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April 3, 2013

RBG-47351

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

Subject: Eighteenth Fuel Cycle Core Operating Limits Report (COLR)
River Bend Station - Unit 1
Docket No. 50-458
License No. NPF-47

Dear Sir or Madam:

Enclosed is Revision 0 of the River Bend Station (RBS) Core Operation Limits Report (COLR) for the eighteenth fuel cycle. This report is submitted in accordance with Technical Specification 5.6.5 of Appendix A of the Facility Operating License NPF-47.

This letter does not contain any commitments.

For further information, please contact me at (225) 381-4177.

Sincerely,

JAC/bmb

RBF1-13-0044

cc: Regional Administrator
U. S. Nuclear Regulatory Commission, Region IV
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A001
NRR

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U. S. Nuclear Regulatory Commission
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Public Utility Commission of Texas
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Austin, TX 78711-3326

Core Operating Limits Report
Cycle 18
Revision 0

River Bend Station
Core Operating Limits Report
Cycle 18
Revision 0

LAR-2013-03

REVISION HISTORY	
Revision	**Revision Description**
0	Original Issue

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1.0 PURPOSE

The COLR is controlled as a License Basis Document and revised accordingly for each fuel cycle or remaining portion of a fuel cycle. Any revisions to the COLR must be submitted to the NRC for information as required by Tech Spec 5.6.5 and tracked by RBS License Commitment L11358.

2.0 SCOPE

As defined in Technical Specification 1.1, the COLR is the document that provides the core operating limits for the current fuel cycle. This document is prepared in accordance with Technical Specification 5.6.5 for each reload cycle using NRC-approved analytical methods.

The limits included in this report are:

1) LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR),
2) LCO 3.2.2, Minimum Critical Power Ratio (MCPR), including power and flow dependent limits.
3) LCO 3.2.3, Linear Heat Generation Rate (LHGR), including power and flow dependent limits.
4) LCO 3.2.4, Fraction of Core Boiling Boundary (FCBB)
5) LCO 3.3.1.1, RPS Instrumentation (RPS), Function 2.b
6) LCO 3.3.1.3, Periodic Based Detection System (PBDS)

3.0 REFERENCES

This section contains the background, cycle-specific, and methodology references used in the current cycle reload analysis.

3.1 Current Cycle References

3.1.1 ECH-NE-12-00094 Revision 0, Supplemental Reload Licensing Report for River Bend Station – Unit 1 Reload 17 Cycle 18.

3.1.2 ECH-NE-12-00093 Revision 0, Fuel Bundle Information Report for River Bend Station – Unit 1 Reload 17 Cycle 18.

3.1.3 Letter, R. E. Kingston to G. W. Scronce, "Time Constant Values for Simulated Thermal Power Monitor", RBC-46410, November 30, 1995.

3.1.4 RBS Updated Safety Analysis Report

3.1.5 ECH-NE-13-00014, Revision 0, "Evaluation Of Loss Of Stator Water Cooling For River Bend"

3.2 Methodology References

The Technical Specifications (TS) supported by each methodology reference are provided in brackets.

The following are applicable to GNF supplied fuel.

3.2.1 NEDE-24011-P-A, General Electric Standard Application for Reactor Fuel (GESTAR-II).

4.0 DEFINITIONS

4.1 Average Planar Linear Heat Generation Rate (APLHGR) - the APLHGR shall be applicable to a specific planar height and is equal to the sum of the linear heat generation rates for all the fuel rods in the specified bundle at the specified height divided by the number of fuel rods in the fuel bundle.

4.2 Average Planar Exposure - the Average Planar Exposure shall be applicable to a specific planar height and is equal to the sum of the exposure of all the fuel rods in the specified bundle at the specified height divided by the number of fuel rods in the fuel bundle.

4.3 Critical Power Ratio (CPR) - the ratio of that power in the assembly, which is calculated by application of the fuel vendor's appropriate boiling correlation, to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.

4.4 Core Operating Limits Report (COLR) - The River Bend Station specific document that provides core operating limits for the current reload cycle in accordance with Technical Specification 5.6.5.

4.5 Linear Heat Generation Rate (LHGR) - the 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.

4.6 Minimum Critical Power Ratio (MCPR) - the MCPR shall be the smallest CPR which exists in the core.

4.7 MCPR Safety Limit - the minimum value of the CPR at which the fuel could be operated with the expected number of rods in boiling transition not exceeding 0.1% of the fuel rods in the core.

4.8 Aligned Drive Flow – Adjusted FCTR card input drive flow signal that accounts for actual variations in the core flow to drive flow relationship.

4.9 Monitored Region – The area of the core power and flow operating domain where the reactor may be susceptible to reactor instabilities under conditions exceeding the licensing basis of the current reactor system.

4.10 Restricted Region – The area of the core power and flow operating domain where the reactor is susceptible to reactor instabilities in the absence of restrictions on core void distributions.

4.11 Setpoint "Setup" – A FCTR card feature that sets the normal "non-setup" E1A APRM flow–biased scram and control rod block trip reference setpoints associated with the Exclusion and Restricted Regions higher to permit required reactor maneuvering in the Restricted Region when stability controls are in effect.

4.12 EOR - the cycle exposure corresponding to all rods out, 100% power/100% flow, and normal feedwater temperature.

4.13 MOC - Middle of Cycle (EOR 3,220 MWd/MTU) [Reference 3.1.1, page 22].

4.14 EOC - End of Cycle (Core Exposure 33,934 MWd/MTU) [Reference 3.1.1. page 6].

4.15 FFWTR – Final Feedwater Temperature Reduction.

4.16 FHOOS – Feedwater Heater Out of Service.

4.17 PROOS – Pressure Regulator Out of Service.

4.18 SLO – Single Loop Operation.

4.19 TBOOS –Turbine Bypass Out of Service

4.20 AREVA – AREVA NP Inc.

4.21 GNF – Global Nuclear Fuel

4.22 EOC-RPT – End of Cycle Recirculation Pump Trip

4.23 Reference Core Loading Pattern – The Core Loading Pattern Used for Reload Licensing Analysis.

4.24 Application Condition – The combination of equipment out of service conditions for which LHGRFAC and MCPR limits are determined [Reference 3.1.1, page 38]. The Application Conditions are as follows:

Application Condition	FWHOOS / FFWTR	EOC-RPT OOS	PROOS	TBOOS
1	X			
2	X	X		
3	X		X	
4	X			X
5	X	X		X
6	X		X	X
7	X	X	X	X

All application conditions address the licensed core flow.

5.0 CORE DESIGN

5.1 Reference Core Loading Pattern

The Reference Core Loading pattern is presented in Reference 3.1.1.

5.2 Control Rods

The River Bend core utilizes the GE design control rods, non GE design CR-82M and CR-82M-1 bottom entry cruciform control rods. These control rod designs are discussed in more detail in Reference 3.1.4, Sections 4.1 and 4.2.

6.0 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

Per Technical Specification 3.2.1, all APLHGR values shall not exceed the exposure-dependent limits reported as follows:

Fuel Type	Figure
GNF2	6.1-1a
GE14	6.1-1b

For single loop operation (SLO) a multiplier of 0.83 [Reference 3.1.1, page 58] is applied to the APLHGR limits for all fuel types.

7.0 MINIMUM CRITICAL POWER RATIO (MCPR)

Per Technical Specification 3.2.2, the MCPR values shall be equal to or greater than the operating limit. The operating limit is the maximum of the flow-dependent minimum critical power ratio ($MCPR_F$) and the power-dependent minimum critical power ratio ($MCPR_P$).

$MCPR_F$ and $MCPR_P$ limits are provided in Sections 7.1 and 7.2 below. These limits address the different fuel types, exposure ranges and application conditions.

For single recirculation loop operation (SLO), the MCPR limit is increased by 0.02 [Reference 3.1.1, page 37] to address the difference in the safety limit MCPR reported in Technical Specification 2.1.1.2.

7.1 Flow-Dependent Minimum Critical Power Ratio ($MCPR_F$) Values:

The $MCPR_F$ curves are from Reference 3.1.1, Appendix D and are found in the following figures:

Application Condition(s)	Fuel Type(s)	Exposure Range	Figure
1, 2, 3	GNF2 & GE14	BOC-EOC	7.1-1
4, 5, 6, 7	GNF2 & GE14	BOC-EOC	7.1-2

7.2 Power-Dependent Minimum Critical Power Ratio ($MCPR_P$) Values:

The $MCPR_P$ curves are from Reference 3.1.1, Appendix D as modified by Reference 3.1.5 and are found in the following figures:

Application Conditions	Figure			
	BOC – MOC		MOC - EOC	
	GNF2	GE14	GNF2	GE14
1	7.2-1a	7.2-1b	7.2-1c	7.2-1d
2	7.2-2a	7.2-2b	7.2-2c	7.2-2d
3	7.2-3a	7.2-3b	7.2-3c	7.2-3d
4	7.2-4a	7.2-4b	7.2-4c	7.2-4d
5	7.2-5a	7.2-5b	7.2-5c	7.2-5d
6	7.2-6a	7.2-6b	7.2-6c	7.2-6d
7	7.2-7a	7.2-7b	7.2-7c	7.2-7d

More limiting values of the power dependent limits may be used in lieu of those indicated by a particular operating mode. For example EOC values may be used instead of the MOC values.

8.0 LINEAR HEAT GENERATION RATE (LHGR)

Per Technical Specification 3.2.3, the LHGR values for any rod at any axial location shall not exceed the exposure-dependent limits multiplied by the smaller of either the power-dependent or flow-dependent LHGR factors.

For single loop operation (SLO) a multiplier of 0.83 [Reference 3.1.1, page 58] is applied to the LHGR limits for all fuel types.

For two recirculation loop and single recirculation loop operation the LHGR multiplier is as follows:

For two recirculation loop operation:

$$LHGRFAC = MIN(LHGRFAC_P, LHGRFAC_F)$$

For single loop operation:

$$LHGRFAC = MIN(LHGRFAC_P, LHGRFAC_F, 0.83)$$

8.1 Exposure-Dependent Linear Heat Generation Rate (LHGR) Values:

GNF2 and GE14 exposure-dependent LHGR values are considered GNF proprietary and will not be contained in the COLR. The GNF2 and GE14 LHGR values may be found in Reference 3.1.2.

8.2 Flow-Dependent Linear Heat Generation Rate Factors ($LHGRFAC_F$) Values:

There is one set flow-dependent LHGRFAC values. It is applicable to all application conditions and fuel types, from are from Reference 3.1.1, Appendix D and is contained in Figure 8.2-1.

8.3 Power-Dependent Linear Heat Generation Rate Factors ($LHGRFAC_P$) Values:

The $LHGRFAC_P$ curves are from Reference 3.1.1, Appendix D as modified by Reference 3.1.5 and are found in the following figures:

Application Conditions	Figure			
	BOC – MOC		MOC - EOC	
	GNF2	GE14	GNF2	GE14
1	8.3-1a	8.3-1b	8.3-1c	8.3-1d
2	8.3-2a	8.3-2b	8.3-2c	8.3-2d
3	8.3-3a	8.3-3b	8.3-3c	8.3-3d
4	8.3-4a	8.3-4b	8.3-4c	8.3-4d
5	8.3-5a	8.3-4b	8.3-5c	8.3-5d
6	8.3-6a	8.3-4b	8.3-6c	8.3-6d
7	8.3-7a	8.3-4b	8.3-7c	8.3-7d

More limiting values of the power dependent multipliers may be used in lieu of those indicated by a particular operating mode. For example EOC values may be used instead of the MOC values.

9.0 STABILITY

The following Technical Specifications / Technical Requirements contain stability related requirements:

- TS 3.2.4, Fraction of Core Boiling Boundary (FCBB)
- TS 3.3.1.1, RPS Instrumentation (RPS)
- TS 3.3.1.3, Periodic Based Detection System (PBDS)
- TR 3.3.1.1, RPS Instrumentation (RPS)
- TR 3.3.2.1, Control Rod Block Instrumentation

9.1 Stability Region Boundaries and Setpoints

This section contains region boundaries, setpoints and other stability related requirements. The stability region boundaries and setpoints are as follows

Description	Figure
Monitored Region Boundary (Case 1)	9.1-1
Monitored Region Boundary (Case 2)	9.1-2
APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Two Recirculation Loop Operation – Case 1)	9.1-3
APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Two Recirculation Loop Operation – Case 2)	9.1-4
APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Single Recirculation Loop Operation – Case 1)	9.1-5
APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Single Recirculation Loop Operation – Case 2)	9.1-6
APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Two Recirculation Loop	9.1-7

Description	Figure
Operation – Case 1)	
APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Two Recirculation Loop Operation – Case 2)	9.1-8
APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Single Recirculation Loop Operation – Case 1)	9.1-9
APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Single Recirculation Loop Operation – Case 2)	9.1-10

Note: For Figures 9.1-3 to 9.1-10, the Nominal Setpoints should be used for indicating the entry into a particular stability region as allowed and appropriate actions be taken prior to the entry

In the table above, two distinct operating states (Case 1 and Case 2) are considered. These are described as follows:

Case 1 - Normal Feedwater Heating Operation or Low Reactor Power :

$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°F$, and rated equivalent at off-rated reactor conditions

OR

$P \leq 30\%$

Case 2 - Reduced Feedwater Heating Operation:

$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°F$

AND

$P > 30\%$

The APRM Flow Biased Simulated Thermal Power - High scram setpoint and Restricted Region Boundary, and APRM Flow Biased Neutron Flux – High Rod-Block Setpoints are given in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the following relationship:

$$W_D = \frac{101.209 \times \Delta^{40} - 31.028 \times \Delta^{100} + 70.181 \times W_{\tilde{D}}}{70.181 - (\Delta^{100} - \Delta^{40})}$$

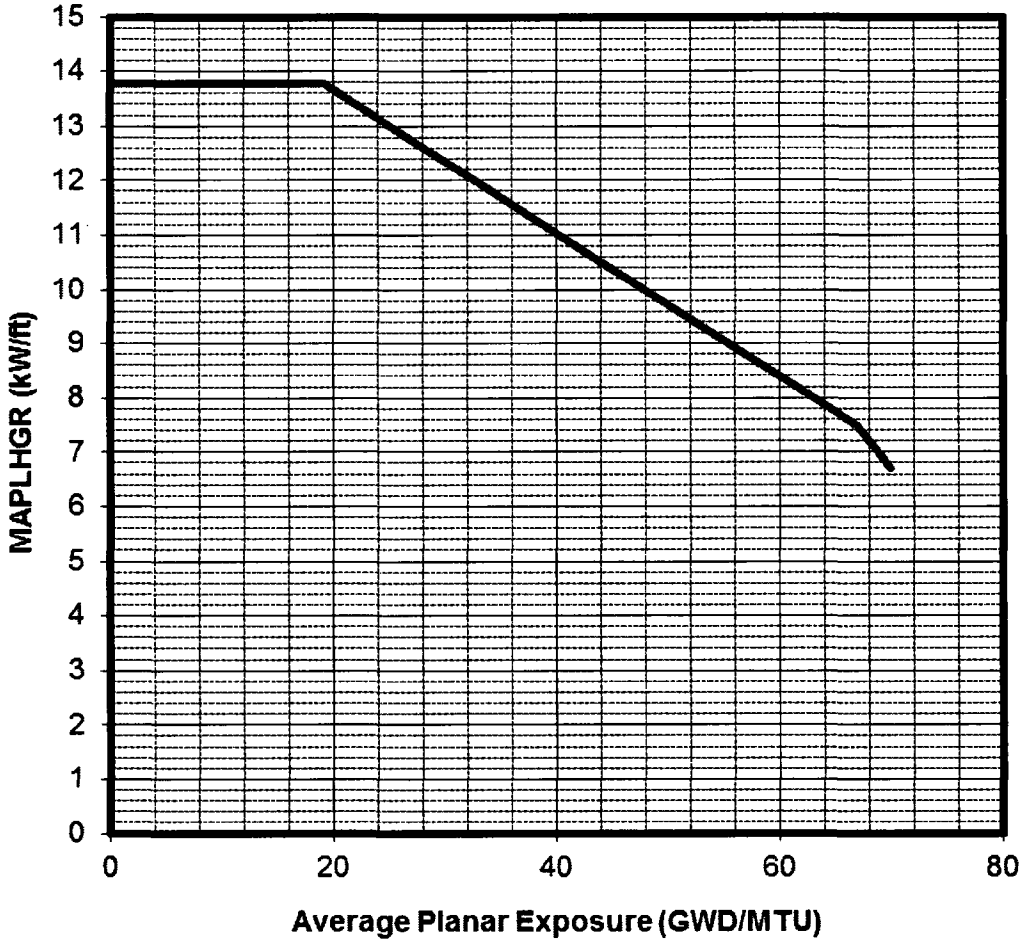
Where:
$W_{\tilde{D}}$ = FCTR card input drive flow in percent rated,
W_D = Aligned drive flow in percent rated,
Δ^{40} = Low flow drive flow alignment setting, and
Δ^{100} = High flow drive flow alignment setting.

9.2 APRM Flow Biased Simulated Thermal Power–High Time Constant (SR 3.3.1.1.14)

The simulated thermal power time constant is 6 ± 0.6 seconds (Reference 3.1.3). Thus the maximum simulated thermal power time constant for use in meeting the surveillance requirement is 6.6 seconds.

