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May 13, 2003

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

SUBJECT: Entergy Nuclear Operations, Inc.
Docket No. 50-293
License No. DPR-35

Core Operating Limits Report 15A

LETTER NUMBER: 2.03.076

Dear Sir or Madam:

The attached revision of Pilgrim's Core Operating Limits Report (COLR) is submitted in accordance with the requirements of Pilgrim's Technical Specification 5.6.5.

Revision 15A provides cycle-specific limits for operating Pilgrim during cycle 15. The core operating limits in COLR, Revision 15A, have been established using the NRC-approved methodology provided in the reference listed in COLR, Section 5.0, and in Technical Specification 5.6.5.

Should you require further information concerning COLR, Revision 15A, please contact Bryan Ford (508) 830-8403.

Sincerely,

WJR William J. Riggs

Attachment: Pilgrim Power Station Core Operating Limits Report, Revision 15A

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PILGRIM NUCLEAR POWER STATION
PNPS CORE OPERATING LIMITS REPORT

RTYPE: G4.02

(CYCLE 15)

APPROVED: Gary T James 5/07/2003
Reactor Engineering Superintendent Date

APPROVED: Steve Bethany 5/7/03
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APPROVED: Eric Olson 5/7/03
On-Site Safety Review Committee Date

OSRC Meeting #: 2003-020

APPROVED: Eric Olson 5/7/03
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APPROVED: TRD 5/8/03
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APPROVED: Mark Kelly 5/18/03
Vice President - Operations Date

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RECORD OF REVISIONS

<u>Revision</u>	<u>Effective Date</u>	<u>Description</u>
8A	Effective date based on issuance of license amendment by NRC	Applicable for use during Cycle 8 Operation
9A	Effective date based on issuance of license amendment by NRC for ARTS and SAFER/GESTR	Applicable for use during Cycle 9 operation
10A	Effective date based on initial startup of Cycle 10	Applicable for use during Cycle 10 Operation
11A	Effective date based on initial startup of Cycle 11	Applicable for use during Cycle 11 Operation
11B	Effective upon final approval	Applicable for use during Cycle 11 Operation
11C	Effective upon final approval	Applicable for use during Cycle 11 Operation
11D	Effective upon final approval	Applicable for use during Cycle 11 Operation
12A	Effective date based on issuance of license amendment by NRC for SLMCPR of 1.08	Applicable for use during Cycle 12 Operation
12B	Effective upon final approval	Renumbered Table 3.3-2 to 3.3-1, Sh. 2 of 2 and Table 3.3-1 to 3.3-1, Sh. 1 of 2
12C	Effective upon final approval	Changed Tech Spec section numbers referenced due to Tech Amendment #177. Pages affected: 6, 24
12D	Effective upon final approval	Incorporated stability log-term solution option I-A.
13A	Effective upon final approval	Applicable for use during Cycle 13 Operation
14A	Effective upon final approval	Applicable for use during Cycle 14 Operation
15A	Effective upon final approval	Applicable for use during Cycle 15 Operation

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**PILGRIM NUCLEAR POWER STATION
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1.0 INTRODUCTION

This report provides the cycle-specific limits for operation of the Pilgrim Nuclear Power Station (PNPS) during Cycle 15. In this report, Cycle 15 will be referred to as the present cycle.

Although this report is not a part of the PNPS Technical Specifications, the Technical Specifications refer to this report for the applicable values of the following fuel-related parameters:

	<u>Reference Technical Specification</u>
APRM Flux Scram Trip Setting (Run Mode)	Table 3.1.1
APRM Rod Block Trip Setting (Run Mode)	Table 3.2.C-2
Rod Block Monitor Trip Setting	Table 3.2.C-2
Average Planar Linear Heat Generation Rate	3.11.A
Linear Heat Generation Rate (LHGR)	3.11.B
Minimum Critical Power Ratio (MCPR)	3.11.C
Power/Flow Relationship	3.11.D
Reactor Vessel Core Design	4.2

If any of the core operating limits in this report is exceeded, actions will be taken as defined in the referenced Technical Specification.

The core operating limits in this report have been established for the present cycle using the NRC-approved methodology provided in the documents listed in Technical Specification 5.6.5. These limits are established such that the applicable limits of the plant safety analysis are met.

2.0 INSTRUMENTATION TRIP SETTINGS:

2.1 APRM Flux Scram Trip Setting (Run Mode) Ref. Technical Specifications: Table 3.1.1

a. Normal Feedwater Heating or Low Thermal Reactor Power:

$T_{FW} \geq T_{FW}(\text{rated}) - 50^{\circ}\text{F}$ OR $P < 30\%$,
Where T_{FW} = rated equivalent Feedwater Temperature in $^{\circ}\text{F}$; P = Core Power, % of rated.

When the mode switch is in the RUN position, the average power range monitor (APRM) flux scram trip setting (S_S), in percent of rated thermal power, as a function of aligned drive flow shall be as given by Figure 2.1-1. S_S is clamped at 120% of rated core thermal power. Formulae used to develop Figure 2.1-1 are listed in Table 2.1-1.

The aligned drive flow to the input drive flow relationship is as follows:

$$W_D = \frac{W_{D100}(\Delta D40) - W_{D40}(\Delta D100) + \Delta W_D W_{D1}}{\Delta W_D - \Delta D100 + \Delta D40}$$

Where:

W_{D100} = 100.319 (Ref: 5.10 Table 16)
 W_{D40} = 34.957 (Ref: 5.10 Table 16)
 ΔW_D = $W_{D100} - W_{D40}$
 $\Delta D40$ = Low flow drive flow alignment setting
 $\Delta D100$ = High flow drive flow alignment setting
 W_{D1} = FCTR card input drive flow in percent of rated
 W_D = Aligned drive flow in percent of rated

Source: Reference 5.20, Equation 5-14

The APRM flux scram trip setting is valid only for operation using two recirculation loops. Operation with one recirculation loop out of service is restricted by License Condition 3.E.

In accordance with Technical Specification Table 3.1.1, Note 15, for no combination of loop recirculation flow rate and core thermal power shall the APRM flux scram trip setting be allowed to exceed 120% of rated thermal power. The 50 $^{\circ}\text{F}$ Feedwater Temperature reduction limit only applied to the APRM FCTR Card Settings, based on the validity range of Stability Analysis.

Drive flow alignment will be done within 7 days of reaching equilibrium xenon at 100 % Core Thermal Power after a Refueling Outage.

b. Reduced Feedwater Heating:

$T_{FW} < T_{FW}(\text{rated}) - 50^{\circ}\text{F}$ AND $P > 30\%$,

Cycle 15 operation is not fully analyzed for reduced feedwater temperature. Core stability has been analyzed for feedwater temperature reduction. Use of this analysis requires implementation of the appropriate settings on the Flow Control Trip Reference (FCTR) cards, changes to thermal limits and Power to Flow map.

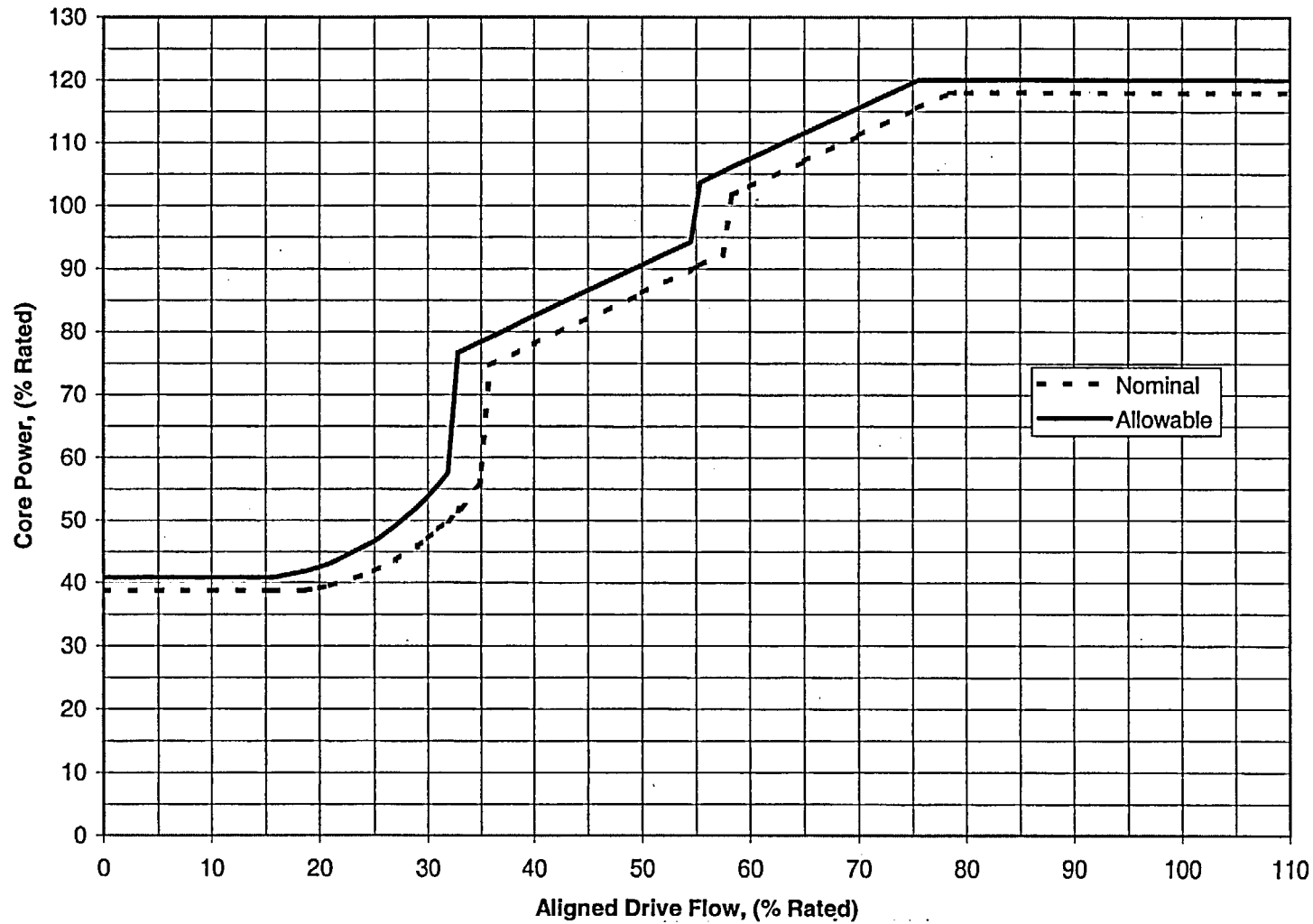
Table 2.1-1
Formulae For Nominal and Allowable APRM Flux Scram Settings
(Normal Feedwater Temperature)

Expression $S_s = P$, % power, where	A	B	C	D	E	Drive Flow Range % Rated
$P=A$	38.791					$0 \leq W_d \leq 18.669$
$P = A \times B \left[C + D \left(\frac{W_d}{100} \right) + E \left(\frac{W_d}{100} \right)^2 \right]$	41.2469	1.7257	0.3699	-6.1436	19.0656	$18.669 < W_d \leq 34.865$
$P=A + B \times W_d$	-644.1699	20.0695				$34.865 < W_d \leq 35.817$
$P=A + B \times W_d$	45.6282	0.8105				$35.817 < W_d \leq 57.49$
$P=A + B \times W_d$	-524.2987	10.7241				$57.49 < W_d \leq 58.37$
$P=A + B \times W_d$	54.1885	0.8134				$58.37 < W_d \leq 78.447$
$P=A$	118					$78.447 < W_d \leq 109.688$

Notes:

1. S_s is the Scram Trip Setting in % Core Power and W_d is the % Aligned Drive Flow as stated in section 2.1
2. Figure 2.1-1 shows the plot of S_s vs. W_d .
3. Allowable setting = 2 + Nominal S_s calculated at ($W_d + 3$)
4. Reference 5.10, Table 12.C lists the values of constants listed in this Table.

Figure 2.1-1 Nominal and allowable APRM Flux Scram Trip Settings



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2.2 APRM Rod Block Trip Setting (Run Mode)

Reference Technical Specifications: Table 3.2.C-2, 3.1.B.1

a. Normal Feedwater Heating or Low Thermal Reactor Power :

$$T_{FW} \geq T_{FW}(\text{rated}) - 50^{\circ}\text{F} \text{ OR } P < 30\%$$

Where T_{FW} = rated equivalent Feedwater Temperature. $^{\circ}\text{F}$ & P = Core Power, % of rated

When the mode switch is in the run position, the average power range monitor (APRM) rod block trip setting (S_{RB}) as a function of aligned drive flow shall be as given by Figure 2.2-1. S_{RB} is clamped at 115% of rated core thermal power. Formulae that form the basis of the Figure 2.2-1 are listed in Table 2.2-1.

