Nebraska Public Power District
Always there when you need us

NLS2006090
November 5, 2006

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: Core Operating Limits Report, Cycle 24, Revision 0
Cooper Nuclear Station, Docket No. 50-298, DPR-46

The purpose of this letter is to provide to the Nuclear Regulatory Commission (NRC) the Core Operating Limits Report (COLR) for Cooper Nuclear Station (CNS) for Cycle 24. CNS Technical Specification 5.6.5.d requires that the COLR, including any midcycle revisions or supplements, be provided to the NRC upon issuance for each reload cycle. The COLR for CNS Cycle 24 contains no proprietary information.

In accordance with 10 CFR 50.4(b)(1), we are also transmitting a copy of this COLR to the Regional Office and to the NRC Senior Resident Inspector.

Should you have any questions regarding this matter, please contact Mr. Paul Fleming at (402) 825-2774.

Sincerely,

Paul V. Fleming
Licensing Manager

/lb

Enclosure

cc: Regional Administrator w/enclosure
USNRC - Region IV

Cooper Project Manager w/enclosure
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector w/enclosure
USNRC - CNS

NPG Distribution w/o enclosure

CNS Records w/enclosure

COOPER NUCLEAR STATION
P.O. Box 98 / Brownville, NE 68321-0098
***Telephone:** (402) 825-3811 / **Fax:** (402) 825-5211*
www.nppd.com

A001

NLS2006090
Enclosure

ENCLOSURE

CORE OPERATING LIMITS REPORT

CYCLE 24, REVISION 0

COOPER NUCLEAR STATION

DOCKET No. 50-298, DPR-46

COOPER NUCLEAR STATION

CORE OPERATING LIMITS REPORT

Cycle 24

Revision 0

	Print	Sign	Date
Preparer	Lorne Covington		10/25/06
Reviewer	Christine Parkyn		10/25/06
Fuels and Reactor Engineering Manager	George Griffith		10/25/06

REVISION HISTORY

Revision	Date	Description
0	25Oct06	Original issue

TABLE OF CONTENTS

Section		Page
1.0	INTRODUCTION	5
2.0	AVERAGE PLANAR LINEAR HEAT GENERATION RATE	6
2.1	Technical Specification Reference	6
2.2	Two Recirculation Loop Operation	6
2.3	Single Recirculation Loop Operation	7
3.0	MINIMUM CRITICAL POWER RATIO	11
3.1	Technical Specification Reference	11
3.2	Two Recirculation Loop Operation	11
3.3	Application of Scram Time Surveillance Data to OLMCPR(100)	12
3.4	Single Recirculation Loop Operation	13
3.5	Use of Full Arc Turbine Control Valve	14
4.0	TURBINE BYPASS SYSTEM RESPONSE TIME	18
4.1	Technical Specification Reference	18
4.2	System Response Time	18
5.0	ROD BLOCK MONITOR TRIP SETPOINTS	18
5.1	Technical Specification Reference	18
5.2	Trip Setpoints	18
6.0	MAXIMUM LINEAR HEAT GENERATION RATE	20
6.1	Technical Requirements Manual Reference	20
6.2	Two Recirculation Loop Operation	20
6.3	Single Recirculation Loop Operation	21
7.0	STABILITY POWER/FLOW MAP	29
7.1	Technical Specification Reference	29
7.2	Stability Exclusion Region	29
8.0	REFERENCES	32

LIST OF TABLES

Table		Page
2-1	$MAPLHGR_{STD}$ Values By Fuel Bundle Type	8
3-1	OLMCPR Values for OLMCPR(100) Calculation	15
5-1	Rod Block Monitor Channel Settings	19
6-1	$LHGR_{STD}$ Values By Fuel Bundle Type	22

LIST OF FIGURES

Figure		Page
2-1	Power Dependent MAPFAC(P) and LHGRFAC(P) Multiplier	9
2-2	Flow Dependent MAPFAC(F) and LHGRFAC(F) Multiplier	10
3-1	Power Dependent K(P) and MCPR(P) for GE14 Fuel with Safety Limit = 1.12	16
3-2	Flow Dependent MCPR(F) for GE14 Fuel with Safety Limit = 1.12	17
7-1	Stability Exclusion Region Map	31

1. INTRODUCTION

The Core Operating Limits Report (COLR) provides the limits for operation of the Cooper Nuclear Station for Cycle 24. Cooper Nuclear Station Technical Specification 5.6.5(a) requires the COLR to contain the following limits:

- The Average Planar Linear Heat Generation Rate for Specification 3.2.1,
- The Minimum Critical Power Ratio for Specifications 3.2.2 and 3.7.7,
- The three Rod Block Monitor Upscale Allowable Values for Specification 3.3.2.1,
- The power/flow map defining the Stability Exclusion Region for Specification 3.4.1.

In addition, the following information is required to be in the COLR:

- Turbine Bypass System response time for Surveillance Requirement 3.7.7.3,
- Maximum allowable Linear Heat Generation Rate (LHGR) for Technical Requirements Manual Specification T3.2.1.

The analytical methods used to determine the core operating limits are those previously reviewed and approved by the NRC as required by Technical Specification 5.6.5(b). These methods are:

- NEDE-24011-P-A-15, "General Electric Standard Application for Reactor Fuel", September 2005 (Reference 1),
- NEDE-23785-1-P-A, "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-of-Coolant Accident", Volume III, Revision 1, October 1984 (Reference 2),
- NEDO-31960-A and NEDO-31960-A Supplement 1, "BWR Owner's Group Long-Term Stability Solutions Licensing Methodology", November 1995 (Reference 3).

2. AVERAGE PLANAR LINEAR HEAT GENERATION RATE

2.1 Technical Specification Reference

Technical Specification 3.2.1.

2.2 Two Recirculation Loop Operation

During steady-state power operation, the maximum Average Planar Linear Heat Generation Rate (MAPLHGR), as a function of fuel bundle type, axial location, and average planar exposure, shall not exceed the applicable limiting value.

The maximum allowable Average Planar Linear Heat Generation Rate with two recirculation loops in operation is defined as follows:

MAPLHGR Limit = minimum [MAPLHGR(P), MAPLHGR(F)]

where,

MAPLHGR(P) = $MAPLHGR_{STD}$ * MAPFAC(P),

MAPLHGR(F) = $MAPLHGR_{STD}$ * MAPFAC(F),

$MAPLHGR_{STD}$ = Fuel bundle type and exposure dependent MAPLHGR values for rated core power and flow conditions represented by the values shown in Table 2-1,

MAPFAC(P) = Core power dependent multiplier shown in Figure 2-1,

MAPFAC(F) = Core flow rate dependent multiplier shown in Figure 2-2.

The $MAPLHGR_{STD}$ values presented in Table 2-1 are the most limiting values for each fuel bundle type from the exposure dependent values defined in Reference 6. The values in Table 2-1 are intended only for use in hand calculations as described in Technical Specification 3.2.1. The actual $MAPLHGR_{STD}$ values defined in Reference 6 are utilized in the process computer. The process computer will be used to verify the MAPLHGR limits for each fuel bundle type are not violated.

The MAPFAC(P) and MAPFAC(F) multipliers presented in Figure 2-1 and Figure 2-2, respectively, are defined in Reference 5.

