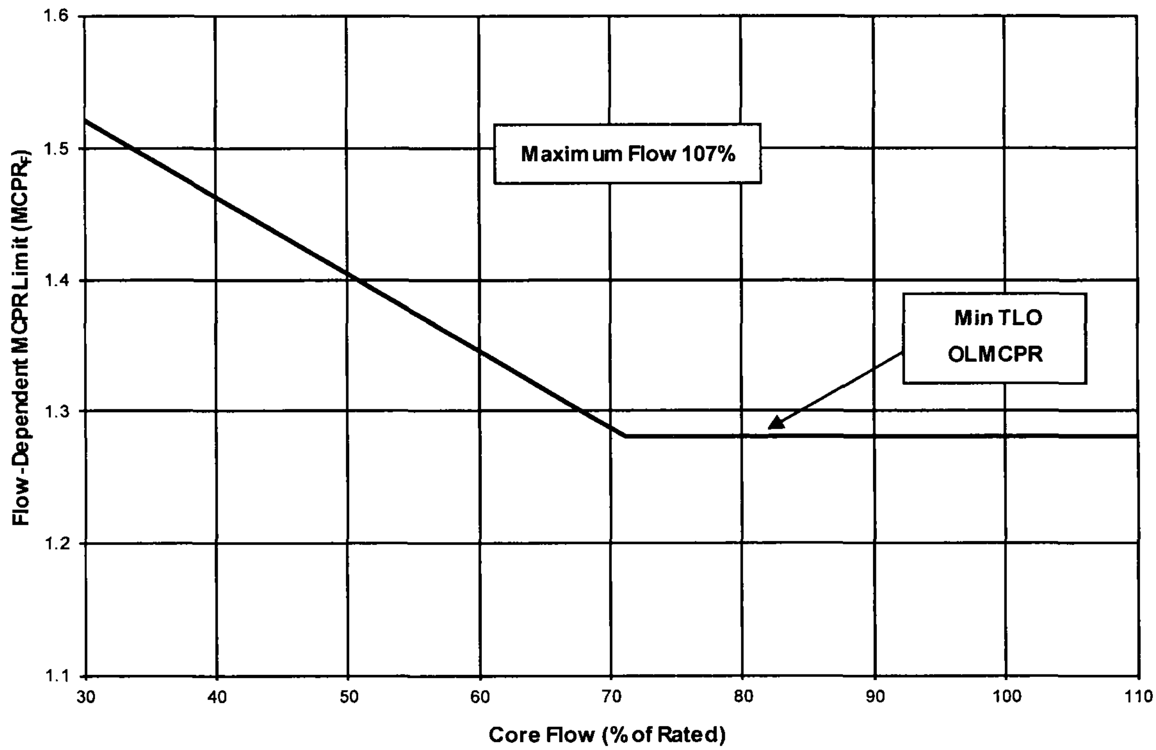

**$MCPR_P(TLO) = A + B*P$**
**$MCPR_P(SLO) = MCPR_P(TLO) + 0.02$**

| F | P | A | B |
|---|---|---|---|
| ≤ 60 | 24 ≤ P < 28 | 4.3600 | -0.07000 |
| > 60 | 24 ≤ P < 28 | 6.5876 | -0.11670 |
| ≤ 60 | 28 ≤ P < 45 | 2.0810 | -0.00624 |
| > 60 | 28 ≤ P < 45 | 2.4861 | -0.01067 |

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

**FIGURE 3-1B**

**Power-Dependent MCPR Limit ($MCPR_P$) versus Core Power from 24% to 45% of Rated Core Power**
***(Main Turbine Bypass System Inoperable)***