The aligned drive flow is calculated from the input drive flow using the relationship given in section 2.1.

The APRM rod block trip setting is valid only for operation using two recirculation loops. Operation with one recirculation loop out of service is restricted by License Condition 3.E.

2.2 APRM Rod Block Trip Setting (Run Mode)

b. Reduced Feedwater Heating :

$$T_{FW} < T_{FW}(\text{rated}) - 50^{\circ}\text{F} \text{ AND } P > 30\%$$

Cycle 15 operation is not fully analyzed for reduced feedwater temperature. Core stability has been analyzed for feedwater temperature reduction. Use of this analysis requires implementation of the appropriate settings on the Flow Control Trip Reference (FCTR) cards, changes to thermal limits and Power to Flow map.

2.3 Rod Block Monitor Trip Setting

Reference Technical Specification: Table 3.2.C-2

Allowable values for the power-dependent Rod Block Monitor trip setpoints shall be:

Reactor Power, P (% of Rated)	Trip Setpoint (% of Reference Level)
$P \leq 25.9$	Not applicable (All RBM Trips Bypassed)
$25.9 < P \leq 62.0$	120
$62.0 < P \leq 82.0$	115
$82.0 < P$	110

The allowable value for the RBM downscale trip setpoint shall be $\leq 94.0\%$ of the reference level. The RBM downscale trip is bypassed for reactor power $\leq 25.9\%$ of rated.

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Table 2.2-1
Formulae For Nominal & Allowable APRM Rod Block Settings
(Normal Feedwater Temperature)

Expression $S_{RB} = P$, % power , where	A	B	C	D	E	Drive Flow Range % Rated
$P = A$	29.6577	N/A	N/A	N/A	N/A	$0 \leq W_D \leq 18.669$
$P = A \times B \left[C + D \left(\frac{W_D}{100} \right) + E \left(\frac{W_D}{100} \right)^2 \right]$	32.0	2.5918	-0.0718	-1.0956	5.6374	$18.669 < W_D \leq 34.876$
	32.0	2.5918	-0.0928	-0.7999	4.9601	$34.876 < W_D \leq 51.488$
	32.0	2.5918	-0.1237	0.1291	3.2741	$51.488 \leq W_D \leq 60.6$
$P = A + B \times W_D$	47.0121	0.8133	N/A	N/A	N/A	$60.6 < W_D \leq 81.133$
$P = A$	113.000	N/A	N/A	N/A	N/A	$81.133 < W_D \leq 109.237$

Notes:

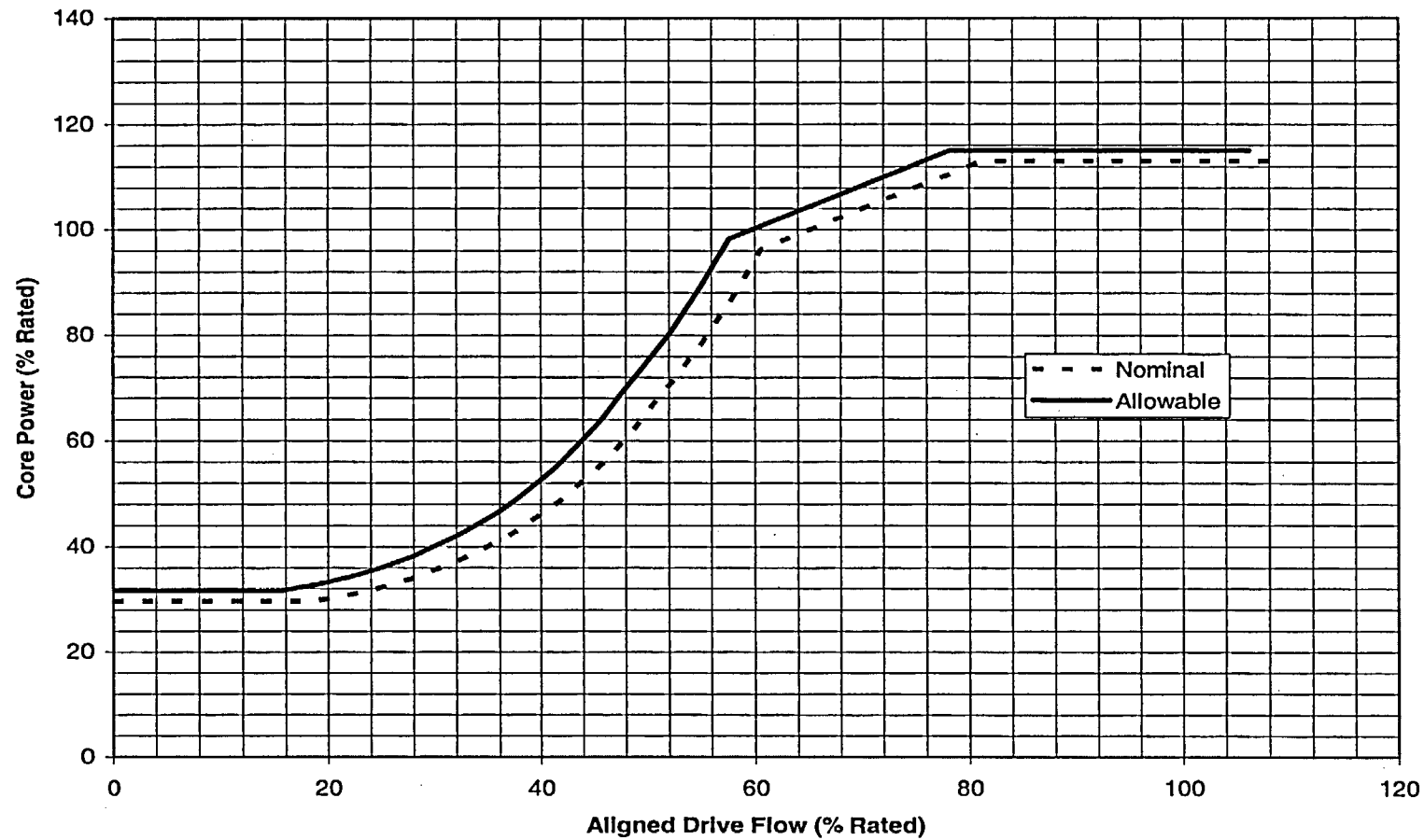
1. S_{RB} is the APRM Rod Block Trip Setting in % Core Power and W_D is the % Aligned Drive Flow as stated in section 2.2
2. Figure 2.2-1 shows the plot of S_{RB} vs. W_D .
3. Allowable setting = 2 + Nominal S_{RB} calculated at $(W_D + 3)$
4. Reference 5.10, Table 12.C lists the values of constants listed in this Table.

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Figure 2.2-1 Nominal & Allowable APRM Rod Block Trip Settings



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3.0 CORE OPERATING LIMITS

3.1 Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)

Reference Technical Specification: 3.11.A

During power operation, MAPLHGR for each fuel type as a function of axial location and average planar exposure shall not exceed the applicable limiting value. The applicable limiting value for each fuel type is the smaller of the flow-dependent and power-dependent MAPLHGR limits, $MAPLHGR_F$ and $MAPLHGR_P$. The flow-dependent MAPLHGR limit, $MAPLHGR_F$, is the product of the MAPLHGR flow factor, $MAPFAC_F$, shown in Figure 3.1-3 for both GE11 and GE14 fuels and the MAPLHGR for rated power and flow conditions, given in Tables 3.1-1 for GE11 fuel or Table 3.1-2 for GE14 fuel. The power-dependent MAPLHGR limit, $MAPLHGR_P$, is the product of the MAPLHGR power factor, $MAPFAC_P$, (shown in Figure 3.1-4 for both GE11 and GE14 fuels) and the MAPLHGR limit for rated power and flow conditions, given in Tables 3.1-1 for GE11 fuel or Table 3.1-2 for GE14 fuel.

The MAPLHGR for rated power and flow conditions for each fuel type as a function of axial location and average planar exposure are based on the approved methodology referenced in Section 5.0 and programmed in the plant process computer. The MAPLHGR for rated power and flow conditions for the most limiting lattice in each fuel type (excluding natural uranium lattices) are presented in Figures 3.1-1 and 3.1-2. The MAPLHGR limits for off-rated conditions are based on the approved methodology in reference 5.3.

MAPLHGR limits are based on ECCS-LOCA considerations. The new GNF SER issued by the NRC (Reference 5.18) documents the basis for the elimination of an Upperbound PCT limit. Cycle 15 MAPLHGR limits are based on use of this SER. Peak LHGR and peak MAPLHGR were both reduced in order to obtain a margin to the Licensing basis PCT limit of 2200 °F. Lattice and exposure dependent MAPLHGR limits were to control the peak LHGR and MAPLHGR within a node. For each lattice type, the MAPLHGR values for rated power and flow conditions are listed in Tables 3.1-1 for GE11 fuel or Table 3.1-2 for GE14 fuel, which are obtained from the Supplemental Reload Licensing Report (Ref. 5.14).

Pbypass is the power level below which more restrictive thermal limits are applied, as the Turbine Stop Valve closure and Turbine Control Valve fast closure scrams are assumed to be bypassed. Pbypass is currently set at 32.5% power.

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**Table 3.1-1 MAPLHGR Limits for Rated Power and Rated Flow for GE11 fuel
Bundle Type: GE11-P9DUB407-14GZ-100T-141-T6**

Average Planar Exposure GWd/MT (GWd/ST)	MAPLHGR Limit (kW/ft)			
	Lattice 4338	Lattice 4339	Lattice 4340	Lattice 4341
0.00 (0.00)	11.43	10.37	10.28	12.14
0.22 (0.20)	11.37	10.43	10.33	12.11
1.10 (1.00)	11.20	10.48	10.44	12.02
2.20 (2.00)	11.16	10.60	10.59	12.02
3.31 (3.00)	11.19	10.72	10.74	12.06
4.41 (4.00)	11.24	10.83	10.88	12.11
5.51 (5.00)	11.30	10.94	11.02	12.16
6.61 (6.00)	11.35	11.06	11.16	12.20
7.72 (7.00)	11.39	11.18	11.31	12.24
8.82 (8.00)	11.42	11.30	11.47	12.27
9.92 (9.00)	11.45	11.42	11.63	12.29
11.02 (10.00)	11.46	11.54	11.80	12.30
12.13 (11.00)	11.47	11.64	11.96	12.31
13.23 (12.00)	11.42	11.72	12.07	12.30
14.33 (13.00)	11.38	11.79	12.16	12.25
14.59 (13.24)	11.36	11.81	12.17	12.23
15.43 (14.00)	11.32	11.86	12.21	12.19
16.53 (15.00)	11.27	11.92	12.23	12.14
18.74 (17.00)	11.15	11.98	12.22	12.02
22.05 (20.00)	10.98	11.96	12.18	11.84
27.56 (25.00)	10.69	11.91	12.10	11.56
33.07 (30.00)	10.16	11.67	11.83	11.26
36.76 (33.35)	9.63	11.24	11.46	10.73
38.58 (35.00)	9.37	11.02	11.28	10.47
44.09 (40.00)	8.59	10.29	10.52	9.69
49.60 (45.00)	7.81	9.57	9.80	8.91
55.12 (50.00)	6.29	8.85	9.10	8.14
57.76 (52.40)	5.36	--	--	--
60.63 (55.00)	--	7.63	8.07	6.31
62.25 (56.47)	--	--	--	5.74
62.50 (56.70)	--	7.00	7.42	--
64.88 (58.86)	--	6.20	--	--
65.74 (59.63)	--	--	6.31	--

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Table 3.1-1 Continued: Bundle Type: GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6