FIGURE 6.1-1a. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE

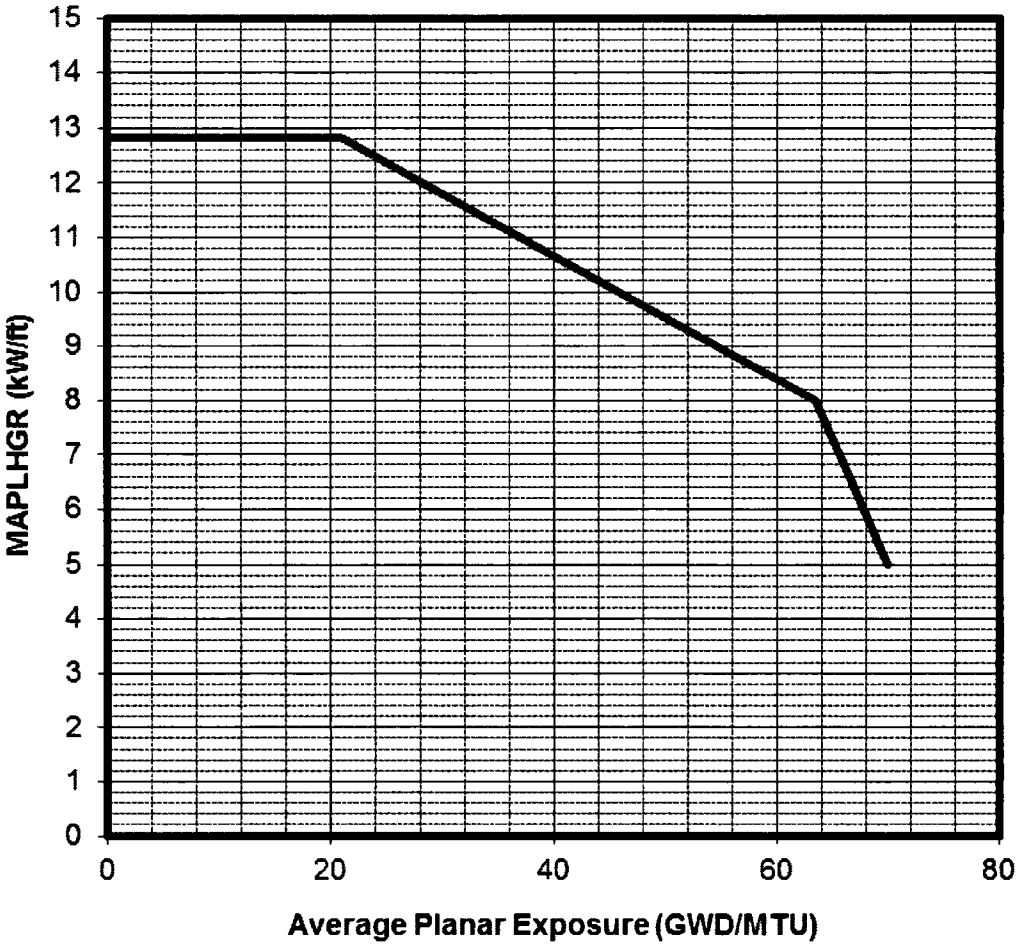
FUEL TYPE: GNF2



Average Planar Exposure	MAPLHGR Limit (kW/ft)
0.00	13.78
19.31	13.78
67.00	7.50
70.00	6.69

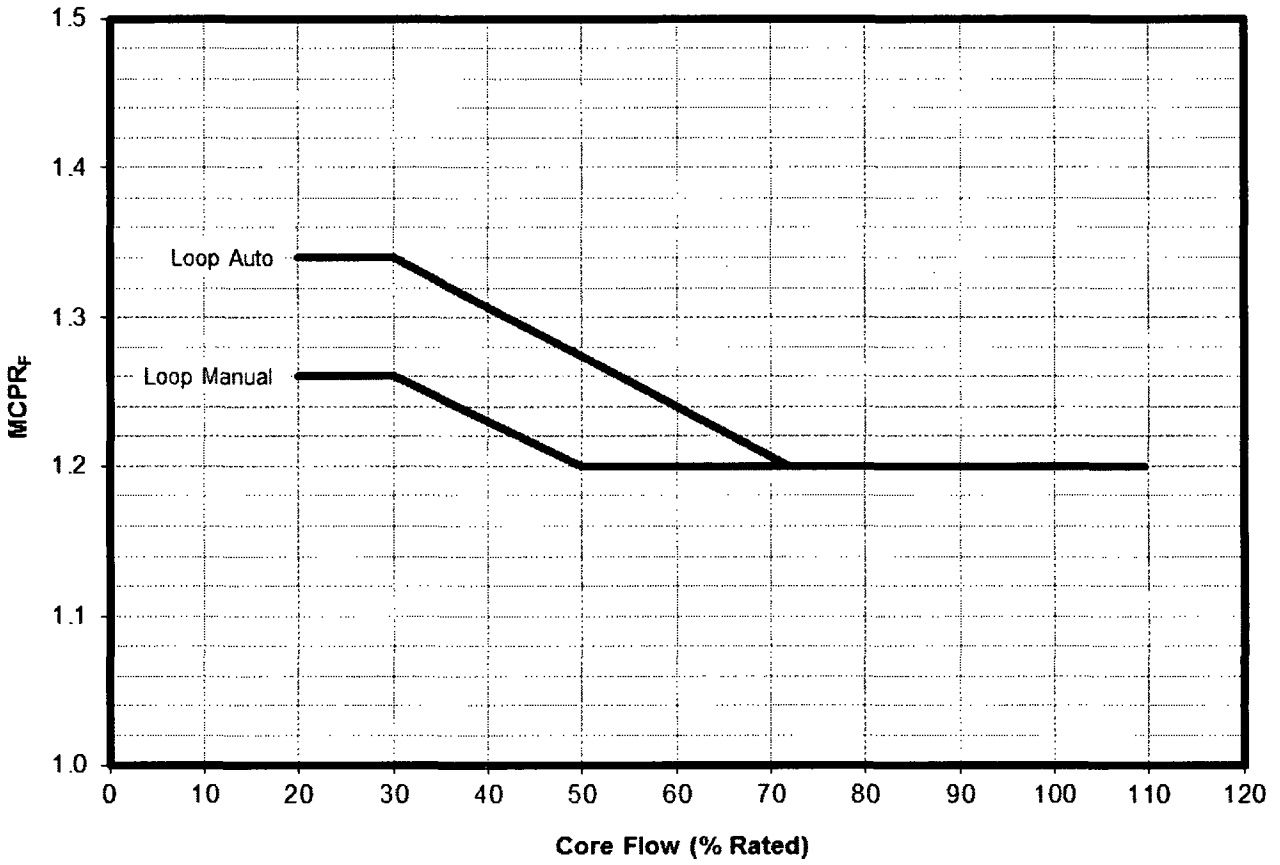
FIGURE 6.1-1b. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE

FUEL TYPE: GE14



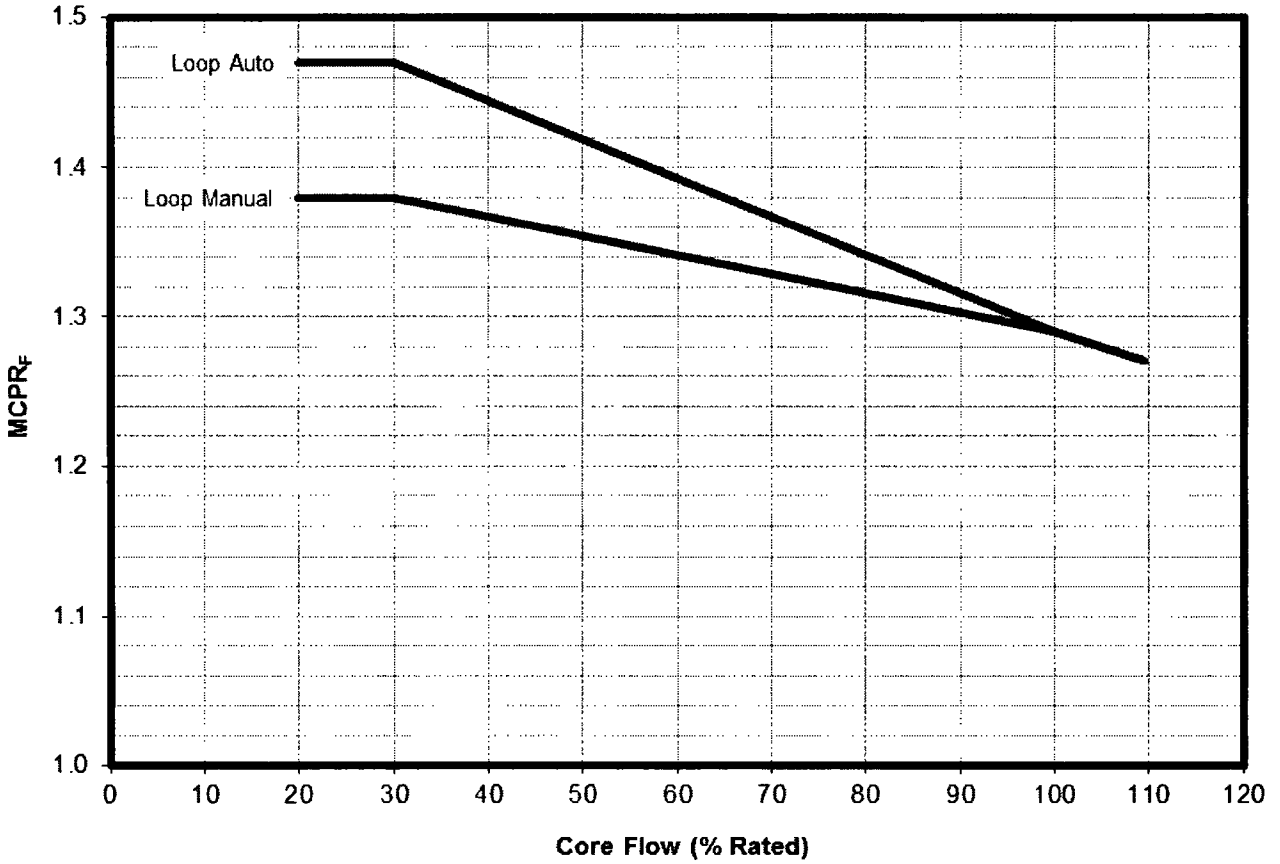
Average Planar Exposure	MAPLHGR Limit (kW/ft)
0.00	12.82
16.00	12.82
21.10	12.82
63.50	8.00
70.00	5.00

FIGURE 7.1-1. OPERATING LIMIT MCPR VERSUS CORE FLOW ($MCPR_F$)
APPLICATION CONDITION: 1 - 3
EXPOSURE RANGE: BOC - EOC
FUEL TYPE: GNF2 and GE14



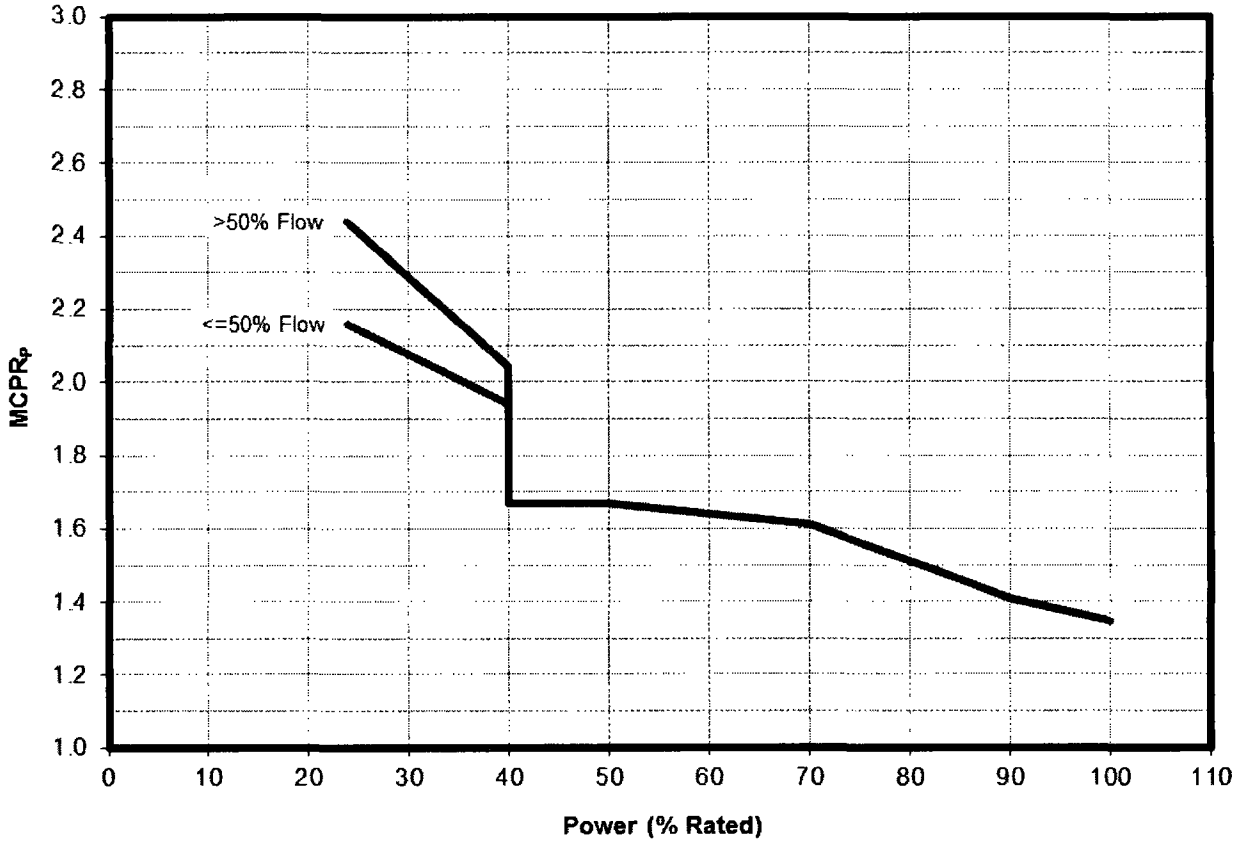
Loop Manual		Loop Auto	
Core Flow (%)	$MCPR_F$	Core Flow (%)	$MCPR_F$
20.0	1.26	20.0	1.34
30.0	1.26	30.0	1.34
50.0	1.20	72.0	1.20
109.5	1.20	109.5	1.20

FIGURE 7.1-2. OPERATING LIMIT MCPR VERSUS CORE FLOW ($MCPR_F$)
APPLICATION CONDITION: 4 - 7
EXPOSURE RANGE: BOC - EOC
FUEL TYPE: GNF2 & GE14



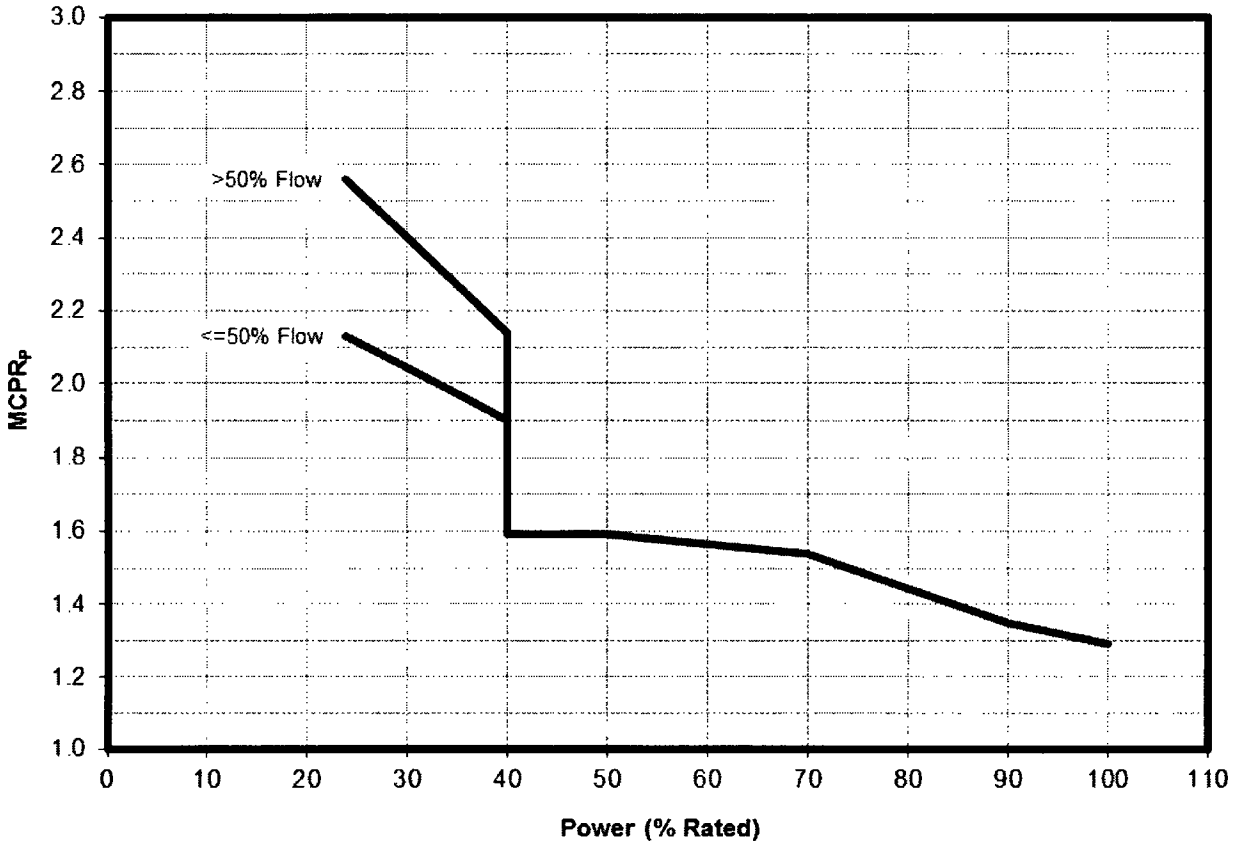
Loop Manual		Loop Auto	
Core Flow (%)	$MCPR_F$	Core Flow (%)	$MCPR_F$
20.0	1.38	20.0	1.47
30.0	1.38	30.0	1.47
100.0	1.29	100.0	1.29
109.5	1.27	109.5	1.27