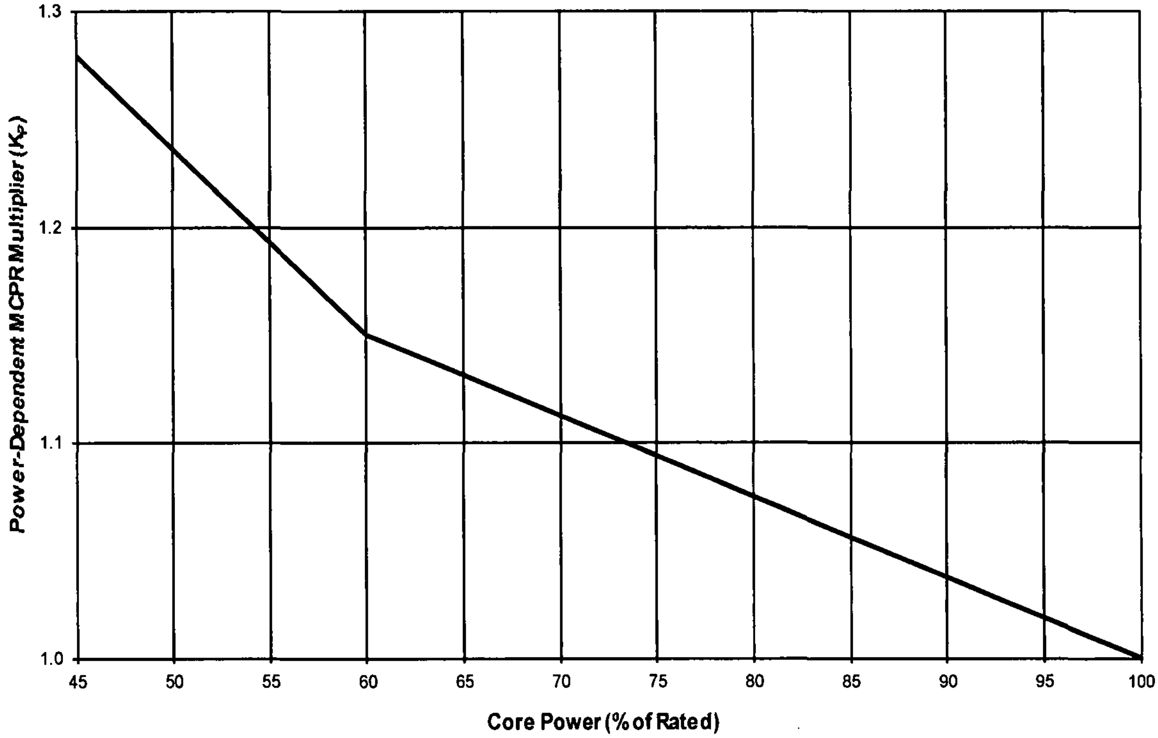

**$MCPR_F(TLO) = A + B*F$**
**$MCPR_F(SLO) = MCPR_F(TLO) + 0.02$**

| Flow | A | B |
|---|---|---|
| 30 ≤ F ≤ 71.160 | 1.697 | -0.00586 |
| 71.160 < F | 1.280 | 0.00000 |

F = Percent of Rated Core Flow

**FIGURE 3-2**

**Flow-Dependent MCPR Limit ($MCPR_F$) versus Core Flow**



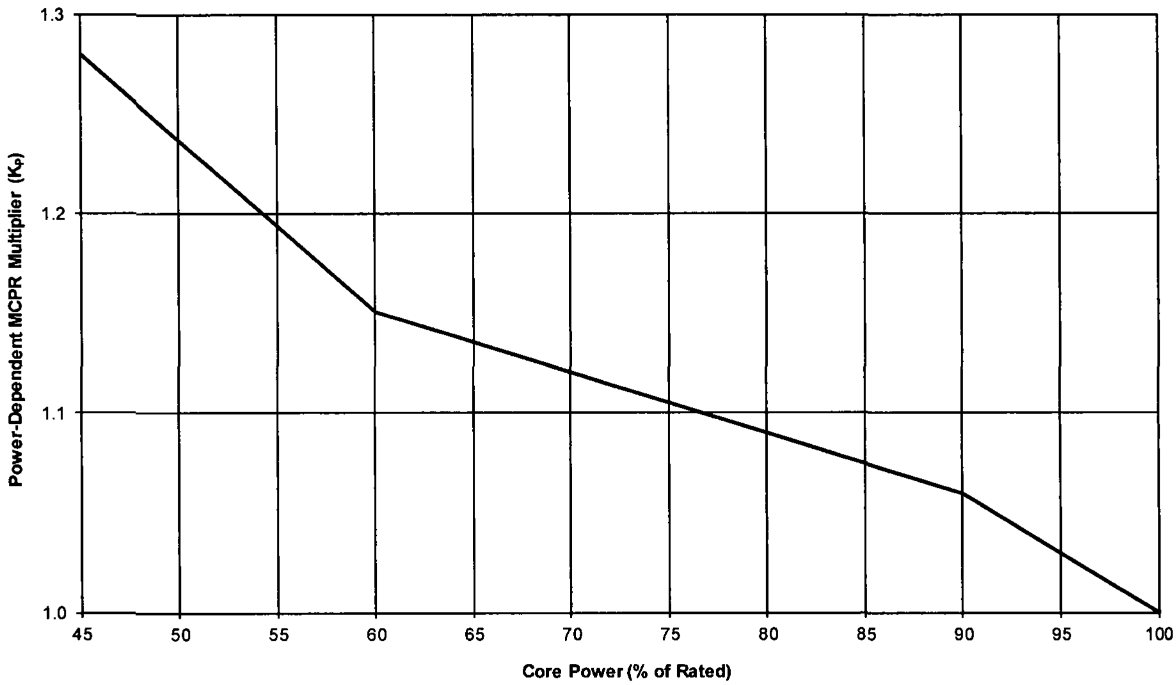

$K_P = A + B*P$

| P | A | B |
|---|---|---|
| $45 \le P < 60$ | 1.6702 | -0.00867 |
| $60 \le P$ | 1.3750 | -0.00375 |

P = Percent of Rated Core Power

**FIGURE 3-3A**

**Power-Dependent MCPR Multiplier ($K_P$) versus Core Power**
***(EOC-RPT System in Service and/or Main Turbine Bypass System operable)***