Average Planar Exposure GWd/MT (GWd/ST)	MAPLHGR Limit (kW/ft)			
	Lattice 4324	Lattice 4325	Lattice 4326	Lattice 4327
0.00 (0.00)	11.43	10.59	10.57	12.01
0.22 (0.20)	11.37	10.64	10.61	11.98
1.10 (1.00)	11.20	10.73	10.70	11.88
2.20 (2.00)	11.16	10.83	10.82	11.88
3.31 (3.00)	11.19	10.94	10.95	11.92
4.41 (4.00)	11.24	11.06	11.08	11.97
5.51 (5.00)	11.30	11.17	11.22	12.03
6.61 (6.00)	11.35	11.29	11.36	12.07
7.72 (7.00)	11.39	11.41	11.51	12.11
8.82 (8.00)	11.42	11.53	11.66	12.14
9.92 (9.00)	11.45	11.65	11.83	12.16
11.02 (10.00)	11.46	11.77	11.99	12.18
12.13 (11.00)	11.47	11.88	12.13	12.19
13.23 (12.00)	11.42	11.94	12.21	12.17
14.33 (13.00)	11.38	11.98	12.25	12.12
14.59 (13.24)	11.36	11.99	12.26	12.11
15.43 (14.00)	11.32	12.01	12.27	12.07
16.53 (15.00)	11.27	12.03	12.27	12.01
18.74 (17.00)	11.15	12.02	12.19	11.89
22.05 (20.00)	10.98	11.98	12.02	11.71
27.56 (25.00)	10.69	11.92	11.76	11.43
33.07 (30.00)	10.16	11.71	11.56	11.09
36.76 (33.35)	9.63	11.28	11.33	10.56
38.58 (35.00)	9.37	11.07	11.22	10.30
44.09 (40.00)	8.59	10.33	10.56	9.52
49.60 (45.00)	7.81	9.60	9.83	8.75
55.12 (50.00)	6.29	8.88	9.13	7.94
57.76 (52.40)	5.36	--	--	--
60.63 (55.00)	--	7.67	8.09	6.01
61.57 (55.85)	--	--	--	5.68
62.50 (56.70)	--	7.04	7.46	--
65.09 (59.05)	--	6.16	--	--
65.90 (59.78)	--	--	6.31	--

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Table 3.1-1 Continued: Bundle Type: GE11-P9DUB408-16GZ-100T-141-T6

Average Planar Exposure	MAPLHGR Limit (kW/ft) For Lattice Number					
GWd/MT (GWd/ST)	3651	3944	3955	3956	3957	3958
0.00 (0.00)	11.46	10.36	10.53	10.26	10.54	12.35
0.22 (0.20)	11.40	10.42	10.58	10.32	10.58	12.33
1.10 (1.00)	11.23	10.46	10.65	10.43	10.67	12.25
2.20 (2.00)	11.20	10.58	10.75	10.58	10.78	12.25
3.31 (3.00)	11.23	10.71	10.86	10.73	10.90	12.28
4.41 (4.00)	11.28	10.82	10.96	10.90	11.02	12.32
5.51 (5.00)	11.33	10.93	11.07	11.07	11.15	12.36
6.61 (6.00)	11.38	11.05	11.17	11.24	11.29	12.40
7.72 (7.00)	11.42	11.17	11.28	11.40	11.43	12.43
8.82 (8.00)	11.45	11.29	11.39	11.56	11.57	12.46
9.92 (9.00)	11.47	11.42	11.50	11.71	11.72	12.47
11.02 (10.00)	11.49	11.54	11.62	11.87	11.88	12.48
12.13 (11.00)	11.50	11.65	11.72	12.01	12.03	12.49
13.23 (12.00)	11.45	11.73	11.78	12.11	12.13	12.49
14.33 (13.00)	11.40	11.81	11.84	12.12	12.13	12.44
14.59 (13.24)	11.39	11.83	11.86	12.12	12.13	12.42
15.43 (14.00)	11.35	11.88	11.90	12.12	12.13	12.38
16.53 (15.00)	11.29	11.93	11.95	12.08	12.08	12.33
18.74 (17.00)	11.18	11.95	11.99	11.98	11.98	12.21
22.05 (20.00)	11.00	11.77	11.88	11.81	11.81	12.04
27.56 (25.00)	10.71	11.50	11.58	11.56	11.55	11.75
33.07 (30.00)	10.19	11.22	11.34	11.35	11.34	11.48
36.76 (33.35)	9.66	10.94	11.11	11.07	11.07	10.97
38.58 (35.00)	9.39	10.80	11.00	10.93	10.94	10.72
44.09 (40.00)	8.61	10.04	10.30	10.32	10.28	9.94
49.60 (45.00)	7.83	9.29	9.58	9.71	9.49	9.17
55.12 (50.00)	6.32	8.54	8.86	9.08	8.73	8.39
57.83 (52.46)	5.37	--	--	--	--	--
60.63 (55.00)	--	7.54	7.66	8.06	7.62	6.76
62.50 (56.70)	--	6.95	7.03	7.42	6.99	6.11
63.29 (57.41)	--	--	--	--	--	5.83
64.95 (58.92)	--	6.19	--	--	--	--
65.03 (58.99)	--	--	6.17	--	--	--
65.67 (59.57)	--	--	--	--	5.93	--
65.80 (59.70)	--	--	--	6.30	--	--

**PILGRIM NUCLEAR POWER STATION
PNPS CORE OPERATING LIMITS REPORT**

RTYPE: G4.02

**Table 3.1-2 MAPLHGR Limits for Rated Power and Rated Flow for GE14 fuel
Bundle Type: GE14-P10DNAB412-16GZ-100T-145-T6-3901**

Average Planar Exposure GWd/MT (GWd/ST)	MAPLHGR Limit (kW/ft) for Lattice Number						
	4820	4827	4828	4829	4830	4825	4831
0.00 (0.00)	10.36	9.29	9.07	9.22	9.12	10.80	11.61
0.22 (0.20)	10.27	9.31	9.11	9.26	9.20	10.74	11.58
1.10 (1.00)	10.05	9.38	9.19	9.36	9.30	10.59	11.49
2.20 (2.00)	9.98	9.49	9.31	9.50	9.44	10.56	11.47
3.31 (3.00)	10.00	9.61	9.44	9.65	9.59	10.59	11.48
4.41 (4.00)	10.04	9.73	9.57	9.77	9.72	10.63	11.51
5.51 (5.00)	10.08	9.86	9.70	9.90	9.85	10.68	11.54
6.61 (6.00)	10.12	9.97	9.82	10.03	9.99	10.73	11.57
7.72 (7.00)	10.16	10.07	9.94	10.16	10.13	10.77	11.60
8.82 (8.00)	10.19	10.17	10.06	10.30	10.28	10.80	11.61
9.92 (9.00)	10.22	10.28	10.18	10.44	10.44	10.83	11.63
11.02 (10.00)	10.24	10.39	10.30	10.59	10.60	10.85	11.64
12.13 (11.00)	10.25	10.50	10.42	10.75	10.77	10.86	11.64
13.23 (12.00)	10.21	10.54	10.48	10.83	10.85	10.86	11.64
14.33 (13.00)	10.15	10.57	10.52	10.87	10.89	10.80	11.64
15.43 (14.00)	10.08	10.58	10.55	10.88	10.89	10.73	11.57
15.99 (14.51)	10.04	10.58	10.55	10.87	10.89	10.69	11.53
16.53 (15.00)	10.01	10.57	10.56	10.86	10.88	10.66	11.49
18.74 (17.00)	9.86	10.53	10.53	10.81	10.82	10.51	11.34
22.05 (20.00)	9.61	10.43	10.43	10.71	10.72	10.28	11.12
27.44 (24.89)	8.96	10.02	10.01	10.29	10.31	9.67	10.61
27.56 (25.00)	8.95	10.01	10.00	10.28	10.30	9.66	10.60
33.07 (30.00)	8.30	9.58	9.58	9.85	9.87	9.01	9.95
38.58 (35.00)	7.65	9.15	9.15	9.42	9.40	8.36	9.31
44.09 (40.00)	7.02	8.70	8.70	8.97	8.92	7.73	8.68
49.60 (45.00)	6.38	8.22	8.21	8.49	8.46	7.09	8.05
54.78 (49.70)	3.98	--	--	--	--	--	--
55.12 (50.00)	--	7.68	7.63	7.95	7.98	5.63	7.42
58.14 (52.75)	--	--	--	--	--	4.21	--
60.63 (55.00)	--	5.21	5.16	5.89	5.96	--	5.46
61.32 (55.63)	--	--	4.84	--	--	--	--
61.44 (55.74)	--	4.84	--	--	--	--	--
62.67 (56.86)	--	--	--	--	--	--	4.51
62.81 (56.98)	--	--	--	4.90	--	--	--
62.91 (57.07)	--	--	--	--	4.92	--	--

**PILGRIM NUCLEAR POWER STATION
PNPS CORE OPERATING LIMITS REPORT**

RTYPE: G4.02

Table 3.1-2 Continued: Bundle Type: GE14-P10DNAB397-10G6.0/3G5.0-100T-145-T6-2613

Average Planar Exposure	MAPLHGR Limit (kW/ft) for Lattice Number					
GWd/MT (GWd/ST)	5841	5848	5849	5850	5846	5851
0.00 (0.00)	10.36	9.26	9.22	9.22	10.80	11.50
0.22 (0.20)	10.27	9.32	9.29	9.29	10.74	11.46
1.10 (1.00)	10.05	9.43	9.42	9.42	10.59	11.36
2.20 (2.00)	9.98	9.58	9.60	9.60	10.56	11.33
3.31 (3.00)	10.00	9.73	9.78	9.79	10.59	11.35
4.41 (4.00)	10.04	9.84	9.97	9.98	10.63	11.38
5.51 (5.00)	10.08	9.92	10.11	10.17	10.68	11.42
6.61 (6.00)	10.12	10.00	10.20	10.27	10.73	11.45
7.72 (7.00)	10.16	10.09	10.30	10.36	10.77	11.48
8.82 (8.00)	10.19	10.17	10.39	10.46	10.80	11.50
9.92 (9.00)	10.22	10.26	10.49	10.56	10.83	11.51
11.02 (10.00)	10.24	10.35	10.59	10.66	10.85	11.52
12.13 (11.00)	10.25	10.44	10.70	10.77	10.86	11.53
13.23 (12.00)	10.21	10.48	10.78	10.86	10.86	11.53
14.33 (13.00)	10.15	10.51	10.84	10.92	10.80	11.52
15.43 (14.00)	10.08	10.55	10.88	10.96	10.73	11.45
15.99 (14.51)	10.04	10.56	10.89	10.97	10.69	11.41
16.53 (15.00)	10.01	10.58	10.90	10.98	10.66	11.38
18.74 (17.00)	9.86	10.60	10.89	10.97	10.51	11.23
22.05 (20.00)	9.61	10.58	10.85	10.92	10.28	11.00
27.44 (24.89)	8.96	10.23	10.53	10.60	9.67	10.48
27.56 (25.00)	8.95	10.22	10.52	10.60	9.66	10.46
33.07 (30.00)	8.30	9.86	10.16	10.23	9.01	9.82
38.58 (35.00)	7.65	9.46	9.69	9.70	8.36	9.18
44.09 (40.00)	7.02	9.01	9.17	9.18	7.73	8.54
49.60 (45.00)	6.38	8.50	8.64	8.65	7.09	7.91
54.78 (49.70)	3.98	--	--	--	--	--
55.12 (50.00)	--	7.92	8.10	8.12	5.63	7.28
58.14 (52.75)	--	--	--	--	4.21	--
60.63 (55.00)	--	5.76	6.51	6.74	--	5.12
62.02 (56.27)	--	--	--	--	--	4.47
62.56 (56.75)	--	4.87	--	--	--	--
63.49 (57.60)	--	--	5.18	5.42	--	--
64.09 (58.14)	--	--	4.91	--	--	--
64.53 (58.54)	--	--	--	4.94	--	--

