Fermi 2
6400 North Dixie Hwy., Newport, MI 48166

Detroit Edison

April 28, 2000
NRC-00-0039

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

References: 1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

2) NRC Letter to Detroit Edison "Fermi 2 – Issuance of Amendment Re: Safety Limit Minimum Critical Power Ratio Limits For Cycle 8 (TAC NO. MA7372) ", dated March 30, 2000

Subject: Transmittal of Cycle 8 Core Operating Limits Report

In accordance with Fermi 2 Technical Specification 5.6.5, Detroit Edison hereby submits a copy of the Core Operating Limits Report (COLR), Cycle 8, Revision 0. This COLR will be used during the Fermi 2 eighth operating cycle which is scheduled to begin in May 2000.

Reference 2 issued License Amendment Number 138 on Safety Limit Minimum Critical Power Ratio (SLMCPR) Limits. In this reference, the NRC requested that Detroit Edison submit a letter informing the NRC when this amendment is fully implemented. This letter is to notify the NRC that Detroit Edison has fully implemented Amendment Number 138 on April 28, 2000.

Should you have any questions or require additional information, please contact me at (734) 586-4258.

Sincerely,

Norman K. Peterson
Director – Nuclear Licensing

Enclosure

cc: A. J. Kugler [w/o enclosure]
Mark A Ring [w/o enclosure]
NRC Resident Office [w/enclosure]
Regional Administrator, Region III [w/enclosure]

A001

ENCLOSURE TO
NRC-00-0039

CORE OPERATING LIMITS REPORT [COLR]

CYCLE 8

REVISION 0

FERMI 2

CORE OPERATING LIMITS REPORT

CYCLE 8

REVISION 0

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APRIL 2000

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1.0 INTRODUCTION AND SUMMARY

This report provides the cycle specific plant operating limits, which are listed below, for Fermi 2, Cycle 8, as required by Technical Specifications 5.6.5. The analytical methods used to determine these core operating limits are those previously reviewed and approved by the Nuclear Regulatory Commission in GESTAR II.

The cycle specific limits contained within this report are valid for the full range of the licensed operating domain.

OPERATING LIMIT	TECHNICAL SPECIFICATION
APLHGR	3.2.1
MCPR	3.2.2
LHGR	3.2.3
RBM	3.3.2.1

APLHGR = AVERAGE PLANAR LINEAR HEAT GENERATION RATE

MCPR = MINIMUM CRITICAL POWER RATIO

LHGR = LINEAR HEAT GENERATION RATE

RBM = ROD BLOCK MONITOR SETPOINTS

2.0 AVERAGE PLANAR LINEAR HEAT GENERATION RATE

TECH SPEC IDENT	OPERATING LIMIT
3.2.1	APLHGR

2.1 Definition

The AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) shall be applicable to a specific planar height and is equal to the sum of the LINEAR HEAT GENERATION RATE's (LHGR) for all the fuel rods in the specified bundle at the specified height divided by the number of fuel rods in the fuel bundle at the height.

2.2 Determination of MAPLHGR Limit

The maximum APLHGR (MAPLHGR) limit is a function of reactor power, core flow, fuel and lattice type, and average planar exposure. The limit is developed, using NRC approved methodology described in References 1 and 2, to ensure gross cladding failure will not occur following a loss of coolant accident (LOCA) and that fuel thermal-mechanical design criteria will not be violated during any postulated transient events. The MAPLHGR limit ensures that the peak clad temperature during a LOCA will not exceed the limits as specified in 10CFR50.46(b)(1) and that the fuel design analysis criteria defined in References 1 and 2 will be met.