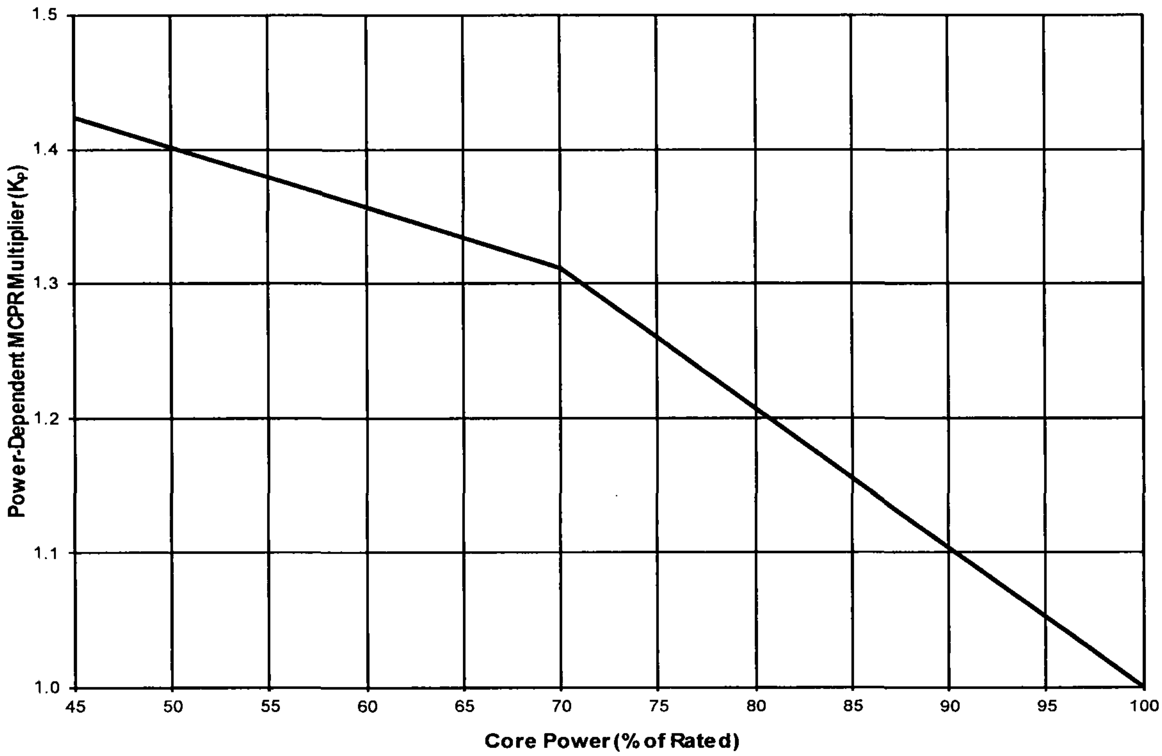

$K_P = A + B*P$

| P | A | B |
|---|---|---|
| $45 \leq P < 60$ | 1.6702 | -0.00867 |
| $60 \leq P < 90$ | 1.3308 | -0.00301 |
| $90 \leq P$ | 1.5961 | -0.00596 |

P = Percent of Rated Core Power

**FIGURE 3-3B**

**Power-Dependent MCPR Multiplier ($K_P$) versus Core Power**
***(EOC-RPT System Out of Service and Main Turbine Bypass System Inoperable Simultaneously)***



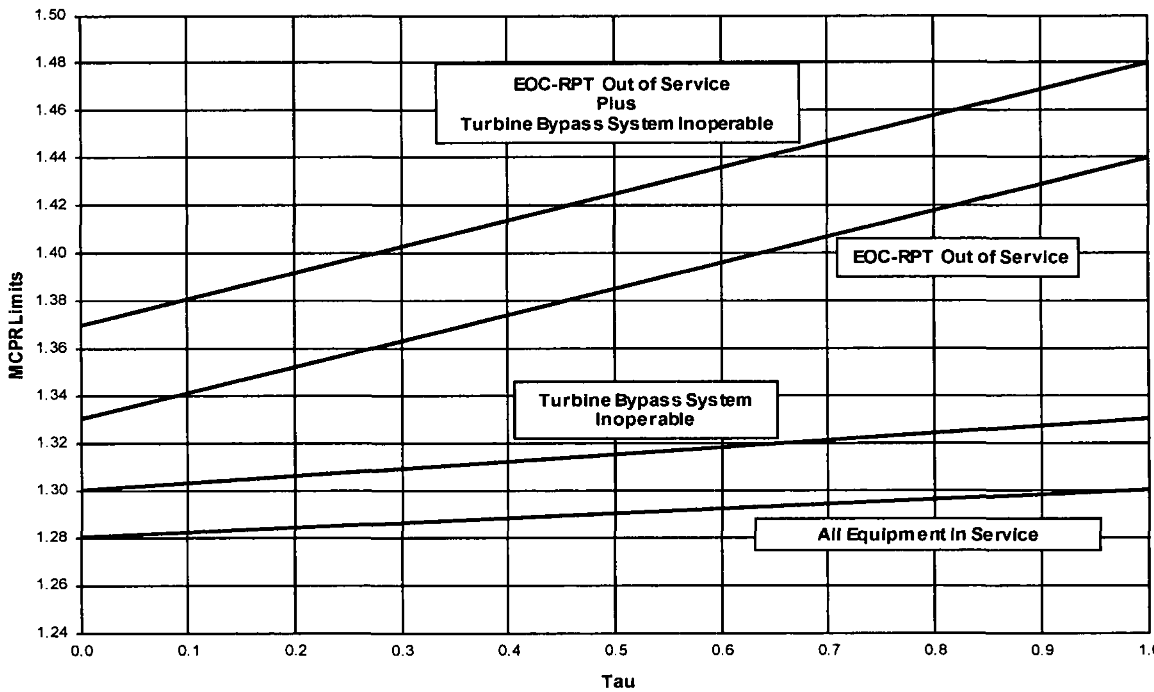

$K_P = A + B*P$

| P | A | B |
|---|---|---|
| $45 \leq P < 70$ | 1.6268 | -0.00451 |
| $70 \leq P$ | 2.0367 | -0.01037 |

