



**Nebraska Public Power District**  
*Nebraska's Energy Leader*

NLS2001113  
December 13, 2001

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

Subject: Core Operating Limits Report  
Cooper Nuclear Station  
NRC Docket No. 50-298, DPR-46

Gentlemen:

Cooper Nuclear Station Technical Specification 5.6.5 requires that core operating limits be documented in the Core Operating Limits Report (COLR) and submitted to the Nuclear Regulatory Commission prior to each reload cycle for changes to the following cycle specific parameters:

1. The Average Planar Linear Heat Generation Rate (APLHGR)
2. The Minimum Critical Power Ratio (MCPR)
3. The Rod Block Monitor Upscale Allowable Values
4. The power/flow map defining the Stability Exclusion Region

For Cycle 21 operations, changes have been made to the operating limits for APLHGR, MCPR, and the power/flow map defining the Stability Exclusion Region. Consequently, the COLR has been updated and it is being submitted as an attachment. 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.

ADD1

Should you have any questions regarding this matter, please contact David F. Kunsemiller at (402) 825-5236.

Sincerely,

A handwritten signature in black ink, appearing to read "David L. Wilson", with a long horizontal flourish extending to the right.

David L. Wilson  
Vice President of Nuclear Energy

/wrv

Attachment

cc: Regional Administrator w/attachment  
USNRC Region IV

Senior Project Manager w/attachment  
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector w/attachment  
USNRC

NPG Distribution w/o attachment

Records w/attachment

# COOPER NUCLEAR STATION

## CORE OPERATING LIMITS REPORT

Cycle 21  
Revision 0

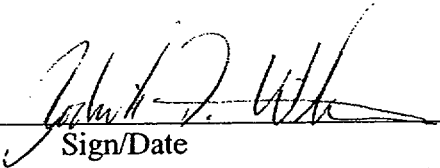
## Signature Page

Revision 1

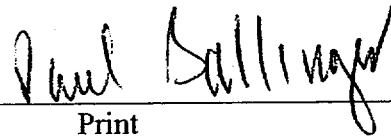
Preparer:

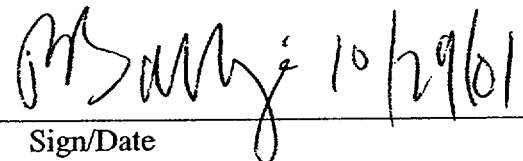
Rodrick D. Wilson

Print

 10/29/01  
Sign/Date

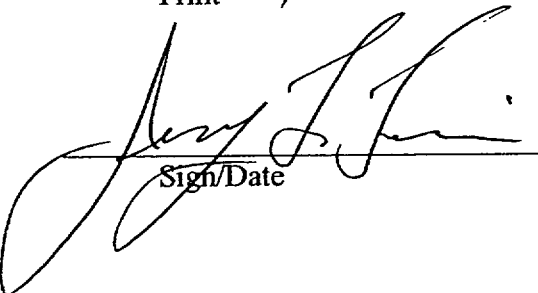
Reviewer:

  
Print

 10/29/01  
Sign/Date

RE Manager:

Jerry L. Lewis  
Print

 1 Nov 01  
Sign/Date

## 1.0 INTRODUCTION

The Core Operating Limits Report provides the limits for operation of the Cooper Nuclear Station for Cycle 21. It includes the limits for the Rod Block Monitor Upscale Set Point, Average Planar Linear Heat Generation Rate (APLHGR), and Minimum Critical Power Ratio (MCPR). In addition, this COLR also contains:

- MCPR limits for an inoperable Main Turbine Bypass System (one bypass valve inoperable)
- Power to flow map defining the Stability Exclusion Region
- Turbine Bypass System response time
- Maximum allowable LHGR

If any of these limits is exceeded, action will be taken as defined in the Technical Specifications.

The core operating limit values have been determined using the NRC-approved methodologies given in References 1, 2, 10, and 11 and have been established such that all applicable plant safety analysis limits are met.

## 2.0 CORE OPERATING LIMITS

Cooper Nuclear Station shall operate within the bounds of the below limits/values. The applicable Technical Specifications are referenced in each subsection.

### 2.1 Rod Block Monitor Upscale Set Point

The Technical Specifications reflect a reference to Allowable Values for the Rod Block Monitor (RBM) upscale (power referenced) trip level setting, found in Reference 9, are as follows:

<u>Lowest Rated MCPR Limit</u>	<u>Low Trip Set Point (LTSP)</u> (LPSP<P≤IPSP)	<u>Intermed Trip Set Point (ITSP)</u> (IPSP<P≤HPSP)	<u>High Trip Set Point (HTSP)</u> (HPSP<P)
≥1.20	≤114.0/125	≤108.5/125	≤104.5/125
≥1.25	≤117.0/125	≤112.5/125	≤107.5/125
≥1.30	≤120.0/125	≤115.0/125	≤110.5/125

LPSP, IPSP, and HPSP are the Low Power Set Point, Intermediate Power Set Point, and High Power Set Point, respectively.

The trip level settings associated with this MCPR limit have been generically calculated and verified to bound the Rod Withdrawal Error Analysis for Cycle 21 operation.

## 2.2 Average Planar Linear Heat Generation Limits

The most limiting lattice APLHGR value (excluding natural uranium) for each fuel bundle as a function of Planar Average Exposure, core power, and core flow is calculated by multiplying the value from Figures 1, 2, 3, 4 and 5 by the smaller of the MAPLHGR Flow Factor,  $MAPFAC_F$  (Figure 6) or the Power-Dependent MAPLHGR Factor,  $MAPFAC_P$ , (Figure 7). APLHGR values determined with the SAFER/GESTR-LOCA methodology are given in References 2, 3, and 5 while  $MAPFAC_F$  and  $MAPFAC_P$  were determined in Reference 8.

The calculated maximum APLHGR (MAPLHGR) limits in Figures 1, 2, 3, 4 and 5 are conservative values bounding all fuel lattice types (excluding natural uranium) in a given fuel bundle design. MAPLHGR limits for each individual fuel lattice design in a bundle design, as a function of axial location and average planar exposure, are determined based on the approved methodology referenced in Technical Specification 5.6.5 and loaded in the process computer for use in core monitoring calculations. The MAPLHGR values for these lattices, along with the axial location of each lattice in the bundle, are considered proprietary information by General Electric and are given in Reference 3 as a function of planar average exposure.

The MAPLHGR limits referred to above are for two recirculation loop operations. For single loop operation, the limiting APLHGR value is multiplied by 0.77 for GE8x8 NB fuel (as can be found in Reference 5) and by 0.91 for GE14 fuel (as can be found in Reference 5).

Technical Specification Reference: 3.2.1 and 3.4.1

## 2.3 Linear Heat Generation Rate Limit

The limiting power density and maximum allowable Linear Heat Generation Rate (LHGR) referred to in Technical Requirements Manual Section T 3.2.1 is the design LHGR. The design LHGR for fuel type GE 8x8 NB is 14.4 kW/ft as found in Reference 12. The design LHGR for fuel type GE14 is 13.4 kW/ft as found in Reference 13.

## 2.4 Minimum Critical Power Ratio Limits

The operating limit MCPR (OLMCPR) values are a function of core thermal power, core flow, fuel bundle, scram time ( $\tau$ ), and fuel exposure. The scram time ( $\tau$ ) is determined from CNS Procedure 10.9, Control Rod Scram Time Evaluation. The OLMCPR values are as follows:

For core thermal power  $\geq 25$  percent and  $<30$  percent of rated power, the OLMCPR is the power dependent MCPR ( $MCPR_P$ ) from Figure 8.

For core thermal power  $\geq 30$  percent of rated power, the OLMCPR is the greater of either:

The applicable flow dependent MCPR ( $MCPR_F$ ) determined from Figure 9, or the appropriate scram time ( $\tau$ ) dependent MCPR at rated power from Figures 10,11,12,14,15 and 16, multiplied by the applicable power dependent MCPR multiplier ( $K_P$ ) from Figure 8.

The appropriate scram time ( $\tau$ ) dependent MCPR at rated power with One Turbine Bypass Valve Unavailable is shown in Figures 13 and 17.

The system response time for the Turbine Bypass System to be at 80% of rated bypass flow is 0.3 seconds.

For single recirculation loop operation, the OLMCPR is 0.01 greater than the two recirculation loop operation OLMCPR.

