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United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

James A. FitzPatrick Nuclear Power Plant
Renewed Facility Operating License No. DPR-59
NRC Docket No. 50-333

Subject: Core Operating Limits Report Cycle 24

Dear Sir or Madam,

Enclosed is the James A. FitzPatrick Nuclear Power Plant (JAF) Core Operating Limits Report (COLR). This revision incorporates changes resulting from a reload analysis completed by Global Nuclear Fuel (GNF) for Cycle 24 operations. This report is submitted in accordance with JAF Technical Specifications (TS) 5.6.5.

There are no new regulatory commitments contained in this letter. Questions concerning this report may be addressed to Mr. Steven J. DeFillippo, (315) 349-6455.

Very truly yours,



William C. Drews
Regulatory Assurance Manager

WD/mh

Enclosure: Core Operating Limits Report for James A. FitzPatrick Nuclear Power Plant
Unit 1 Reload 23 Cycle 24

cc: (w/ enclosure)

NRC Regional Administrator, NRC Region 1
NRC Project Manager
NRC Resident Inspector
NYSERDA
NYSPSC

JAFP-18-0097


ENCLOSURE

**Core Operating Limits Report
for James A. FitzPatrick Nuclear Power Plant Unit 1
Reload 23 Cycle 24**

(18 Pages)


CORE OPERATING LIMITS REPORT
FOR
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
UNIT 1 RELOAD 23 CYCLE 24

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All PROOS Operating Limits for MFLCPR and MFLPD (including rated and off-rated) cannot be used until station EC-DCR 625122 is fully implemented.

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Revision History

<u>Revision</u>	<u>Description</u>
Revision 0	First issuance for Cycle 24

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1.0 Terms and Definitions

ADSOOS	Automatic Depressurization System Out of Service
APLHGR	Average Planar Linear Heat Generation Rate
APRM	Average Power Range Monitor
ARTS	APRM, Rod Block, and Technical Specification Improvement Program
BASE	This condition is defined by a group of individual operating conditions that are applicable to all Modes of Operation discussed in Section 9. The "BASE" condition includes the EOOS conditions provided in Table 9-2, concurrent with FFWTR during cycle extension operation.
DLO	Dual Loop Operation
EOC	End of Cycle
EOOS	Equipment Out of Service
EOR	End of Rated; the cycle exposure at which reactor power is equal to rated thermal power with recirculation system flow equal to 100%, all control rods fully withdrawn, nominal feedwater temperature, and equilibrium xenon.
FFWTR	Final Feedwater Temperature Reduction
ICF	Increased Core Flow
K _P	Off-rated power dependent OLMCPR multiplier
K _F	Off-rated flow dependent OLMCPR multiplier
LHGR	Linear Heat Generation Rate
LHGRFAC _F	Off-rated flow dependent LHGR multiplier
LHGRFAC _P	Off-rated power dependent LHGR multiplier
MAPFAC _F	Off-rated flow dependent MAPLHGR multiplier
MAPFAC _P	Off-rated power dependent MAPLHGR multiplier
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MCPR _F	Off-rated flow dependent OLMCPR
MCPR _P	Off-rated power dependent OLMCPR
MELLLA	Maximum Extended Load Line Limit Analysis
MSIVOOS	Main Steam Isolation Valve Out of Service

OLMCPR	Operating Limit Minimum Critical Power Ratio
P-bypass	Reactor power level below which the TSV position and the TCV fast closure scrams are bypassed
PROOS	Pressure Regulator Out of Service
Rated recirculation flow	Required drive flow to achieve rated core flow
RBM	Rod Block Monitor
RTP	Rated Thermal Power
RWE	Rod Withdrawal Error
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
SRVOOS	Safety/Relief Valve(s) Out of Service
TBVOOS	Turbine Bypass Valve(s) Out of Service
TRM	Technical Requirements Manual
W	Recirculation flow in percent of rated

2.0 General Information

This report provides the following cycle-specific parameter limits for James A. FitzPatrick Unit 1 Cycle 24:

- Average Planar Linear Heat Generation Rate (APLHGR)
- Minimum Critical Power Ratio (MCPR)
- Linear Heat Generation Rate (LHGR)
- Flow-Biased Average Power Range Monitor (APRM) Allowable Values
- Rod Block Monitor (RBM) Upscale Function Allowable Values
- Power/Flow Exclusion Region

This report is prepared in accordance with Technical Specification 5.6.5 of Reference 1. Preparation of this report was performed in accordance with Exelon Nuclear, Nuclear Fuels T&RM NF-AB-120-3600.