**PILGRIM NUCLEAR POWER STATION
PNPS CORE OPERATING LIMITS REPORT**

RTYPE: G4.02

Table 3.1-2 Continued: Bundle Type: GE14-P10DNAB397-14GZ-100T-145-T6-2621

Average Planar Exposure GWd/MT (GWd/ST)	MAPLHGR Limit (kW/ft) for Lattice Number						
	5841	5842	5843	5844	5845	5846	5847
0.00 (0.00)	10.36	9.16	9.27	9.23	9.23	10.80	11.57
0.22 (0.20)	10.27	9.23	9.33	9.30	9.30	10.74	11.54
1.10 (1.00)	10.05	9.35	9.44	9.43	9.43	10.59	11.44
2.20 (2.00)	9.98	9.51	9.59	9.61	9.62	10.56	11.41
3.31 (3.00)	10.00	9.67	9.73	9.80	9.81	10.59	11.43
4.41 (4.00)	10.04	9.78	9.80	9.98	10.01	10.63	11.46
5.51 (5.00)	10.08	9.87	9.88	10.06	10.12	10.68	11.49
6.61 (6.00)	10.12	9.96	9.96	10.14	10.20	10.73	11.52
7.72 (7.00)	10.16	10.05	10.04	10.23	10.28	10.77	11.55
8.82 (8.00)	10.19	10.14	10.12	10.32	10.37	10.80	11.57
9.92 (9.00)	10.22	10.23	10.20	10.42	10.47	10.83	11.58
11.02 (10.00)	10.24	10.32	10.30	10.54	10.60	10.85	11.59
12.13 (11.00)	10.25	10.41	10.40	10.68	10.75	10.86	11.60
13.23 (12.00)	10.21	10.45	10.46	10.78	10.86	10.86	11.60
14.33 (13.00)	10.15	10.49	10.51	10.85	10.93	10.80	11.59
15.43 (14.00)	10.08	10.53	10.56	10.89	10.97	10.73	11.52
15.99 (14.51)	10.04	10.55	10.57	10.90	10.98	10.69	11.49
16.53 (15.00)	10.01	10.57	10.59	10.91	10.99	10.66	11.45
18.74 (17.00)	9.86	10.60	10.61	10.91	10.98	10.51	11.30
22.05 (20.00)	9.61	10.58	10.58	10.86	10.93	10.28	11.08
27.44 (24.89)	8.96	10.23	10.24	10.54	10.61	9.67	10.56
27.56 (25.00)	8.95	10.22	10.23	10.53	10.61	9.66	10.55
33.07 (30.00)	8.30	9.86	9.86	10.17	10.23	9.01	9.90
38.58 (35.00)	7.65	9.46	9.46	9.70	9.70	8.36	9.26
44.09 (40.00)	7.02	9.01	9.01	9.17	9.18	7.73	8.63
49.60 (45.00)	6.38	8.50	8.50	8.64	8.65	7.09	7.99
54.78 (49.70)	3.98	--	--	--	--	--	--
55.12 (50.00)	--	7.92	7.92	8.10	8.12	5.63	7.36
58.14 (52.75)	--	--	--	--	--	4.21	--
60.63 (55.00)	--	5.74	5.75	6.50	6.73	--	5.34
62.43 (56.64)	--	--	--	--	--	--	4.50
62.52 (56.72)	--	4.87	--	--	--	--	--
62.53 (56.73)	--	--	4.87	--	--	--	--
63.49 (57.60)	--	--	--	5.17	5.40	--	--
64.06 (58.11)	--	--	--	4.91	--	--	--
64.49 (58.51)	--	--	--	--	4.94	--	--

**PILGRIM NUCLEAR POWER STATION
PNPS CORE OPERATING LIMITS REPORT**

RTYPE: G4.02

Table 3.1-2 Continued: Bundle Type: GE14-P10DNAB398-8G6.0/5G5.0/1G2.0-100T-145-T6-2614

Average Planar Exposure	MAPLHGR Limit (kW/ft) for Lattice #					
GWd/MT (GWd/ST)	5841	5852	5853	5854	5846	5855
0.00 (0.00)	10.36	9.28	9.25	9.24	10.80	11.56
0.22 (0.20)	10.27	9.34	9.32	9.31	10.74	11.53
1.10 (1.00)	10.05	9.46	9.46	9.45	10.59	11.42
2.20 (2.00)	9.98	9.60	9.65	9.64	10.56	11.40
3.31 (3.00)	10.00	9.69	9.84	9.85	10.59	11.42
4.41 (4.00)	10.04	9.78	9.96	10.02	10.63	11.45
5.51 (5.00)	10.08	9.88	10.06	10.12	10.68	11.48
6.61 (6.00)	10.12	9.97	10.16	10.22	10.73	11.51
7.72 (7.00)	10.16	10.06	10.26	10.32	10.77	11.54
8.82 (8.00)	10.19	10.15	10.36	10.42	10.80	11.56
9.92 (9.00)	10.22	10.24	10.47	10.52	10.83	11.57
11.02 (10.00)	10.24	10.34	10.59	10.65	10.85	11.58
12.13 (11.00)	10.25	10.44	10.72	10.78	10.86	11.59
13.23 (12.00)	10.21	10.49	10.81	10.88	10.86	11.59
14.33 (13.00)	10.15	10.53	10.86	10.94	10.80	11.58
15.43 (14.00)	10.08	10.57	10.90	10.98	10.73	11.51
15.99 (14.51)	10.04	10.59	10.91	10.99	10.69	11.47
16.53 (15.00)	10.01	10.60	10.92	11.00	10.66	11.44
18.74 (17.00)	9.86	10.62	10.92	10.99	10.51	11.29
22.05 (20.00)	9.61	10.59	10.87	10.94	10.28	11.06
27.44 (24.89)	8.96	10.25	10.55	10.63	9.67	10.55
27.56 (25.00)	8.95	10.24	10.54	10.62	9.66	10.54
33.07 (30.00)	8.30	9.87	10.18	10.24	9.01	9.89
38.58 (35.00)	7.65	9.47	9.71	9.71	8.36	9.25
44.09 (40.00)	7.02	9.02	9.18	9.19	7.73	8.61
49.60 (45.00)	6.38	8.51	8.66	8.67	7.09	7.98
54.78 (49.70)	3.98	--	--	--	--	--
55.12 (50.00)	--	7.93	8.11	8.13	5.63	7.35
58.14 (52.75)	--	--	--	--	4.21	--
60.63 (55.00)	--	5.77	6.53	6.77	--	5.30
62.37 (56.58)	--	--	--	--	--	4.49
62.58 (56.77)	--	4.88	--	--	--	--
63.49 (57.60)	--	--	5.20	5.44	--	--
64.13 (58.17)	--	--	4.91	--	--	--
64.56 (58.57)	--	--	--	4.94	--	--

FIGURE 3.1-1 Most Limiting MAPLHGR FOR GE11 Fuel Type

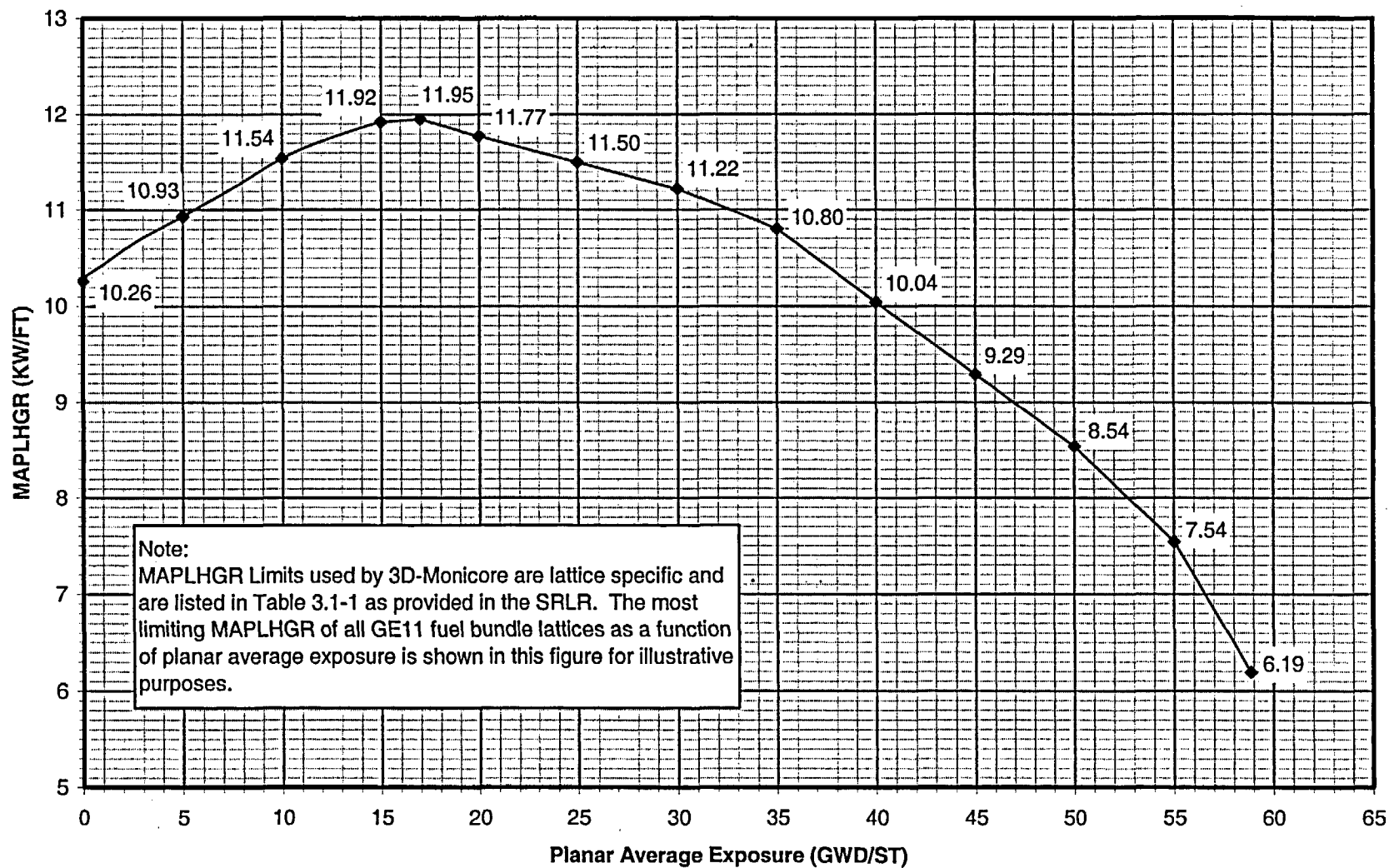


FIGURE 3.1-2 Most Limiting MAPLHGR FOR GE14 Fuel Type

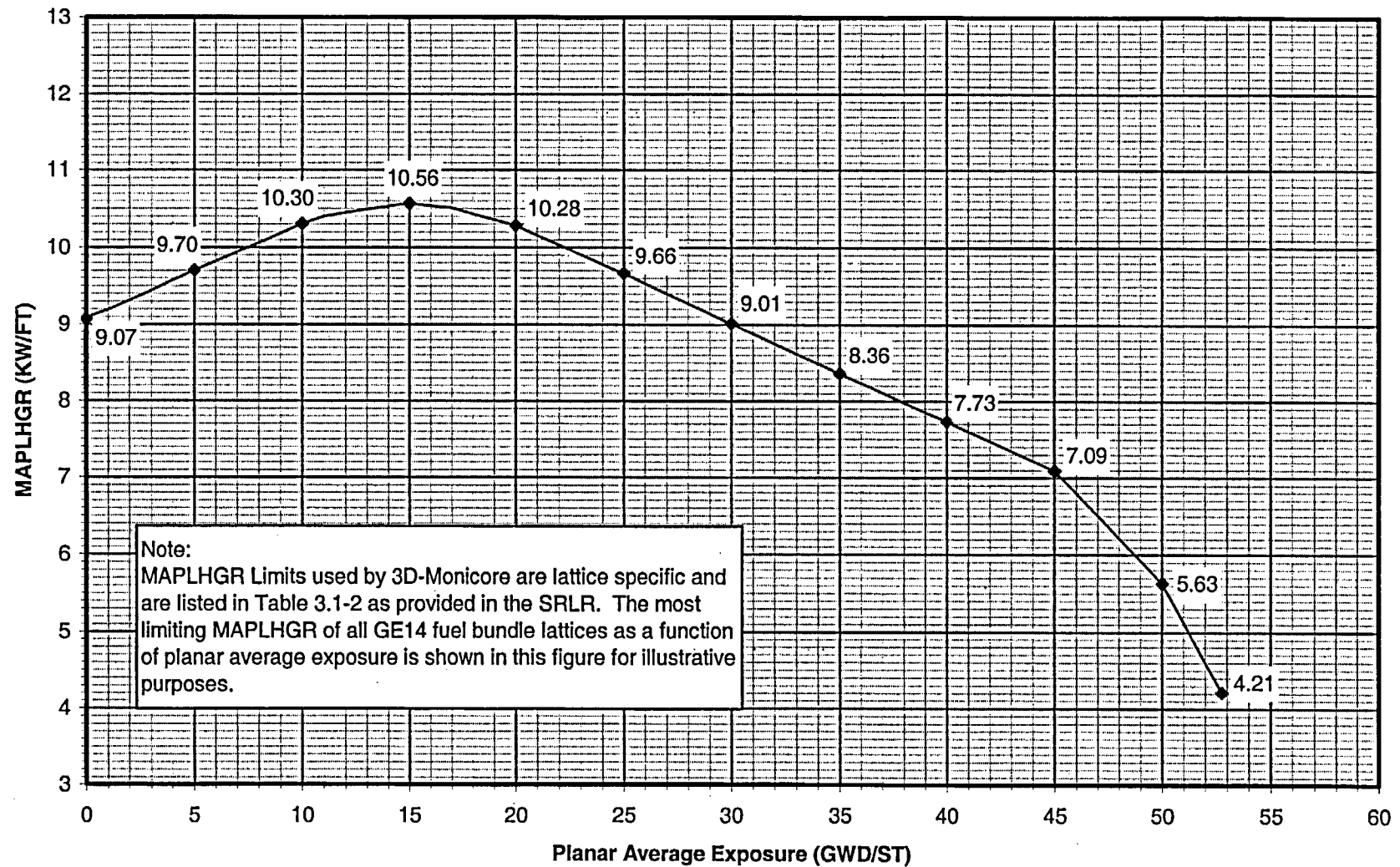


Figure 3.1-3 Flow Dependent MAPLHGR Factor (MAPFACF) for both GE11 and GE14 fuels