FIGURE 7.2-1a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 1
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



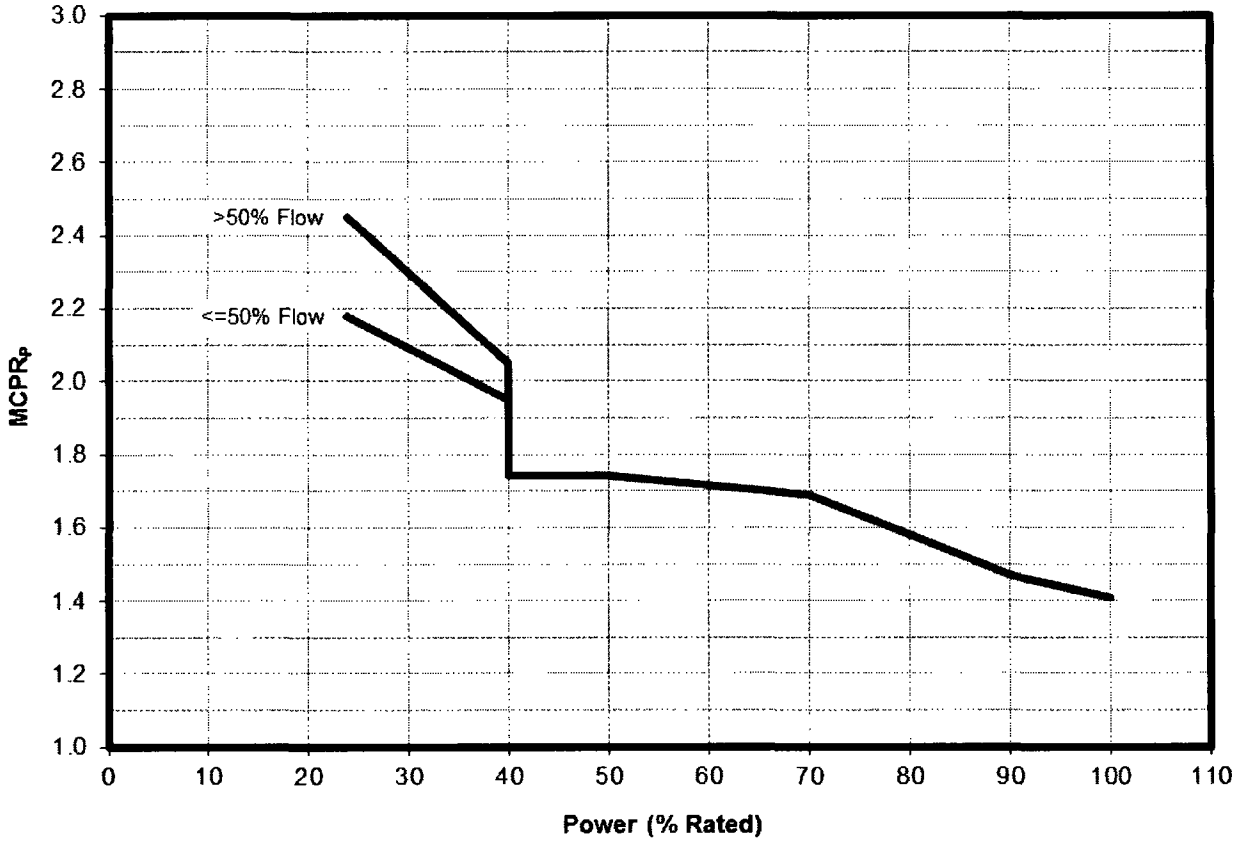
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.44
40.0	1.94	2.04
40.0		1.67
50.0		1.67
70.0		1.61
85.0		1.46
85.0		1.46
90.0		1.41
100.0		1.35

FIGURE 7.2-1b. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 1
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



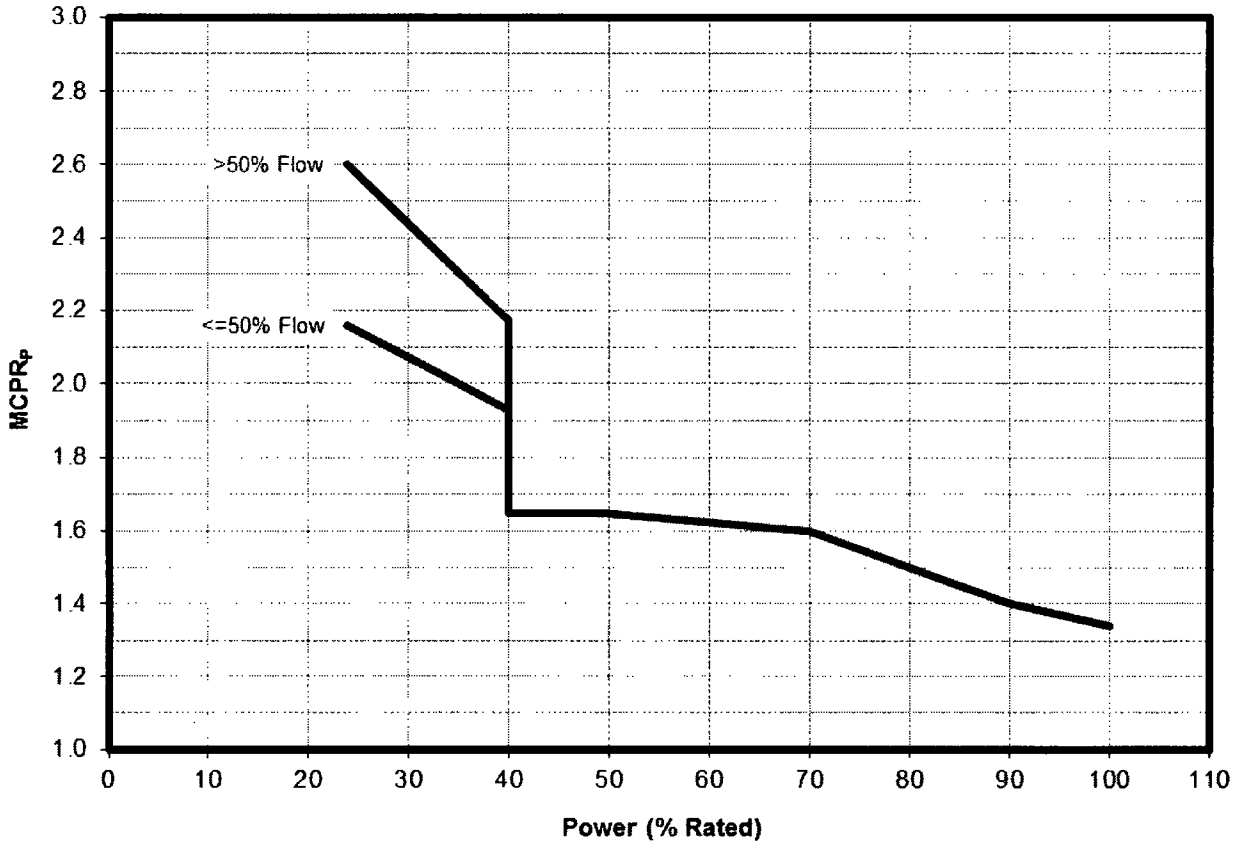
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.13	2.56
40.0	1.90	2.14
40.0		1.59
50.0		1.59
70.0		1.54
85.0		1.40
85.0		1.40
90.0		1.35
100.0		1.29

FIGURE 7.2-1c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 1
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



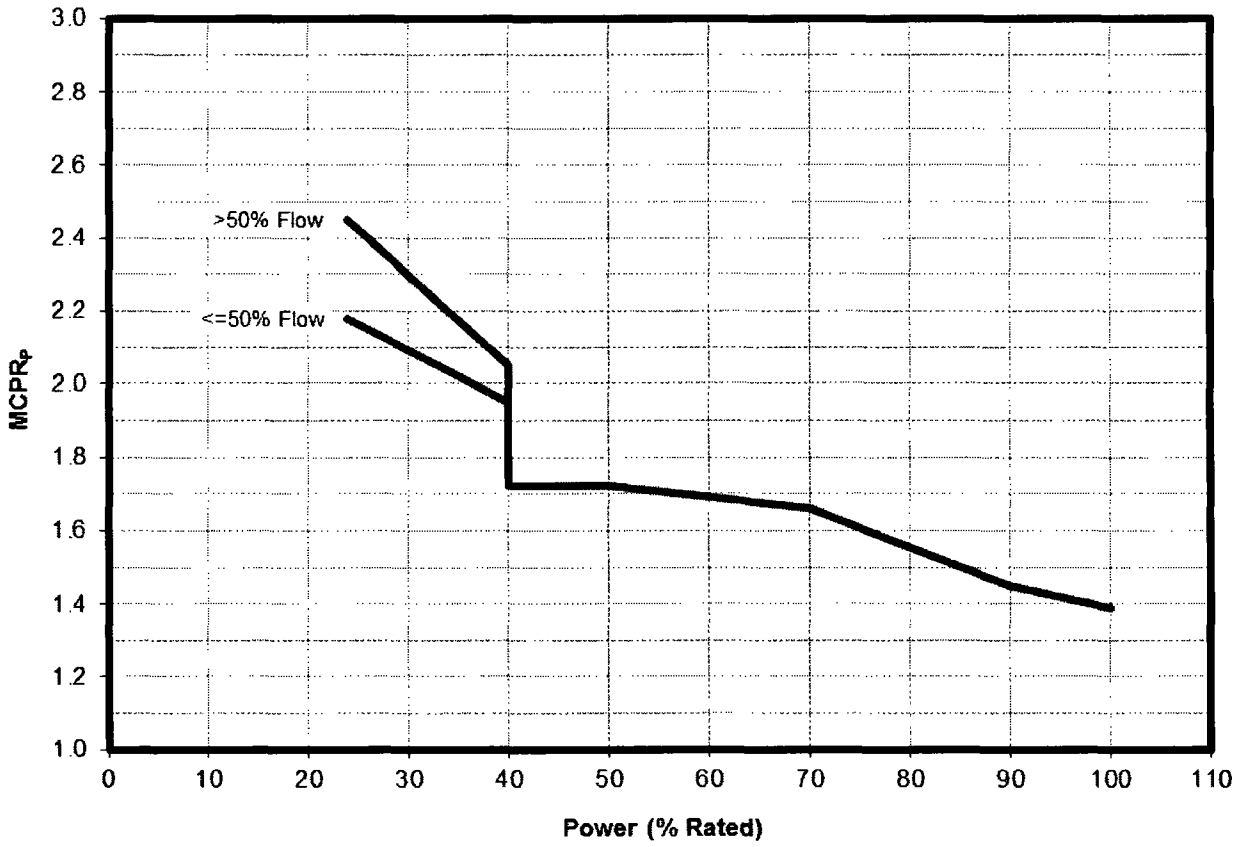
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.18	2.45
40.0	1.95	2.05
40.0		1.74
50.0		1.74
70.0		1.69
85.0		1.53
85.0		1.53
90.0		1.47
100.0		1.41

FIGURE 7.2-1d. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 1
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



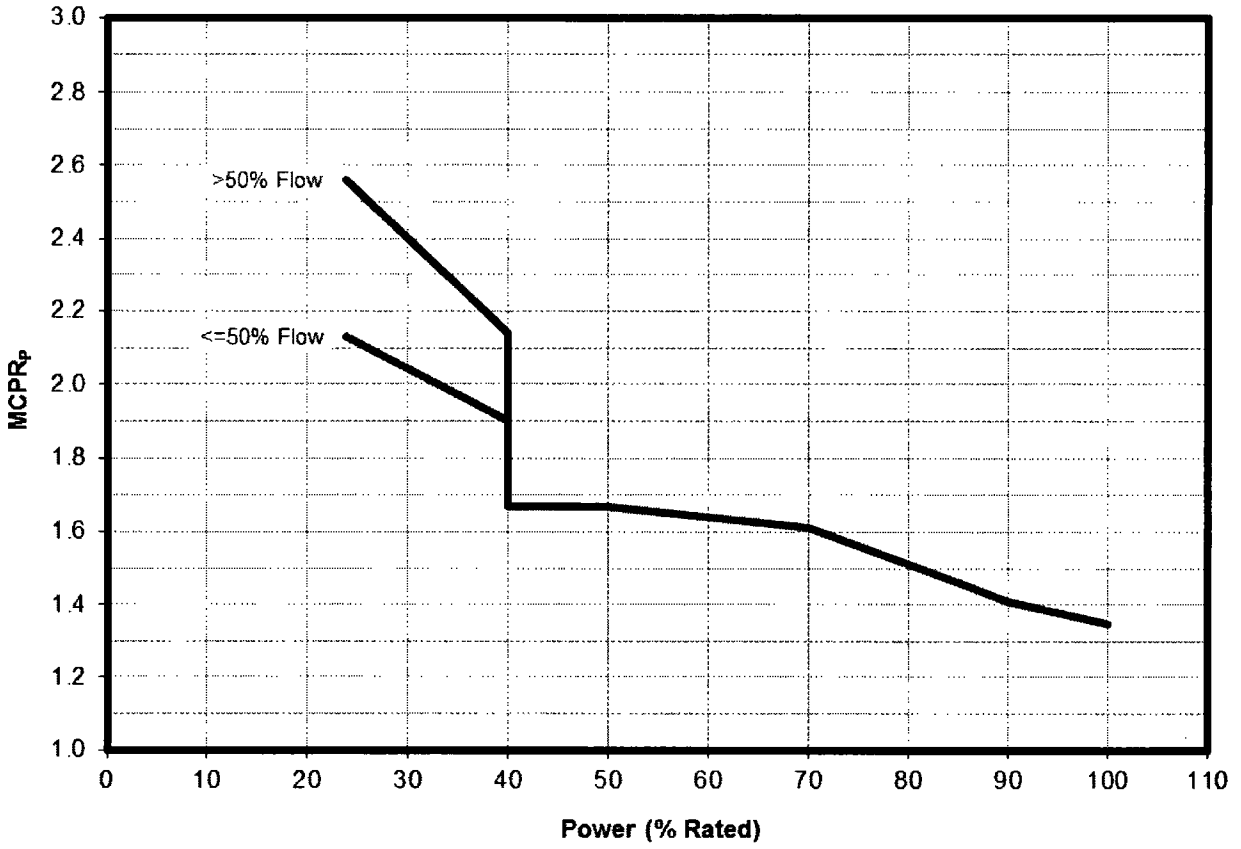
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.60
40.0	1.93	2.17
40.0		1.65
50.0		1.65
70.0		1.60
85.0		1.45
85.0		1.45
90.0		1.40
100.0		1.34

FIGURE 7.2-2a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 2
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



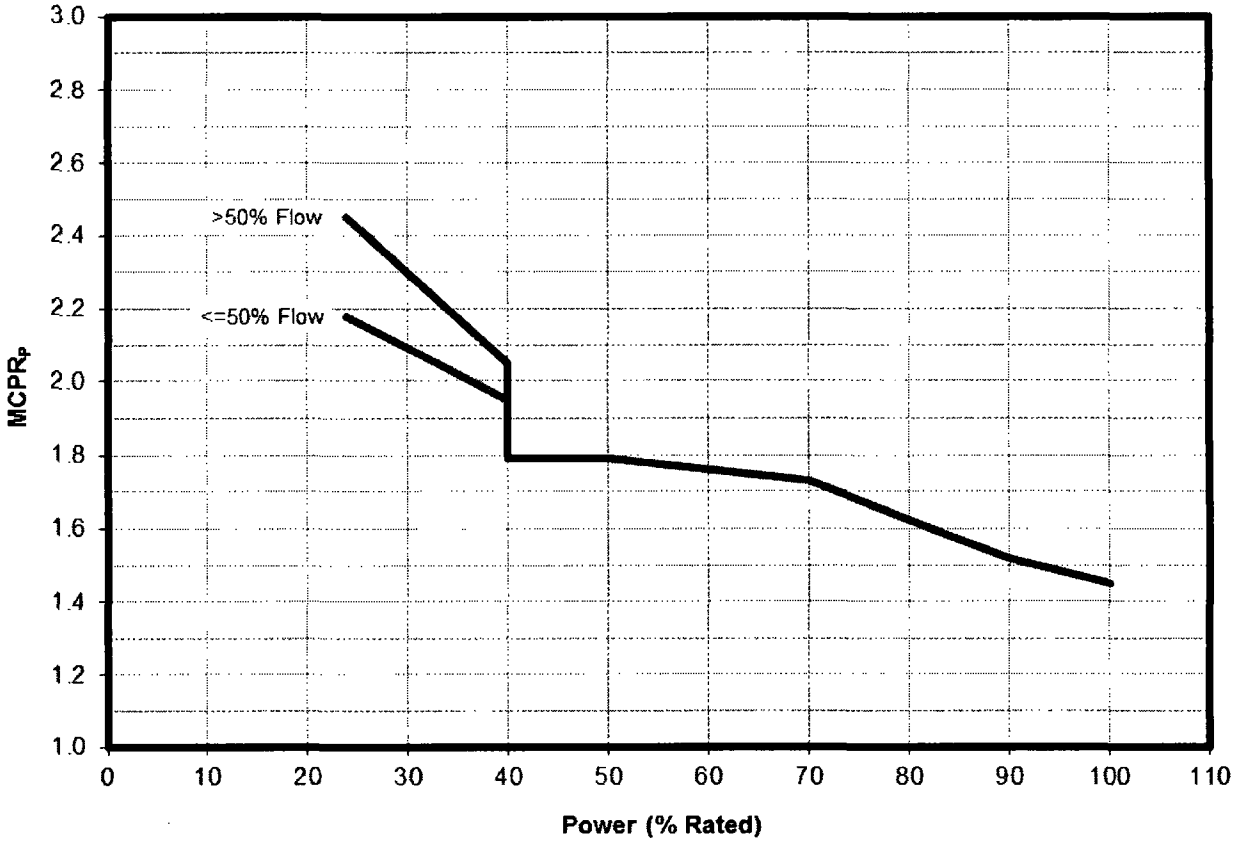
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.18	2.45
40.0	1.95	2.05
40.0		1.72
50.0		1.72
70.0		1.66
85.0		1.50
85.0		1.50
90.0		1.45
100.0		1.39