The data presented in this report is valid for all licensed operating domains on the operating map, including:

- Maximum Extended Load Line Limit down to the minimum licensed core flow (i.e., 79.8% of rated) during full power operation (2536 MWth)
- Rated core flow of 77.0 Mlb/hr
- Increased Core Flow (ICF) up to 105% of rated core flow
- Final Feedwater Temperature Reduction (FFWTR) up to 80°F during cycle extension operation at core flow down to 95% rated core flow at rated core power
- End-of-Cycle coastdown to minimum power level of 40%

Further information on the cycle-specific analyses for FitzPatrick Unit 1 Cycle 24 and the associated operating domains discussed above is available in Reference 2.

Per Technical Specification 5.6.5, these values have been determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met.

3.0 MAPLHGR Limits

3.1 Technical Specification

Sections 3.2.1 and 3.4.1

3.2 Description

The MAPLHGR limits for the most limiting lattice for GNF2 fuel, as a function of average planar exposure, is given in Table 3-1. For single loop operation, a multiplier is used, which is shown in Table 3-2. The power and flow dependent multipliers for MAPLHGR have been removed and replaced with LHGRFAC_P and LHGRFAC_F; therefore, MAPFAC_P and MAPFAC_F are equal to 1.0 for all power and flow conditions (Reference 2). LHGRFAC_P and LHGRFAC_F are addressed in Section 5.0.

**Table 3-1
 MAPLHGR Versus Average Planar Exposure
 (Reference 2)**

Average Planar Exposure (GWd/ST)	MAPLHGR Limit (kW/ft)
0.00	13.78
17.52	13.78
60.78	7.50
63.50	6.69

**Table 3-2
 MAPLHGR Single Loop Operation (SLO) Multiplier
 (Reference 2)**

SLO Multiplier	0.85
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4.0 MCPR Limits

4.1 Technical Specification

Sections 3.2.2, 3.4.1, and 3.7.6

4.2 Description

The Operating Limit MCPR (OLMCPR) for GNF2 fuel is provided in Table 4-1. These values are determined by the cycle-specific reload analyses in Reference 2 and are valid for all Cycle 24 operating domains. Table 4-1 includes OLMCPR values for all conditions listed in Section 9.0, Modes of Operation. For single loop operation, the MCPR operating limit is 0.03 greater than the analyzed dual loop value. A minimum value of 1.43 is required to obtain an OLMCPR set by the Single Loop Operation Recirculation Pump Seizure Event.

Control rod scram time verification is required per Technical Specification 3.1.4, "Control Rod Scram Times". Tau (τ), a measure of scram time performance to notch position 36 throughout the cycle, is determined based on cumulative scram time test results (Reference 7). The calculation of Tau shall be performed in accordance with site procedures. Linear interpolation shall be used to calculate the OLMCPR value if Tau is between 0.0 (Tau Option B) and 1.0 (Tau Option A).

The power dependent MCPR limits for GNF2 fuel are presented in Table 4-2. Below P-bypass, the $MCPR_P$ limits in Table 4-2 are applied directly; at or above P-bypass, the K_P multiplier is applied to the OLMCPR from Table 4-1. The appropriate $MCPR_P$ or K_P value may be determined by linear interpolation for points not explicitly listed. The flow dependent MCPR limits are provided in Tables 4-3 and 4-4.

The OLMCPR is determined for a given power and flow condition by evaluating the power and flow dependent MCPR values and selecting the greater of the two.