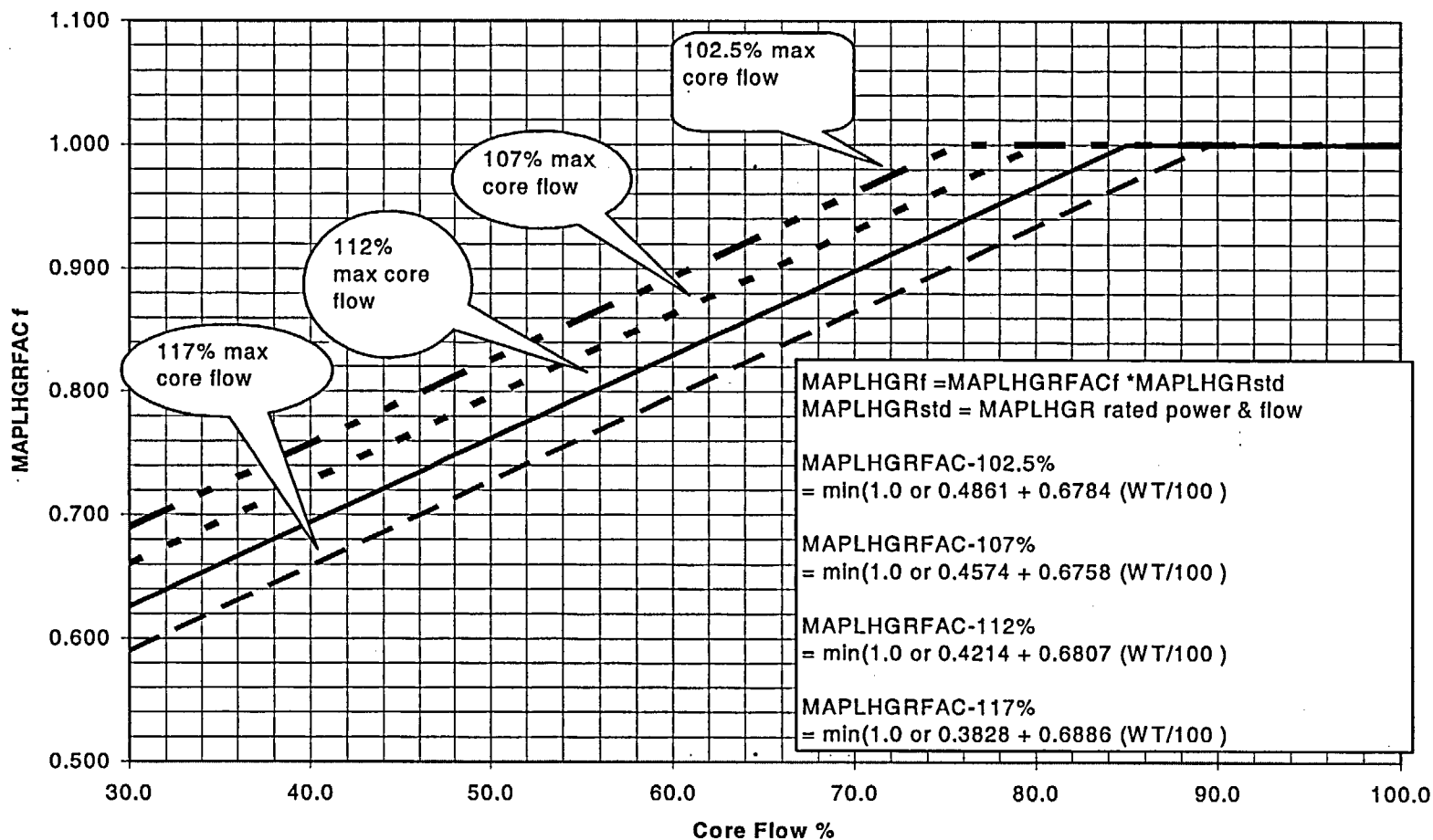
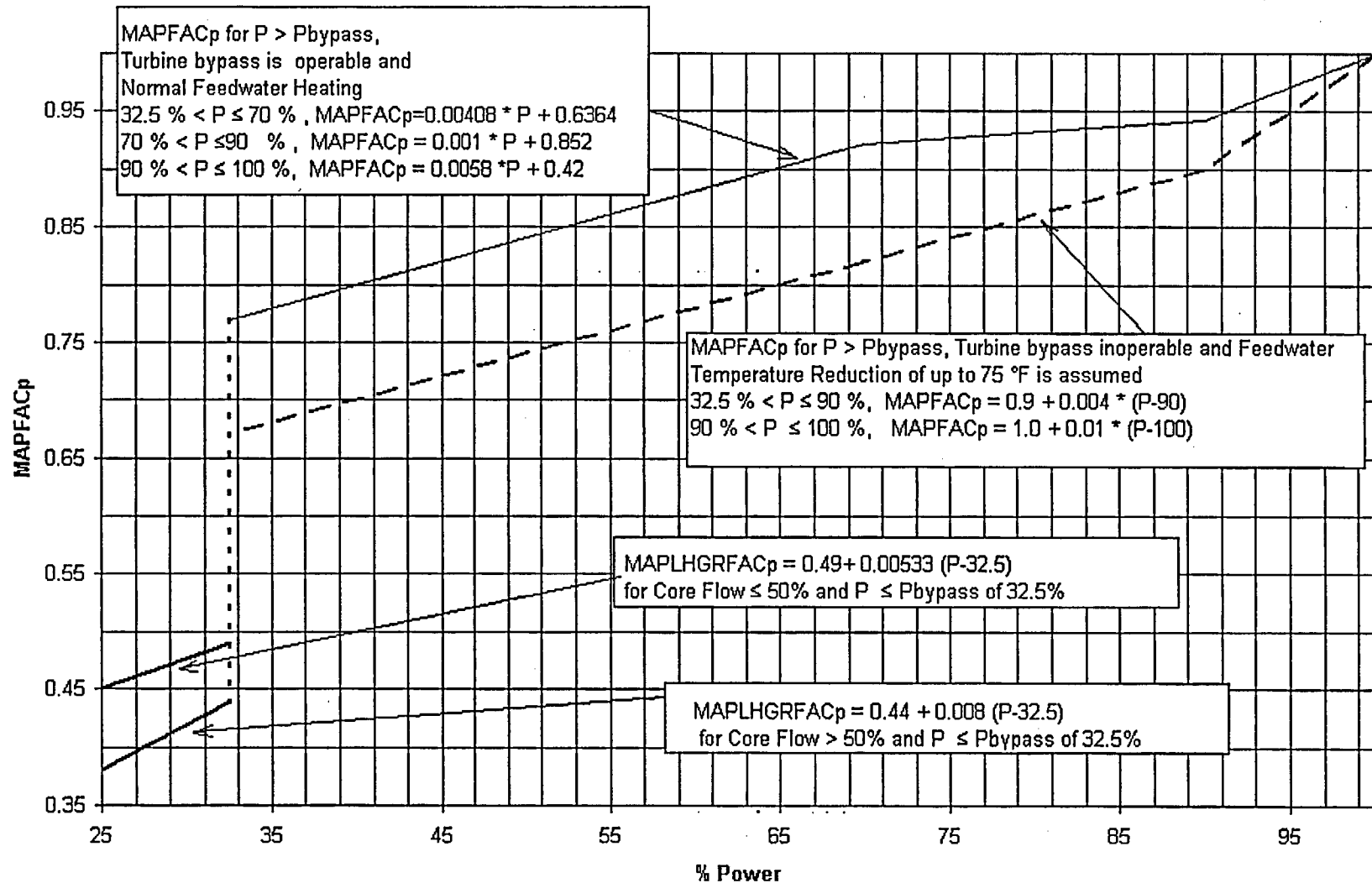


Figure 3.1-4 Power Dependent MAPLHGR Factors for GE11 and GE14 Fuel



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3.2 Linear Heat Generation Range (LHGR)

Reference Technical Specification: 3.11.B

During reactor power operation, the LHGR of any rod in any fuel assembly at any axial location shall not exceed the rated power and rated core flow limits represented by Figures 3.2-1 and 3.2-2, with the detailed values presented in Reference 5.16. At other than rated power and rated flow conditions, the applicable limiting LHGR value for each fuel type is the smaller of the flow- and power-dependent LHGR limits, $LHGR_F$ and $LHGR_P$. The flow-dependent LHGR limit, $LHGR_F$, is the product of the LHGR flow factor, $LHGRFAC_F$, shown in Figure 3.2-3 and the LHGR for rated power and flow conditions in Reference 5.16. The power-dependent LHGR limit, $LHGR_P$, is the product of the LHGR power factor, $LHGRFAC_P$, shown in Figure 3.2-4 and the LHGR for rated power and flow conditions in Reference 5.16.

The LHGR limits for each fuel type as a function of axial location, rod power and exposure are based on the approved methodology referenced in Section 5.0 and programmed in the plant process computer. LHGR limits are based on thermal-mechanical design limits in reference 5.1. LHGR Curves in Figures 3.2-1 and 3.2-2 are representative curves for UO₂ fuel rods and Gd containing rods in GE11 and GE14 fuel bundles. Gd containing fuel rods have different LHGR limits that are also exposure dependent. Reference 5.16 documents the detailed proprietary curves and values. Limits specified in Reference 5.16 are programmed into the 3D Monicore Process Computer.

Pbypass is the power level below which more restrictive thermal limits are applied, as Turbine Stop Valve closure and Turbine Control Valve Fast Closure scrams are assumed to be bypassed. Pbypass is currently set at 32.5% power.