Technical Specification References: 3.2.2, 3.4.1 and 3.7.7

## 2.5 Power/Flow Map

The power/flow map defining the Stability Exclusion Region can be found as Figure 18. References 5 and 6 reflect the documents describing the current Cooper Nuclear Station power/flow map. The Stability Exclusion Region boundary is given by the equation

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

where,

P = a core thermal power value on the region boundary (% of rated),

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

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

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

$W_A$  = core flow rate at point A (% of rated), and

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

Technical Specification Reference: 3.4.1



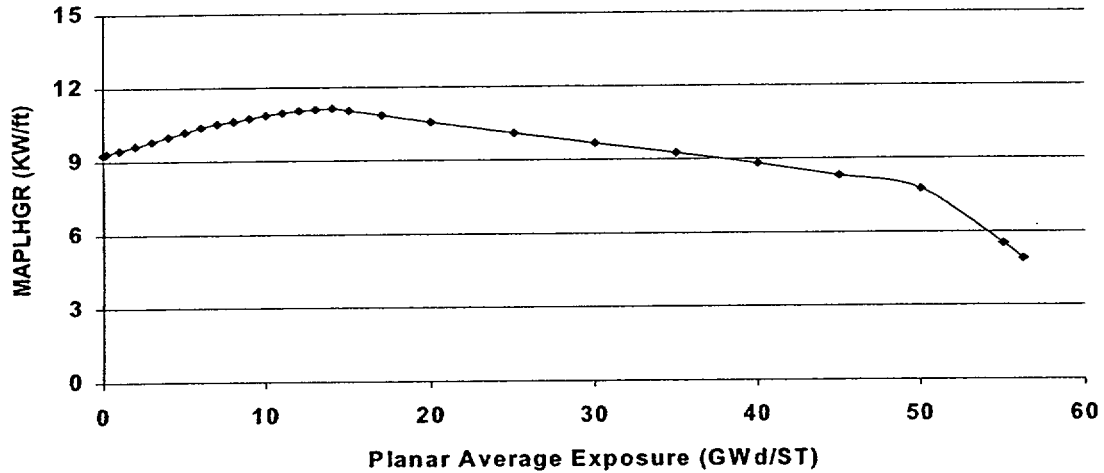
### 3.0 REFERENCES

1. NEDE-24011-P-A-14-US, June 2000, *General Electric Standard Application for Reactor Fuel*.
2. NEDC-32687P, Revision 1, March 1997, *Cooper Nuclear Station SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis*.
3. *Lattice Dependent MAPLHGR Report for Cooper Nuclear Station Reload 20, Cycle 21, J11-03910-10M, Revision 0*.
4. Letter (with attachment), R.H. Buckholz (GE) to P.S. Check (NRC) dated September 5, 1980, *Response to NRC Request for Information on ODYN Computer Model*.
5. *Supplemental Reload Licensing Report for Cooper Nuclear Station Reload 20, Cycle 21, J11-03910-10, Revision 0*.
6. GE-NE-A13-00395-01, Class I, November, 1996, *Application of the "Regional Exclusion with Flow-Biased APRM Neutron Flux Scram" Stability Solution (Option 1-D) to the Cooper Nuclear Station, Licensing Topical Report*.
7. Letter from James R. Hall (NRC) to G. R. Horn (NPPD) dated September 23, 1997, *Approval of SAFER/GESTAR LOCA Analysis for Cooper Nuclear Station (TAC NO. M98293)*.
8. GE-NE-L12-00867-12, *Cooper Nuclear Station MIG Project Task 900: Transient Analysis, Revision 1, May 2000*.
9. NEDC 98-024, Revision 3, May 2000, *APRM - RBM Setpoint Calculation*.
10. NEDO-31960-A and NEDO-31960-A Supplement 1, *BWR Owner's Group Long-Term Stability Solutions Licensing Methodology*.  
(The approved revision at the time the reload analysis is performed.)
11. 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*.
12. *Nuclear Design Report for Cooper Nuclear Station Reload, 18, J11-03354-03, July 1998*.
13. GE-NE-L12-00867-09-02, *Cooper Nuclear Station MIG Project Task 407: SAFER/GESTR-LOCA Analysis, May 2000*.
14. Letter from S. Shelton (GNF) to J.L. Lewis (NPPD) dated December 21, 2000, *GE9B LHGR Relaxation for Cooper Nuclear Station*.
15. NEDE-31152P, *GE Fuel Bundle Designs, December 1988 (As Revised)*
16. NEDC-32538P-A, *Determination of Limiting Cold Water Event*
17. GE-NE-J1103910-09-02P, *Cooper Nuclear Station ECCS-LOCA Evaluation for Cycle 21, August 2001*.
18. GE-NE-J1103910-09-01, *Cooper Nuclear Station ECCS-LOCA Evaluation for GE14, August 2001*.
19. NEDC-32687P, *Cooper Nuclear Station SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis, Revision 1, March 1997*.

# CORE OPERATING LIMITS REPORT

Figure 1

**Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)  
versus Exposure with LPCI Modification and Bypass Holes Plugged,  
3.79 w/o with 17GZ GE14 Fuel**

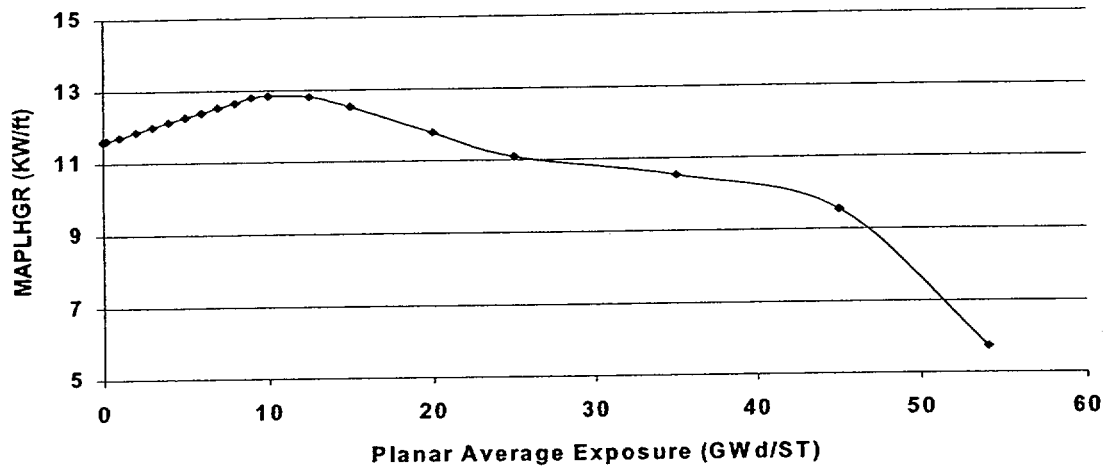


DATA COORDINATES (Reference 5)	
Planar Average Exposure	MAPLHGR
(GWd/ST)	(kW/ft)
0.0	9.25
0.2	9.32
1.0	9.45
2.0	9.62
3.0	9.80
4.0	9.99
5.0	10.18
6.0	10.38
7.0	10.52
8.0	10.62
9.0	10.74
10.0	10.86
11.0	10.96
12.0	11.04
13.0	11.10
14.0	11.13
15.0	11.04
17.0	10.85
20.0	10.56
25.0	10.10
30.0	9.67
35.0	9.25
40.0	8.81
45.0	8.31
50.0	7.75
55.0	5.52
56.21	4.91

## CORE OPERATING LIMITS REPORT

Figure 2

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)  
versus Exposure with LPCI Modification and Bypass Holes Plugged,  
3.50 w/o with 10GZ GE8X8NB Fuel



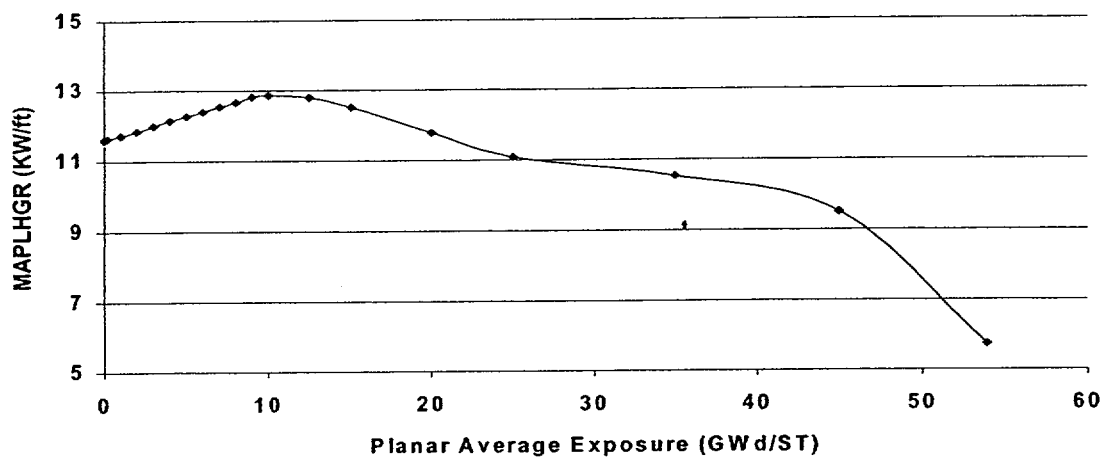
### DATA COORDINATES (Reference 5)