No thermal limits monitoring is required below 25% of rated power. Therefore, the MAPLHGR limit defined above is only applicable for core conditions at or above 25% of rated power.

2.3 Single Recirculation Loop Operation

The maximum allowable Average Planar Linear Heat Generation Rate with one recirculation loop in operation (SLO) is defined as follows:

MAPLHGR Limit = minimum [MAPLHGR(P), MAPLHGR(F), MAPLHGR(SLO)]

where,

MAPLHGR(SLO) = $MAPLHGR_{STD}$ * MAPFAC(SLO),

MAPFAC(SLO) = Single loop operation MAPLHGR multiplier,

and MAPLHGR(P) and MAPLHGR(F) are as defined in Section 2.2 above.

As shown above, it is not necessary to apply both the off-rated (MAPFAC(P) and MAPFAC(F)) and SLO multiplier corrections at the same time.

The single loop operation MAPLHGR multiplier for each fuel bundle type are defined in Reference 6 as shown in the table below.

Fuel Bundle Type	SLO MAPLHGR Multiplier
All GE14B bundles	0.87
All GE14C bundles	0.87

Table 2-1

$MAPLHGR_{STD}$ Values By Fuel Bundle Type

Average Planar Exposure (GWd/MT)	$MAPLHGR_{STD}$ Values (in kW/ft) by GNF Fuel Bundle Design Number							
	EDB-3881	EDB-2476	EDB-2611	EDB-2569	EDB-2800	EDB-2801	EDB-2901	EDB-2902
0.00	12.82	12.82	12.82	12.82	12.82	12.82	12.82	12.82
21.10	12.82	12.82	12.82	12.82	12.82	12.82	12.82	12.82
63.50	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
70.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

GNF Bundle #	GNF Fuel Bundle Identification
EDB-3881	GE14-P10HNAB385-14GZ-100T-148-T6-3881 (GE14B)
EDB-2476	GE14-P10HNAB379-17GZ-100T-150-T6-2476 (GE14C)
EDB-2611	GE14-P10DNAB393-17GZ-100T-150-T6-2611 (GE14C)
EDB-2569	GE14-P10DNAB398-16GZ-100T-150-T6-2569 (GE14C)
EDB-2800	GE14-P10DNAB395-14GZ-100T-150-T6-2800 (GE14C)
EDB-2801	GE14-P10DNAB393-17GZ-100T-150-T6-2801 (GE14C)
EDB-2901	GE14-P10DNAB385-13GZ-100T-150-T6-2901 (GE14C)
EDB-2902	GE14-P10DNAB386-14GZ-100T-150-T6-2902 (GE14C)

Figure 2-1

Power Dependent MAPFAC(P) and LHGRFAC(P) Multiplier

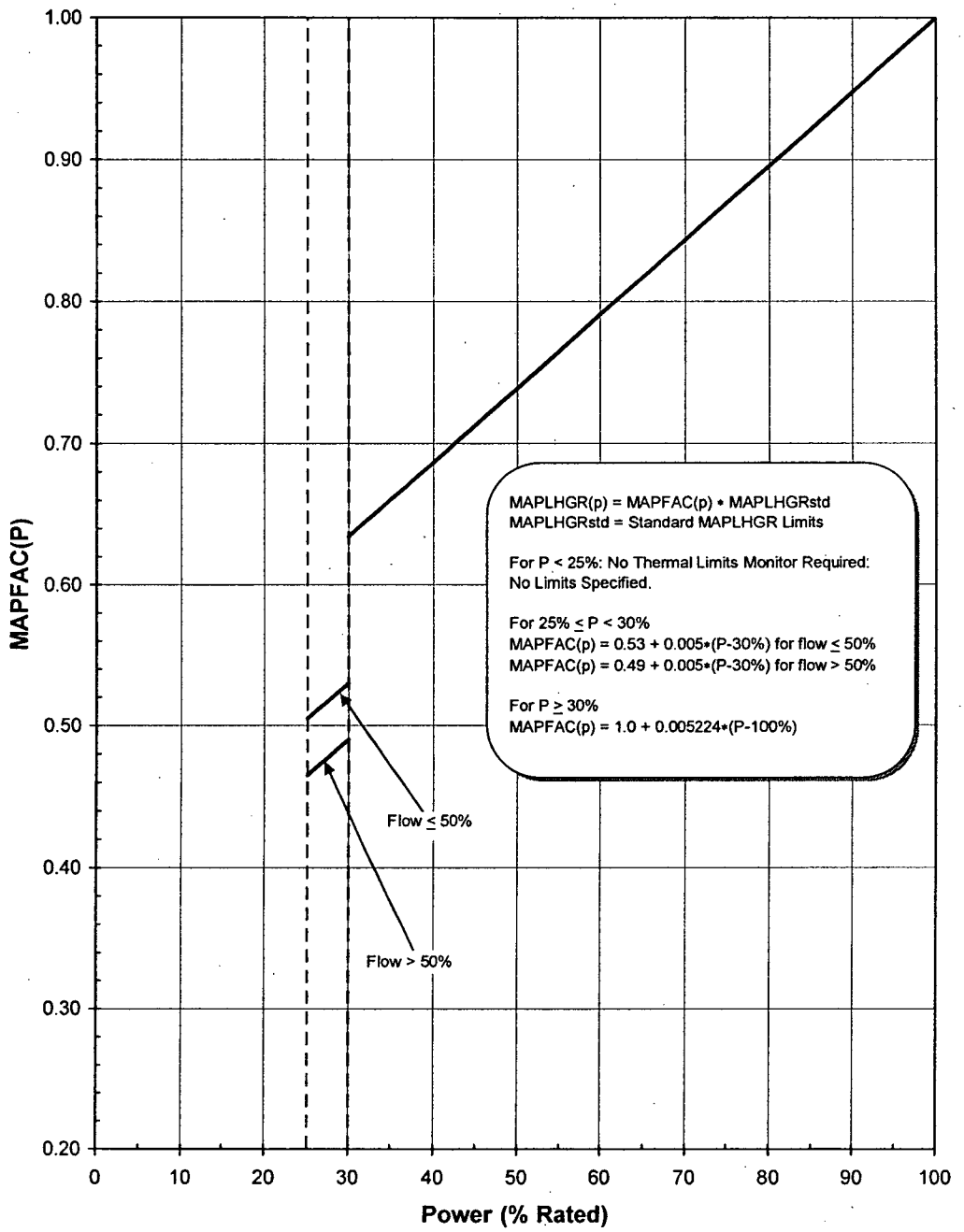
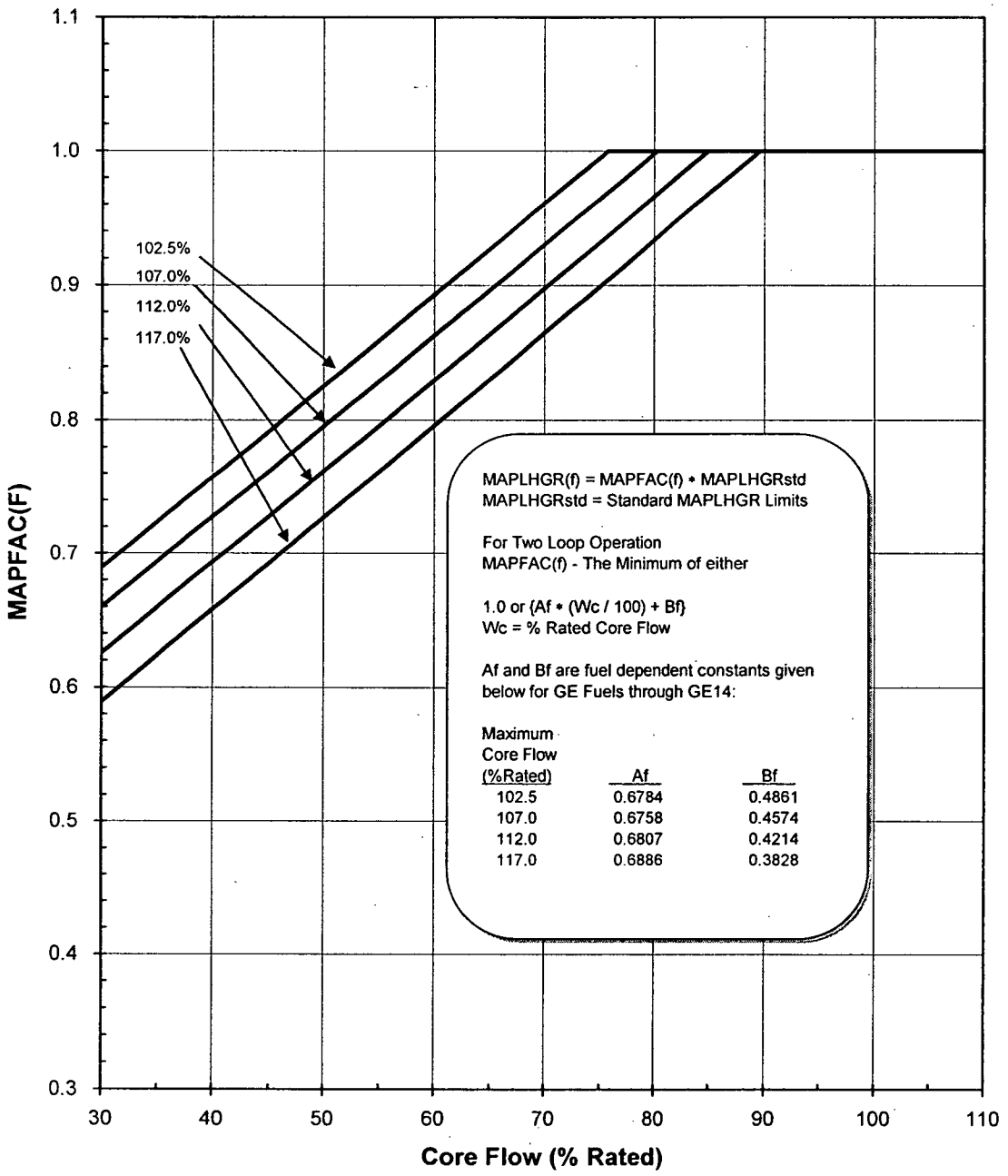