Figure 3.2-1 LHGR Limit for GE11 Fuel At Rated Power and rated Core Flow

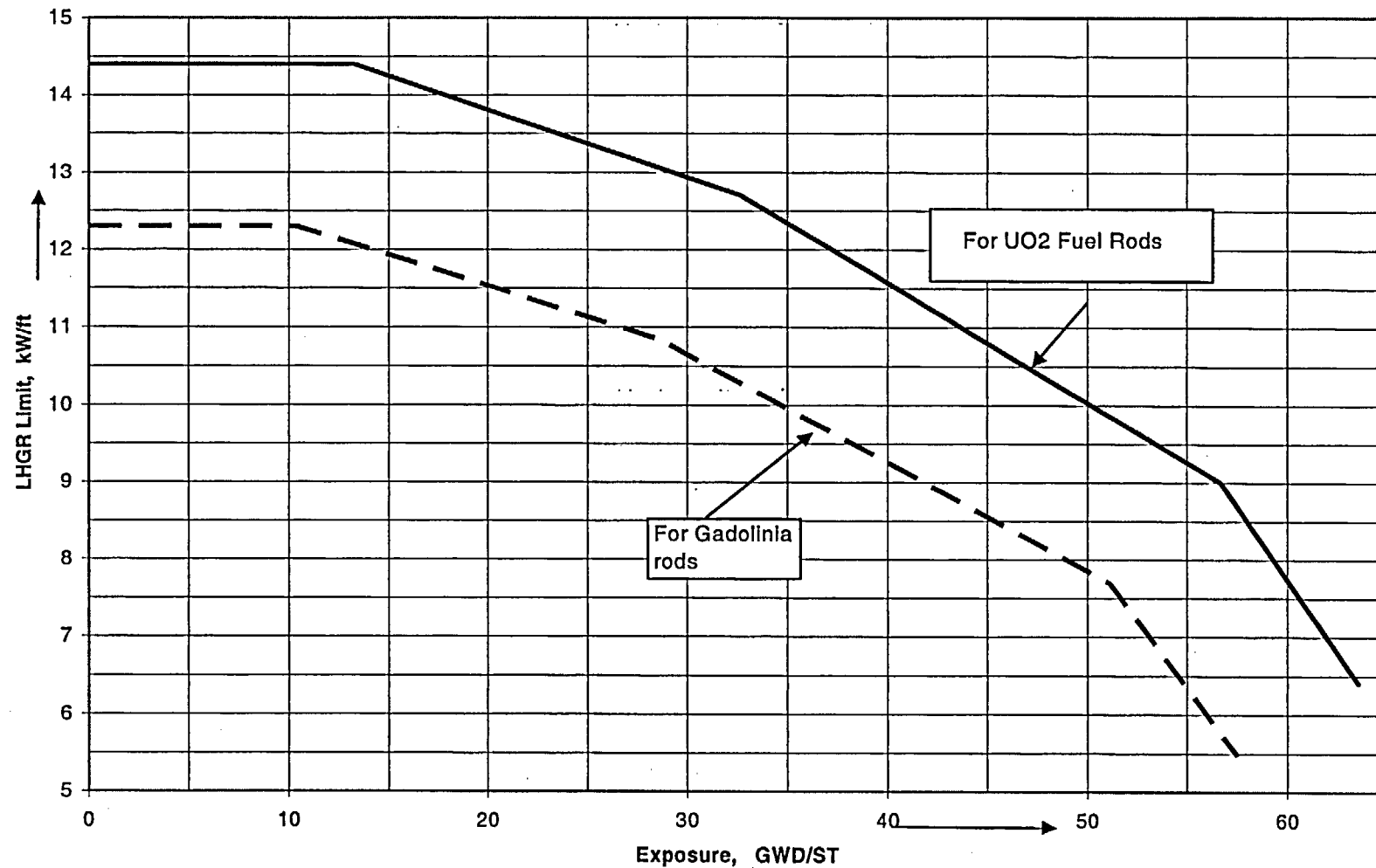


Figure 3.2-2 LHGR for GE14 Fuel At Rated Power and rated Core Flow

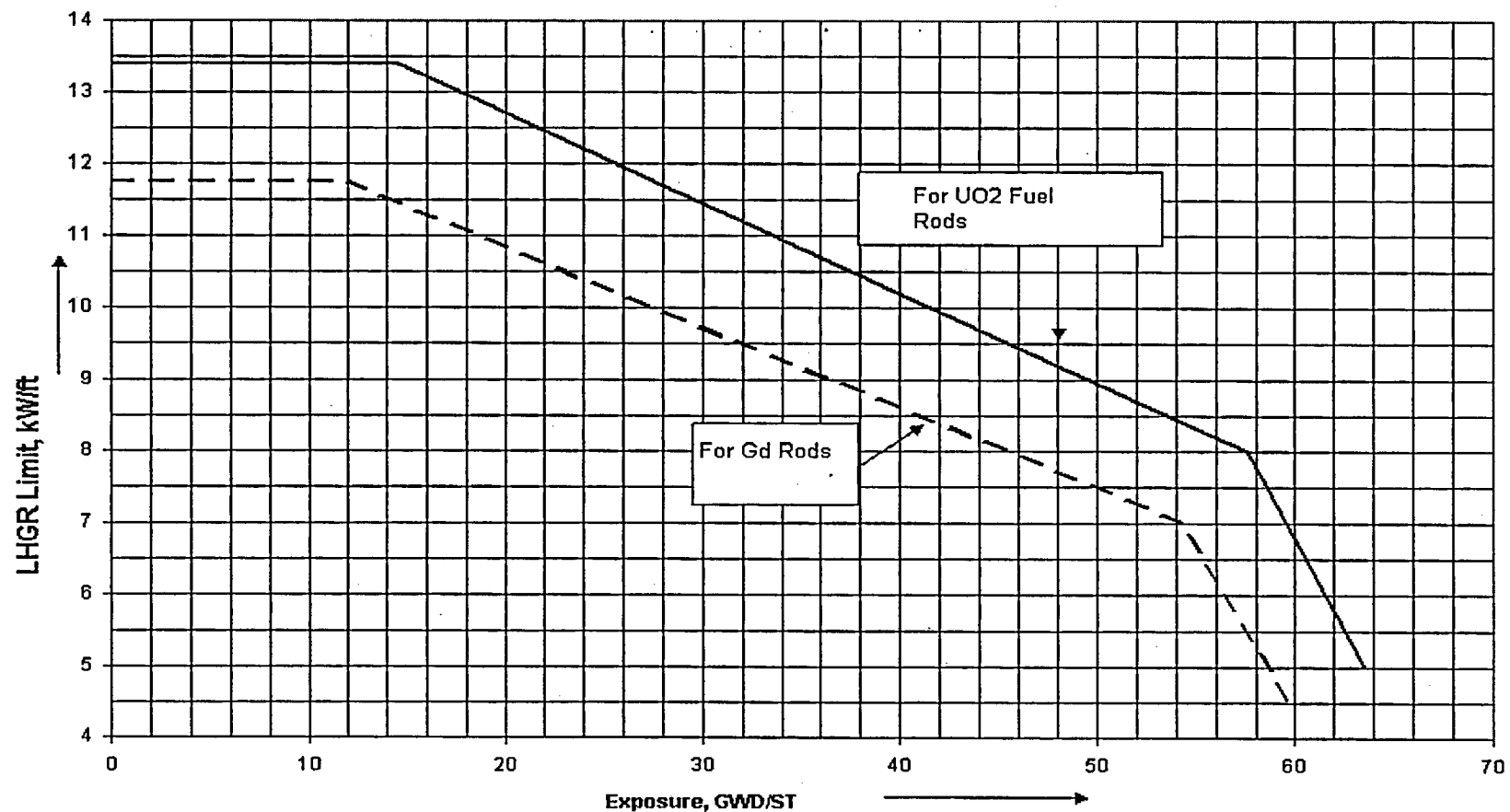


Figure 3.2-3 Flow Dependent LHGR Factor (LHGRFACf) for both GE11 and GE14 fuels

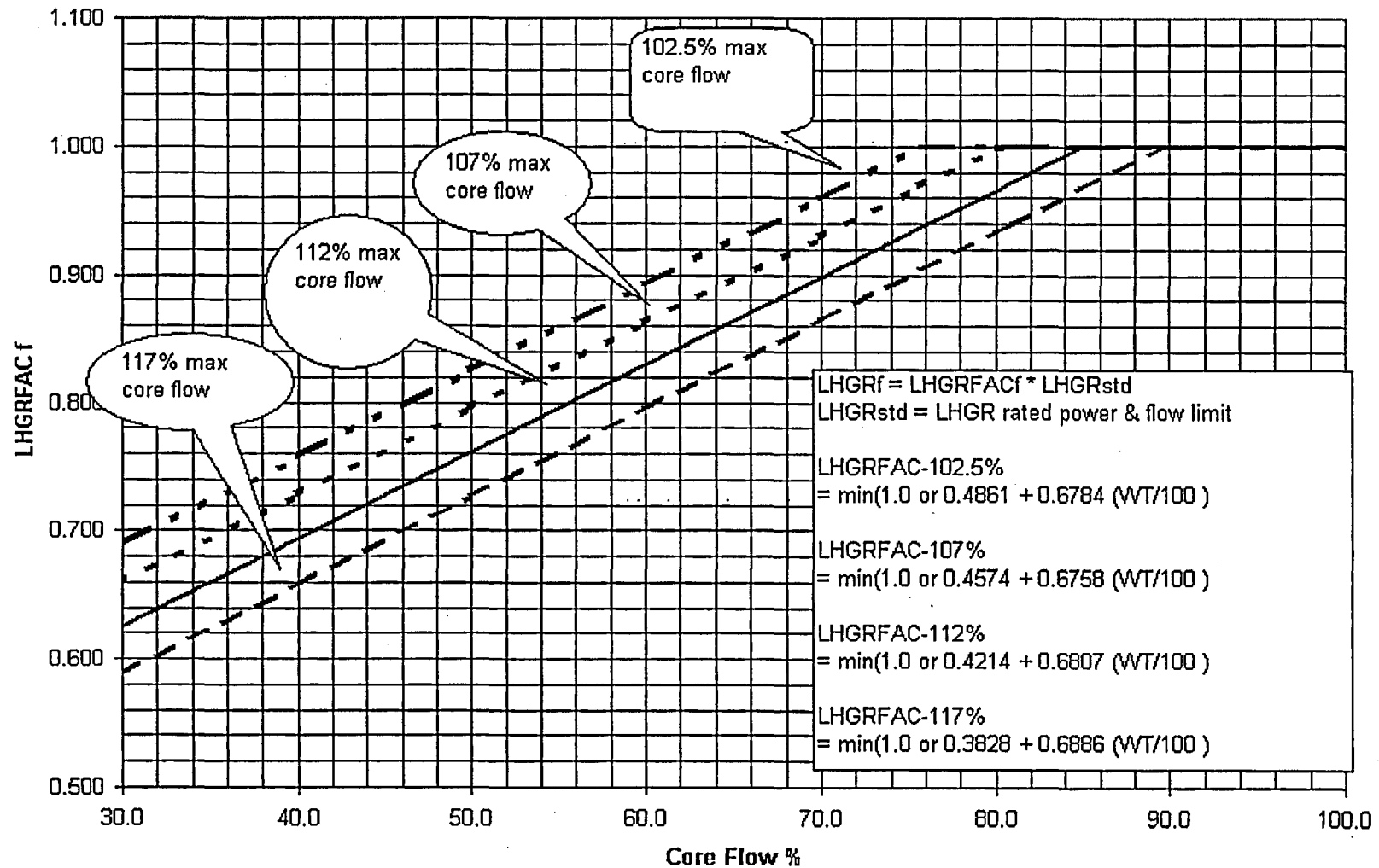
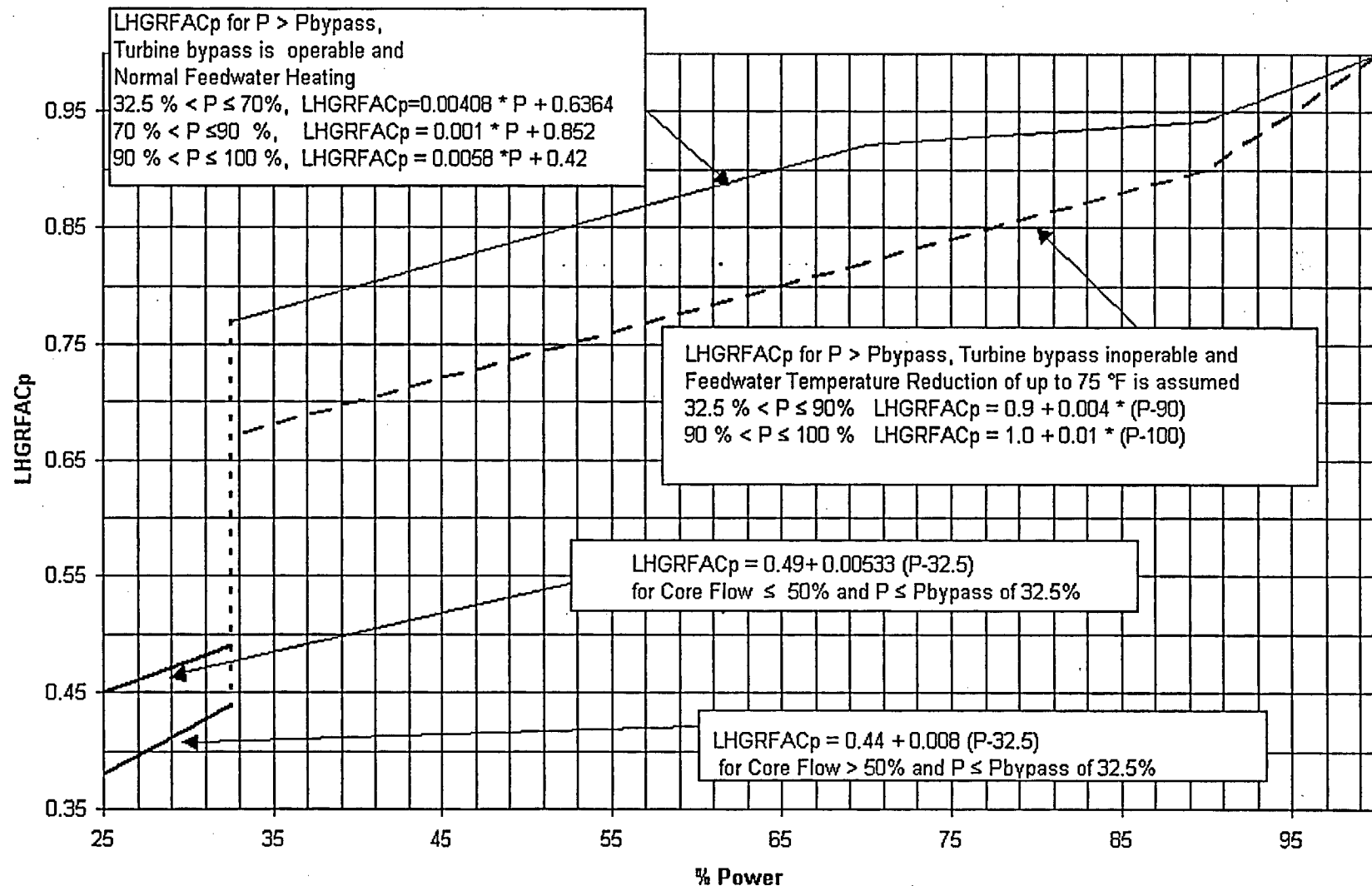