FIGURE 7.2-2b. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 2
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



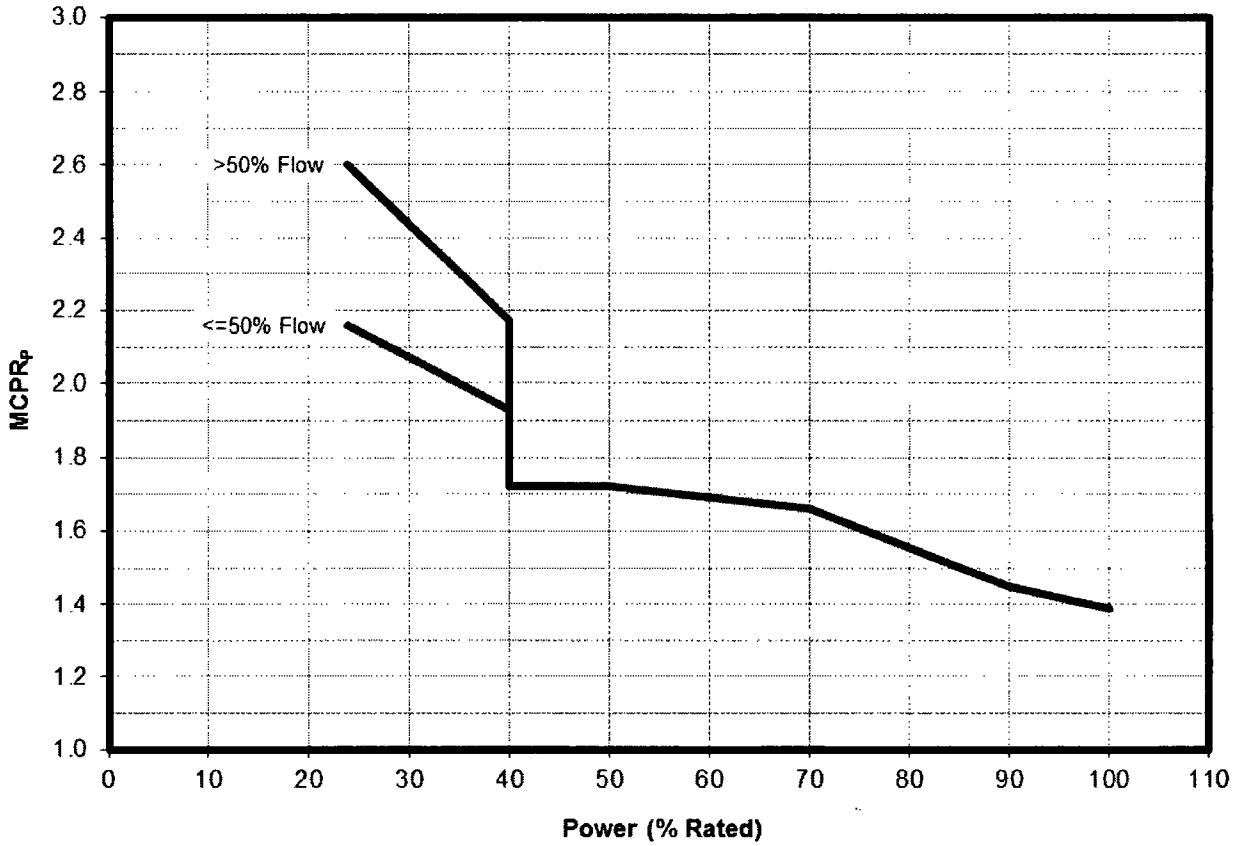
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.13	2.56
40.0	1.90	2.14
40.0		1.67
50.0		1.67
70.0		1.61
85.0		1.46
85.0		1.46
90.0		1.41
100.0		1.35

FIGURE 7.2-2c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 2
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



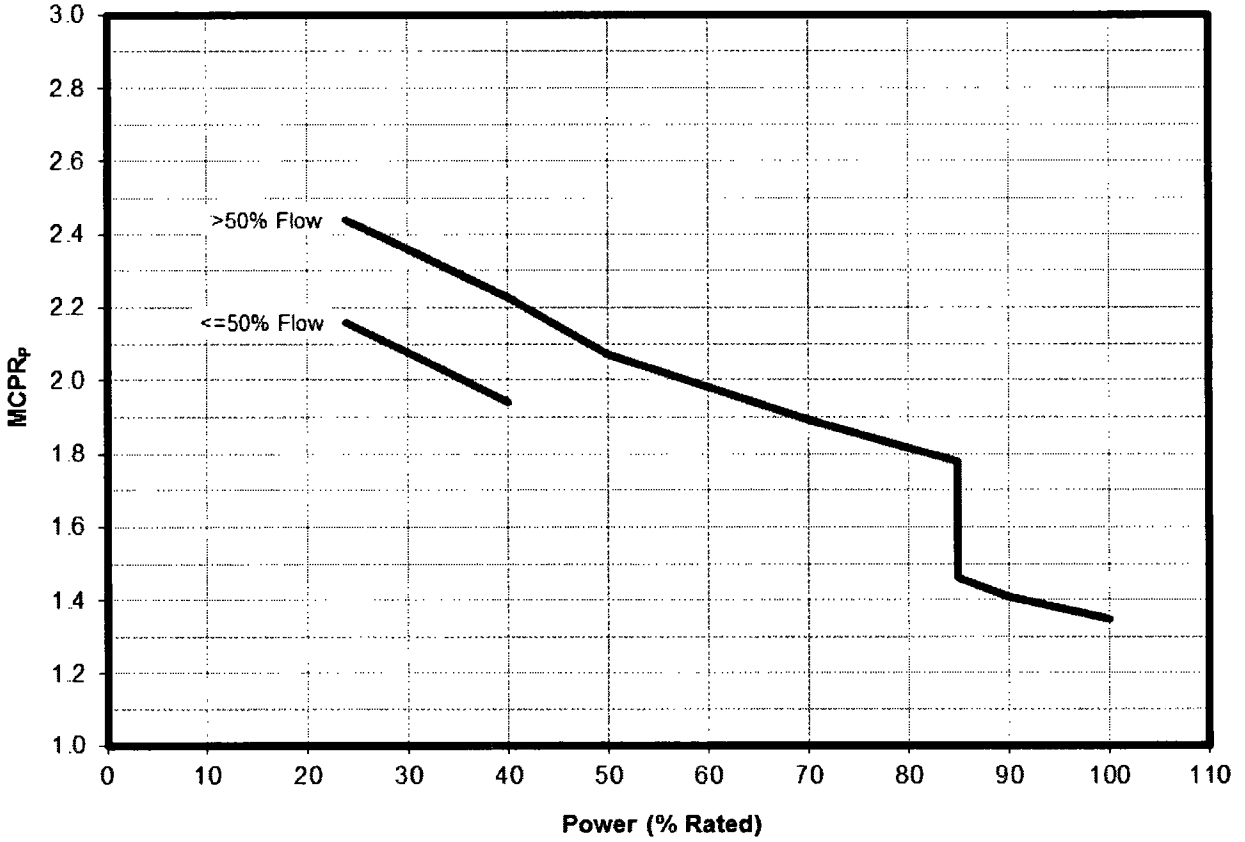
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.18	2.45
40.0	1.95	2.05
40.0		1.79
50.0		1.79
70.0		1.73
85.0		1.57
85.0		1.57
90.0		1.52
100.0		1.45

FIGURE 7.2-2d. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 2
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



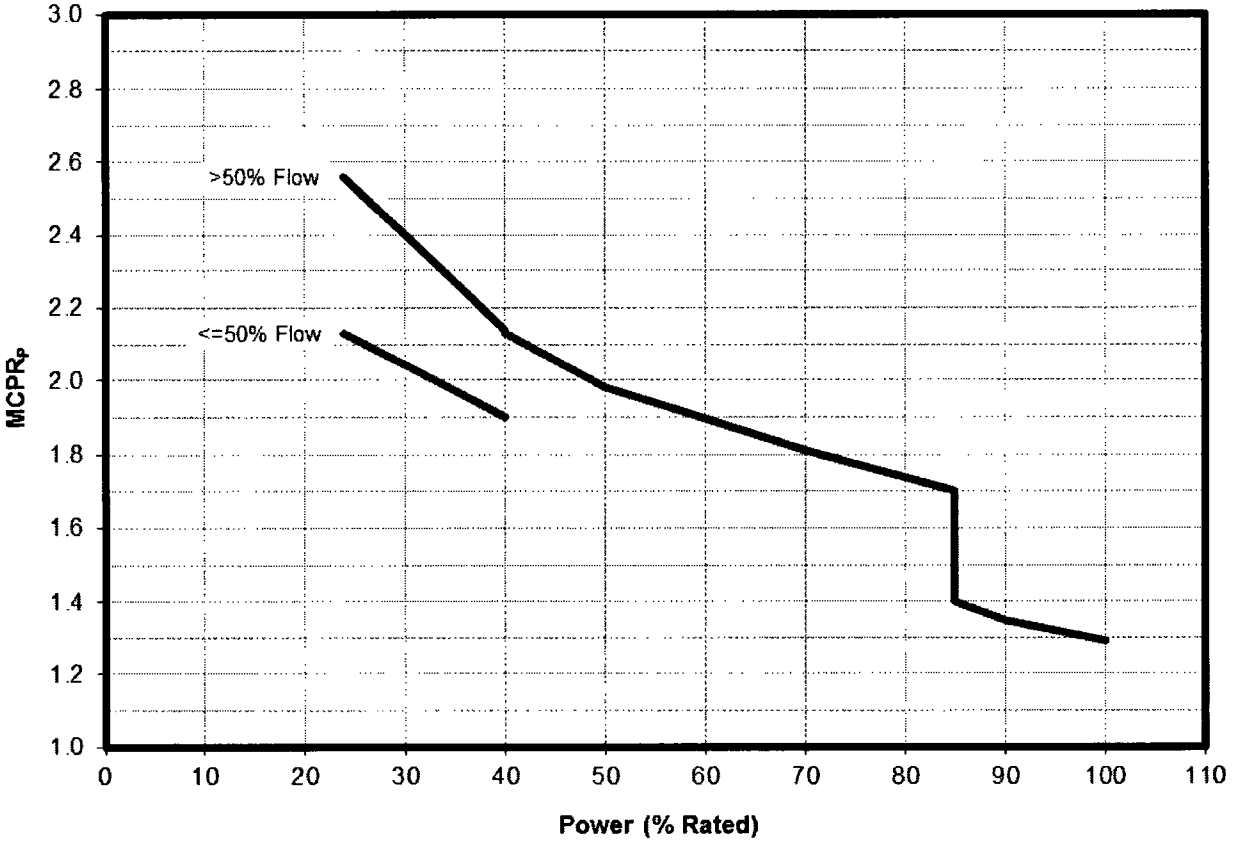
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.60
40.0	1.93	2.17
40.0		1.72
50.0		1.72
70.0		1.66
85.0		1.50
85.0		1.50
90.0		1.45
100.0		1.39

FIGURE 7.2-3a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 3
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



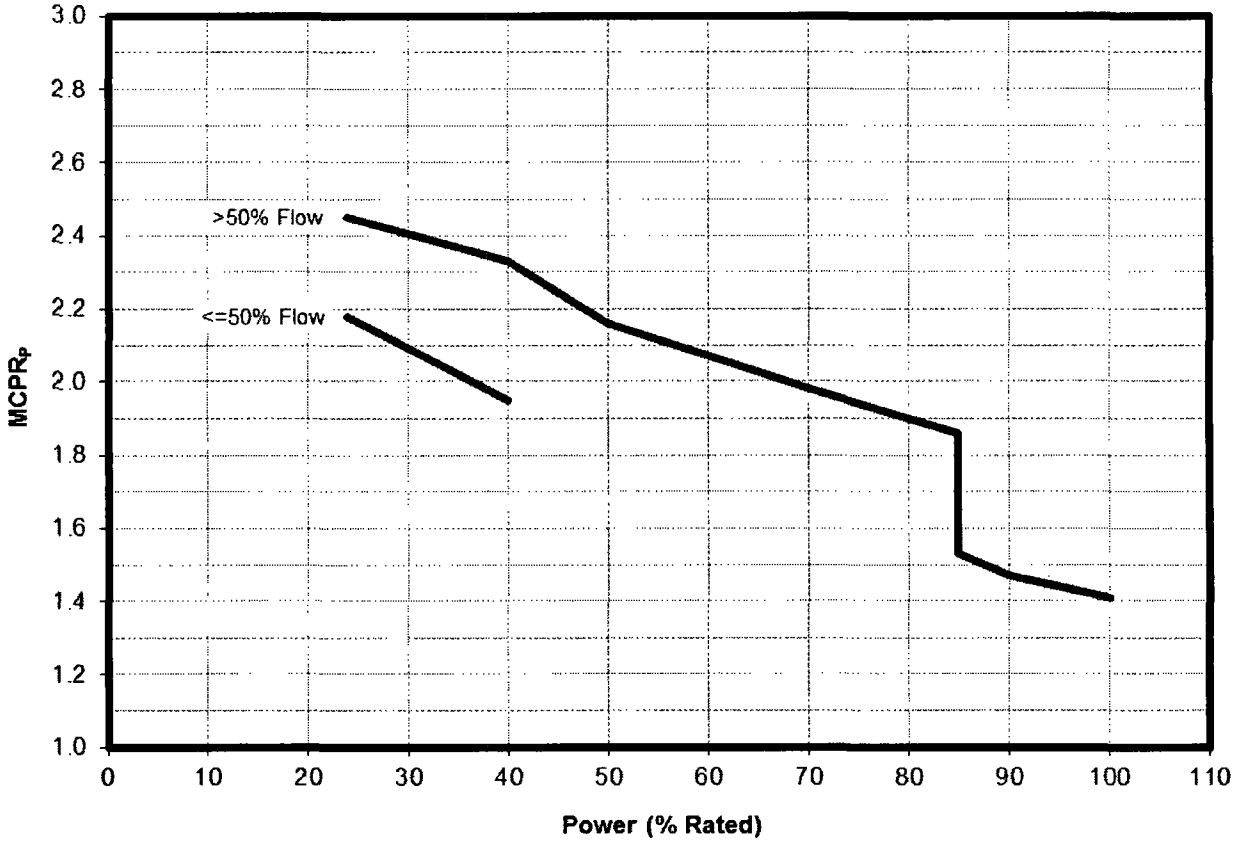
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.44
40.0	1.94	2.23
40.0		2.23
50.0		2.07
70.0		1.89
85.0		1.78
85.0		1.46
90.0		1.41
100.0		1.35

FIGURE 7.2-3b. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 3
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



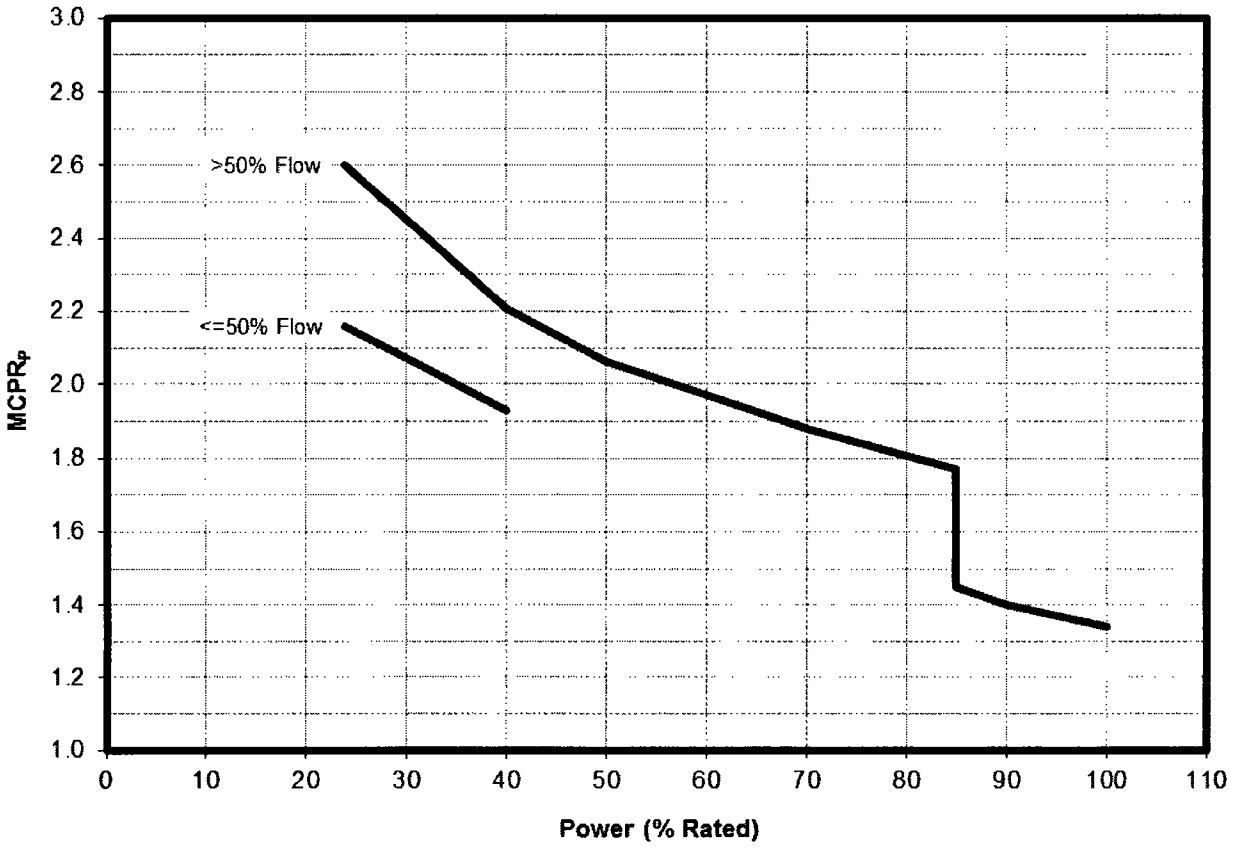
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.13	2.56
40.0	1.90	2.14
40.0		2.13
50.0		1.98
70.0		1.81
85.0		1.70
85.0		1.40
90.0		1.35
100.0		1.29