Figure 2-2

Flow Dependent MAPFAC(F) and LHGRFAC(F) Multiplier



3. MINIMUM CRITICAL POWER RATIO

3.1 Technical Specification Reference

Technical Specifications 3.2.2 and 3.7.7.

3.2 Two Recirculation Loop Operation

During steady-state power operation, the minimum Critical Power Ratio (MCPR) shall be greater than or equal to the Operating Limit MCPR (OLMCPR) defined as a function of cycle exposure and plant conditions.

The Operating Limit MCPR with two recirculation loops in operation is defined as follows:

OLMCPR = maximum [MCPR(P), MCPR(F)]

where,

MCPR(P) = Core power dependent MCPR shown in Figure 3-1,

MCPR(F) = Core flow rate dependent MCPR shown in Figure 3-2.

The MCPR(P) and MCPR(F) graphs presented in Figure 3-1 and Figure 3-2, respectively, are defined in Reference 6 Appendix D.

As shown in Figure 3-1, the MCPR(P) value is calculated as follows:

For $P \geq P(Bypass)$, $MCPR(P) = OLMCPR(100) * K_P$

For $P < P(Bypass)$, MCPR(P) = MCPR(P) as a function of core flow

where,

P(Bypass) = P(Bypass) is the core power level below which the Turbine Stop Valve closure and Turbine Control Value fast closure scrams are assumed to be bypassed. P(Bypass) is currently set at 30% of rated power.

OLMCPR(100) = OLMCPR for rated core power and flow conditions. OLMCPR(100) is defined as a function of scram time surveillance data as defined in Section 3.3.

K_P = Core power dependent OLMCPR multiplier.

No thermal limits monitoring is required below 25% of rated power. Therefore, the OLMCPR limit defined above is only applicable for core conditions at or above 25% of rated power.

3.3 Application of Scram Time Surveillance Data to OLMCPR(100)

The OLMCPR(100) value applicable to the MCPR(P) calculation presented in Section 3.2 is determined based on scram time surveillance data recorded for the current operating cycle and the following methodology defined in Reference 7, Reference 11, and Reference 12.

3.3.1 Mean Scram Time (τ_{ave})

The mean scram time for control rod insertion to notch 36 is calculated as follows:

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

where,

i = Scram time test sequential identification number,

n = Number of scram time tests performed to date in the cycle (including beginning of cycle),

N_i = Number of control rods measured in test i,

τ_i = Average insertion time to notch 36 measured in test i,

3.3.2 20% Insertion Conformance Limit Scram Time (τ_B)

The 20% insertion conformance limit scram time is calculated as follows:

$$\tau_B = \mu + 1.65\sigma \sqrt{\frac{N_1}{\sum_{i=1}^{n} N_i}}$$

where,

μ = Mean of the distribution for average scram time insertion to position 36 used in the ODYN Option B analysis,

σ = Standard deviation of the distribution for average scram time insertion to position 36 used in the ODYN Option B analysis,

N_1 = Total number of control rods measured during the first surveillance test performed at beginning of cycle.

The values for μ, σ and N_1 are given below.

μ = 0.830

σ = 0.019

N_1 = 137

Using the values given above, Reference 7 defines the 20% insertion conformance limit scram time as,

$$\tau_B = 0.830 + 0.367\sqrt{\frac{1}{\sum_{i=1}^{n} N_i}}$$

3.3.3 Scram Time Quality Factor (τ)

The scram time quality factor is calculated as follows:

If $\tau_{ave} \leq \tau_B$, $\tau = 0$.

If $\tau_{ave} > \tau_B$, $\tau = \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B}$

where,

τ_A = Technical Specification limit for 20% insertion (notch 36)
= 1.08 seconds (Technical Specification Table 3.1.4-1),

3.3.4 Calculation of OLMCPR(100)

The OLMCPR for rated power and core flow conditions is calculated as follows based on the calculated values for τ_{ave}, τ_B, and τ:

OLMCPR(100) = $OLMCPR_B + \tau * (OLMCPR_A - OLMCPR_B)$

Using the following values obtained from section 11 of Reference 6 ,

$OLMCPR_A$ = Option A OLMCPR value given in Table 3-1,

$OLMCPR_B$ = Option B OLMCPR value given in Table 3-1.