Planar Average Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	11.59
0.2	11.63
1.0	11.71
2.0	11.85
3.0	12.00
4.0	12.13
5.0	12.26
6.0	12.38
7.0	12.52
8.0	12.65
9.0	12.80
10.0	12.84
12.5	12.81
15.0	12.52
20.0	11.78
25.0	11.09
35.0	10.53
45.0	9.54
54.0	5.75

# CORE OPERATING LIMITS REPORT

Figure 3

**Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)  
versus Exposure with LPCI Modification and Bypass Holes Plugged,  
3.50 w/o with 10GZ1 GE8X8NB Fuel**



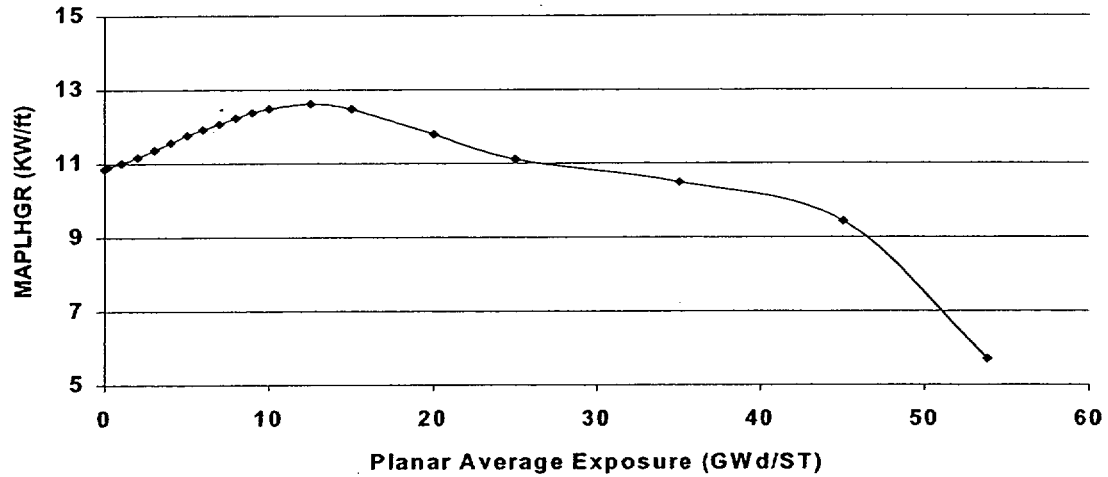
## DATA COORDINATES (Reference 5)

<u>Planar Average Exposure</u> (GWd/ST)	<u>MAPLHGR</u> (kW/ft)
0.0	11.59
0.2	11.63
1.0	11.71
2.0	11.84
3.0	11.99
4.0	12.14
5.0	12.26
6.0	12.39
7.0	12.53
8.0	12.66
9.0	12.81
10.0	12.85
12.5	12.79
15.0	12.51
20.0	11.78
25.0	11.08
35.0	10.53
45.0	9.51
53.92	5.74

## CORE OPERATING LIMITS REPORT

Figure 4

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)  
versus Exposure with LPCI Modification and Bypass Holes Plugged,  
3.48 w/o with 11GZ GE8X8NB Fuel



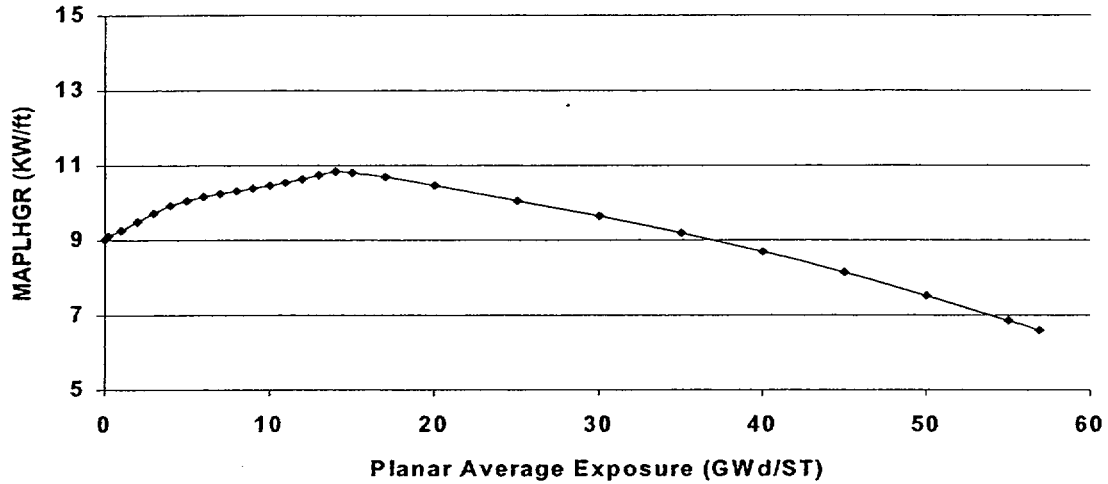
### DATA COORDINATES (Reference 5)

Planar Average Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.85
0.2	10.90
1.0	11.01
2.0	11.17
3.0	11.36
4.0	11.56
5.0	11.76
6.0	11.91
7.0	12.07
8.0	12.23
9.0	12.38
10.0	12.48
12.5	12.61
15.0	12.47
20.0	11.79
25.0	11.11
35.0	10.49
45.0	9.43
53.83	5.71

# CORE OPERATING LIMITS REPORT

Figure 5

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)  
versus Exposure with LPCI Modification and Bypass Holes Plugged,  
3.85 w/o with 14GZ GE14 Fuel



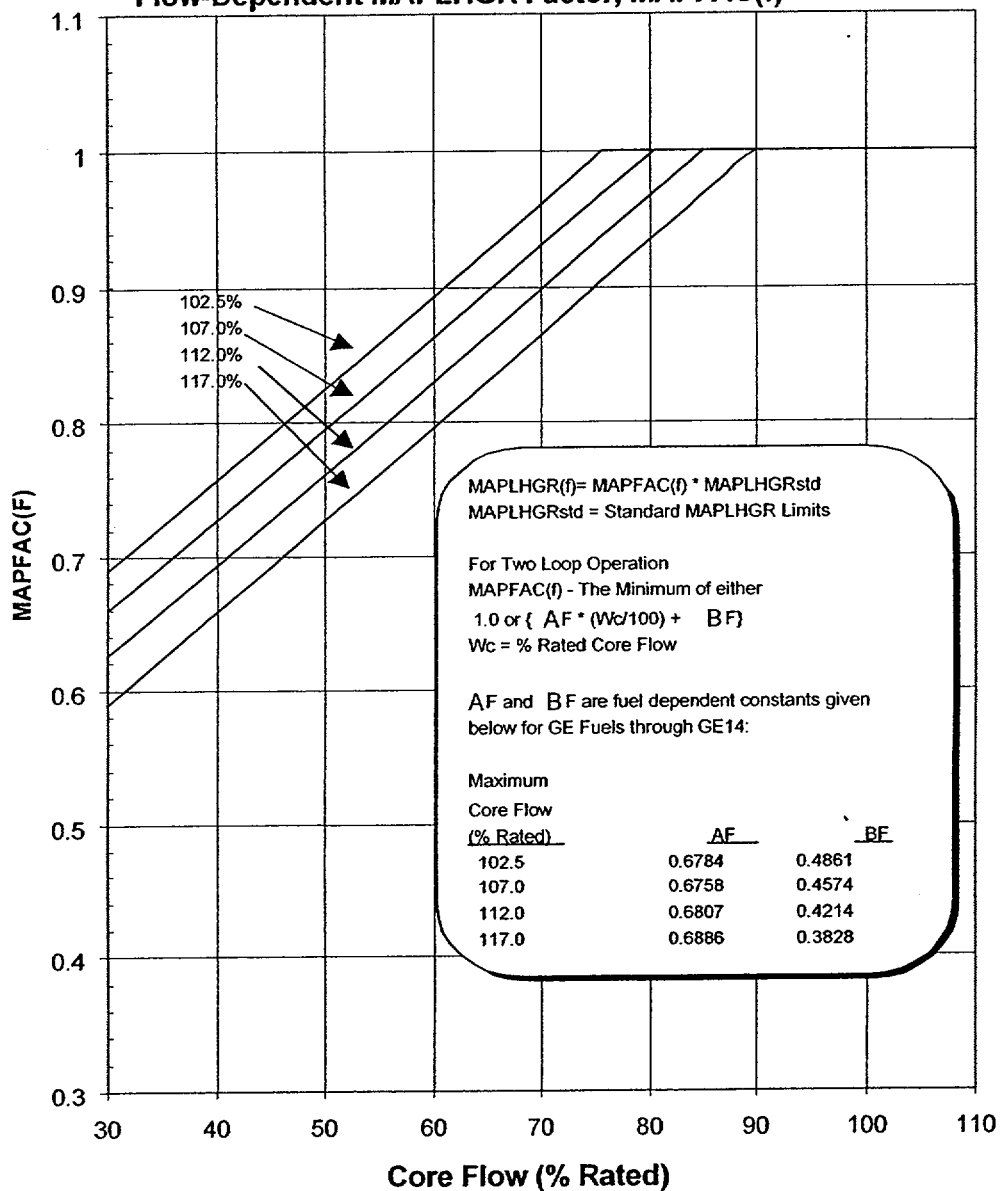
DATA COORDINATES (Reference 3)	
Planar Average Exposure	MAPLHGR
(GWd/ST)	(kW/ft)
0.0	9.02
0.2	9.11
1.0	9.26
2.0	9.49
3.0	9.71
4.0	9.92
5.0	10.05
6.0	10.16
7.0	10.24
8.0	10.31
9.0	10.38
10.0	10.46
11.0	10.54
12.0	10.63
13.0	10.74
14.0	10.83
15.0	10.80
17.0	10.69
20.0	10.46
25.0	10.05
30.0	9.64
35.0	9.19
40.0	8.69
45.0	8.14
50.0	7.51
55.0	6.85
56.86	6.59