The MAPLHGR limit during dual loop operation is calculated by the following equation:

$$MAPLHGR_{LIMIT} = \mathrm{MIN}\ (MAPLHGR\ (P), MAPLHGR\ (F))$$

where:

$$MAPLHGR\ (P) = MAPFAC\ (P) \times MAPLHGR_{STD}$$

$$MAPLHGR\ (F) = MAPFAC\ (F) \times MAPLHGR_{STD}$$

Within four hours after entering single loop operation, the MAPLHGR limit is calculated by the following equation:

$$MAPLHGR_{LIMIT} = \mathrm{MIN}\ (MAPLHGR\ (P), MAPLHGR\ (F), MAPLHGR\ (SLO))$$

where:

$$MAPLHGR\ (SLO) = 0.73 \times MAPLHGR_{STD}$$

$MAPLHGR_{STD}$, the standard MAPLHGR limit, is defined at a power of 3430 MWt and flow of 105 Mlbs/hr for each fuel type as a function of average planar exposure and is presented in Table 1. Since fuel types may contain more than one lattice type (axially), Table 1 represents the most limiting lattice type at each exposure point for that fuel type. When hand calculations are required, $MAPLHGR_{STD}$ shall be determined by interpolation from Table 1.

MAPFAC(P), the core power-dependent MAPLHGR limit adjustment factor, shall be calculated by using Section 2.2.1.

MAPFAC(F), the core flow-dependent MAPLHGR limit adjustment factor, shall be calculated by using Section 2.2.2.

TABLE 1 FUEL TYPE-DEPENDENT STANDARD MAPLHGR LIMITS

Standard MAPLHGR Limit
(KW/FT)

Exposure GWD/ST	Fuel Type 10	12	14	15	16
0.0	11.51	10.75	11.01	10.65	10.48
0.2	11.54	10.79	11.07	10.70	10.56
1.0	11.62	10.90	11.18	10.81	10.70
2.0	11.71	11.11	11.33	10.97	10.87
3.0	11.79	11.36	11.48	11.14	11.08
4.0	11.87	11.54	11.64	11.32	11.30
5.0	11.96	11.67	11.80	11.51	11.45
6.0	12.04	11.81	11.96	11.69	11.59
7.0	12.13	11.95	12.13	11.87	11.72
8.0	12.23	12.09	12.29	12.06	11.85
9.0	12.34	12.23	12.45	12.23	11.98
10.0	12.48	12.39	12.61	12.39	12.09
12.5	12.50	12.46	12.70	12.47	12.07
15.0	12.19	12.18	12.48	12.34	11.91
17.5	11.82	11.88	12.18	12.10	11.63
20.0	11.45	11.57	11.87	11.81	11.32
25.0	10.71	10.88	11.25	11.20	10.71
30.0	9.99	10.15	10.64	10.59	10.10
35.0	9.28	9.43	10.01	9.97	9.50
40.0	8.59	8.73	9.28	9.23	8.88
45.0	7.91	8.05	8.59	8.53	8.24
50.0	7.24	7.37	7.93	7.87	7.57
55.0	6.56	6.68	7.25	7.20	6.87
56.37	6.37				
56.89					6.59
57.12		6.39			
57.24		6.37			
58.58				6.66	
58.84			6.67		

Fuel Types

10 = GE11-P9CUB353-10GZ-100M-146-T
12 = GE11-P9CUB366-15GZ-100T-146-T
14 = GE11-P9CUB380-12GZ-100T-146-T
15 = GE11-P9CUB378-4G6/8G5-100T-146-T
16 = GE11-P9CUB396-13GZ-100T-146-T

2.2.1 Calculation of MAPFAC(P)

The core power-dependent MAPLHGR limit adjustment factor, MAPFAC(P), shall be calculated by one of the following equations:

For $0 \leq P < 25$:

No thermal limits monitoring is required.

For $25 \leq P < 30$:

<u>With turbine bypass OPERABLE,</u>

For core flow $\leq$ 50 Mlbs/hr,

$$MAPFAC(P) = 0.606 + 0.0038 (P - 30)$$

For core flow > 50 Mlbs/hr,

$$MAPFAC(P) = 0.586 + 0.0038 (P - 30)$$

<u>With turbine bypass INOPERABLE,</u>

For core flow $\leq$ 50 Mlbs/hr,

$$MAPFAC(P) = 0.490 + 0.0050(P - 30)$$

For core flow > 50 Mlbs/hr,

$$MAPFAC(P) = 0.438 + 0.0050(P - 30)$$

For $30 \leq P \leq 100$:

$$MAPFAC(P) = 1.0 + 0.005224(P - 100)$$

where: P = Core power (fraction of rated power times 100).