3.4 Single Recirculation Loop Operation

The Operating Limit MCPR with a single recirculation loop in operation is defined as follows:

OLMCPR = maximum [MCPR(SL-P), MCPR(SL-F)]

where,

For $P \geq P(Bypass)$, $MCPR(SL\text{-}P) = [OLMCPR(100)+\Delta OLMCPR(SLO)] * K_P$

For $P < P(Bypass)$, $MCPR(SL\text{-}P) = MCPR(P) + \Delta OLMCPR(SLO)$,

For all core flows, $MCPR(SL\text{-}F) = MCPR(F) + \Delta OLMCPR(SLO)$,

$\Delta OLMCPR(SLO) = 0.02$ from Reference 6 Section 11, and OLMCPR(100), MCPR(P), and MCPR(F) are as defined in Section 3.2.

The increase in the OLMCPR for single loop operation corresponds to an increase in the safety limit MCPR (SLMCPR) for single loop operation as described in Reference 6 Appendix G.

3.5 Use of Full Arc Turbine Control Valve

The Operating Limit MCPR when using full arc turbine control valve mode (CNS operating procedures refer to this as single valve mode) is defined as follows:

OLMCPR (single valve mode) = OLMCPR + ΔOLMCPR (single valve mode)

where,

OLMCPR = OLMCPR as calculated in Section 3.2 for two recirculation loop operation or in Section 3.4 for single loop operation.

ΔOLMCPR (single valve mode) = 0.03 from Reference 6 Appendix F.

Table 3-1

OLMCPR Values for OLMCPR(100) Calculation

Equipment Status	Applicable Cycle Exposure Range	$OLMCPR_A$	$OLMCPR_B$
Equipment In-Service	BOC to EOR-2.326 GWd/MT	1.56	1.39
	EOR-2.326 GWd/MT to EOC	1.63	1.46
Turbine Bypass Valve Out of Service (TBVOOS)	BOC to EOC	1.64	1.47

NOTES:

1. The range of OLMCPR values are defined as follows:

   $OLMCPR_A$ = Option A OLMCPR from Reference 6 based on Option A analysis using full core scram times defined in Technical Specification Table 3.1.4-1.

   OLMCPRB = Option B OLMCPR from Reference 6 based on Option B analysis described in Reference 1.

2. The OLMCPR values presented above apply to rated power operation based on a two loop operation Safety Limit MCPR (SLMCPR) of 1.12.

3. The OLMCPR values presented above bound Increased Core Flow (ICF) operation to 105% of rated flow throughout the cycle.

4. Exposure ranges are defined as follows:

   BOC = Beginning of cycle,

   EOC = End of cycle,

   EOR = End of rated power operation at rated core flow and all rods withdrawn. EOR is projected to be 10.571 GWd/MT in Reference 6 Section 3. The EOR exposure will vary based on actual cycle operations.

Figure 3-1

Power Dependent K(P) and MCPR(P) for GE14 Fuel with Safety Limit = 1.12

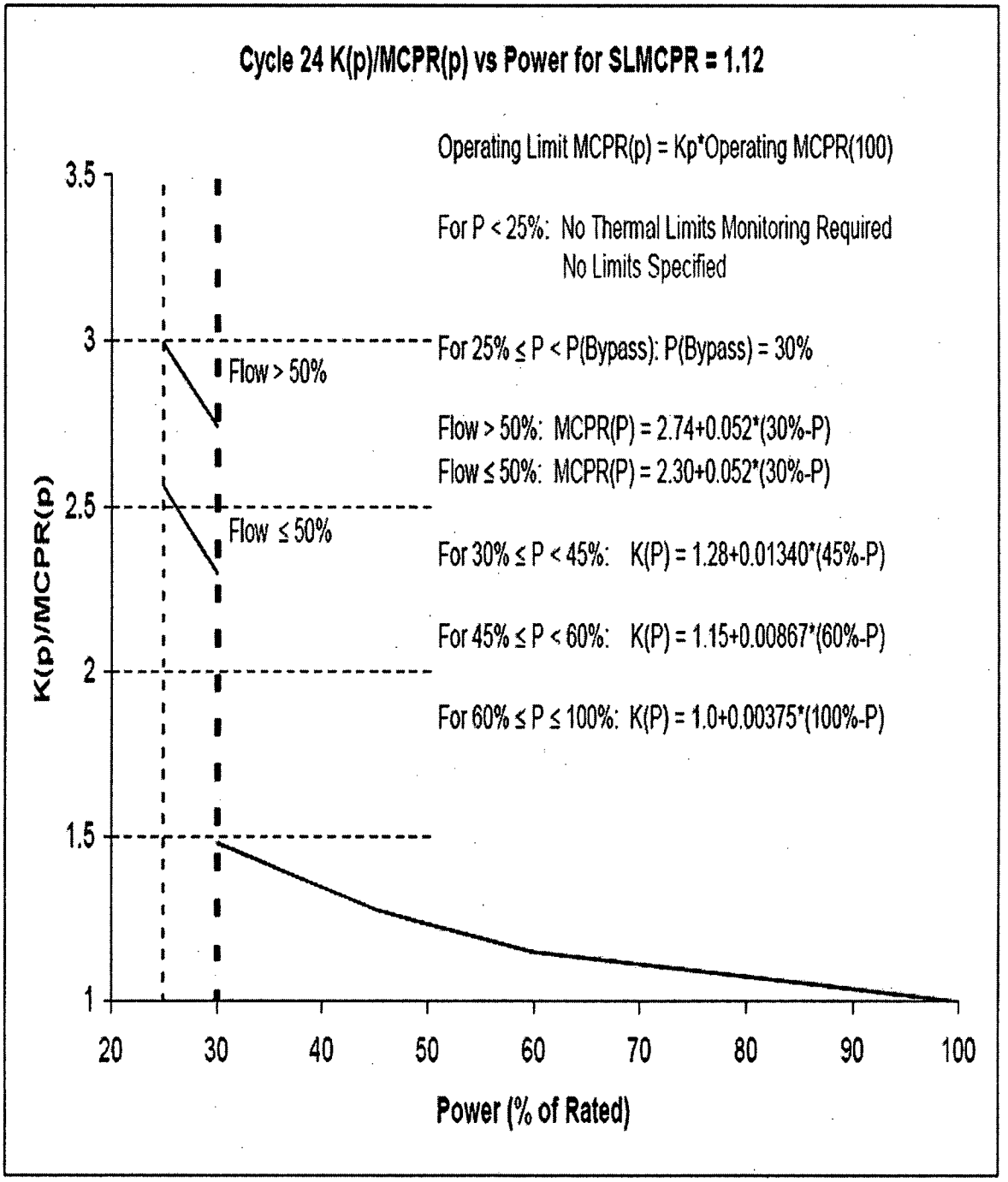
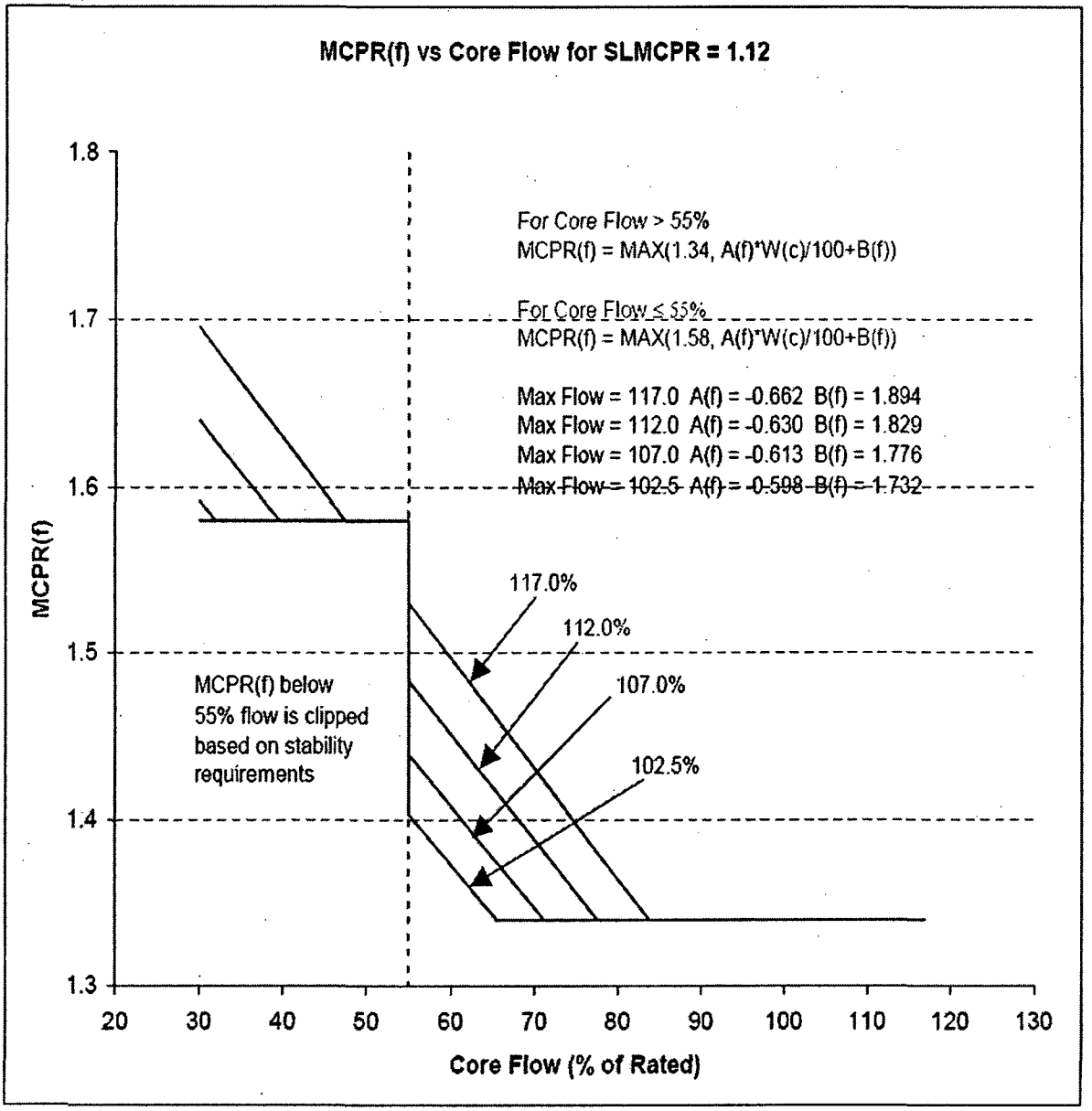