Table 4-1
Operating Limit Minimum Critical Power Ratio (OLMCPR)
(Reference 2)

EOOS Combination	SCRAM Time Option	Cycle Exposure	
		< EOR – 2587 MWd/ST	≥ EOR – 2587 MWd/ST
BASE	A	1.48	1.50
	B	1.40	1.40
BASE SLO	A	1.51	1.53
	B	1.43	1.43
TBVOOS	A	1.55	1.55
	B	1.41	1.41
TBVOOS SLO	A	1.58	1.58
	B	1.44	1.44
PROOS	A	1.48	1.50
	B	1.40	1.40
PROOS SLO	A	1.51	1.53
	B	1.43	1.43

Table 4-2
Power Dependent MCPR Limits and Multipliers, MCPR_P and K_P
(Reference 2)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of Rated)							
		0	25	< 29	≥ 29	40	60	85	100
		Operating Limit MCPR, MCPR _P			Operating Limit MCPR Multiplier, K _P				
BASE	≤ 60	2.41	2.41	2.35	1.520	1.390	1.150	1.056	1.000
	> 60	2.74	2.74	2.63					
BASE SLO	≤ 60	2.44	2.44	2.38	1.520	1.390	1.150	1.056	1.000
	> 60	2.77	2.77	2.66					
TBVOOS	≤ 60	2.53	2.53	2.35	1.520	1.390	1.150	1.056	1.000
	> 60	2.74	2.74	2.63					
TBVOOS SLO	≤ 60	2.56	2.56	2.38	1.520	1.390	1.150	1.056	1.000
	> 60	2.77	2.77	2.66					
PROOS	≤ 60	2.41	2.41	2.35	1.520	1.390	1.177	1.164	1.000
	> 60	2.74	2.74	2.63					
PROOS SLO	≤ 60	2.44	2.44	2.38	1.520	1.390	1.177	1.164	1.000
	> 60	2.77	2.77	2.66					

Table 4-3
Flow Dependent MCPR Limits, $MCPR_F$
(Reference 2)

Flow (% rated)	$MCPR_F$¹
0.0	1.75
30.0	1.57
87.5	1.22
117.0	1.22

Table 4-4
Single Loop Operation (SLO) Flow Dependent MCPR Limits, $MCPR_F$
(Reference 2)

Flow (% rated)	$MCPR_F$
0.0	1.78
30.0	1.60
87.5	1.25
117.0	1.25

¹ Values are applicable up to a Maximum Runout Flow of 112% of rated.

5.0 LHGR Limits

5.1 Technical Specification

Sections 3.2.3 and 3.7.6

5.2 Description

The LHGR limit for the GNF2 fuel type is the product of the exposure dependent LHGR limit (from Table 5-1 for UO₂ fuel rods and Table 5-2 for Gadolinia fuel rods) and the minimum of the power dependent LHGR factor, LHGRFAC_P, and the flow dependent LHGR factor, LHGRFAC_F. The LHGRFAC_P multiplier is determined from Table 5-4. The LHGRFAC_F multiplier is determined from Table 5-5.

The single loop operation multiplier is shown in Table 5-3 and applied in Table 5-5.

Linear interpolation should be used for points not explicitly listed.

Table 5-1
Linear Heat Generation Rate Limits – UO₂ Rods
 (References 4 and 6)

Fuel Type	LHGR
GNF2	See Table B-1 of Reference 6

Table 5-2
Linear Heat Generation Rate Limits – Gadolinia Rods
 (References 4 and 6)

Fuel Type	LHGR
GNF2	See Table B-2 of Reference 6

Table 5-3
LHGR Single Loop Operation (SLO) Multiplier
 (Reference 2)

SLO Multiplier	0.85
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Table 5-4
Power Dependent LHGR Multiplier, LHGRFAC_P
(Reference 2)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of Rated)							
		0	25	< 29	≥ 29	40	60	85	100
		LHGRFAC _P Multiplier							
BASE	≤ 60	0.513	0.513	0.524	0.625	0.683	0.789	0.921	1.000
	> 60	0.513	0.513	0.524					
BASE SLO	≤ 60	0.513	0.513	0.524	0.625	0.683	0.789	0.921	1.000
	> 60	0.513	0.513	0.524					
TBVOOS	≤ 60	0.415	0.415	0.470	0.625	0.683	0.789	0.921	1.000
	> 60	0.408	0.408	0.410					
TBVOOS SLO	≤ 60	0.415	0.415	0.470	0.625	0.683	0.789	0.921	1.000
	> 60	0.408	0.408	0.410					
PROOS	≤ 60	0.513	0.513	0.524	0.625	0.683	0.789	0.921	1.000
	> 60	0.513	0.513	0.524					
PROOS SLO	≤ 60	0.513	0.513	0.524	0.625	0.683	0.789	0.921	1.000
	> 60	0.513	0.513	0.524					

Table 5-5
Flow Dependent LHGR Multiplier, LHGRFAC_F
(Reference 2)