FIGURE 7.2-3c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 3
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



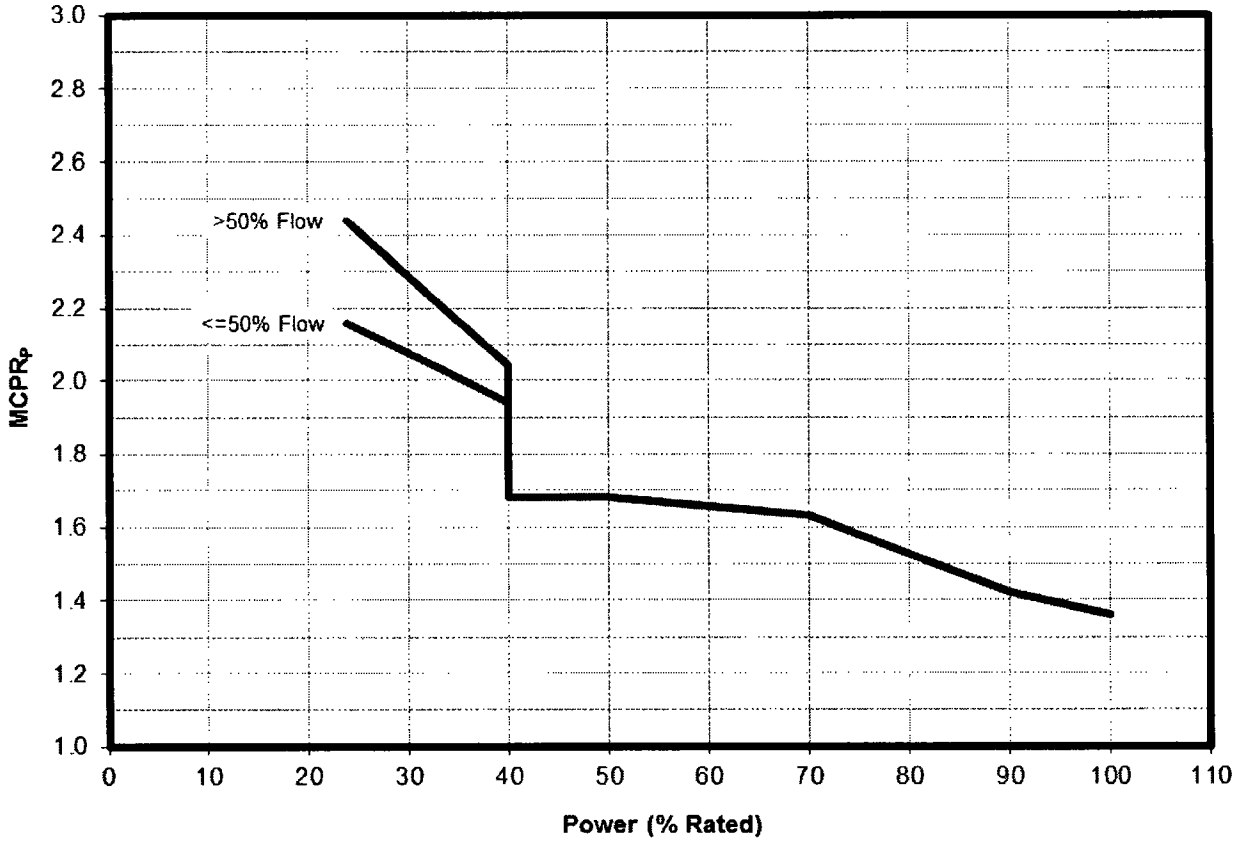
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.18	2.45
40.0	1.95	2.33
40.0		2.33
50.0		2.16
70.0		1.98
85.0		1.86
85.0		1.53
90.0		1.47
100.0		1.41

FIGURE 7.2-3d. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 3
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



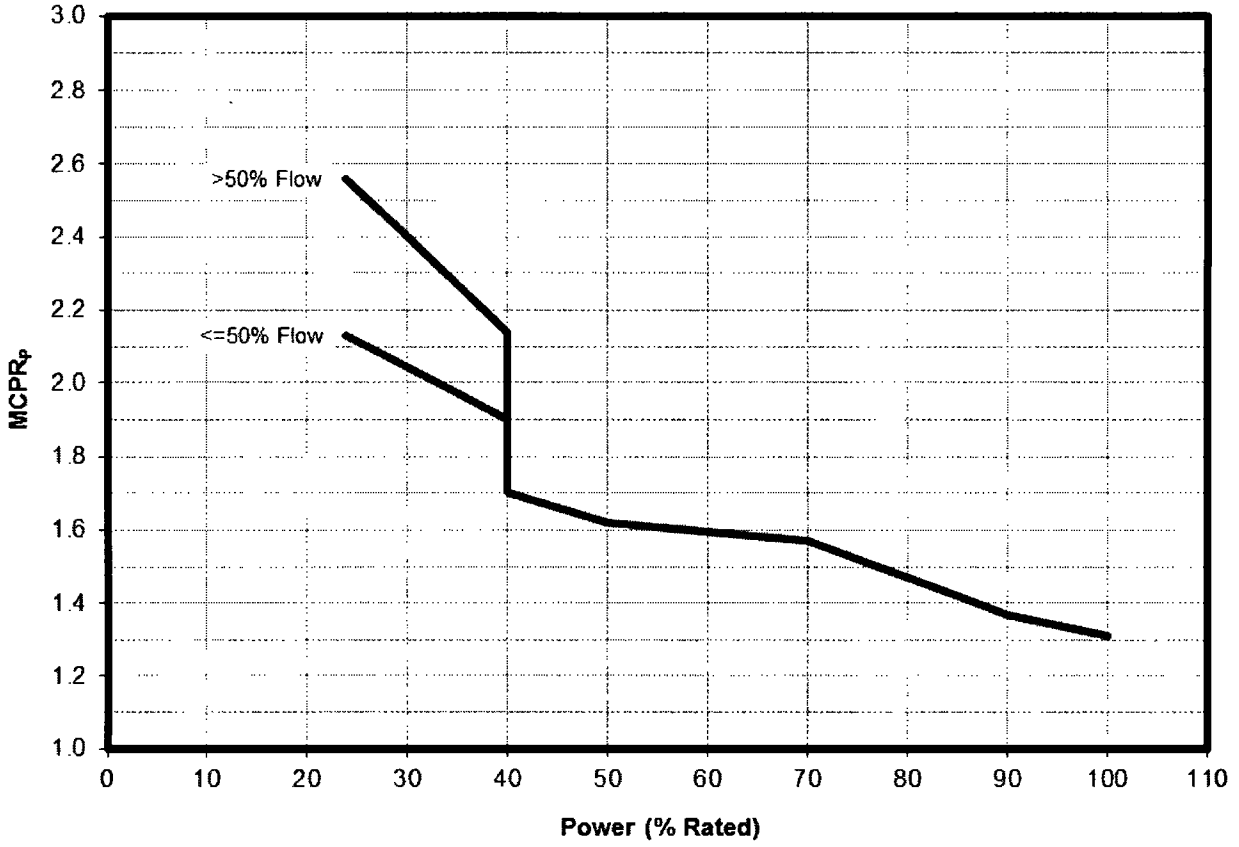
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.60
40.0	1.93	2.21
40.0		2.21
50.0		2.06
70.0		1.88
85.0		1.77
85.0		1.45
90.0		1.40
100.0		1.34

FIGURE 7.2-4a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 4
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



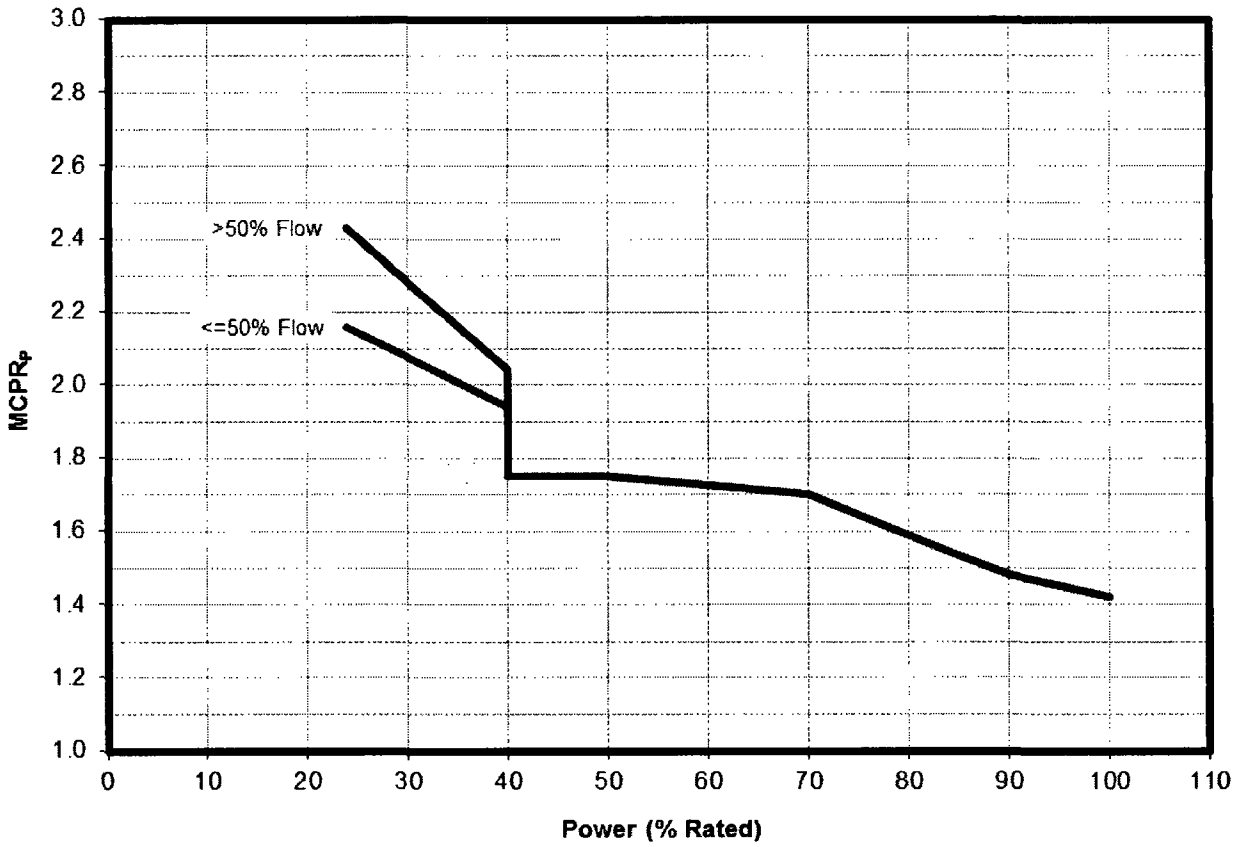
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.44
40.0	1.94	2.04
40.0		1.68
50.0		1.68
70.0		1.63
85.0		1.47
85.0		1.47
90.0		1.42
100.0		1.36

FIGURE 7.2-4b. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 4
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



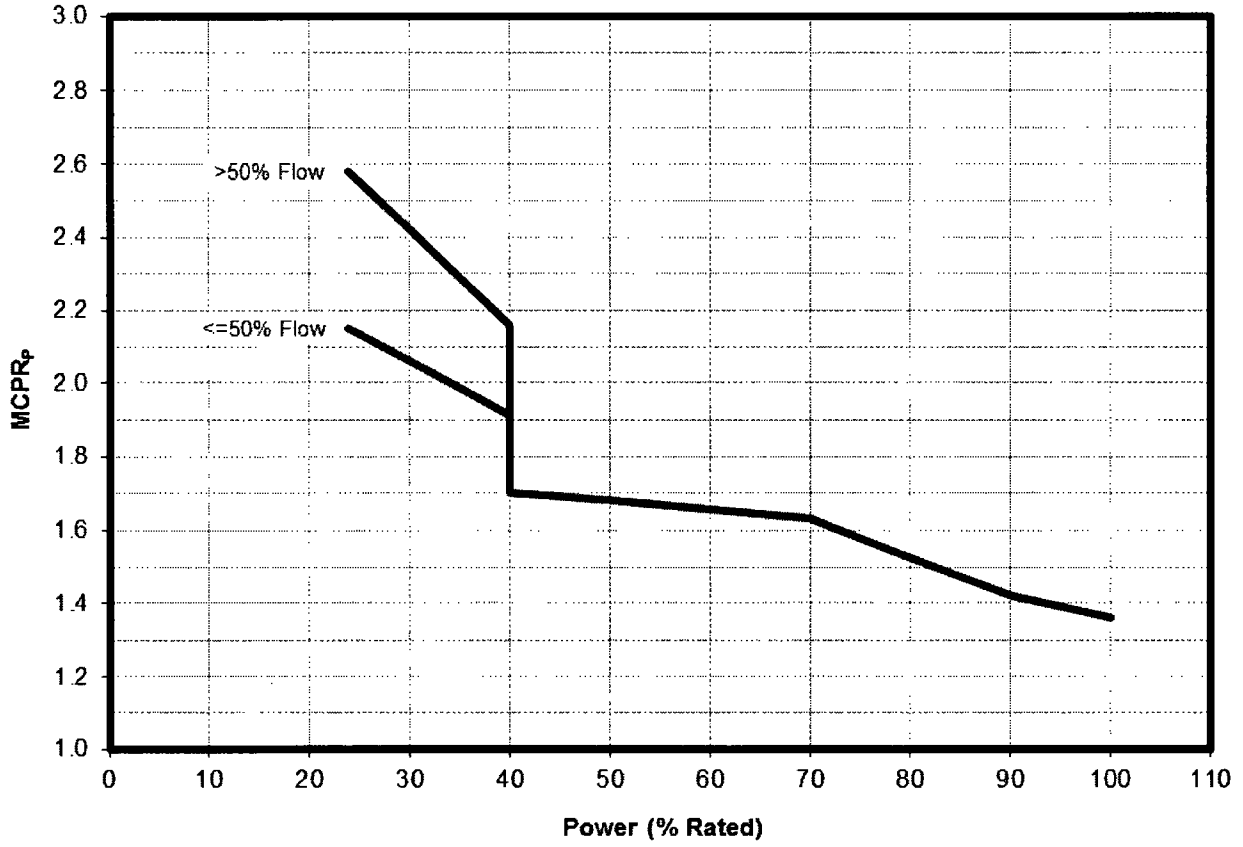
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.13	2.56
40.0	1.90	2.14
40.0		1.70
50.0		1.62
70.0		1.57
85.0		1.42
85.0		1.42
90.0		1.37
100.0		1.31

FIGURE 7.2-4c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 4
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