Figure 3-2

Flow Dependent MCPR(F) for GE14 Fuel with Safety Limit = 1.12



4. TURBINE BYPASS SYSTEM RESPONSE TIME

4.1 Technical Specification Reference

Technical Specification 3.7.7.3.

4.2 System Response Time

The system response time for the Turbine Bypass System to be at 80% of rated bypass flow is 0.3 seconds. This was obtained from Reference 8.

5. ROD BLOCK MONITOR TRIP SETPOINTS

5.1 Technical Specification Reference

Technical Specification 3.3.2.1.

5.2 Trip Setpoints

The allowable values for the power dependent Rod Block Monitor (RBM) upscale trip setpoints are defined in Table 5-1, along with the applicable reactor power ranges associated with each trip setpoint. The Analytical Limit (AL) and Technical Specification Allowable Value (AV) presented in Table 5-1 were determined in Reference 9 and Reference 4.

Table 5-1

Rod Block Monitor Channel Settings

Trip Function	Analytical Limit [1]	Allowable Value [1]
Low Power Setpoint (LPSP)	30.0%	**27.5%**
Intermediate Power Setpoint (IPSP)	65.0%	**62.5%**
High Power Setpoint (HPSP)	85.0%	**82.5%**
Downscale Trip Setpoint (DTSP)	89.0%	**92.0%**

Trip Function	Applicable Core Power Range	MCPR Limit [2]	Analytical Limit [3]	Allowable Value [3]
Low Trip Setpoint (LTSP)	LPSP ≤ P ≤ IPSP	1.31	≤ 120.0 / 125	**≤ 117.0 / 125**
Intermediate Trip Setpoint (ITSP)	IPSP < P ≤ HPSP	1.31	≤ 115.2 / 125	**≤ 112.5 / 125**
High Trip Setpoint (HTSP)	HPSP < P	1.31	≤ 110.2 / 125	**≤ 107.5 / 125**

NOTES:

1. Setpoints are given in units of percent of rated power.
2. The RBM trip level settings associated with the MCPR limit were verified in Reference 6 to bound the cycle specific Rod Withdrawal Error (RWE) analysis for an RBM setpoint of 111% of reference level. The MCPR limit is based on an adjusted MCPR limit from the generic analysis documented in Reference 4 performed for an Analyzed Trip Level Setting (without RBM filter) of 111.0% of the reference level or an Analyzed Trip Level Setting (with RBM filter) of 110.2% of the reference level. The generic MCPR limit of 1.25 was calculated in Reference 4 for an SLMCPR of 1.07. The MCPR limit documented above was calculated by multiplying the generic limit of 1.25 by the ratio of the SLMCPR values (1.12/1.07).
3. RBM trip setpoints are given in units of divisions of full scale.

6. MAXIMUM LINEAR HEAT GENERATION RATE

6.1 Technical Requirements Manual Reference

Technical Requirements Manual Specification T3.2.1.

6.2 Two Recirculation Loop Operation

During steady-state power operation, the maximum Linear Heat Generation Rate (LHGR) in any fuel rod in any fuel bundle at any axial location shall not exceed the applicable limiting value.

The maximum allowable Linear Heat Generation Rate with two recirculation loops in operation is defined as follows:

LHGR Limit = minimum [LHGR(P), LHGR(F)]

where,

LHGR(P) = $LHGR_{STD}$ * LHGRFAC(P),

LHGR(F) = $LHGR_{STD}$ * LHGRFAC(F),

$LHGR_{STD}$ = Fuel bundle type, fuel rod type, and peak pellet exposure dependent maximum LHGR values for rated core power and flow conditions represented by the values shown in Table 6-1,

LHGRFAC(P) = Core power dependent multiplier shown in Figure 2-1,

LHGRFAC(F) = Core flow rate dependent multiplier shown in Figure 2-2.