# CORE OPERATING LIMITS REPORT

Figure 6

Reference 8

**Figure 3-11**  
**Cooper Nuclear Station**  
**Flow-Dependent MAPLHGR Factor, MAPFAC(f)**

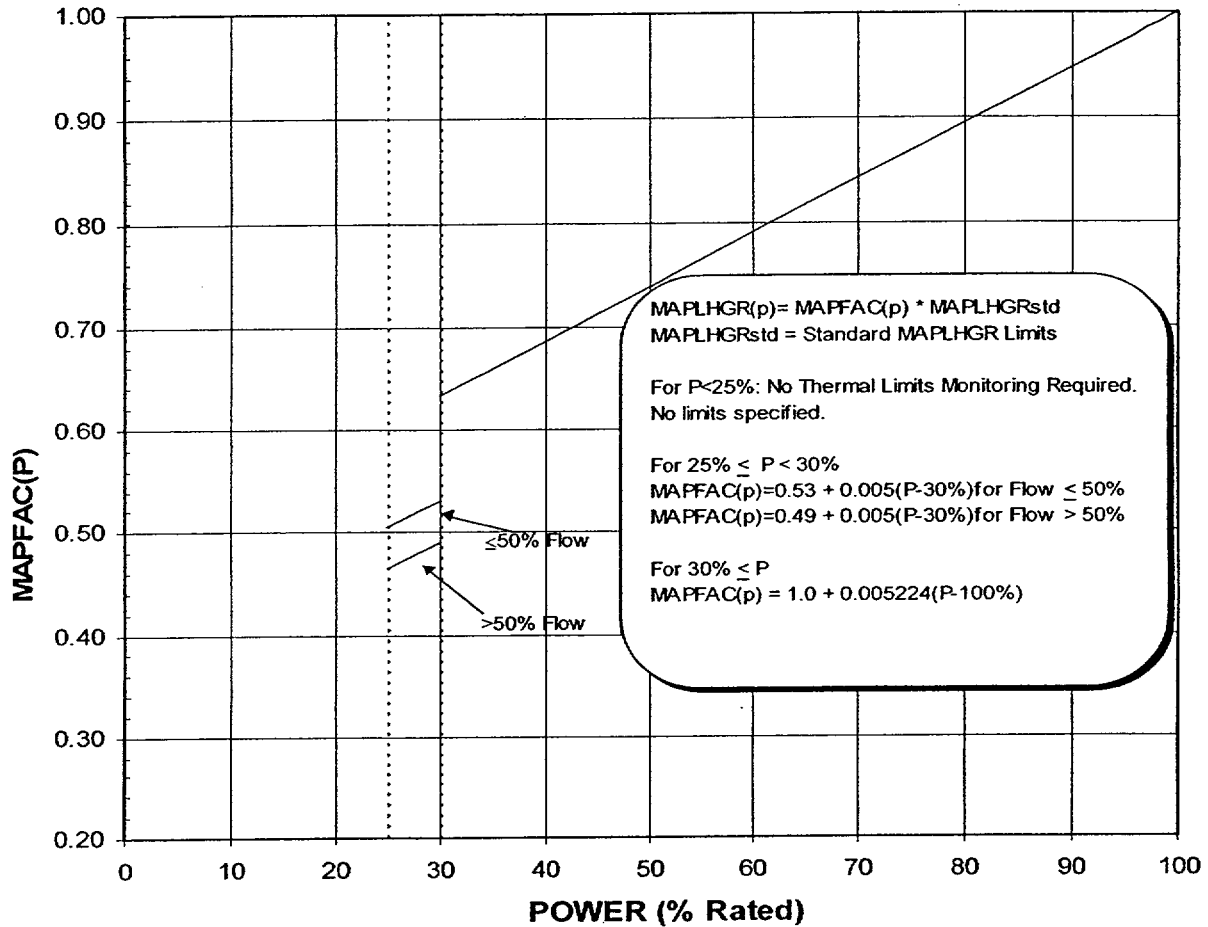


CORE OPERATING LIMITS REPORT

Figure 7

Reference 8

**Figure 3-9**  
**Cooper Nuclear Station**  
**Power-Dependent MAPLHGR Factor MAPFAC(p)**





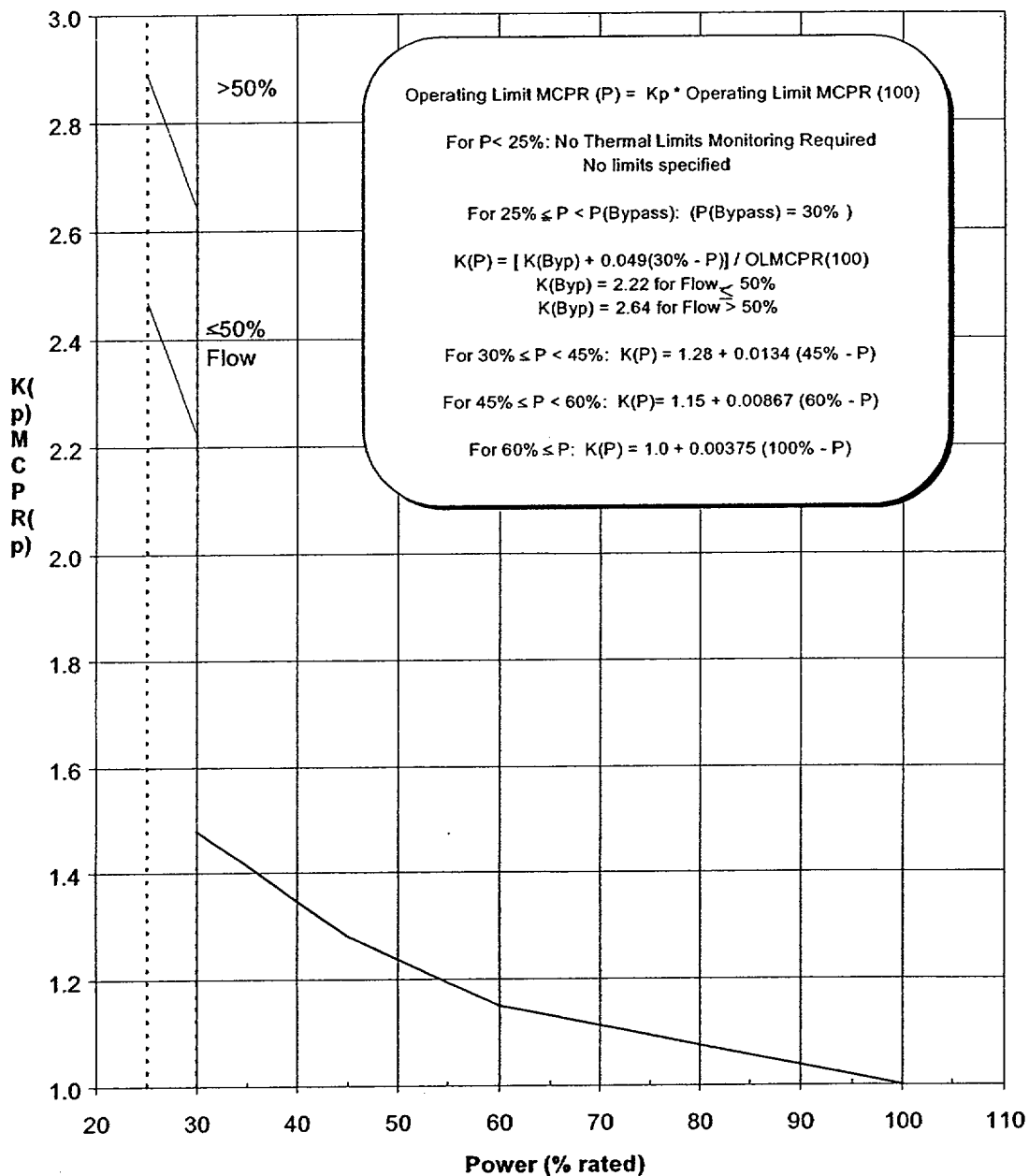