P = Percent of Rated Core Power

**FIGURE 3-3C**

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

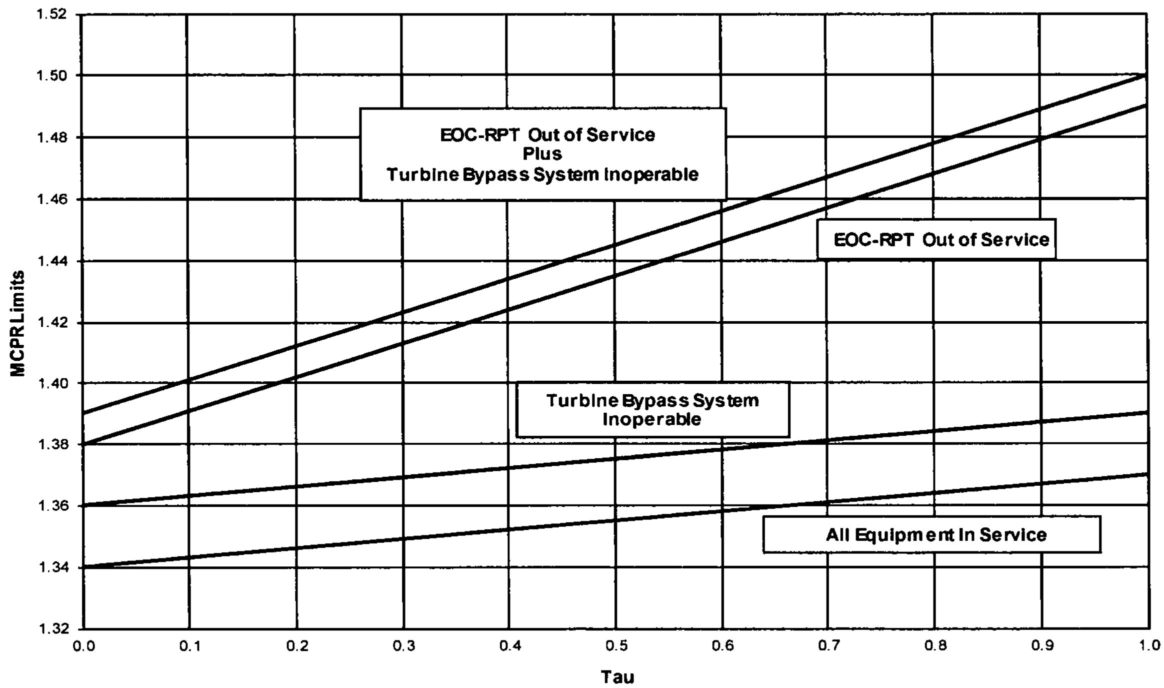



**OLMCPR(SLO) = OLMCPR(TLO) + 0.02**

| Operating Conditions | | OLMCPR(TLO) | |
|---|---|---|---|
| **EOC-RPT** | **Bypass Valve System** | **$\tau$ = 0.0** | **$\tau$ = 1.0** |
| In Service | Operable | 1.28 | 1.30 |
| Out of Service | Operable | 1.33 | 1.44 |
| In Service | Inoperable | 1.30 | 1.33 |
| Out of Service | Inoperable | 1.37 | 1.48 |

**FIGURE 3-4A**

**MCPR Limits versus Average Scram Time**
***(BOC to MOC1)***

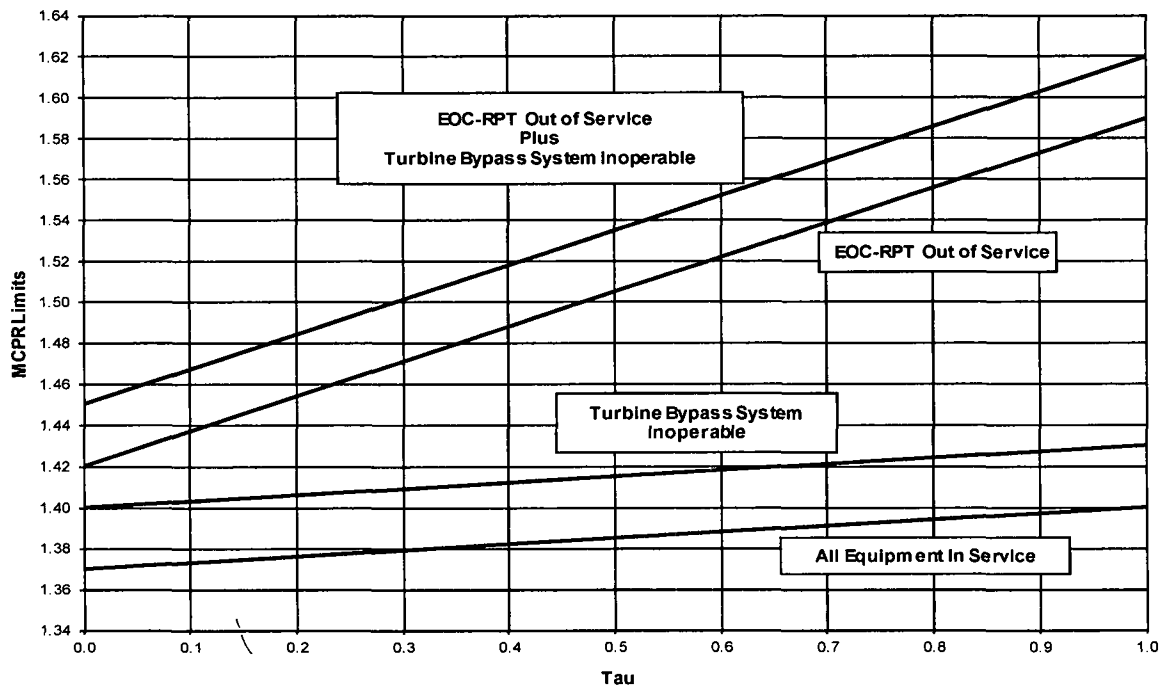



**OLMCPR(SLO) = OLMCPR(TLO) + 0.02**

| Operating Conditions | | OLMCPR(TLO) | |
|---|---|---|---|
| **EOC-RPT** | **Bypass Valve System** | **$\tau$ = 0.0** | **$\tau$ = 1.0** |
| In Service | Operable | 1.34 | 1.37 |
| Out of Service | Operable | 1.38 | 1.49 |
| In Service | Inoperable | 1.36 | 1.39 |
| Out of Service | Inoperable | 1.39 | 1.50 |

**FIGURE 3-4B**

**MCPR Limits versus Average Scram Time**
***(MOC1 to MOC2)***




**OLMCPR(SLO) = OLMCPR(TLO) + 0.02**

| Operating Conditions | | OLMCPR(TLO) | |
|---|---|---|---|
| **EOC-RPT** | **Bypass Valve System** | **$\tau = 0.0$** | **$\tau = 1.0$** |
| In Service | Operable | 1.37 | 1.40 |
| Out of Service | Operable | 1.42 | 1.59 |
| In Service | Inoperable | 1.40 | 1.43 |
| Out of Service | Inoperable | 1.45 | 1.62 |

**FIGURE 3-4C**

**MCPR Limits versus Average Scram Time**
***(MOC2 to EOC)***

## 4.0 LHGR LIMITS (Technical Specification 3.2.3)

The LHGR 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 4-2 multiplied by the smaller of either:

a. The flow-dependent multiplier, $LHGRFAC_F$, from Figure 4-1,

or

b. The power-dependent multiplier, $LHGRFAC_P$, as determined by Table 4-1.