The $LHGR_{STD}$ values presented in Table 6-1 represent the maximum allowable peak pellet power (LHGR) as a function of pellet exposure for each pin type in each fuel bundle design. The maximum allowable LHGR limit values have the following pin type dependencies; UO_2 only pins which can either be full and partial length fuel rods, Gadolinia rods based on the local and maximum gadolinia concentration in the rod. Each combination of pin type is determined using the fuel bundle gadolinia distributions from Reference 13. The LHGR limits for cycle 24 implement compliance with the Alternative Source Term Reg. Guide 1.183 fuel rod average power limitations as defined in Reference 10. The process computer will be used to verify the pellet specific LHGR limits for each fuel bundle type are not violated.

Reference 6 Appendix D defines the LHGRFAC(P) and LHGRFAC(F) multipliers to be identical to the MAPFAC(P) and MAPFAC(F) multipliers presented in Figure 2-1 and Figure 2-2, respectively.

No thermal limits monitoring is required below 25% of rated power. Therefore, the LHGR limit defined above is only applicable for core conditions at or above 25% of rated power.

6.3 Single Recirculation Loop Operation

The maximum allowable Linear Heat Generation Rate with one recirculation loop in operation (SLO) is defined as follows:

LHGR Limit = minimum [LHGR(P), LHGR(F), LHGR(SLO)]

where,

LHGR(SLO) = $LHGR_{STD}$ * LHGRFAC(SLO),

LHGRFAC(SLO) = Single loop operation PLHGR multiplier.

and LHGR(P) and LHGR(F) are as defined in Section 6.2 above.

As shown above, it is not necessary to apply both the off-rated (LHGRFAC(P) and LHGRFAC(F)) and SLO multiplier corrections at the same time.

The single loop operation peak LHGR (PLHGR) multipliers for each fuel bundle type are defined in Reference 6 as shown in the table below.

Fuel Bundle Type	SLO PLHGR Multiplier
All GE14B bundles	0.87
All GE14C bundles	0.87

Table 6-1

$LHGR_{STD}$ Values By Fuel Bundle Type

EDB-3881					
Peak Pellet Exposure (GWd/MT)	$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length	$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length	$LHGR_{STD}$ (kW/ft) 6% gad	$LHGR_{STD}$ (kW/ft) 3% gad	$LHGR_{STD}$ (kW/ft) 0% gad 3-6% max
0.0000	13.400	13.400	11.346	11.800	13.100
12.8880	--	--	11.346	--	--
13.0690	--	--	--	11.800	--
15.6420	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--
59.9400	--	8.030	--	7.462	7.686
59.9401	--	7.245	--	7.120	7.120
61.5600	7.832	--	--	--	--
61.5601	7.308	--	--	--	--
63.6470	--	--	--	7.120	--
64.5790	--	--	--	--	7.120
65.8270	7.308	--	--	--	--
66.3590	--	7.245	--	--	--
68.4330	--	--	--	--	6.648
68.8200	--	6.944	6.309	6.640	--
70.000	6.800	--	--	--	--

EDB-2476								
Peak Pellet Exposure (GWd/MT)	$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length	$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length	$LHGR_{STD}$ (kW/ft) 5% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 4% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 4% gad 4% max gad	$LHGR_{STD}$ (kW/ft) 3% gad	$LHGR_{STD}$ (kW/ft) 0% gad 3% max gad	$LHGR_{STD}$ (kW/ft) 0% gad 4-5% max gad
0.0000	13.400	13.400	12.521	12.700	12.800	12.945	13.000	13.100
12.8880	--	--	--	--	--	--	--	--
13.6440	--	--	--	12.700	--	--	--	--
13.6560	--	--	12.521	--	--	--	--	--
13.7540	--	--	--	--	--	12.945	--	--
13.7900	--	--	--	--	12.800	--	--	--
15.5220	--	--	--	--	--	--	13.000	--
15.6420	--	--	--	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--	--	--	--
59.9400	--	8.405	7.600	7.712	7.826	7.898	7.950	8.060
59.9401	--	7.245	7.120	7.120	7.120	7.120	7.120	7.120
61.5600	8.220	--	--	--	--	--	--	--
61.5601	7.308	--	--	--	--	--	--	--
61.9400	--	--	7.120	--	--	--	--	--
62.2070	--	--	--	7.120	--	--	--	--
62.8440	--	--	--	--	7.120	--	--	--
62.8780	--	--	--	--	--	7.120	--	--
63.0000	--	--	--	--	--	--	7.120	--
63.6000	--	--	--	--	--	--	--	7.120
65.0000	7.308	--	--	--	--	--	--	--
65.1360	--	7.245	--	--	--	--	--	--
67.6100	--	--	4.672	--	--	--	--	--
67.6460	--	--	--	4.739	--	--	--	--
67.9100	--	--	--	--	--	--	4.850	--
68.0390	--	--	--	--	--	4.830	--	--
68.1980	--	--	--	--	4.776	--	--	--
68.4330	--	--	--	--	--	--	--	4.888
68.8200	--	5.545	--	--	--	--	--	--
70.0000	5.000	--	--	--	--	--	--	--

EDB-2611						
Peak Pellet Exposure (GWd/MT)	**$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length**	**$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length**	**$LHGR_{STD}$ (kW/ft) 5% gad 5% max gad**	**$LHGR_{STD}$ (kW/ft) 3% gad**	**$LHGR_{STD}$ (kW/ft) 0% gad 3% max gad**	**$LHGR_{STD}$ (kW/ft) 0% gad 5% max gad**
0.0000	13.400	13.400	12.521	12.945	13.000	13.100
13.6560	--	--	12.521	--	--	--
13.7540	--	--	--	12.945	--	--
15.5220	--	--	--	--	13.000	--
15.6420	--	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--	--
59.9400	--	8.405	7.600	7.898	7.950	8.060
59.9401	--	7.245	7.120	7.120	7.120	7.120
61.4900	--	--	7.120	--	--	--
61.5600	8.220	--	--	--	--	--
61.5601	7.308	--	--	--	--	--
62.8780	--	--	--	7.120	--	--
63.0000	--	--	--	--	7.120	--
63.6000	--	--	--	--	--	7.120
65.0000	7.308	--	--	--	--	--
65.1360	--	7.245	--	--	--	--
67.6100	--	--	4.672	--	--	--
67.9100	--	--	--	--	4.850	--
68.0390	--	--	--	4.830	--	--
68.4330	--	--	--	--	--	4.888
68.8200	--	5.545	--	--	--	--
70.0000	5.000	--	--	--	--	--

EDB-2569						
Peak Pellet Exposure (GWd/MT)	**$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length**	**$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length**	**$LHGR_{STD}$ (kW/ft) 4% gad 4% max gad**	**$LHGR_{STD}$ (kW/ft) 3% gad**	**$LHGR_{STD}$ (kW/ft) 0% gad 3% max gad**	**$LHGR_{STD}$ (kW/ft) 0% gad 4% max gad**
0.0000	13.400	13.400	12.800	12.945	13.000	13.100
13.7540	--	--	--	12.945	--	--
13.7900	--	--	12.800	--	--	--
15.5220	--	--	--	--	13.000	--
15.6420	--	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--	--
59.9400	--	8.405	7.826	7.898	7.950	8.060
59.9401	--	7.245	7.120	7.120	7.120	7.120
61.5600	8.220	--	--	--	--	--
61.5601	7.308	--	--	--	--	--
62.8440	--	--	7.120	--	--	--
62.8780	--	--	--	7.120	--	--
63.0000	--	--	--	--	7.120	--
63.6000	--	--	--	--	--	7.120
65.0000	7.308	--	--	--	--	--
65.1360	--	7.245	--	--	--	--
67.9100	--	--	--	--	4.850	--
68.0390	--	--	--	4.830	--	--
68.1980	--	--	4.776	--	--	--
68.4330	--	--	--	--	--	4.888
68.8200	--	5.545	--	--	--	--
70.0000	5.000	--	--	--	--	--