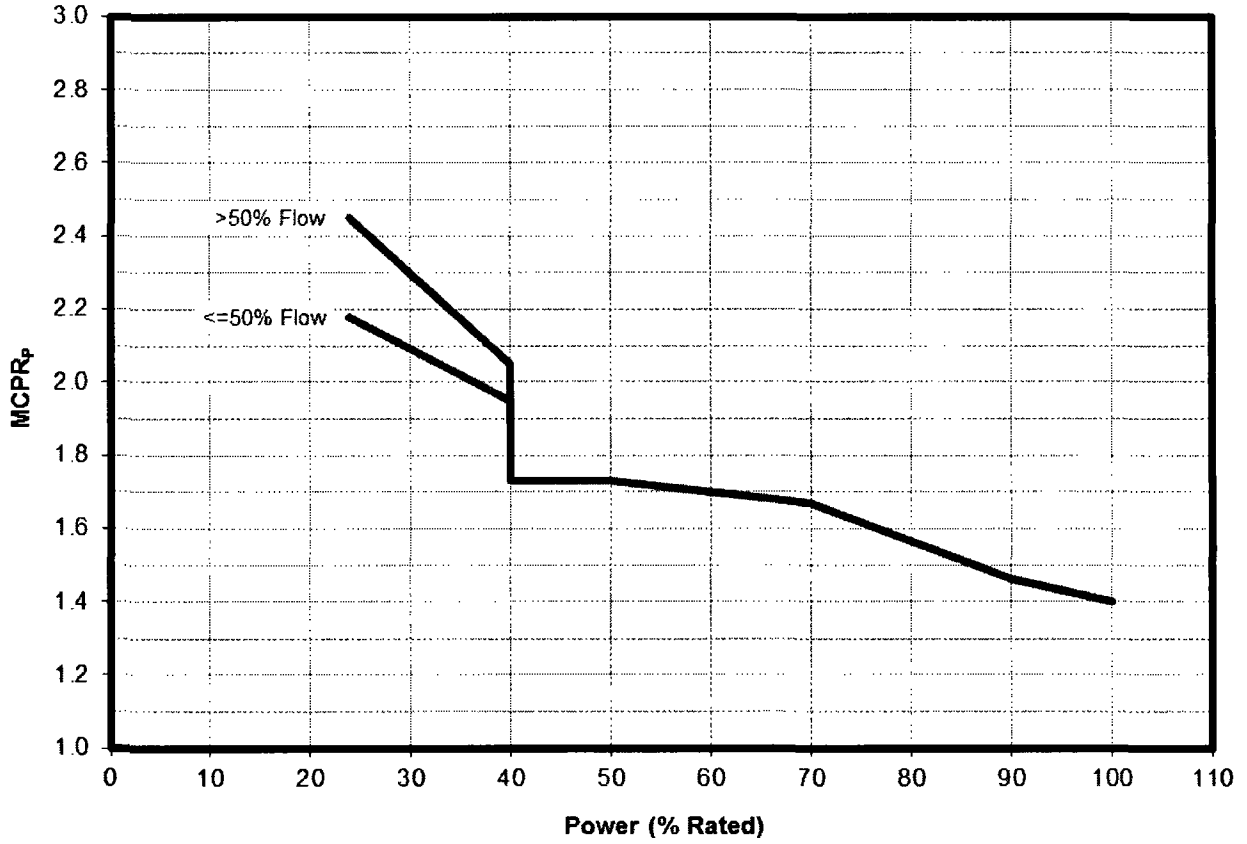
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.43
40.0	1.94	2.04
40.0		1.75
50.0		1.75
70.0		1.70
85.0		1.54
85.0		1.54
90.0		1.48
100.0		1.42

FIGURE 7.2-4d. **OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)**
APPLICATION CONDITION: 4
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



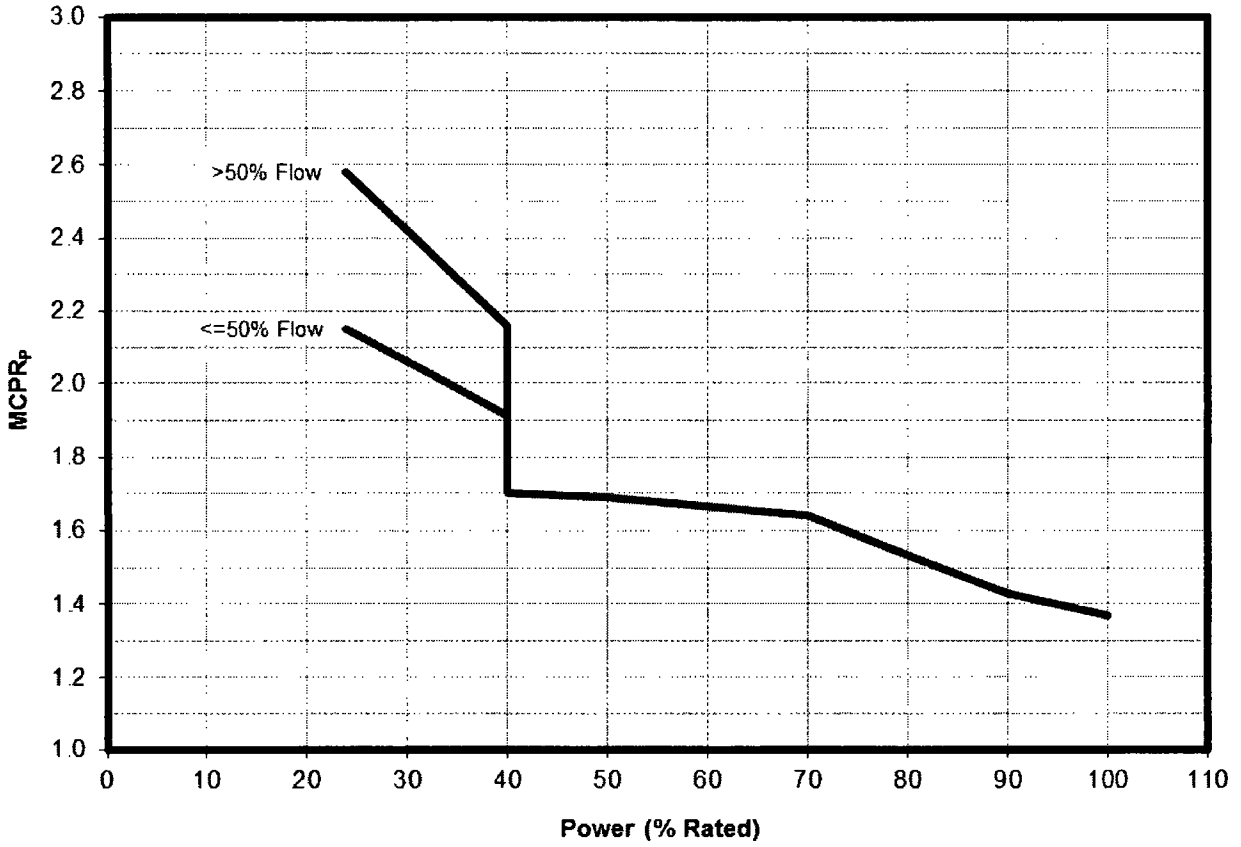
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.15	2.58
40.0	1.91	2.16
40.0		1.70
50.0		1.68
70.0		1.63
85.0		1.47
85.0		1.47
90.0		1.42
100.0		1.36

FIGURE 7.2-5a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 5
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



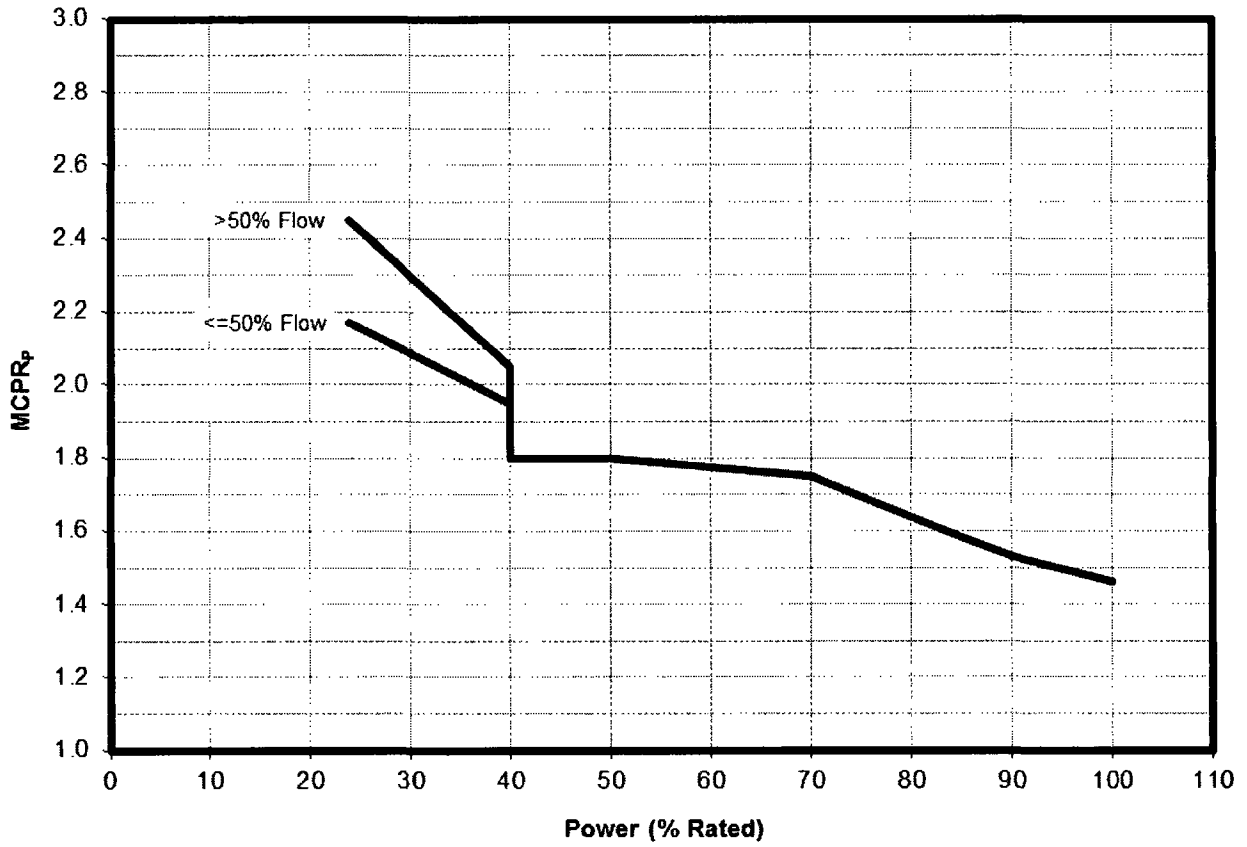
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.18	2.45
40.0	1.95	2.05
40.0		1.73
50.0		1.73
70.0		1.67
85.0		1.51
85.0		1.51
90.0		1.46
100.0		1.40

FIGURE 7.2-5b. **OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)**
APPLICATION CONDITION: 5
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



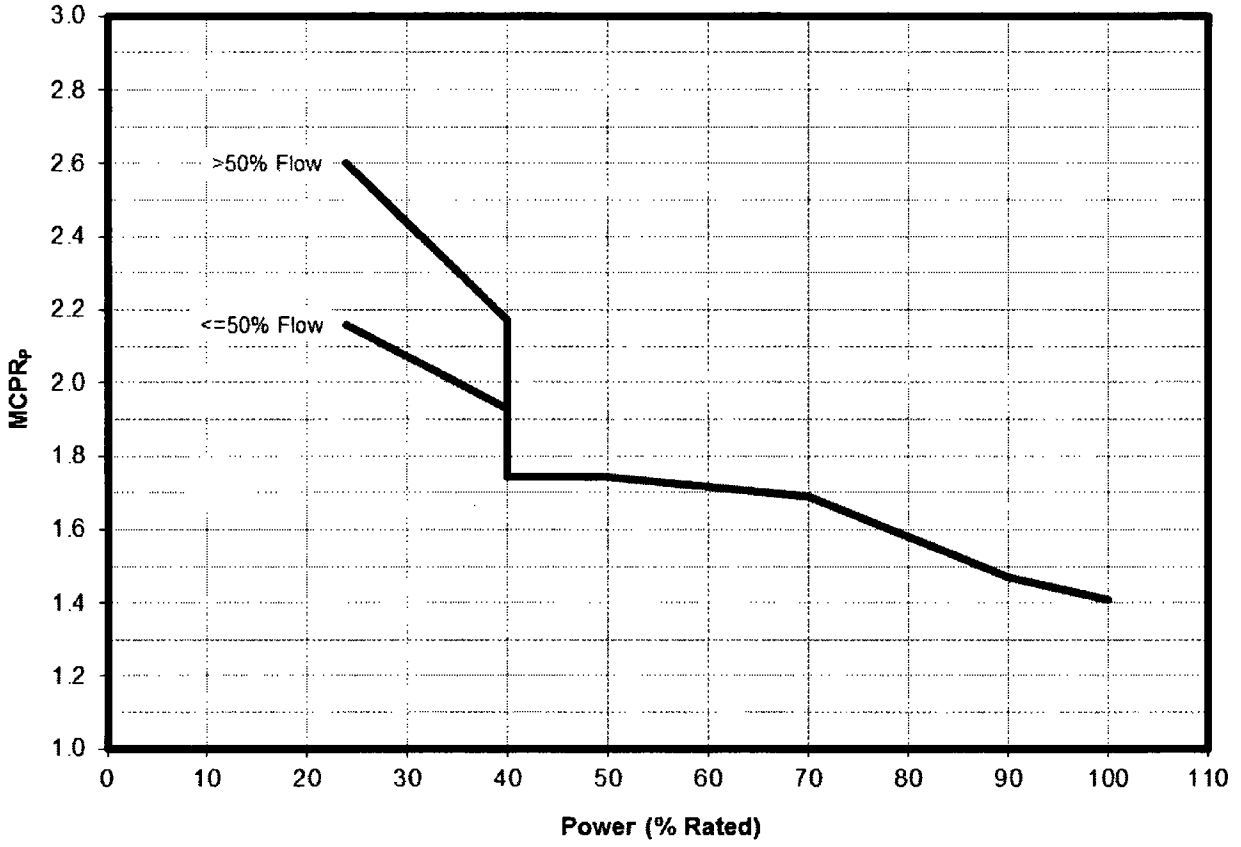
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.15	2.58
40.0	1.91	2.16
40.0		1.70
50.0		1.69
70.0		1.64
85.0		1.48
85.0		1.48
90.0		1.43
100.0		1.37

FIGURE 7.2-5c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 5
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



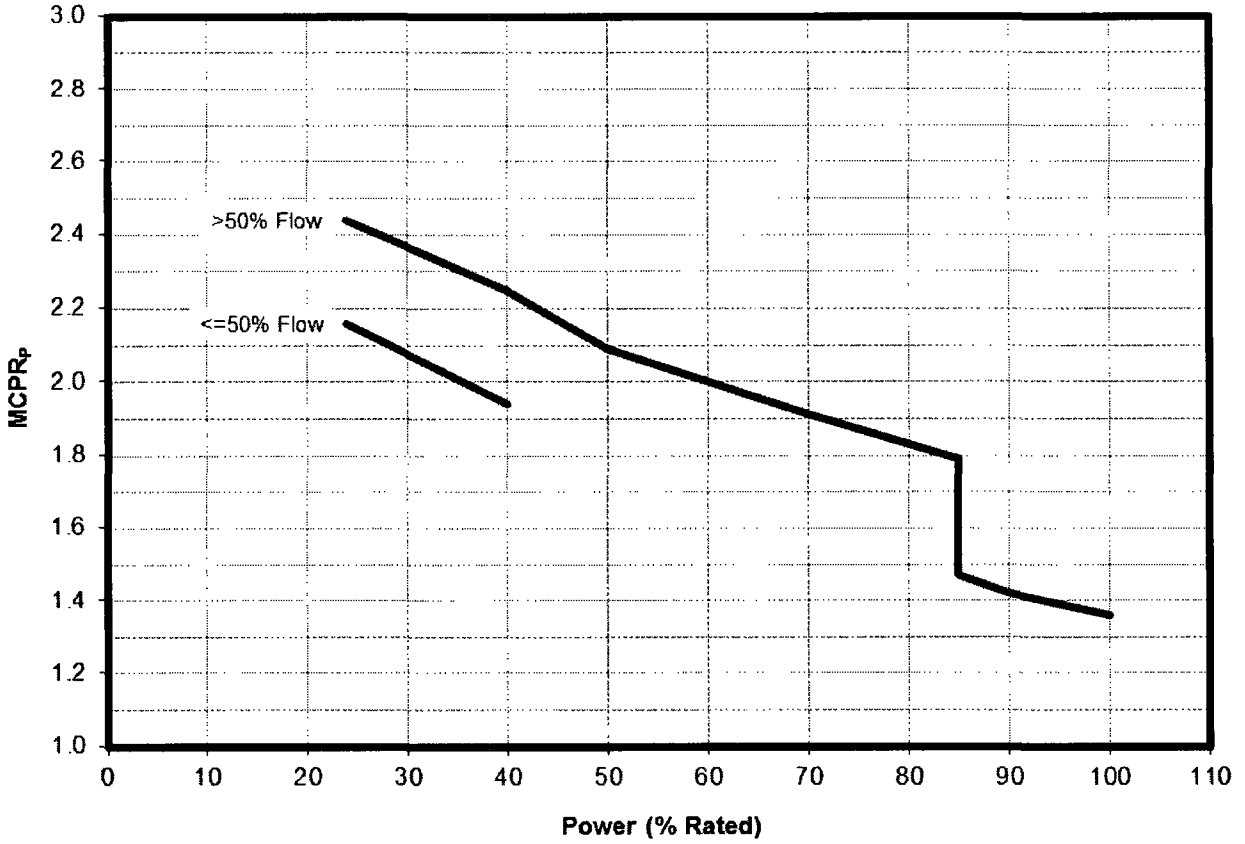
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.17	2.45
40.0	1.95	2.05
40.0		1.80
50.0		1.80
70.0		1.75
85.0		1.59
85.0		1.59
90.0		1.53
100.0		1.46

FIGURE 7.2-5d. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 5
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