Table 4-2 shows the exposure-dependent LHGR limits as a function of initial gadolinium concentrations in a six inch segment of a fuel rod. For exposures between the values shown in Table 4-2, the LHGR limit is based on linear interpolation. For illustration purposes, Figure 4-3 shows the LHGR limits for fuel segments with the lowest ($UO_2$) and the highest ($UO_2$+$Gd_2O_3$) initial Gd concentration.

**TABLE 4-1**

**LHGR Operating Flexibility Options**

| **$LHGRFAC_P$** | |
|---|---|
| Main Turbine Pressure Regulator System Status | |
| TLCO 3.3.13.a or b | Figure 4-2A |
| TLCO 3.3.13.c | Figure 4-2B* |

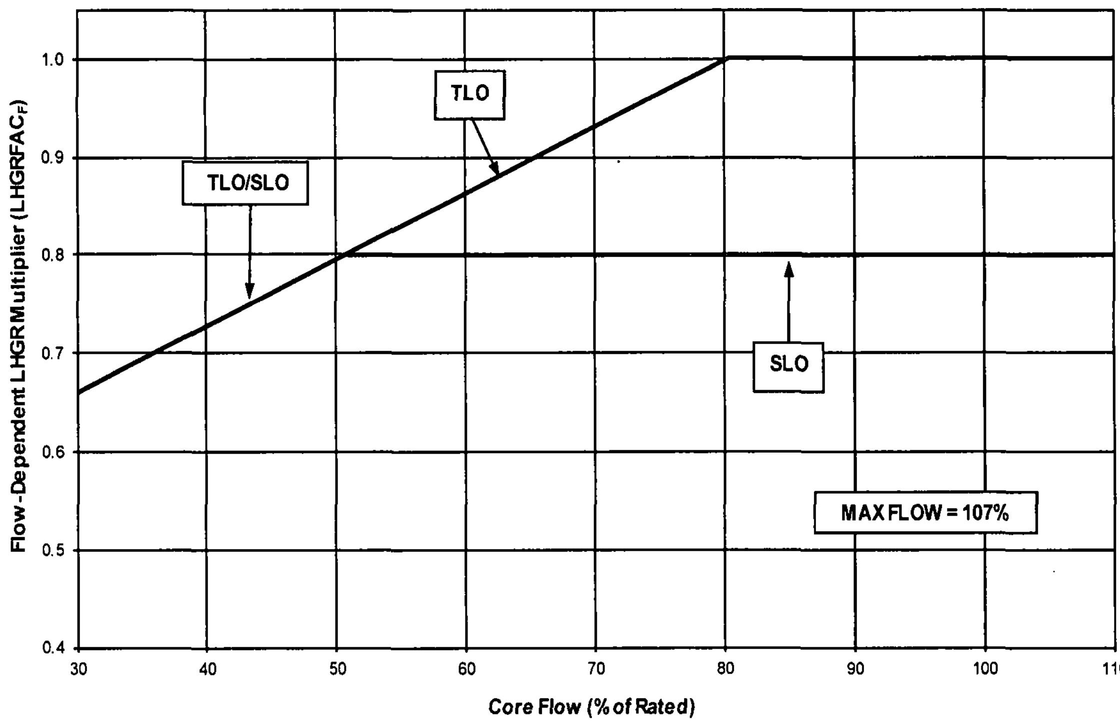
* Option B scram speeds must be met (in place) at CTP ≥ 45% RTP

**TABLE 4-2**

**LHGR Limit versus Peak Pellet Exposure**

| ***Initial* Rod/Section Wt-% $Gd_2O_3$** | **Pellet Maximum Power (kW/ft)** | **Pellet Exposure Knee 1 (GWd/st)** | **Pellet Power at Knee 2 (kW/ft)** | **Pellet Exposure Knee 2 (GWd/st)** | **Pellet Power at EOL (kW/ft)** | **Pellet Exposure at EOL (GWd/st)** |
|---|---|---|---|---|---|---|
| [[ | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | ]] |

Section = Six inch segment of a fuel rod.
EOL = End of Life (maximum licensed pellet exposure)