# CORE OPERATING LIMITS REPORT

Figure 8

Reference 8

Figure 3-8

## Cooper Nuclear Station Power-Dependent MCPR Limits, Kp and MCPRp

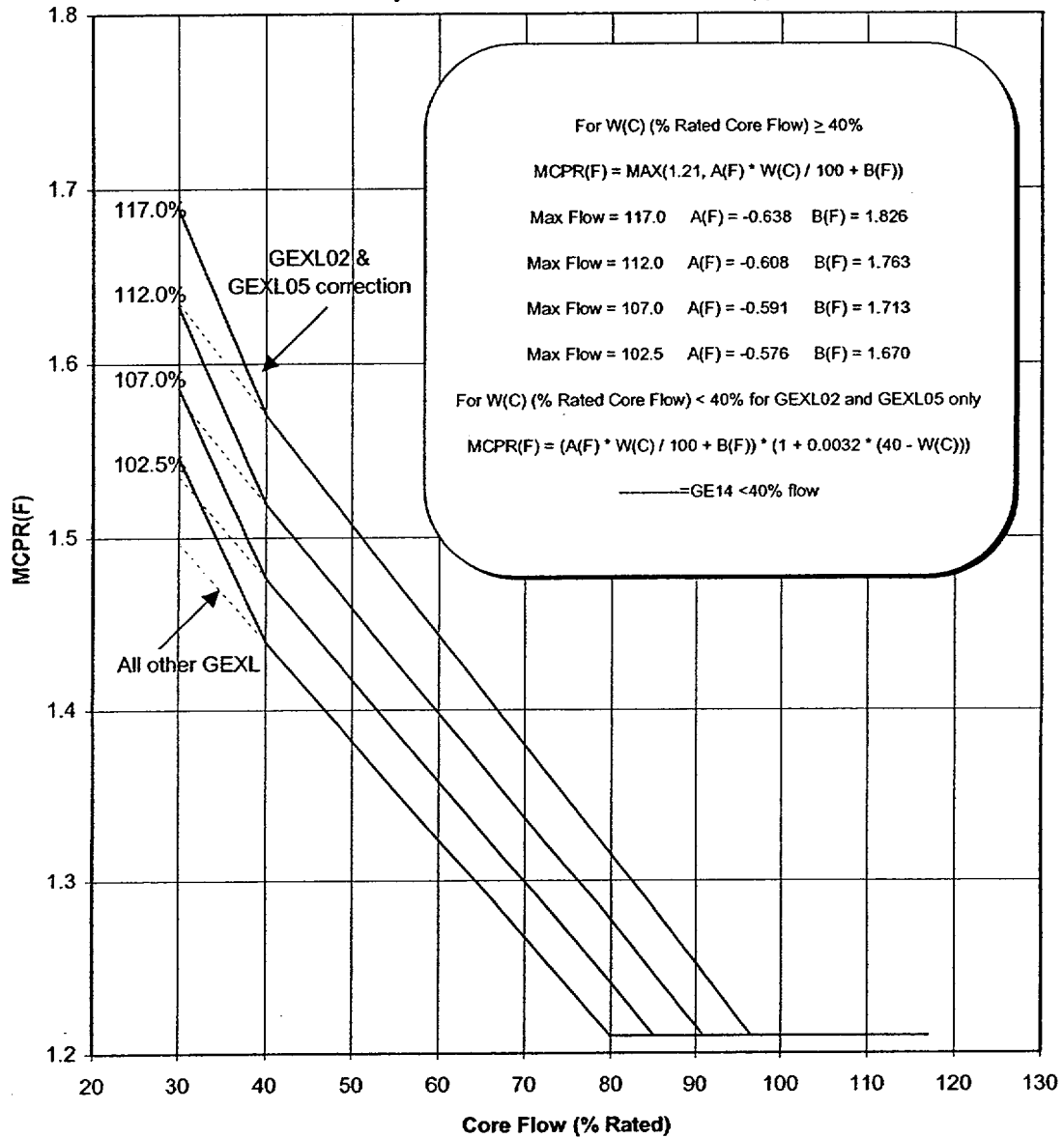


# CORE OPERATING LIMITS REPORT

Figure 9

Reference 8

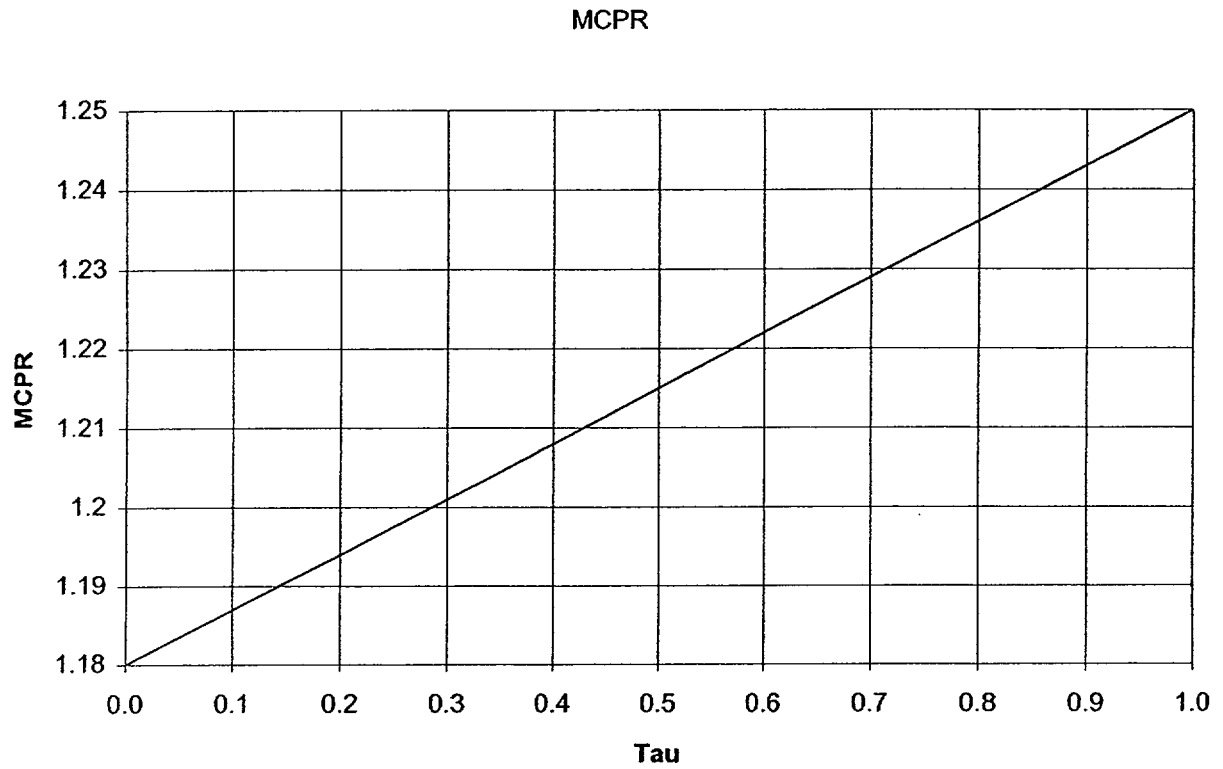
**Figure 3-10**  
**Cooper Nuclear Station**  
**Flow-Dependent MCPR Limits, MCPR(f)**