2.2.2 Calculation of MAPFAC(F)

The core flow-dependent MAPLHGR limit adjustment factor, MAPFAC(F), shall be calculated by the following equation:

$$MAPFAC(F) = \mathrm{MIN}(1.0,\ A_F \times \frac{WT}{100} + B_F)$$

where:

WT = Core flow (Mlbs/hr).
A_F = Given in Table 2.
B_F = Given in Table 2.

TABLE 2 FLOW-DEPENDENT MAPLHGR LIMIT COEFFICIENTS

Maximum Core Flow* (Mlbs/hr)	A_F	B_F
110	0.67874	0.4358

*As limited by the Recirculation System MG Set mechanical scoop tube stop setting.

3.0 MINIMUM CRITICAL POWER RATIO

TECH SPEC IDENT	OPERATING LIMIT
3.2.2	MCPR

3.1 Definition

The MINIMUM CRITICAL POWER RATIO (MCPR) shall be the smallest Critical Power Ratio (CPR) that exists in the core for each type of fuel. The CPR is that power in the assembly that is calculated by application of the appropriate correlation(s) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.

3.2 Determination of Operating Limit MCPR

The required Operating Limit MCPR (OLMCPR) at steady-state rated power and flow operating conditions is derived from the established fuel cladding integrity Safety Limit MCPR of 1.07 and an analysis of abnormal operational transients. To ensure that the Safety Limit MCPR is not exceeded during any anticipated abnormal operational transient, the most limiting transients have been analyzed to determine which event will cause the largest reduction in CPR. Three different core average exposure conditions are evaluated. The result is an Operating Limit MCPR which is a function of exposure and τ. τ is a measure of scram speed, and is defined in Section 3.3.2.

The OLMCPR shall be calculated by the following equation:

$$OLMCPR = \mathrm{MAX}(MCPR(P), MCPR(F))$$

MCPR(P), the core power-dependent MCPR operating limit, shall be calculated using Section 3.3.

MCPR(F), the core flow-dependent MCPR operating limit, shall be calculated using Section 3.4.

In case of **Single Loop Operation**, the Safety Limit MCPR is increased by 0.02 to 1.09, but OLMCPR does not change.

3.3 Calculation of MCPR(P)

MCPR(P), the core power-dependent MCPR operating limit, shall be calculated by the following equation:

$$MCPR(P) = K_P \times OLMCPR_{100/105}$$

K_P, the core power-dependent MCPR Operating Limit adjustment factor, shall be calculated by using Section 3.3.1.

$OLMCPR_{100/105}$ shall be determined by interpolation from Table 3, and τ shall be calculated by using Section 3.3.2.

TABLE 3 $OLMCPR_{100/105}$ AS A FUNCTION OF EXPOSURE AND τ

CONDITION	EXPOSURE (MWD/ST)		$OLMCPR_{100/105}$
Both Turbine Bypass **and** Moisture Separator Reheater **OPERABLE**	BOC to 7500	$\tau = 0$	1.26
		$\tau = 1$	1.31
	7500 to 9500	$\tau = 0$	1.29
		$\tau = 1$	1.34
	9500 to EOC	$\tau = 0$	1.30
		$\tau = 1$	1.38
Either Turbine Bypass **or** Moisture Separator Reheater **INOPERABLE**	BOC to EOC	$\tau = 0$	1.35
		$\tau = 1$	1.43
Both Turbine Bypass **and** Moisture Separator Reheater **INOPERABLE**	BOC to EOC	$\tau = 0$	1.37
		$\tau = 1$	1.45

3.3.1 Calculation of K_P

The core power-dependent MCPR operating limit adjustment factor, K_P, shall be calculated by using one of the following equations:

For $0 \leq P < 25$:

No thermal limits monitoring is required.