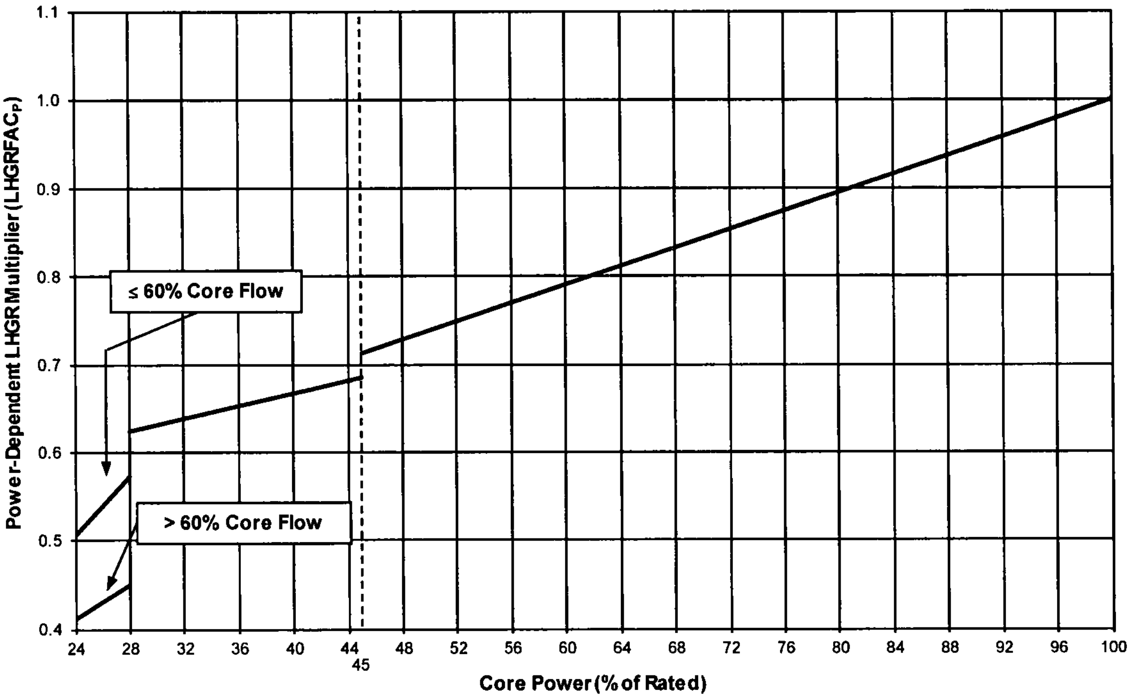

**$LHGRFAC_F = A + B*F$**

| Operating Conditions | | Values of Variables | |
|---|---|---|---|
| **F** | **SLO / TLO** | **A** | **B** |
| 30 ≤ F < 50.70 | SLO / TLO | 0.4574 | 0.006758 |
| 50.70 ≤ F < 80.29 | TLO | 0.4574 | 0.006758 |
| 50.70 ≤ F | SLO | 0.8000 | 0.000000 |
| 80.29 ≤ F | TLO | 1.0000 | 0.000000 |

F = Percent of Rated Core Flow

**FIGURE 4-1**

**Flow-Dependent LHGR Multiplier ($LHGRFAC_F$) versus Core Flow**



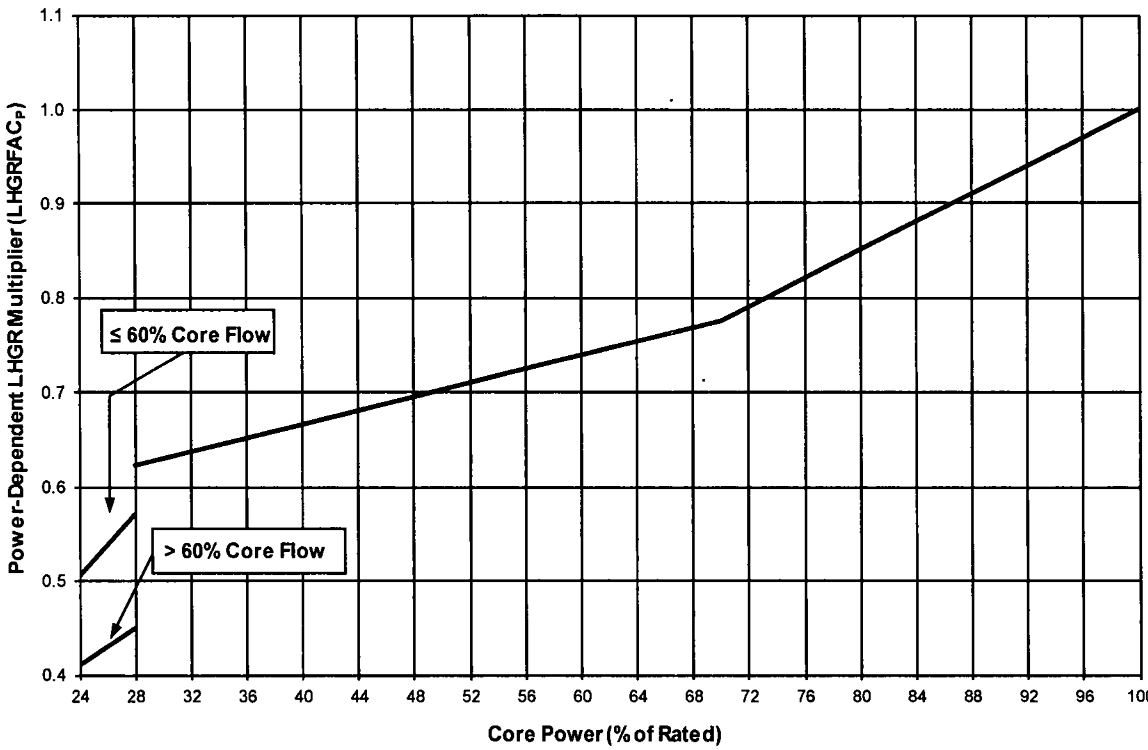

$LHGRFAC_P = A + B*P$

| Operating Conditions | | Values of Variables | |
|---|---|---|---|
| P | F | A | B |
| 24 ≤ P < 28 | F > 60 | 0.17924 | 0.009670 |
| 24 ≤ P < 28 | F ≤ 60 | 0.10366 | 0.016741 |
| 28 ≤ P < 45 | All | 0.52261 | 0.003617 |
| 45 ≤ P | All | 0.47760 | 0.005224 |

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

**FIGURE 4-2A**

**Power-Dependent LHGR Multiplier (LHGRFAC$_P$) versus Core Power**
***(Main Turbine Bypass System Operable or Inoperable)***