## CORE OPERATING LIMITS REPORT

Figure 10

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE8X8NB Fuel

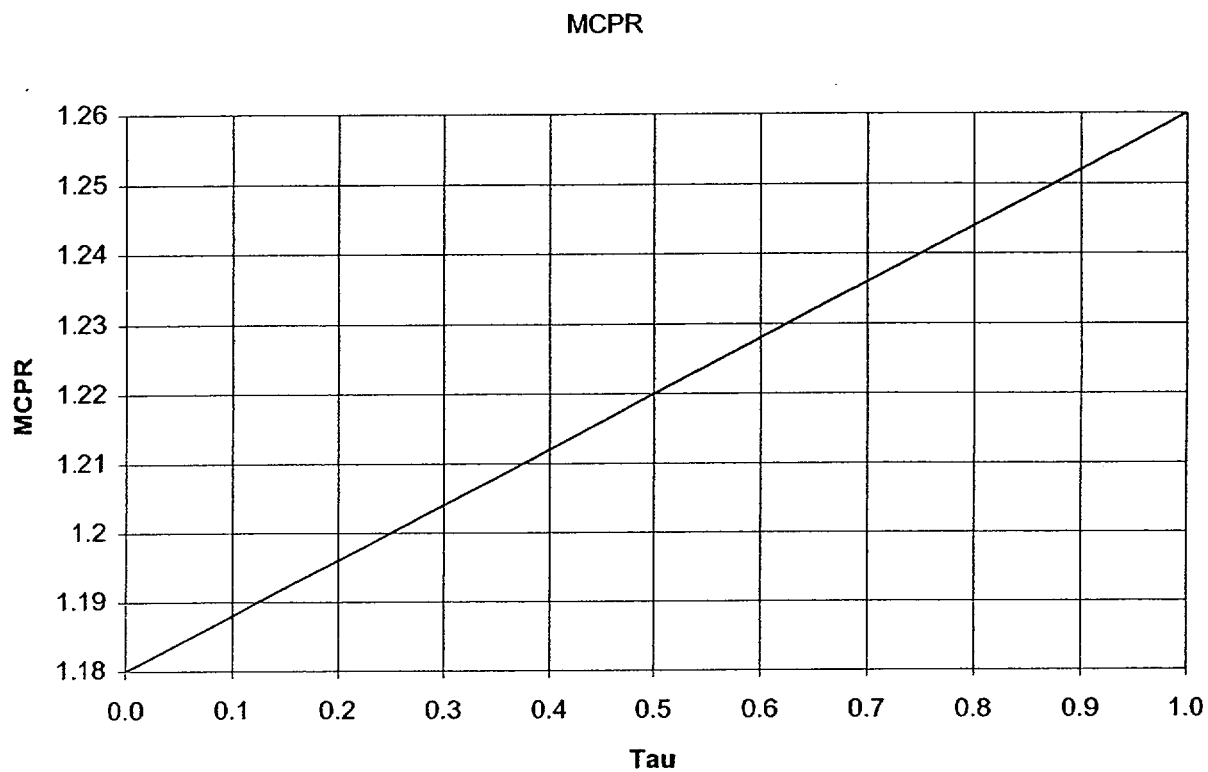


Exposure range: BOC21 to EOC21-1440 MWd/MT (1306 MWd/ST)

## CORE OPERATING LIMITS REPORT

Figure 11

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE8X8NB Fuel

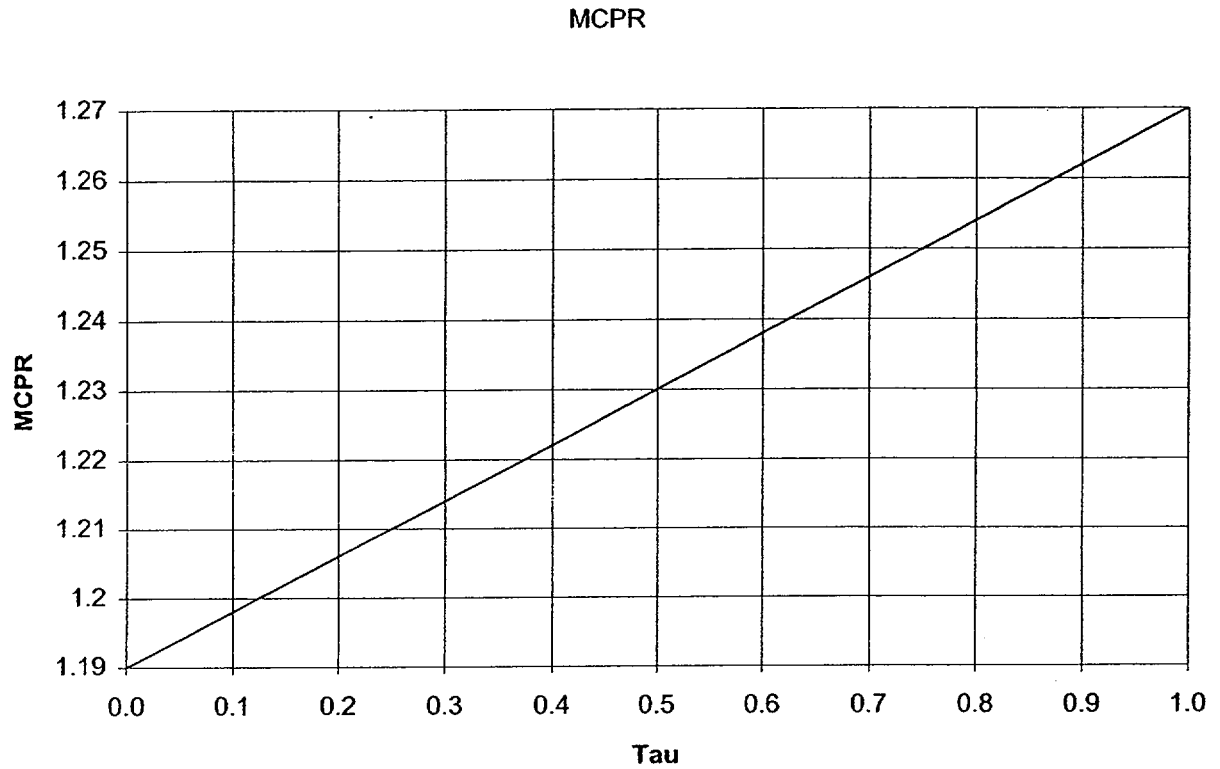


Exposure range: EOC21 -1440 MWd/MT (1306 MWd/ST) to EOC21

## CORE OPERATING LIMITS REPORT

Figure 12

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE8X8NB Fuel

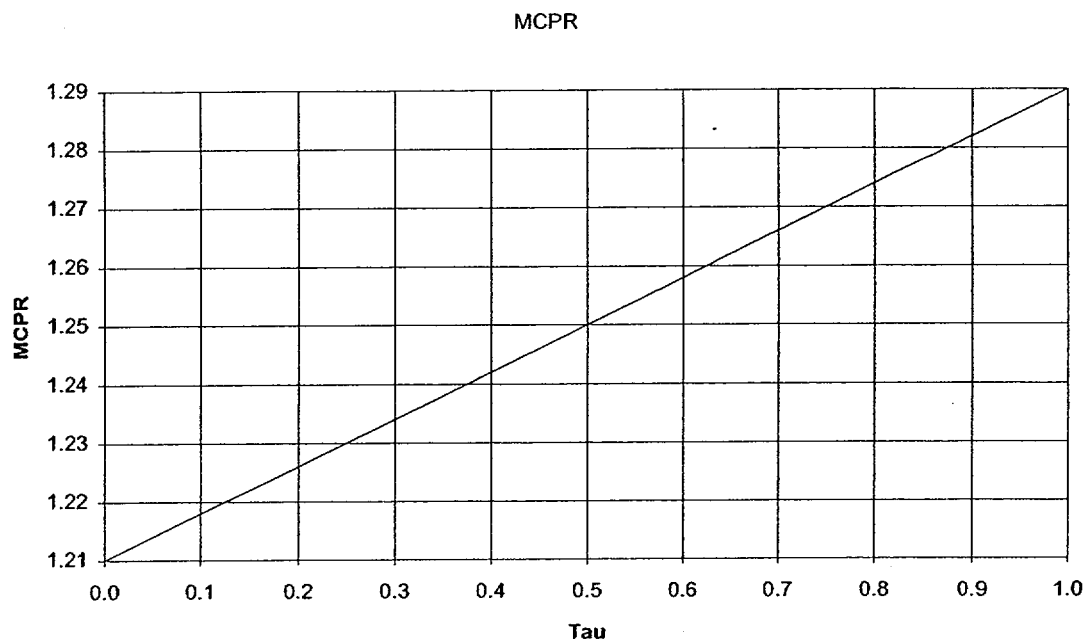


Exposure range: BOC21 to EOC21 ICF

## CORE OPERATING LIMITS REPORT

Figure 13

Minimum Critical Power Ratio (MCPR) versus Tau with One Turbine Bypass Valve Unavailable (based on tested measured scram time as defined in Reference 4), GE8X8NB Fuel