Figure 3.2-4 Power Dependent LHGR Factors for GE11 and GE14 Fuel



3.3 Minimum Critical Power Ratio (MCPR)

Reference Technical Specification: 3.11.C

During power operation, the MCPR shall be greater than or equal to the Operating Limit MCPR (OLMCPR). The operating limit MCPR is the greater of the flow- and power-dependent MCPR operating limits, $MCPR_F$ and $MCPR_P$. The flow-dependent MCPR operating limit, $MCPR_F$, is provided in Figure 3.3-1. For core thermal powers less than or equal to P_{Bypass} , the power-dependent MCPR operating limit, $MCPR_P$, is provided in Figure 3.3-2 for normal Feedwater Temperature. Above P_{Bypass} , $MCPR_P$ is the product of the rated power and flow MCPR operating limit presented in Table 3.3-1, and the K_p factor presented in Figure 3.3-2, when Turbine Bypass is in service and Feedwater Temperature is normal. Figure 3.3-2 indicates $MCPR_P$ up to 45% power, which is the maximum analyzed value for P_{bypass} . The rated power and flow MCPR operating limits presented in Tables 3.3-1 are functions of τ for both GE11 and GE14 fuels. In arriving at the $MCPR_P$ for off-rated power conditions, K_p from Figure 3.3-2 is multiplied by the rated OLMCPR from Table 3.3-1 for the appropriate fuel type, GE11 or GE14, when power is above P_{bypass} . For power level less than P_{bypass} , the $MCPR_P$ is independent of the fuel type and can be directly read from Figure 3.3-2.

The value of τ in Table 3.3-1 shall be equal to 1.0, unless it is calculated from the results of the surveillance testing of Technical Specification 4.3.C, as follows:

$$\tau = \frac{\tau_{ave} - \tau_B}{1.252 - \tau_B}$$

Where:

$$\tau_{ave} = \begin{array}{l} \text{Average scram time to drop out of} \\ \text{Notch 34} \end{array} = \frac{\sum_{i=1}^n N_i \tau_i}{\sum_{i=1}^n N_i}$$

$$\tau_B = \begin{array}{l} \text{Adjusted analysis mean} \\ \text{scram time} \end{array} = \mu + 1.65\sigma \sqrt{\frac{N_1}{\sum_{i=1}^n N_i}}$$

- n = Number of surveillance tests performed to date in the present cycle
- N_1 = Total number of active control rods
- N_i = Number of active control rods measured in the i^{th} surveillance test
- τ_i = Average scram time to drop out of Notch 34 position of all rods measured in the i^{th} surveillance test
- μ = Mean of the distribution for average scram insertion time to drop out of Notch 34
= 0.937 sec
- σ = Standard deviation of the distribution for average scram insertion time to dropout of Notch 34
= 0.021 sec

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Pbypass is the power level below which more restrictive thermal limits are applied, as Turbine Stop Valve Closure and Turbine Control Valve Fast Closure scrams are assumed to be bypassed. Pbypass is currently set at 32.5%.

Table 3.3-1

M CPR Operating Limits At Rated Power and Rated Flow

The M CPR Operating Limit (OLM CPR) is a function of fuel type, exposure and τ , derived from scram timing measurements

τ		<u>GE11 Fuel</u>		<u>GE14 Fuel</u>	
<u>from</u>	<u>to</u>	<u>BOC to</u> <u>(EOR-2)</u> <u>GWD/ST</u>	<u>(EOR-2) to</u> <u>EOC</u> <u>GWD/ST</u>	<u>BOC to</u> <u>(EOR-2)</u> <u>GWD/ST</u>	<u>(EOR-2)</u> <u>to EOC</u> <u>GWD/ST</u>
	≤ 0.0	1.37	1.39	1.41	1.50
0.0	≤ 0.1	1.38	1.40	1.42	1.52
0.1	≤ 0.2	1.39	1.41	1.43	1.53
0.2	≤ 0.3	1.40	1.42	1.44	1.55
0.3	≤ 0.4	1.41	1.43	1.45	1.57
0.4	≤ 0.5	1.43	1.45	1.47	1.59
0.5	≤ 0.6	1.44	1.46	1.48	1.60
0.6	≤ 0.7	1.45	1.47	1.49	1.62
0.7	≤ 0.8	1.46	1.48	1.50	1.64
0.8	≤ 0.9	1.47	1.49	1.51	1.65
0.9	≤ 1.0	1.48	1.50	1.52	1.67

BOC = Beginning Of Cycle 15

EOC = End Of Cycle 15

EOR = End Of Rated Power Operation At Rated Flow

Note: Limits for other Out Of Service Conditions such as Turbine Bypass Valve OOS and Final Feedwater Temperature Reduction are in the Supplemental Reload Licensing Report (Reference 5.14)

Figure 3.3-1 Flow Dependent MCPR Limits (MCPR_F) for both GE11 and GE14 fuels

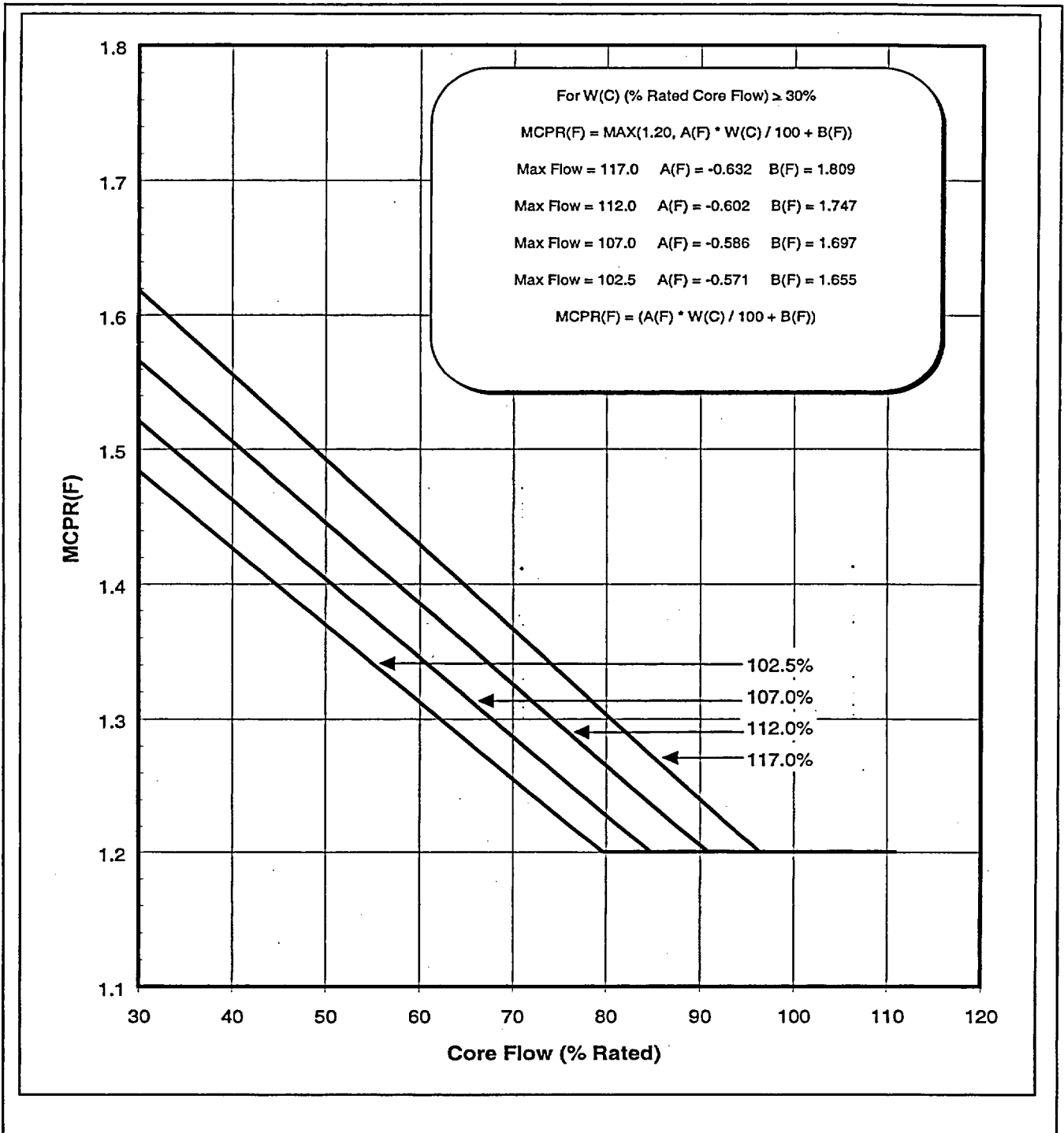
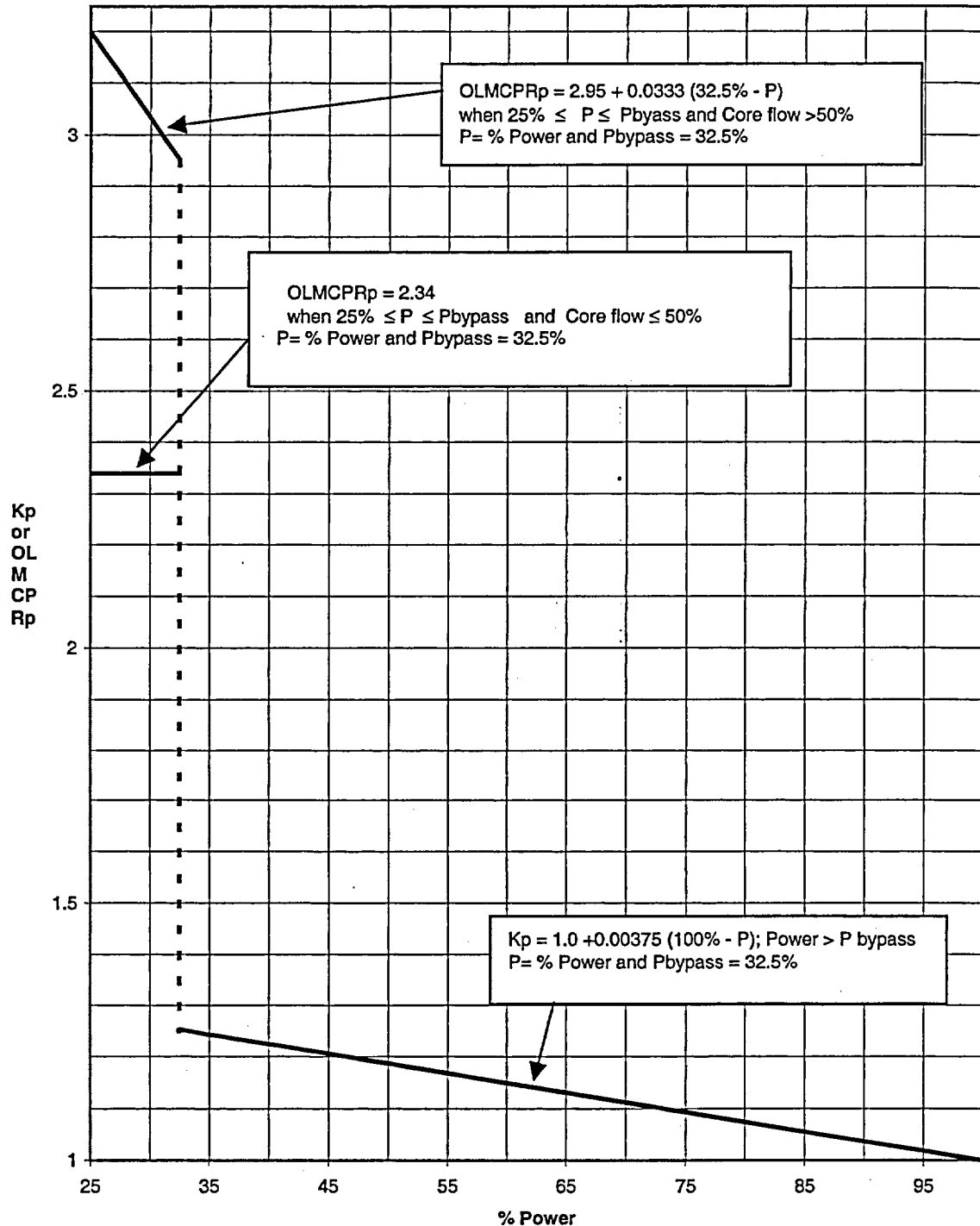