EOOS Combination	Core Flow (% of rated)				
	0	30	62.94	85	110
	LHGRFAC _F Multiplier				
Dual Loop Operation	0.422	0.626		1.000	1.000
Single Loop Operation	0.422	0.626	0.85		0.85

6.0 APRM Allowable Values

6.1 Technical Specification

Section 3.3.1.1

6.2 Description

When operating in MODE 1, the APRM Neutron Flux-High (Flow Biased) Allowable Values shall be set as provided in Table 6-1. APRM Neutron Flux-High (Flow Biased) Rod Block Allowable Values are found in TRM 3.3.B, Control Rod Block Instrumentation.

**Table 6-1
 APRM Allowable Values
 (Reference 3)**

APRM Neutron Flux-High (Flow Biased) Function	Allowable Value (% RTP)	Applicable Drive Flow Range
Dual Loop Operation	0.38W + 61.0%	0 < W ≤ 24.7%
	1.15W + 42.0%	24.7 < W ≤ 47.0%
	0.63W + 73.7%	47.0 < W ≤ 68.7%
	117.0% (clamp)	W > 68.7%
Single Loop Operation	0.38W + 57.9%	0 < W ≤ 32.7%
	1.15W + 32.8%	32.7 < W ≤ 50.1%
	0.58W + 61.3%	50.1 < W ≤ 95.9%
	117.0% (clamp)	W > 95.9%

7.0 RBM Allowable Values

7.1 Technical Specification

Sections 3.3.2.1 and 3.4.1

7.2 Description

The Rod Block Monitor Upscale Allowable Values are determined from the relationships shown in Table 7-1. The setpoint is set at maximum equipment adjustability limits and still complies with the RWE analysis because RWE is analyzed unblocked (Reference 2). The allowable value is clamped with a maximum value not to exceed 120.9%, the allowable value for recirculation loop drive flow (W) of 100% per Reference 5.

Table 7-1
Rod Block Monitor Setpoints
(Reference 5)

Rod Block Monitor Upscale Trip Function	Allowable Value (%RTP)
Dual Loop and Single Loop Operation	$\leq 0.66W + 54.9\%$