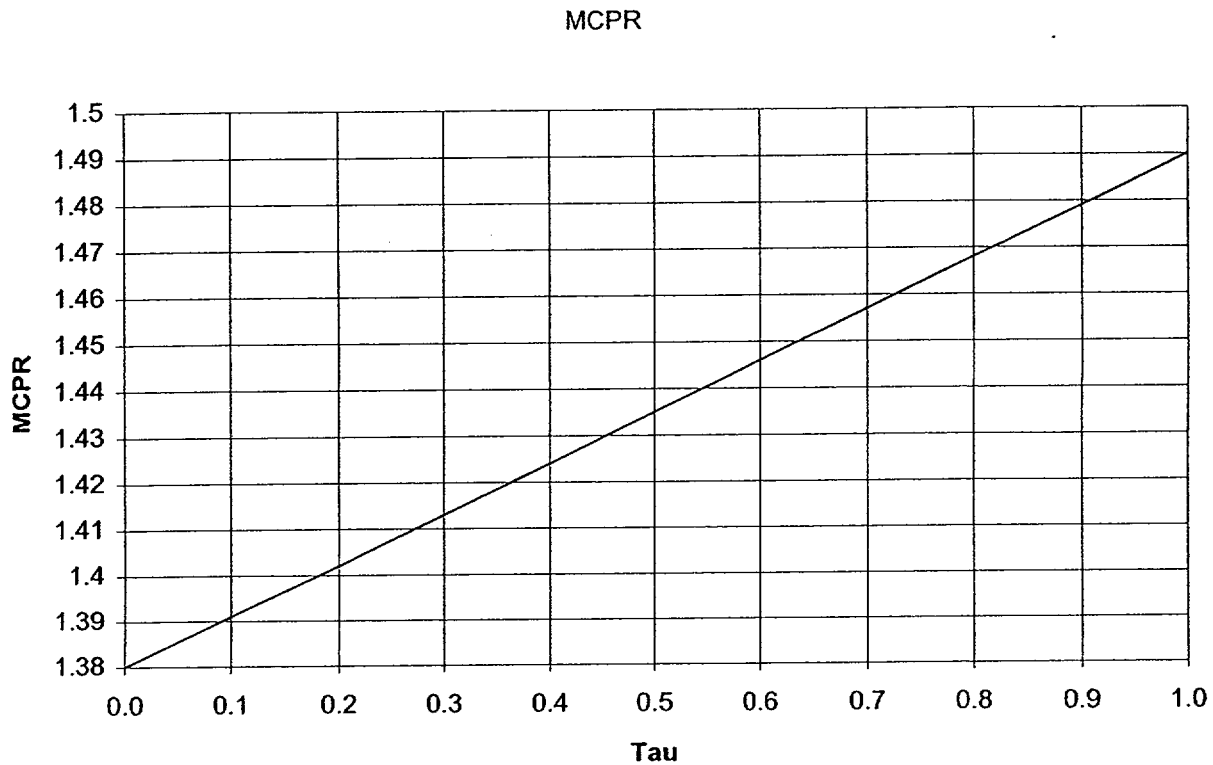


Exposure range: BOC21 to EOC21 ICF\_1TBPOOS

## CORE OPERATING LIMITS REPORT

Figure 14

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE14 Fuel

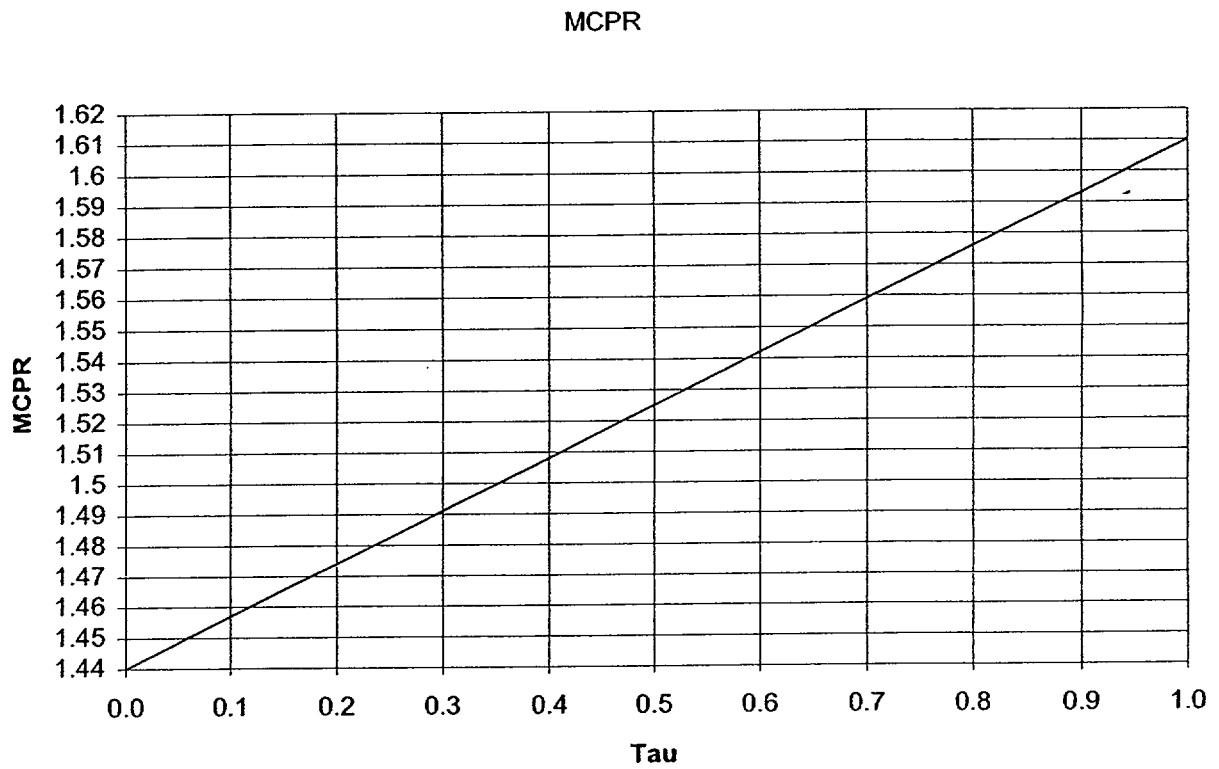


Exposure range: BOC21 to EOC21-1440 MWd/MT (1306 MWd/ST)

## CORE OPERATING LIMITS REPORT

Figure 15

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE14 Fuel



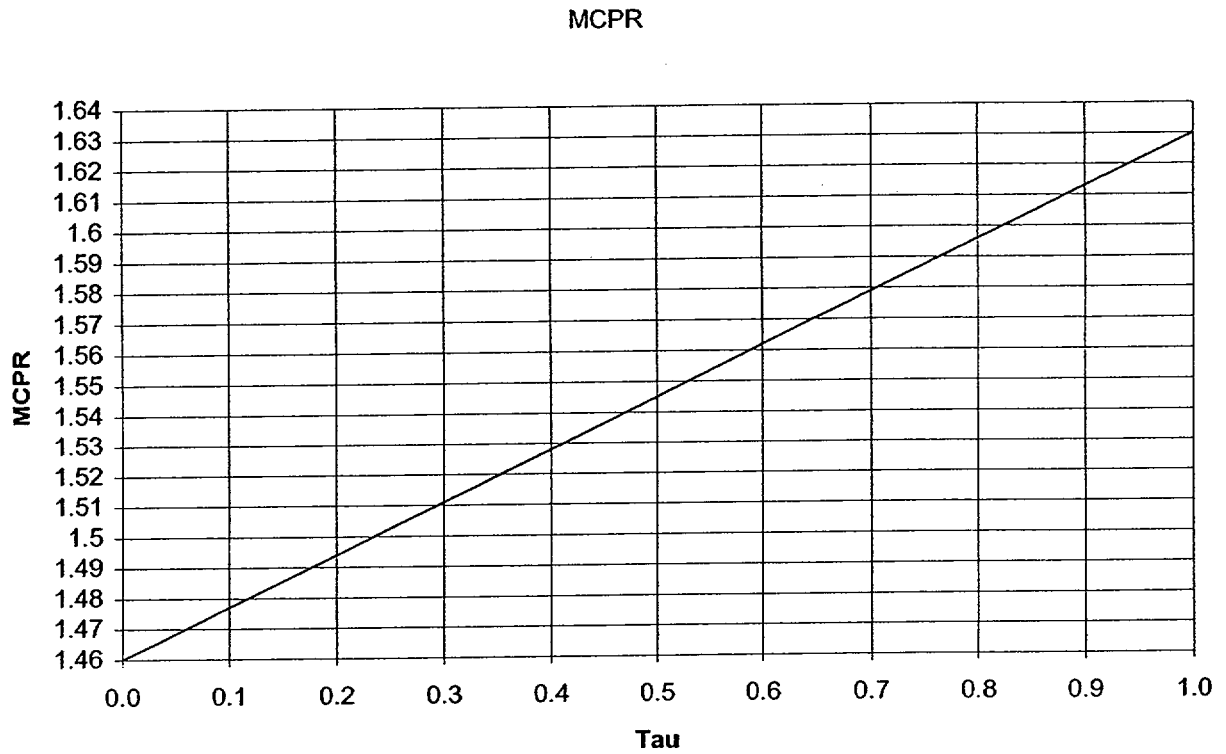
Exposure range: EOC21-1440 MWd/MT (1306 MWd/ST) to EOC21