For $25 \leq P < 30$:

When turbine bypass is OPERABLE,

$$K_P = \frac{(K_{BYP} + (0.026 \times (30 - P)))}{OLMCPR_{100/105}}$$

where: K_{BYP} = 1.90 **for core flow $\leq$ 50 Mlbs/hr**
= 2.23 **for core flow > 50 Mlbs/hr**

When turbine bypass is INOPERABLE,

$$K_P = \frac{(K_{BYP} + (0.054 \times (30 - P)))}{OLMCPR_{100/105}}$$

where: K_{BYP} = 2.26 **for core flow $\leq$ 50 Mlbs/hr**
= 3.03 **for core flow > 50 Mlbs/hr**

For $30 \leq P < 45$:

$$K_P = 1.28 + (0.0134 \times (45 - P))$$

For $45 \leq P < 60$:

$$K_P = 1.15 + (0.00867 \times (60 - P))$$

For $60 \leq P \leq 100$:

$$K_P = 1.0 + (0.00375 \times (100 - P))$$

where: P = Core power (fraction of rated power times 100).

3.3.2 Calculation of τ

The value of τ, which is a measure of the conformance of the actual control rod scram times to the assumed average control rod scram time in the reload licensing analysis, shall be calculated by using the following equation:

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

where: τ_A = 1.096 seconds,

$$\tau_B = 0.830 + 0.019 \times 1.65 \sqrt{\frac{N_1}{\sum_{i=1}^{n} N_i}}$$

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

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 36 of all rods measured in the i^{th} surveillance test, and

N_1 = total number of active rods measured in the initial control rod scram time test for the cycle (Technical Specification Surveillance Requirement 3.1.4.4).

The value of τ shall be calculated and used to determine the applicable $OLMCPR_{100/105}$ value from Table 3 within 72 hours of the conclusion of each control rod scram time surveillance test required by Technical Specification Surveillance Requirements 3.1.4.1, 3.1.4.2, and 3.1.4.4. Prior to performance of the initial scram time measurements for the cycle, a τ value of 1.0 shall be used to determine the applicable $OLMCPR_{100/105}$ value from Table 3.

3.4 Calculation of MCPR(F)

MCPR(F), the core flow-dependent MCPR operating limit, shall be calculated by using the following equation:

$$MCPR(F) = \text{MAX}(1.20, (A_F \times \frac{WT}{100} + B_F))$$

where:

WT = Core flow (Mlbs/hr).
A_F = Given in Table 4.
B_F = Given in Table 4.

TABLE 4 FLOW-DEPENDENT MCPR LIMIT COEFFICIENTS

Maximum Core Flow* (Mlbs/hr)	A_F	B_F
110	-0.5956	1.727

*As limited by the Recirculation System MG Set mechanical scoop tube stop setting.

4.0 LINEAR HEAT GENERATION RATE

TECH SPEC IDENT	OPERATING LIMIT
3.2.3	LHGR

4.1 Definition

The LINEAR HEAT GENERATION RATE (LHGR) shall be the heat generation per unit length of fuel rod. It is the integral of the heat flux over the heat transfer area associated with the unit length. By maintaining the operating LHGR below the applicable LHGR limit, it is assured that all thermal-mechanical design bases and licensing limits for the fuel will be satisfied.

4.2 Determination of LHGR Limit

The LHGR limit is defined as a function of lattice type and average planar exposure and is presented in Table 5. Since fuel types may contain more than one lattice type (axially), Table 5 represents the most limiting lattice type at each exposure point for that fuel type. When hand calculations are required, the LHGR limit shall be determined by interpolation from Table 5.

TABLE 5 LHGR LIMITS FOR VARIOUS FUEL TYPES

LHGR Limit (KW/FT)

Exposure GWD/ST	Fuel Type 10	12	14	15	16
0.0	14.40	14.40	14.40	14.40	14.40
9.81	14.40				
10.43					14.40
10.57				14.40	
10.70		14.40			
10.82			14.40		
54.55				6.80	6.80
54.61			6.80		
54.72		6.80			
56.20	6.80				

Fuel Types

10 = GE11-P9CUB353-10GZ-100M-146-T
12 = GE11-P9CUB366-15GZ-100T-146-T
14 = GE11-P9CUB380-12GZ-100T-146-T
15 = GE11-P9CUB378-4G6/8G5-100T-146-T
16 = GE11-P9CUB396-13GZ-100T-146-T

5.0 CONTROL ROD BLOCK INSTRUMENTATION

TECH SPEC IDENT	SETPOINT
3.3.2.1	RBM

5.1 Definition

The nominal trip setpoints and allowable values of the control rod withdrawal block instrumentation are shown in Table 6. These values are consistent with the bases of the APRM Rod Block Technical Specification Improvement Program (ARTS) and the MCPR operating limits.