**$LHGRFAC_P = A + B*P$**

| Operating Conditions | | Values of Variables | |
|---|---|---|---|
| P | F | A | B |
| 24 ≤ P < 28 | F > 60 | 0.17924 | 0.009670 |
| 24 ≤ P < 28 | F ≤ 60 | 0.10366 | 0.016741 |
| 28 ≤ P < 70 | All | 0.52261 | 0.003617 |
| 70 ≤ P | All | 0.25270 | 0.007473 |

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

**FIGURE 4-2B**

**Power-Dependent LHGR Multiplier ($LHGRFAC_P$) versus Core Power**
***(Main Turbine Bypass System Operable or Inoperable and Main Turbine Pressure Regulator System in TLCO 3.3.13.c)***

[[

| Lowest Initial Gd Conc. | |
|---|---|
| Peak Pellet Exposure (GWd/st) | LHGR (kW/ft) |
| [[ | |
| | |
| | |
| | ]] |

| Highest Initial Gd Conc. | |
|---|---|
| Peak Pellet Exposure (GWd/st) | LHGR (kW/ft) |
| [[ | |
| | |
| | |
| | ]] |

]]

**FIGURE 4-3**

**LHGR versus Peak Pellet Exposure**

## 5.0 PBDA AMPLITUDE SETPOINT

The amplitude trip setpoint in the Period Based Detection Algorithm in the OPRM system shall not exceed the value reported in the Table below. This applies to instruments 1C51K615 A, B, C, and D.

**TABLE 5-1**

**OPRM Setpoint**

| OLMCPR | OPRM Setpoint |
|---|---|
| ≥ 1.28 | 1.15 |

## 6.0 REFERENCES

1. "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-19, May 2012, and the US Supplement, NEDE-24011-P-A-19-US, May 2012.

2. GNF letter VSP-SNC-GEN-13-101, "Hatch 1 Cycle 27 SRLR/FBIR 000N0481 R0," Vickie S. Perry to S. Hoxie-Key, December 11, 2013.

3. Global Nuclear Fuel Document 000N0481-SRLR, "Supplemental Reload Licensing Report for Edwin I. Hatch Nuclear Power Plant Unit 1, Reload 26 Cycle 27," Revision 0, December 2013.

4. Global Nuclear Fuel Document 000N0481-FBIR, "Fuel Bundle Information Report for Edwin I. Hatch Nuclear Power Plant Unit 1, Reload 26 Cycle 27," Revision 0, December 2013.

5. SNC Nuclear Fuel Document NF-13-171, "Hatch-1 Cycle 27 Reload Licensing Analysis Report," Version 1, December 2013.

6. GNF Document NEDC-32868P, "GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II)," Rev. 5, May 2013.

Edwin I. Hatch Nuclear Plant – Unit 1
Cycle 27 Core Operating Limits Report,
Information Letter on NSF Channel Lead Test Assemblies (LTAs), and
Information Letter on GNF-Ziron Cladding Material and Water Rod Material LTAs

Enclosure 4

LTA Information Letter Eight NSF Channel Assemblies

## Description of Lead Test Assemblies

Eight LTAs were loaded into the Plant Hatch Unit 1 at the beginning of Cycle 27. The GNF supplied assemblies contain standard GE14 components and fuel with the exception of the channel. The channels were manufactured with a distortion-resistant material known as NSF. The term NSF reflects the presence of Niobium (Nb), Tin (Sn) and Iron (Fe) as the primary alloying metals combined with Zirconium. Similar Zirconium-Niobium alloys are commonly used in PWR and Russian plants, but not commercially used in BWRs.

The NSF alloy is resistant to channel bowing and has a much lower sensitivity to cold-work compared to Zircaloy. The mechanical properties of NSF are similar to the standard Zircaloys, and are considered adequate for reactor service. Corrosion performance of NSF is adequate based on visual and hot-cell examinations after six years of operation.

The surface condition of these NSF channels has been modified compared to the previous NSF channels irradiated in Hatch 2. The NSF channels inserted in Plant Hatch Unit 1 Cycle 27 have a pre-oxidized surface condition similar to the pre-oxidized surface condition that was standard on Zircaloy-4 channels prior to 1990. The previously discharged NSF channels and current operating NSF channels in Plant Hatch Unit 2 had the standard etched-surface condition.

## Applicability of GESTAR

GNF has reviewed the properties of the NSF channels relative to the properties of Zircaloy-2 and Zircaloy-4 in the context of required functions, including safety, of fuel channels as described in GESTAR and the relevant LTRs. GNF has concluded that the use of NSF as a channel material meets the approved criteria of GESTAR and NRC-approved methods are applicable. Therefore, NSF channels may be used in an LTA.

## Objectives of LTA Program

The objectives of this program are to expand the experience base on Pre-Ox NSF channels and to confirm that the corrosion performance of the pre-oxidized surface condition is equivalent to the standard etched-surface condition. Inspection results of NSF channels currently in operation in other domestic BWRs are expected to be evaluated to confirm the expected lower irradiation growth characteristics of this material as well as validate adequate resistance to shadow corrosion-induced bow and bulge. Standard analyses will be performed to assure that the safety and licensing bases are maintained.

## Outline of Measurements

Corrosion performance will be evaluated after discharge.