8.0 Power/Flow Exclusion Region and Buffer Zone

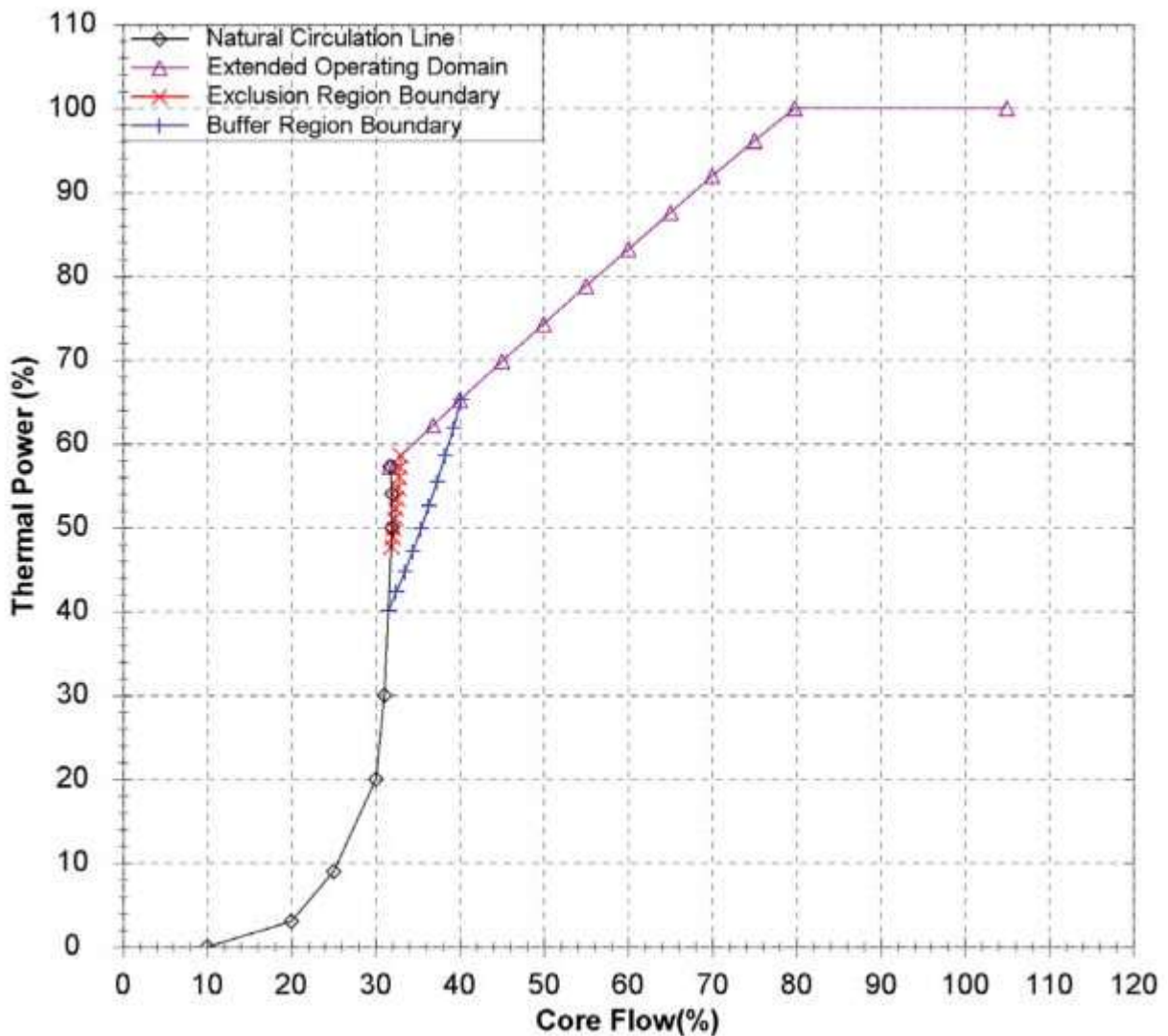
8.1 Technical Specification

Section 3.4.1

8.2 Description

The FitzPatrick Unit 1 Cycle 24 power/flow relationship for the Stability Option I-D Exclusion and Buffer Region is shown in Figure 8-1.

Figure 8-1
Exclusion and Buffer Region Illustration
(Reference 2)



9.0 Modes of Operation

The following conditions are supported by the FitzPatrick Unit 1 Cycle 24 licensing analysis; operation in a condition (or conditions) is controlled by station procedures. **If a combination of options is not listed, it is not supported.** Table 9-1 provides allowed modes of operation with thermal limit sets in this COLR. Table 9-2 provides allowed modes of operation that do not contain explicit thermal limit sets in this COLR.

**Table 9-1
 Modes of Operation
 (Reference 2)**

EOOS Options	Supported Scram Speed Option	Supported Recirculation Loops
BASE	A or B	DLO or SLO
TBVOOS	A or B	DLO or SLO
PROOS	A or B	DLO or SLO

**Table 9-2
 “BASE” EOOS Option – Included Conditions
 (Reference 2)**

Condition
SRVOOS
MSIVOOS ¹

¹ MSIVOOS is valid only at power levels allowed per station procedure.

10.0 Methodology

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following document:

1. "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-26, January 2018 and U.S. Supplement NEDE-24011-P-A-26-US, January 2018.

11.0 References

1. "James A. FitzPatrick Nuclear Power Plant Renewed Facility Operating License", Docket No. 50-333, Renewed License No. DPR-59.
2. "Supplemental Reload Licensing Report for FitzPatrick Reload 23 Cycle 24", Global Nuclear Fuel Document No. 004N2209, Revision 0, July 2018.
3. "Setpoint Calculation for APRM A through F", FitzPatrick Calculation Doc No. JAF-CALC-NMS-00758 Revision 11, January 2006.
4. "Fuel Bundle Information Report for FitzPatrick Reload 23 Cycle 24", Global Nuclear Fuel Document No. 004N2210, Revision 0, July 2018.
5. "Setpoint Calculation for the Rod Block Monitor (07RBM-82A, B)", FitzPatrick Calculation Doc. No. JAF-CALC-NMS-00759, ~~Revision 8, September 2018~~. Revision 8D, October 2018.
6. "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," Global Nuclear Fuel Document No. NEDC-33270P, Revision 9, December 2017.
7. "Scram Times Versus Notch Positions for Option B", GNF Letter REK-E:02-009, May 28, 2002.