TABLE 6 CONTROL ROD BLOCK INSTRUMENTATION SETPOINTS WITH FILTER

Setpoint	Trip Setpoint	Allowable Value
LPSP	27.0	28.4
IPSP	62.0	63.4
HPSP	82.0	83.4
LTSP	117.0	118.9
ITSP	112.2	114.1
HTSP	107.2	109.1
DTSP	94.0	92.3

where:

- LPSP Low power setpoint; Rod Block Monitor (RBM) System trip automatically bypassed below this level
- IPSP Intermediate power setpoint
- HPSP High power setpoint
- LTSP Low trip setpoint
- ITSP Intermediate trip setpoint
- HTSP High trip setpoint
- DTSP Downscale trip setpoint

6.0 REFERENCES

1. "General Electric Standard Application for Reactor Fuel (GESTAR II)," NEDE-24011-P-A, Revision 13 as amended by Amendment 25

2. "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-of-Coolant Accident - SAFER/GESTR Application Methodology," NEDE 23785-1-PA, Revision 1, October 1984

3. "Fermi-2 SAFER/GESTR-LOCA, Loss-of-Coolant Accident Analysis," NEDC-31982P, July 1991, and Errata and Addenda No. 1, April 1992

4. "Lattice-Dependent MAPLHGR Report for Fermi Power Plant Unit 2 Reload 7 Cycle 8," Global Nuclear Fuel, J11-03648-10AA, Revision 0, March 2000

5. "Supplemental Reload Licensing Report for Fermi Power Plant Unit 2 Reload 7, Cycle 8," Global Nuclear Fuel, J11-03648-10, Revision 1, March 2000

6. Letter from T. G. Colburn to W. S. Orser, "Fermi-2 - Amendment No. 87 to Facility Operating License No. NPF-43 (TAC NO. M82102)," September 9, 1992

7. Letter from J. F. Stang to W. S. Orser, "Amendment No. 53 to Facility Operating License No. NPF-43: (TAC No. 69074)," July 27, 1990

8. "Maximum Extended Operating Domain Analysis for Detroit Edison Company Enrico Fermi Energy Center Unit 2," GE Nuclear Energy, NEDC-31843P, July 1990

9. Letter from D. P. Stier, GENE N&SA, to A. Alzaben, GNF, "Fermi 2 Cycle 8 ARTS 110% Flow Dependent Curves" April 5, 2000

10. "Power Range Neutron Monitoring System," DC-4608, Vol. XI DCD, Rev. B and DC-4608 Vol. I Rev. D.

11. Letter from Andrew J. Kugler (USNRC) to Douglas R. Gipson (Detroit Edison), "Fermi-2 - Issuance of Amendment RE: Safety Limit Minimum Critical Power Ratio Limits for Cycle 8 (TAC NO. MA7372)," dated March 30, 2000

12. Letter from Greg Porter to B. L. Myers, "Scram Times for Improved Tech Specs." GP-99014, October 22.1999 containing DRF A12-00038-3, Vol. 4 information from G. A. Watford, GE, to Distribution, Subject: Scram Times versus Notch Position.

6.0 REFERENCES

13. Methodology and Uncertainties for Safety Limit MCPR Evaluations, NEDC-32601P-A, August 1999

14. Power Distribution Uncertainties for Safety Limit MCPR Evaluation, NEDC-32694P-A, August 1999

15. R-Factor Calculation Method for GE11, GE12, and GE13 Fuel, NEDC-32505P-A, Revision 1, July 1999