## CORE OPERATING LIMITS REPORT

Figure 16

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE14 Fuel

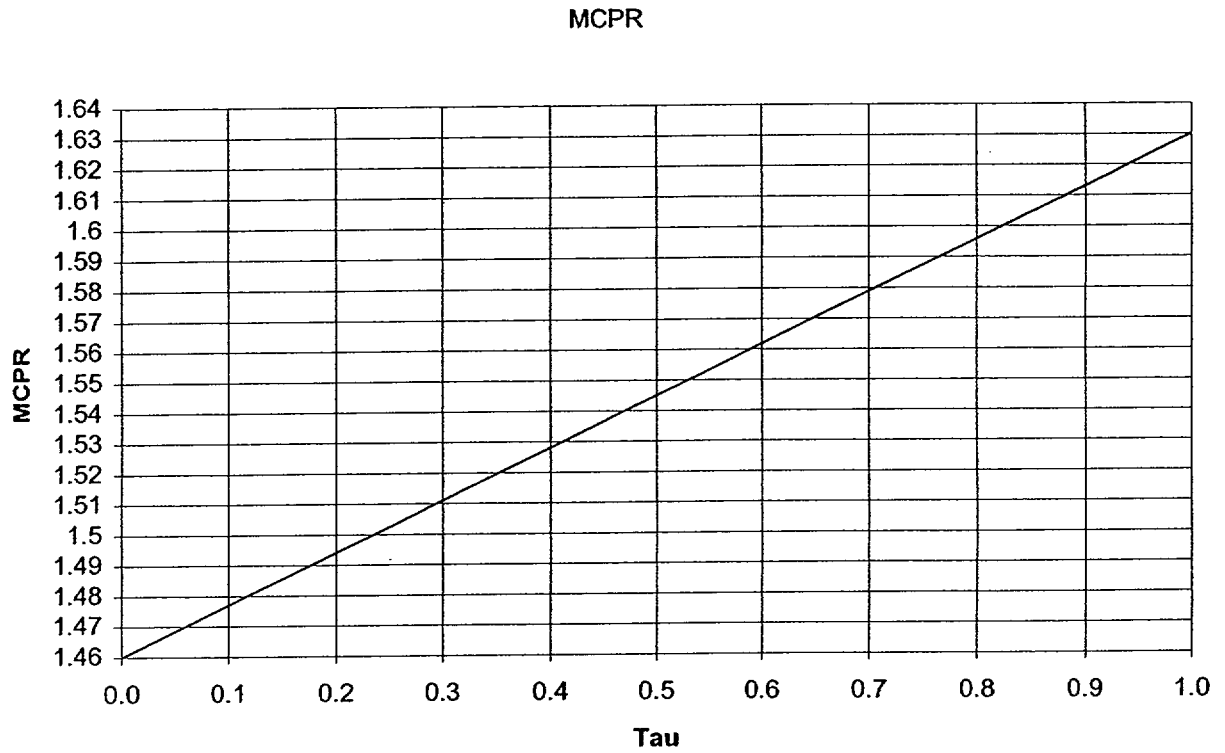


Exposure range: BOC21 to EOC21 ICF

## CORE OPERATING LIMITS REPORT

Figure 17

Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 4), GE14 Fuel

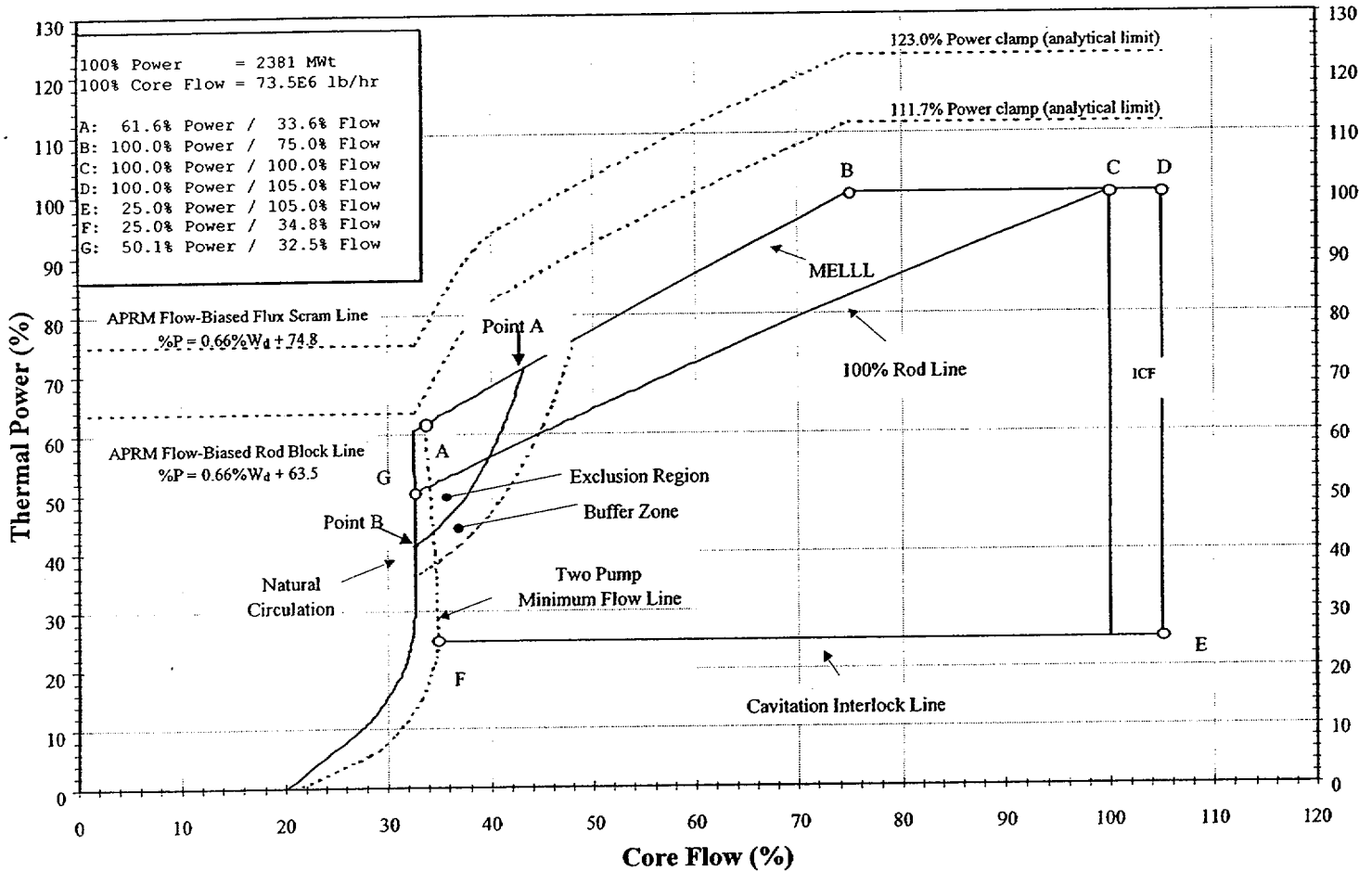


Exposure range: BOC21 to EOC21 ICF\_1TBPOOS

# CORE OPERATING LIMITS REPORT

Figure 18

## Power to Flow Map



### Exclusion Region Endpoints

Point A	72.3% rated power	44.4% rated flow
Point B	41.0% rated power	32.5% rated flow

## ATTACHMENT 3 LIST OF REGULATORY COMMITMENTS

Correspondence Number: NLS2001113

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

[illegible]