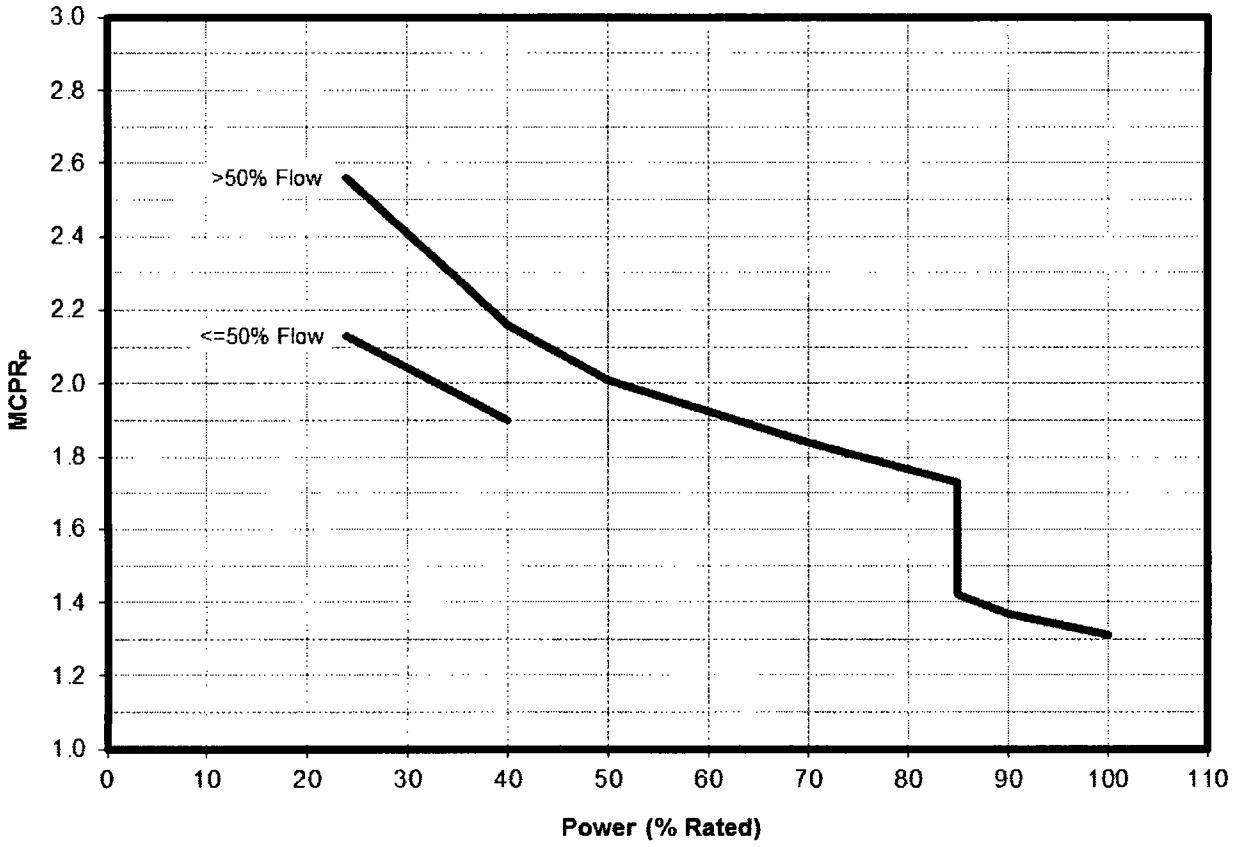
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.60
40.0	1.93	2.17
40.0		1.74
50.0		1.74
70.0		1.69
85.0		1.53
85.0		1.53
90.0		1.47
100.0		1.41

FIGURE 7.2-6a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 6
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



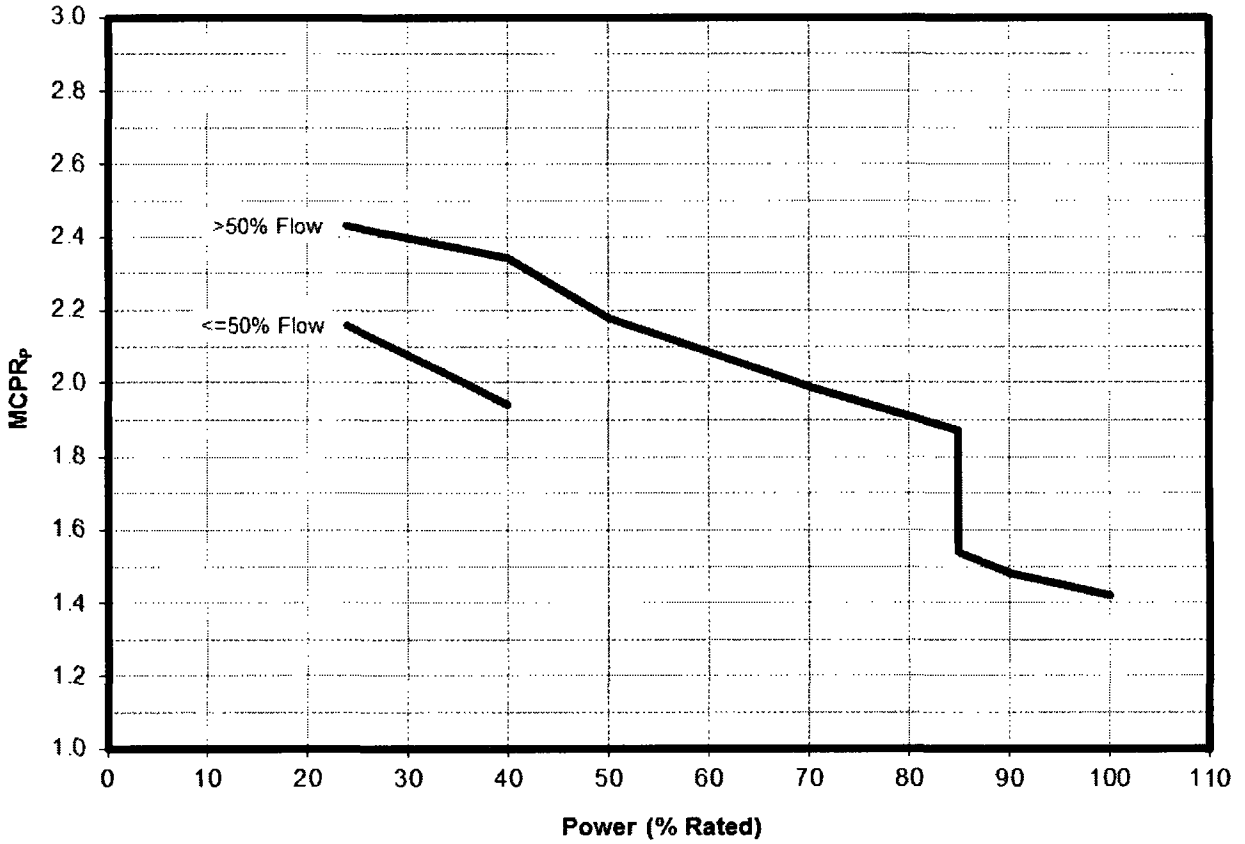
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.44
40.0	1.94	2.25
40.0		2.25
50.0		2.09
70.0		1.91
85.0		1.79
85.0		1.47
90.0		1.42
100.0		1.36

FIGURE 7.2-6b. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 6
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



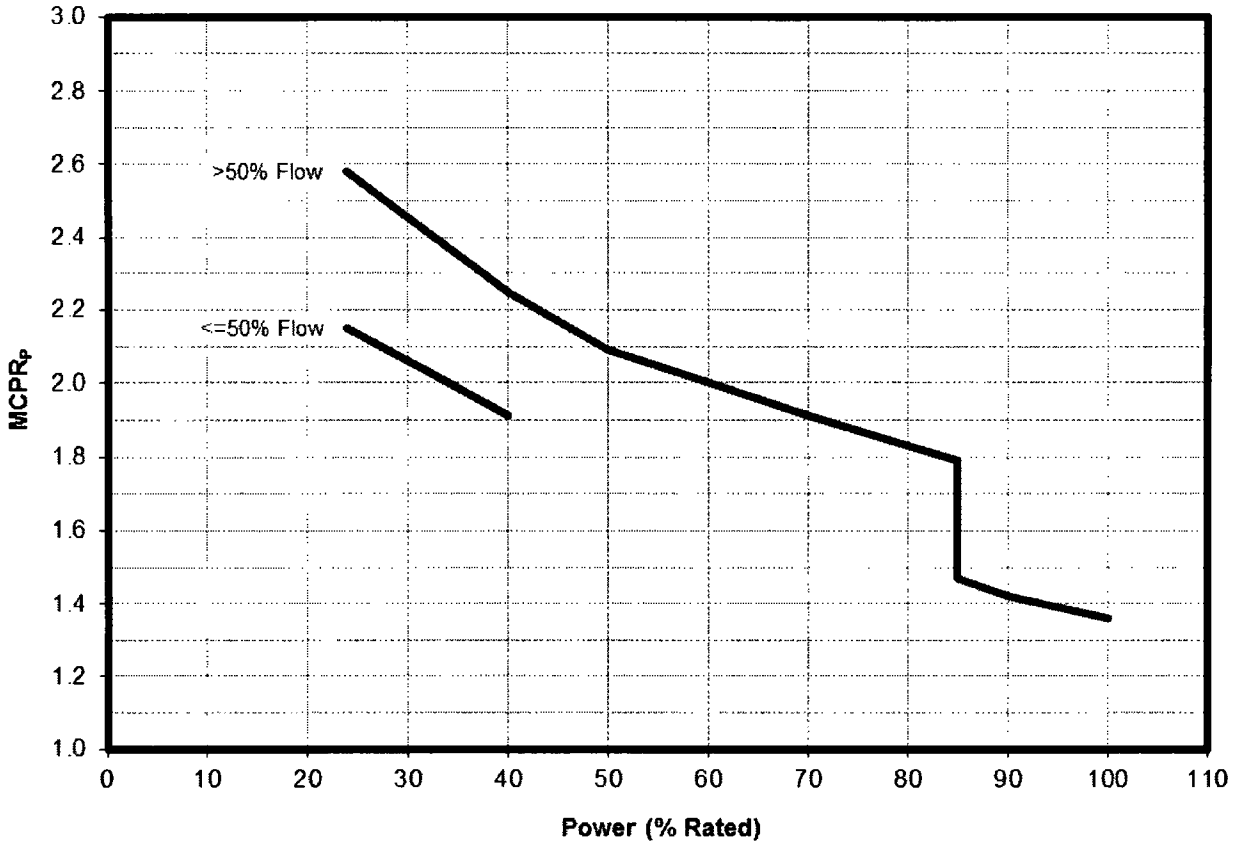
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.13	2.56
40.0	1.90	2.16
40.0		2.16
50.0		2.01
70.0		1.84
85.0		1.73
85.0		1.42
90.0		1.37
100.0		1.31

FIGURE 7.2-6c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 6
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



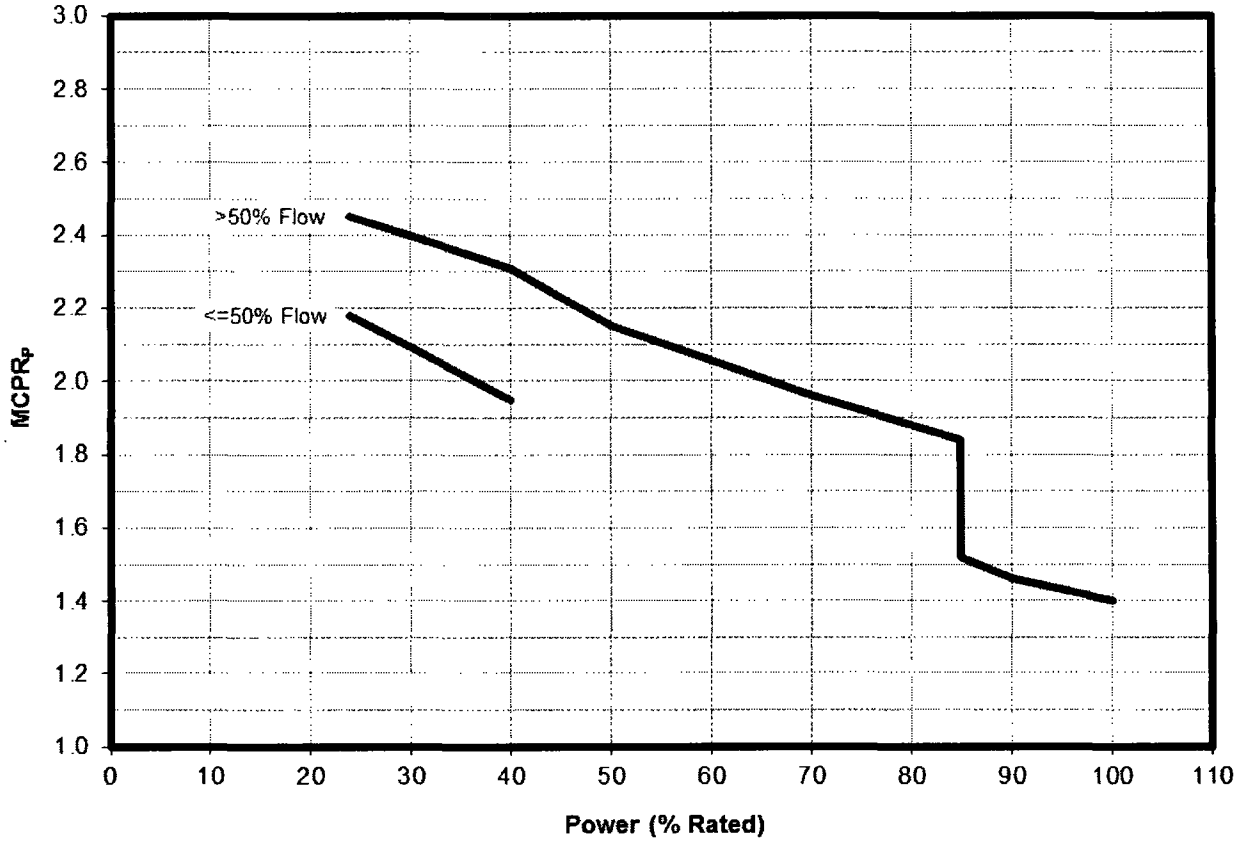
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.43
40.0	1.94	2.34
40.0		2.34
50.0		2.18
70.0		1.99
85.0		1.87
85.0		1.54
90.0		1.48
100.0		1.42

FIGURE 7.2-6d. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 6
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



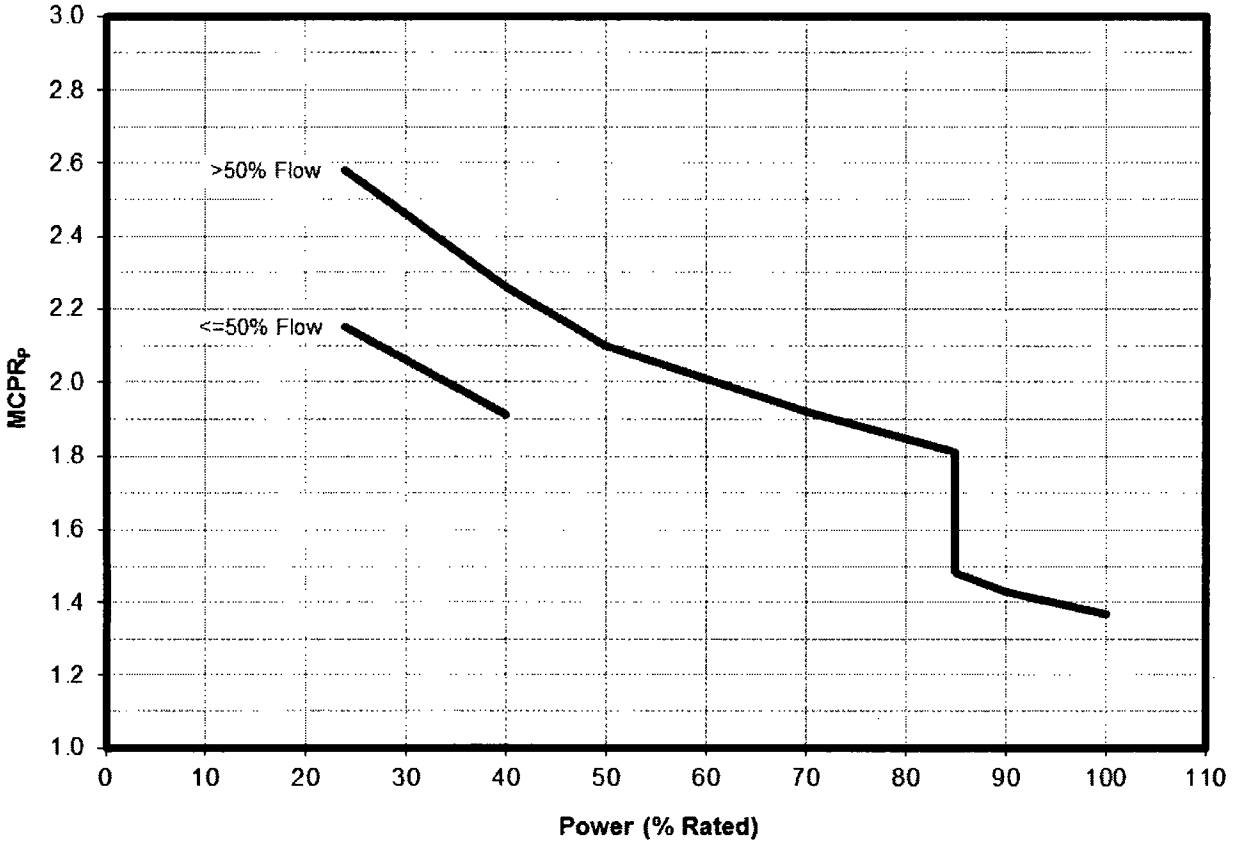
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.15	2.58
40.0	1.91	2.25
40.0		2.25
50.0		2.09
70.0		1.91
85.0		1.79
85.0		1.47
90.0		1.42
100.0		1.36