Figure 3.3-2
Power Dependent MCPR Limits (MCPRp) for both GE11 and GE14 fuels
Turbine Bypass Is Assumed Operable and Normal Feed Water Heating



3.4 Power/Flow Relationship During Power Operation

Reference Technical Specification: 3.11.D

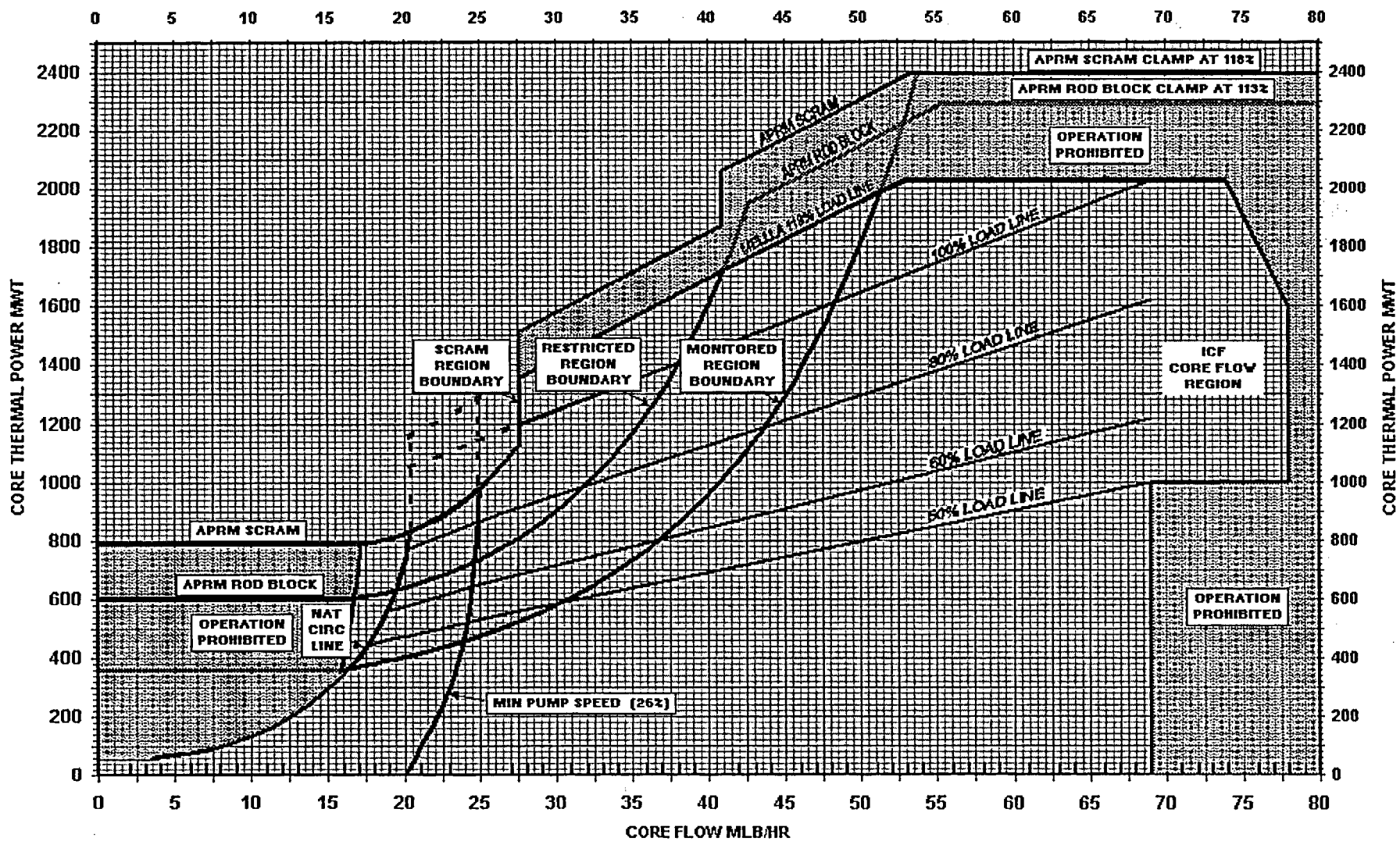
The power/flow relationship shall not exceed the limiting values shown on the Power/Flow Operating Map in Figure 3.4-1. The Power/Flow Map, Figure 3.4-1 is applicable to operation with Normal feedwater heating. Cycle 15 operation is not fully analyzed for reduced feedwater temperature.

Intentional operation within the Restricted Region is prohibited. The Restricted Region boundary as a function of aligned drive flow is as given in Figure 2.2 -1.

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow as shown in Figure 3.4 - 1. The Restricted Region boundary is defined by the locus of APRM Rod Block setpoints as a function of the reactor recirculation flow as shown by Figure 2.2-1.

FIGURE 3.4-1

PILGRIM POWER/FLOW MAP



4.0 REACTOR VESSEL CORE DESIGN

Reference Technical Specification: 4.2

The reactor vessel core for the present cycle consists of 580 fuel assemblies of the types listed below. The core loading pattern for each type of fuel is shown for the present cycle in Figure 4.0-1.

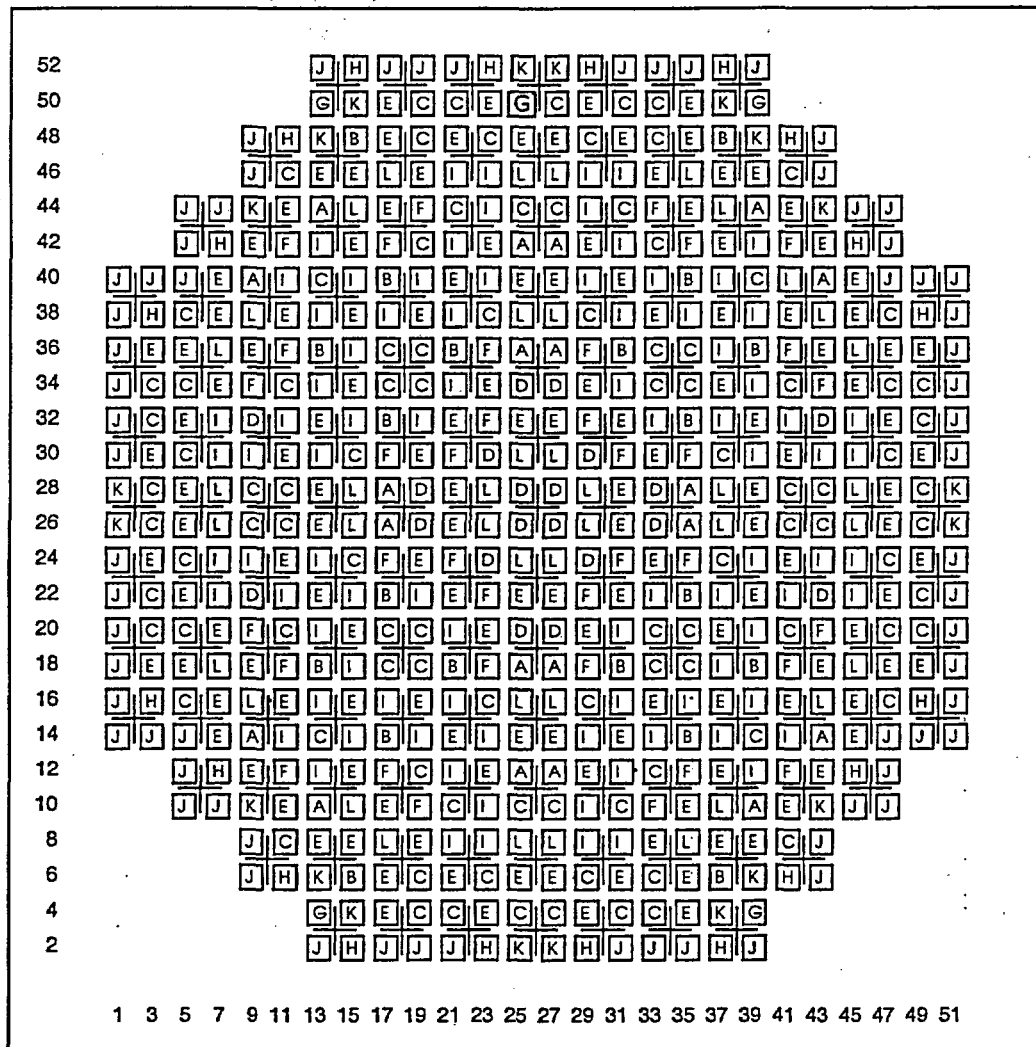
<u>Fuel Type</u>	<u>Cycle Loaded</u>	<u>Number</u>
Irradiated		
GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6	12	40
GE11-P9DUB408-16GZ-100T-141-T6	12	73
GE11-P9DUB407-14GZ-100T-141-T6	13	119
GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6	13	40
GE14-P10DNAB412-16GZ-100T-145-T6-3901	14	144
New		
GE14-P10DNAB397-10G6.0/3G5.0-100T-145-T6-2613	15	36
GE14-P10DNAB397-14GZ-100T-145-T6-2621	15	88
GE14-P10DNAB398-8G6.0/5G5.0/1G2.0-100T-145-T6-2614	15	40
Total		580

The reactor vessel core contains 145 cruciform-shaped control rods. The control materials used are either boron carbide powder (B_4C) compacted to approximately 70% of the theoretical density or a combination of boron carbide powder and solid hafnium.

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FIGURE 4.0-1 Reactor Vessel Core Loading Pattern



Fuel Type

A=GE11-P9DUB407-14GZ-100T-141-T6 (Cycle 13)
B=GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6 (Cycle 13)
C=GE11-P9DUB407-14GZ-100T-141-T6 (Cycle 13)
D=GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6 (Cycle 13)
E=GE14-P10DNAB412-16GZ-100T-145-T6-3901 (Cycle 14)
F=GE14-P10DNAB397-10G6.0/3G5.0-100T-145-T6-2613 (Cycle 15)

G=GE11-P9DUB408-16GZ-100T-141-T6 (Cycle 12)
H=GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6 (Cycle 12)
I=GE14-P10DNAB397-14GZ-100T-145-T6-2621 (Cycle 15)
J=GE11-P9DUB408-16GZ-100T-141-T6 (Cycle 12)
K=GE11-P9DUB408-6G5.0/7G4.0-100T-141-T6 (Cycle 12)
L=GE14-P10DNAB398-8G6.0/5G5.0/1G2.0-100T-145-T6-2614 (Cycle 15)

5.0 REFERENCES

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- 5.2. PDC 03-01, Cycle 15 Reload Core Design .
- 5.3. SUDDS/RF 02-61, NEDC-31852-P, rev. 2, "Pilgrim Nuclear Power Station SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis for GE11 and GE14 Fuels", January 2003
- 5.4. SUDDS/RF 02-63, PNPS Cycle 15 Stability Region Boundary Validation Reports
- 5.5. SUDDS/RF 02-83 Cycle 15, Flow mapping inputs and outputs
- 5.6. SUDDS/RF 02-43, TPO power to flow map
- 5.7. SUDDS/RF 03-007 Calculation of CON161 constant for Cycle 15 stability Analysis
- 5.8. SUDDS/RF 94-42, NEDC-32306P, "Maximum Extended Load Line Limit Analyses", March 1994.
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- 5.10. SUDDS/RF 02-83, GENE-0000-0013-1555, Rev. 1, " Pilgrim Nuclear Power Station Reactor Stability Long-Term Solution Enhanced Option I-A Flow Mapping Application Output Cycle 15 Normal Feedwater Temperature Operating Range", February 2003.
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- 5.12. SUDDS/RF 02-63, GE14 Reference Cycle for Stability Option E1A
- 5.13. SE-3397, Safety Evaluation for Cycle 15 Reload Core Design.
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- 5.15. Calculation S&SA-174, Cycle 15 OPL-3, transient Analysis Inputs
- 5.16. SUDDS/RF 02-84, 0000-0008-6613FBIR, Rev.0, February 2003, Fuel Bundle Information Report, Cycle 15
- 5.17. SUDDS/RF 02-82, Cycle 15 SLMCPR Affidavit
- 5.18. SUDDS/RF 02-86, GNF SER issued by NRC approving elimination of Upper Bound PCT limit requirement.
- 5.19. Calculation S&SA-158, OPL 4 & 5, Cycle 15 Accident Analysis Inputs
- 5.20. NEDO-32339-A Supplement 3, December 1996