EDB-2800							
Peak Pellet Exposure (GWd/MT)	$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length	$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length	$LHGR_{STD}$ (kW/ft) 6% gad 6% max gad	$LHGR_{STD}$ (kW/ft) 5% gad 6% max gad	$LHGR_{STD}$ (kW/ft) 5% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 4% gad 4% max gad	$LHGR_{STD}$ (kW/ft) 0% gad 4-6% max gad
0.0000	13.400	13.400	12.255	12.400	12.521	12.800	13.100
13.5000	--	--	--	12.400	--	--	--
13.5320	--	--	12.255	--	--	--	--
13.6560	--	--	--	--	12.521	--	--
13.7900	--	--	--	--	--	12.800	--
15.6420	--	--	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--	--	--
59.9400	--	8.405	7.387	7.462	7.600	7.826	8.060
59.9401	--	7.245	7.120	7.120	7.120	7.120	7.120
61.0870	--	--	7.120	--	--	--	--
61.1570	--	--	--	7.120	--	--	--
61.5600	8.220	--	--	--	--	--	--
61.5601	7.308	--	--	--	--	--	--
61.9400	--	--	--	--	7.120	--	--
62.8440	--	--	--	--	--	7.120	--
63.6000	--	--	--	--	--	--	7.120
65.0000	7.308	--	--	--	--	--	--
65.1360	--	7.245	--	--	--	--	--
66.9300	--	--	--	4.627	--	--	--
67.0690	--	--	4.572	--	--	--	--
67.6100	--	--	--	--	4.672	--	--
68.1980	--	--	--	--	--	4.776	--
68.4330	--	--	--	--	--	--	4.888
68.8200	--	5.545	--	--	--	--	--
70.0000	5.000	--	--	--	--	--	--

EDB-2801						
Peak Pellet Exposure (GWd/MT)	**$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length**	**$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length**	**$LHGR_{STD}$ (kW/ft) 6% gad 6% max gad**	**$LHGR_{STD}$ (kW/ft) 5% gad 6% max gad**	**$LHGR_{STD}$ (kW/ft) 4% gad 4% max gad**	**$LHGR_{STD}$ (kW/ft) 0% gad 4-6% max gad**
0.0000	13.400	13.400	12.255	12.400	12.800	13.100
13.5000	--	--	--	12.400	--	--
13.5320	--	--	12.255	--	--	--
13.7900	--	--	--	--	12.800	--
15.6420	--	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--	--
59.9400	--	8.405	7.387	7.462	7.826	8.060
59.9401	--	7.245	7.120	7.120	7.120	7.120
61.0870	--	--	7.120	--	--	--
61.1570	--	--	--	7.120	--	--
61.5600	8.220	--	--	--	--	--
61.5601	7.308	--	--	--	--	--
62.8440	--	--	--	--	7.120	--
63.6000	--	--	--	--	--	7.120
65.0000	7.308	--	--	--	--	--
65.1360	--	7.245	--	--	--	--
66.9300	--	--	--	4.627	--	--
67.0690	--	--	4.572	--	--	--
67.6100	--	--	--	--	--	--
68.1980	--	--	--	--	4.776	--
68.4330	--	--	--	--	--	4.888
68.8200	--	5.545	--	--	--	--
70.0000	5.000	--	--	--	--	--

EDB-2901							
Peak Pellet Exposure (GWd/MT)	$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length	$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length	$LHGR_{STD}$ (kW/ft) 6% gad 6% max gad	$LHGR_{STD}$ (kW/ft) 5% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 4% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 4% gad 4% max gad	$LHGR_{STD}$ (kW/ft) 0% gad 4-6% max gad
0.0000	13.400	13.400	12.255	12.521	12.700	12.800	13.100
13.5320	--	--	12.255	--	--	--	--
13.6560	--	--	--	12.521	--	--	--
13.6640	--	--	--	--	12.700	--	--
13.7900	--	--	--	--	--	12.800	--
15.6420	--	--	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--	--	--
59.9400	--	8.405	7.387	7.600	7.712	7.826	8.060
59.9401	--	7.245	7.120	7.120	7.120	7.120	7.120
61.0870	--	--	7.120	--	--	--	--
61.5600	8.220	--	--	--	--	--	--
61.5601	7.308	--	--	--	--	--	--
61.9400	--	--	--	7.120		--	--
62.2070	--	--	--	--	7.120	--	--
62.8440	--	--	--	--	--	7.120	--
63.6000	--	--	--	--	--	--	7.120
65.0000	7.308	--	--	--	--	--	--
65.1360	--	7.245	--	--	--	--	--
67.0690	--	--	4.572	--	--	--	--
67.6460	--	--	--	--	4.739	--	--
67.6100	--	--	--	4.672	--	--	--
68.1980	--	--	--	--	--	4.776	--
68.4330	--	--	--	--	--	--	4.888
68.8200	--	5.545	--	--	--	--	--
70.0000	5.000	--	--	--	--	--	--

EDB-2902					
Peak Pellet Exposure (GWd/MT)	$LHGR_{STD}$ (kW/ft) UO_2 Only Full Length	$LHGR_{STD}$ (kW/ft) UO_2 Only Partial Length	$LHGR_{STD}$ (kW/ft) 5% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 4% gad 5% max gad	$LHGR_{STD}$ (kW/ft) 0% gad 4-5% max gad
0.0000	13.400	13.400	12.521	12.700	13.100
13.6560	--	--	12.521	--	--
13.6640	--	--	--	12.700	--
15.6420	--	--	--	--	13.100
16.0000	13.400	13.400	--	--	--
59.9400	--	8.405	7.600	7.712	8.060
59.9401	--	7.245	7.120	7.120	7.120
61.5600	8.220	--	--	--	--
61.5601	7.308	--	--	--	--
61.9400	--	--	7.120		--
62.2070	--	--	--	7.120	--
63.6000	--	--	--	--	7.120
65.0000	7.308	--	--	--	--
65.1360	--	7.245	--	--	--
67.6460	--	--	--	4.739	--
67.6100	--	--	4.672	--	--
68.4330	--	--	--	--	4.888
68.8200	--	5.545	--	--	--
70.0000	5.000	--	--	--	--

Bundle Types

GNF Bundle #	GNF Fuel Bundle Identification
EDB-3881	GE14-P10HNAB385-14GZ-100T-148-T6-3881 (GE14B)
EDB-2476	GE14-P10HNAB379-17GZ-100T-150-T6-2476 (GE14C)
EDB-2611	GE14-P10DNAB393-17GZ-100T-150-T6-2611 (GE14C)
EDB-2569	GE14-P10DNAB398-16GZ-100T-150-T6-2569 (GE14C)
EDB-2800	GE14-P10DNAB395-14GZ-100T-150-T6-2800 (GE14C)
EDB-2801	GE14-P10DNAB393-17GZ-100T-150-T6-2801 (GE14C)
EDB-2901	GE14-P10DNAB385-13GZ-100T-150-T6-2901 (GE14C)
EDB-2902	GE14-P10DNAB386-14GZ-100T-150-T6-2902 (GE14C)

7. STABILITY POWER/FLOW MAP

7.1 Technical Specification Reference

Technical Specification 3.4.1.