**REFERENCES:**

1. NEDE-24011-P-A-20 & NEDE-24011-P-A-20-US, *General Electric Standard Application for Reactor Fuel & Supplement for United States*, (GESTAR II, Licensing Topical Report).
2. Letter from T.A. Ippolito (NRC) to R.E. Engel (GE), *Lead Test Assembly Licensing*, September 23, 1981

Edwin I. Hatch Nuclear Plant – Unit 1
Cycle 27 Core Operating Limits Report,
Information Letter on NSF Channel Lead Test Assemblies (LTAs), and
Information Letter on GNF-Ziron Cladding Material and Water Rod Material LTAs

Enclosure 5

LTA Information Letter GNF-Ziron Cladding Material and
Water Rod Material Assembly

**Description of Lead Test Assemblies**

Two lead test assemblies (LTAs), with selected fuel rods (29 rod in each assembly) fabricated from GNF-Ziron cladding material were loaded into Plant Hatch Unit 2 during Cycle 21, with planned operation through Cycles 22 and 23. The LTAs completed operation in Plant Hatch Unit 2 during Cycles 21 and 22, but these LTAs were not in operation during Cycle 23. SNC is irradiating one of these LTAs in Plant Hatch Unit 1 during Cycle 27. Due to issues unrelated to the cladding material inspection results, the other LTA is not being used during Unit 1 Cycle 27. These GNF-supplied fuel assemblies are standard GE14 fuel assemblies with the exception of the cladding material and water rod material. GNF-Ziron is a zirconium-based alloy with composition very similar to the industry standard Zircaloy-2 but with increased iron content. The dimensions and processing of all assembly components are identical to the standard GE14 assemblies.

GE14 fuel is licensed according to criteria and requirements specified in GESTAR II (General Electric Standard Application For Reactor Fuel, NEDE-24011-P-A), as reported in the GE14 compliance report (GE14 Compliance With Amendment 22 of NEDE- 24011-P-A, NEDC-32868P, Rev. 5). The GE14 compliance report states that the GE14 fuel cladding and water rods are made of Zircaloy-2. Because the composition of GNF-Ziron falls outside of the ASTM-specification ranges for Zircaloy-2, the current GE14 compliance report does not cover the use of GNF-Ziron for reload applications. Specific approval from the NRC on the use of GNF-Ziron as cladding material is therefore required before the alloy can be deployed in reload quantities; in addition, an amendment to the GE14 compliance report will be needed. GNF has submitted a Licensing Topical Report (LTR) (Reference 1) to the NRC to seek approval for the use of GNF-Ziron as cladding material. The LTR has not yet been approved by the NRC. In the absence of specific approval from the NRC, Reference 2 discusses how LTAs may be loaded provided LTAs are analyzed with approved methods. However, 10 CFR Part 50, Section 50.46 and Appendix K specifically address cladding material made from Zircaloy or Zirlo. As GNF-Ziron is not a Zircaloy, exemptions to the requirements of 10 CFR Part 50, Section 50.46 and Appendix K were submitted to the NRC in 2008 (Reference 3) supporting the LTAs operation starting in 2009 in Plant Hatch Unit 2. Accordingly, two GE14 GNF-Ziron LTAs were loaded into Unit 2 per provisions in 10 CFR Part 50, Section 50.59 and were irradiated in Cycles 21 and 22. Subsequently, in 2013, an additional exemption request was submitted (Reference 4) to support further irradiation of these LTAs for one or more additional cycles in Unit 1 or Unit 2 of the Edwin I. Hatch Nuclear Plant.

A more detailed description of GNF-Ziron material, including its key properties, is given in both the submitted LTR (Reference 1) and SNC's first exemption request submitted in 2008 (Reference 3). A discussion on the applicability of approved methods to GNF-Ziron cladding is given in References 1 and 5. As discussed in Reference 1, GNF's approved methods remain applicable to, and unaffected by, incorporation of GNF-Ziron. In support of the Reference 4 application for exemption from 10 CFR Part 50, Section 50.46 and Appendix K requirements to use Zircaloy fuel cladding, information on the high temperature oxidation behavior of GNF-Ziron pertaining to postulated loss-of coolant accident (LOCA) considerations are provided in Reference 5. The exemption request was approved by the NRC on February 4, 2014 (Reference 6).

**Objectives of LTA Program**

The objective of the LTA program at Plant Hatch is to obtain operational experience with GNF-Ziron cladding and water rod material. The performance of GNF-Ziron under normal operating conditions is expected to be similar to that of Zircaloy-2. The LTA program will provide confirmation on the GNF-Ziron performance.

**Outline of Measurements**

Since obtaining operational experience with GNF-Ziron is the main objective of the Plant Hatch LTA program, poolside inspections (e.g., visual, eddy current liftoff, and profilometry) will be conducted on selected rods.

**References**

1. "Application of GNF-Ziron to GNF Fuel Designs," NEDC-33353P and NEDO-33353, December 22, 2010, MFN 10-358.
2. NRC Letter, "Lead Test Assembly Licensing," T. A. Ippolito (NRC) to R. E. Engel, September 23, 1981.
3. SNC Letter to NRC, "Edwin I. Hatch Nuclear Plant - Unit 2 Submittal of Additional Information to Support Proposed Exemption to 10 CFR 50.46 and 10 CFR 50 Appendix K to Allow Ziron Fuel Cladding", September 22, 2008, ML082681156.
4. SNC Letter NL-13-0402, "Edwin I. Hatch Nuclear Plant Proposed Exemption to 10 CFR 50.46 and 10 CFR 50 Appendix K to Allow GNF-Ziron Fuel Cladding," C. R. Pierce to USNRC, April 23, 2013.
5. "Technical Basis Supporting GNF-Ziron Lead Test Assembly Introduction into the Hatch Nuclear Plant" in License support letter for GNF-Ziron LTA at Hatch, eDRFsection 0000-0079-7396, as attachment in Reference 3.
6. NRC Letter, "Edwin I. Hatch Nuclear Plant, Unit Nos 1 and 2, Exemption from the Requirements of 10 CFR Part 50, Section 50.46, and Appendix K (TAC Nos. MF1479 and MF1480)", R. E. Martin to C. R. Pierce, February 4, 2014, ML13354B755.