7.2 Stability Exclusion Region

The stability region is represented by the Exclusion Region boundaries defined in Reference 6. A detailed view of the Exclusion Region of the power/flow map is presented in Figure 7-1.

Intentional operation within the Exclusion Region is prohibited. The Exclusion Region is defined in the table below.

Exclusion Region	Power (% of Rated)	Flow (% of Rated)
A	84.36	57.49
B	35.77	32.50

Point "A" is on the highest flow control line and point "B" is on the natural circulation line (see Figure 7-1).

The region boundaries are defined using the generic shape function given in Reference 6. The calculation of the region boundaries as a function of core thermal power and core flow rate is summarized below.

$$P = P_B \times \left(\frac{P_A}{P_B}\right)^{\frac{1}{2}\left[\frac{W-W_B}{W_A-W_B}+\left(\frac{W-W_B}{W_A-W_B}\right)^2\right]}$$

where,

P = Core thermal power (% of rated) on the region boundary,

W = Core flow rate (% of rated) corresponding to power, P, on the region boundary,

P_A = Core thermal power (% of rated) at point A,

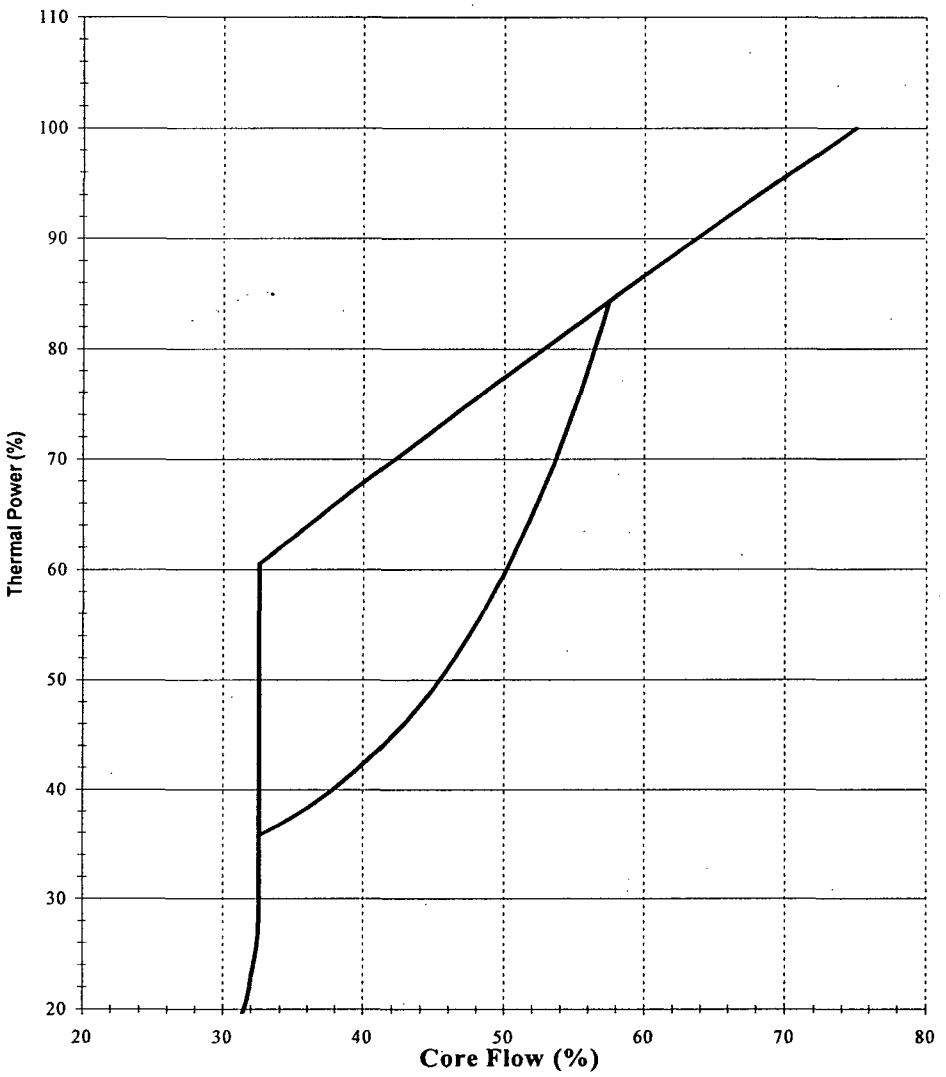
P_B = Core thermal power (% of rated) at point B,

W_A = Core flow rate (% of rated) at point A,

W_B = Core flow rate (% of rated) at point B.

Figure 7-1

Stability Exclusion Region Map



8. REFERENCES

The following references are identified in this report:

1. NEDE-24011-P-A-15, "General Electric Standard Application for Reactor Fuel", September 2005.
2. NEDE-23785-1-P-A, "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-of-Coolant Accident", Volume III, Revision 1, October 1984.
3. NEDO-31960-A and NEDO-31960-A Supplement 1, "BWR Owner's Group Long-Term Stability Solutions Licensing Methodology", November 1995.
4. NEDC-31892P, "Extended Load Line Limit and ARTS Improvement Program Analyses for Cooper Nuclear Station Cycle 14", Revision 1, May 1991.
5. GE-NE-L12-00867-12, "Project Task Report Cooper Nuclear Station MIG Project Task 900: Transient Analysis", Revision 1, May 2000.
6. 0000-0056-7313-SRLR, "Supplemental Reload Licensing Report for Cooper Nuclear Station Reload 23 Cycle 24 (1.12 MCPR Safety Limit)", Revision 0, August 2006.
7. CNS Procedure 10.9, "Control Rod Scram Time Evaluation", current revision.
8. GE Design Specification 22A2859, "Turbine-Generator and Steam Bypass System", Paragraph 4.3.8, Revision 3.
9. NEDC 98-024, "APRM - RBM Setpoint Calculation", current revision.
10. GE Letter, FRL-NPP-HP1-06-020, "LHGR Limit for Cooper to Comply with Reg. Guide 1.183", October 20, 2006.
11. GE Letter DTI:NPPD 81-029, "ODYN Option B Scram Time Surveillance Procedures," March 29, 1981.
12. GE Letter DGC:89-190, "Cooper Reload 13 Technical Specification Changes," November 30, 1989.
13. 0000-0056-7313-FBIR, " Fuel Bundle Information Report for Cooper Nuclear Station Reload 23 Cycle 24", Revision 0, August 2006.

Correspondence Number: NLS2006090

The following table identifies those actions committed to by Nebraska Public Power District (NPPD) in this document. Any other actions discussed in the submittal represent intended or planned actions by NPPD. They are described for information only and are not regulatory commitments. Please notify the Licensing Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITMENT NUMBER	COMMITTED DATE OR OUTAGE
None		