FIGURE 7.2-7a. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2



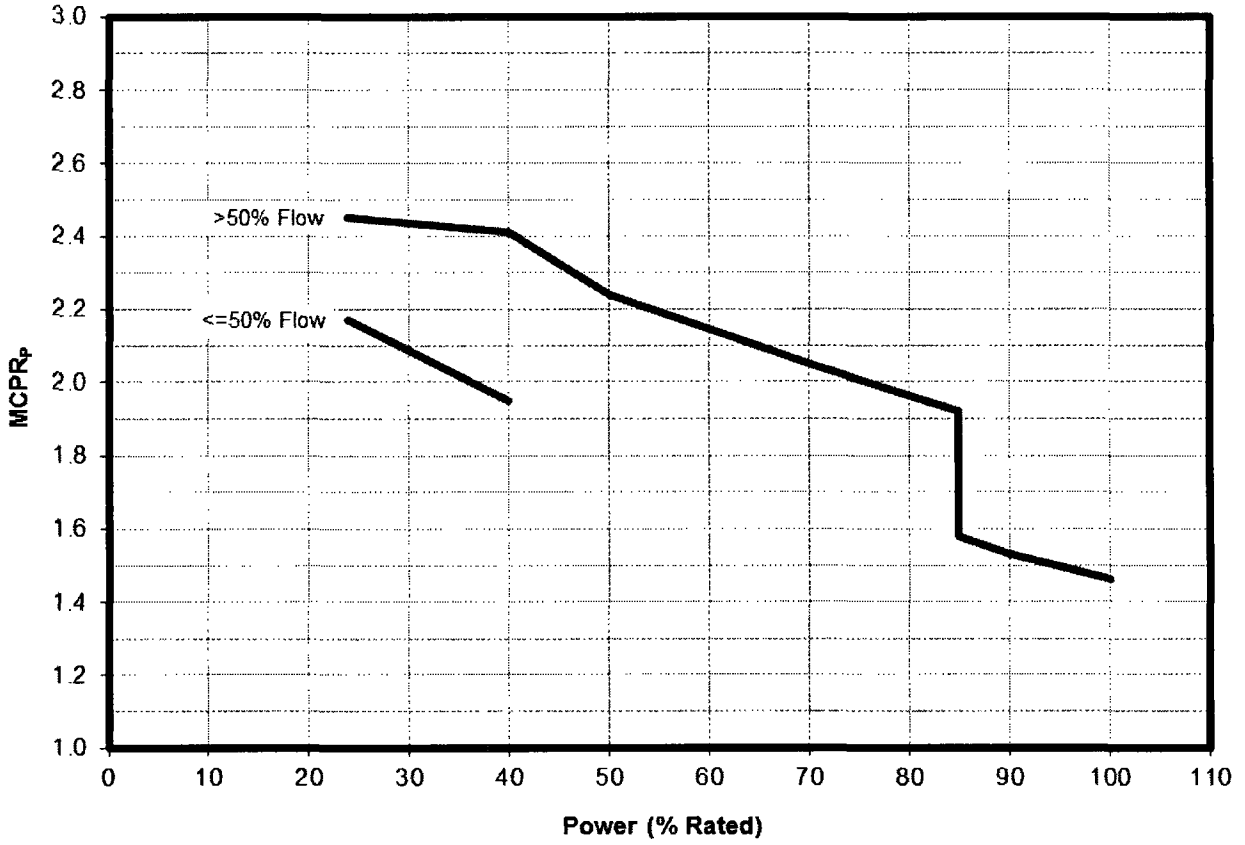
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.18	2.45
40.0	1.95	2.31
40.0		2.31
50.0		2.15
70.0		1.96
85.0		1.84
85.0		1.52
90.0		1.46
100.0		1.40

FIGURE 7.2-7b. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14



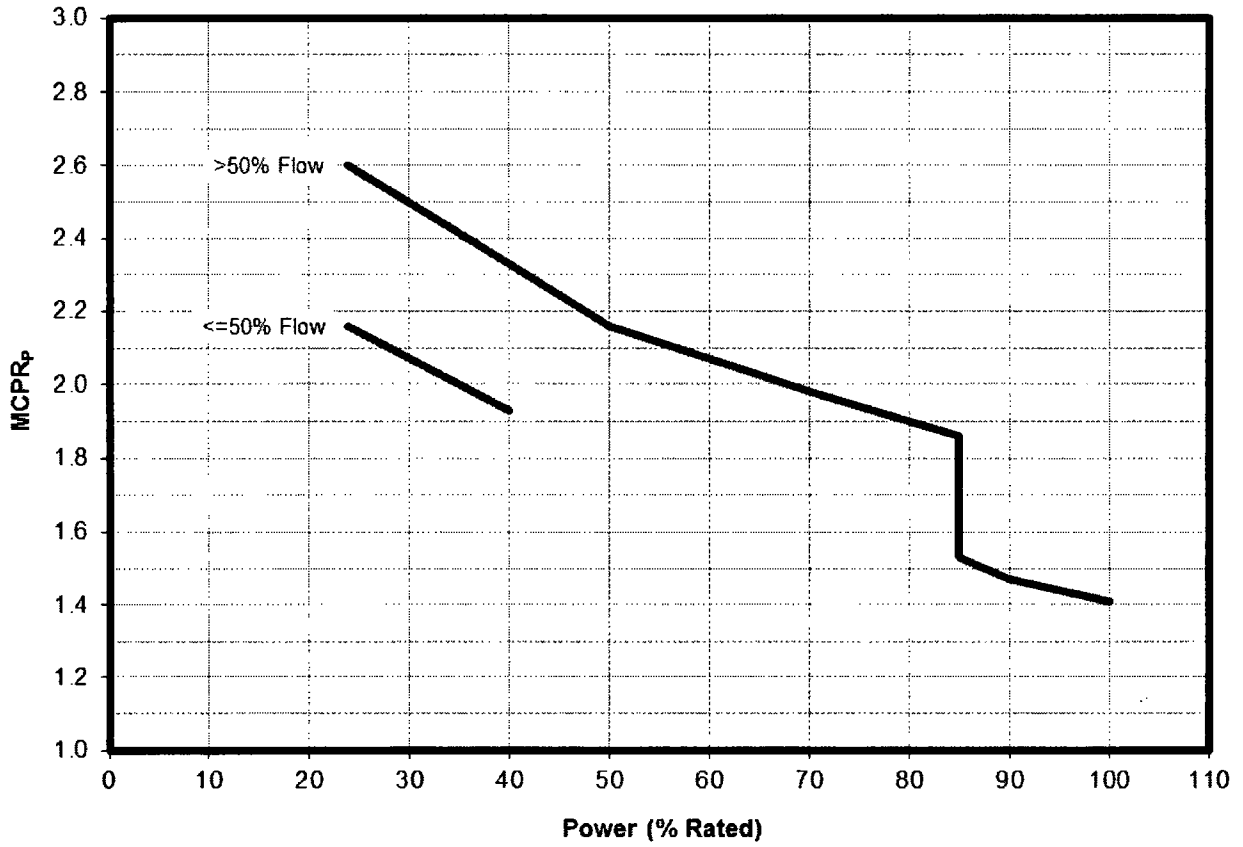
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.15	2.58
40.0	1.91	2.26
40.0		2.26
50.0		2.10
70.0		1.92
85.0		1.81
85.0		1.48
90.0		1.43
100.0		1.37

FIGURE 7.2-7c. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.17	2.45
40.0	1.95	2.41
40.0		2.41
50.0		2.24
70.0		2.05
85.0		1.92
85.0		1.58
90.0		1.53
100.0		1.46

FIGURE 7.2-7d. OPERATING LIMIT MCPR VERSUS CORE POWER ($MCPR_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14



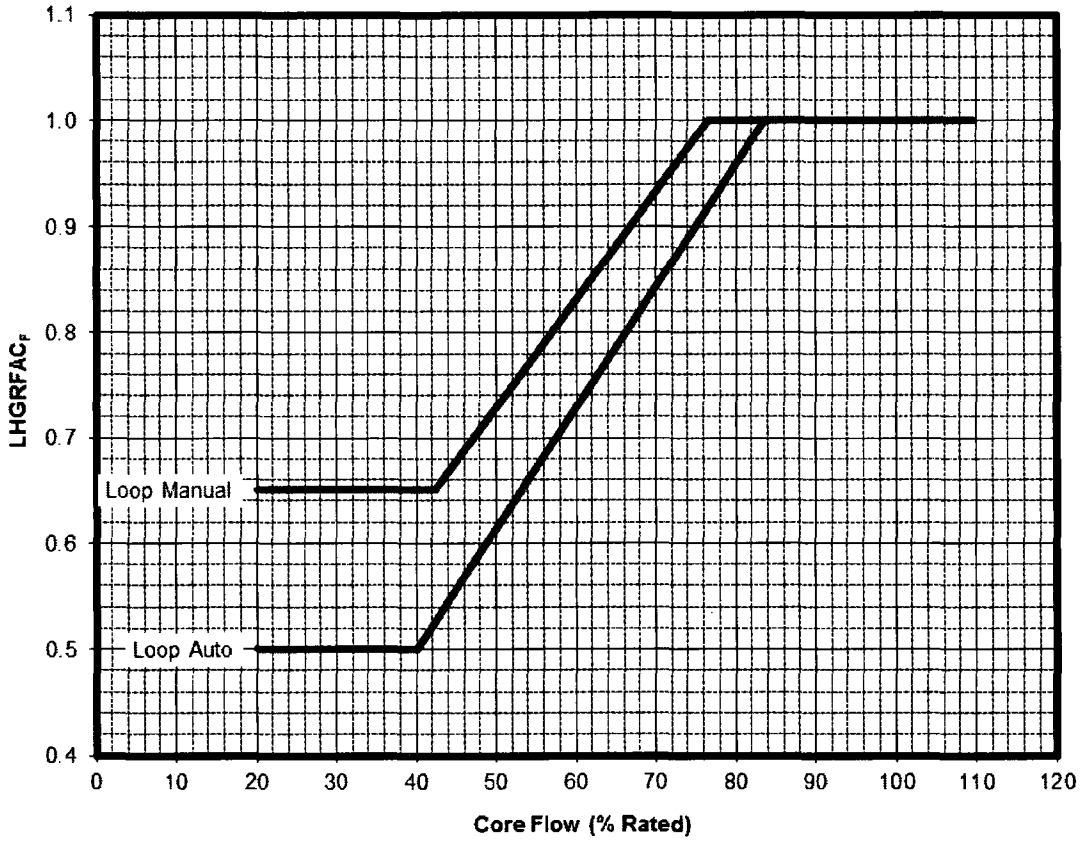
Power (% Rated)	<=50% Flow	>50% Flow
23.8	2.16	2.60
40.0	1.93	2.33
40.0		2.33
50.0		2.16
70.0		1.98
85.0		1.86
85.0		1.53
90.0		1.47
100.0		1.41

FIGURE 8.2-1. LHGR MULTIPLIER VERSUS CORE FLOW ($LHGRFAC_F$)

APPLICATION CONDITION: 1 - 7

EXPOSURE RANGE: BOC - EOC

FUEL TYPE: GNF2 & GE14



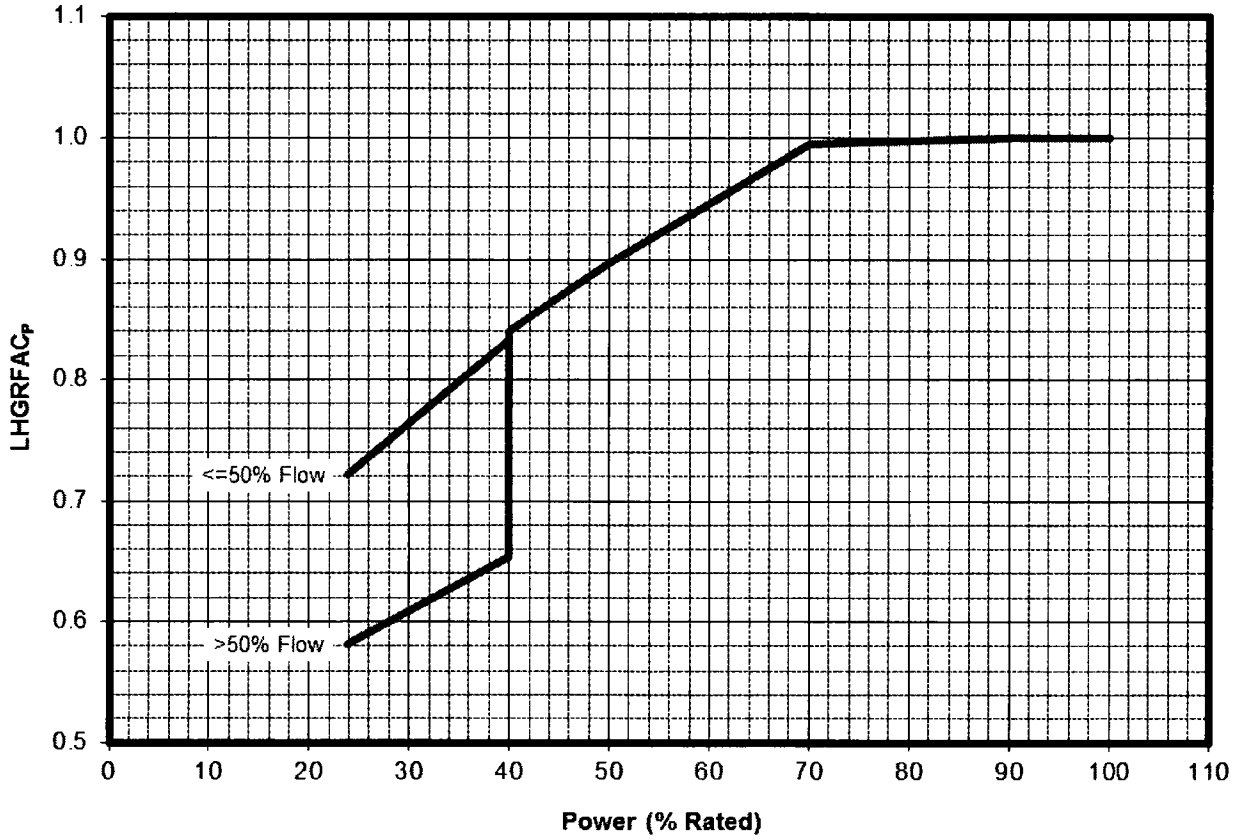
Loop Manual		Loop Auto	
Core Flow (%)	$LHGRFAC_F$	Core Flow (%)	$LHGRFAC_F$
20.0	0.65	20.0	0.50
42.4	0.65	40.0	0.50
76.6	1.00	83.7	1.00
109.5	1.00	109.5	1.00

FIGURE 8.3-1a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 1

EXPOSURE RANGE: BOC TO MOC

FUEL TYPE: GNF2 GNF2



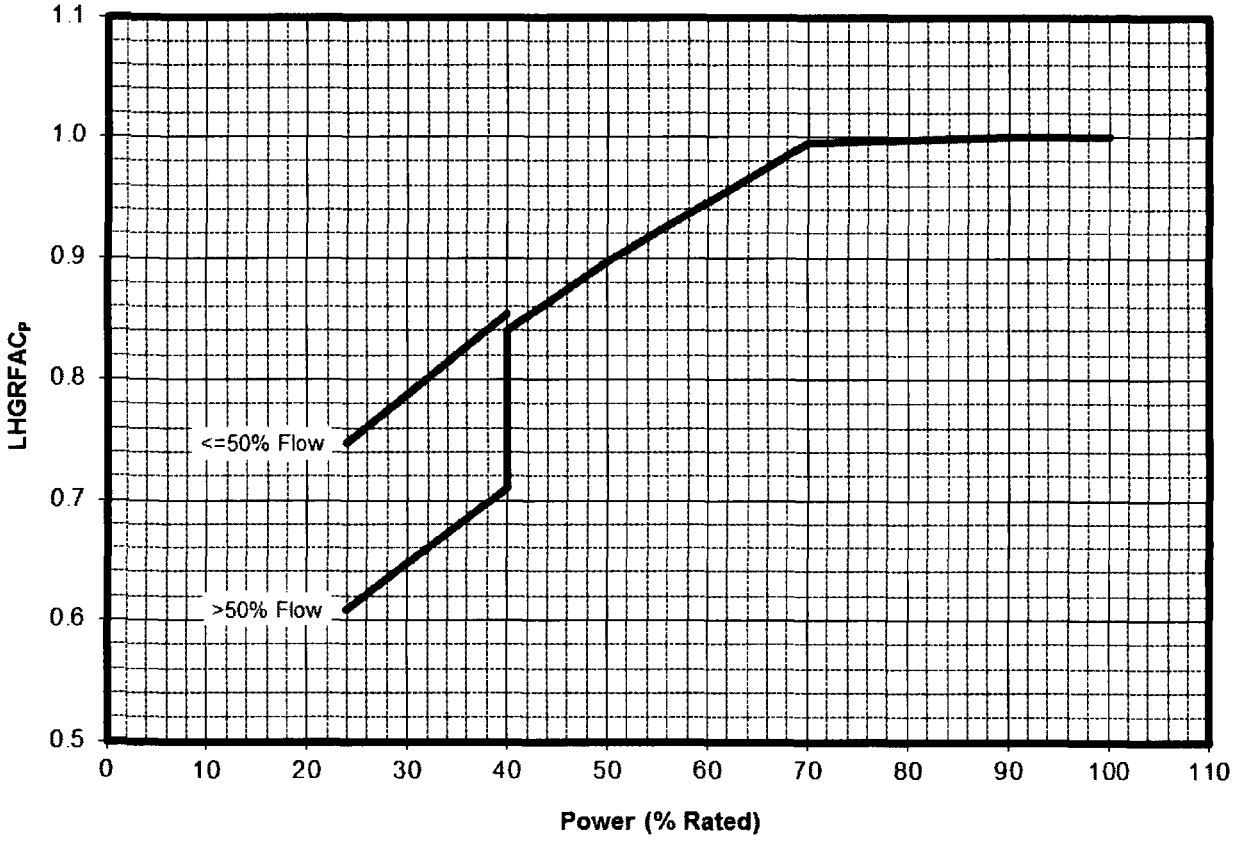
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-1b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 1

EXPOSURE RANGE: BOC TO MOC

FUEL TYPE: GE14 GE14



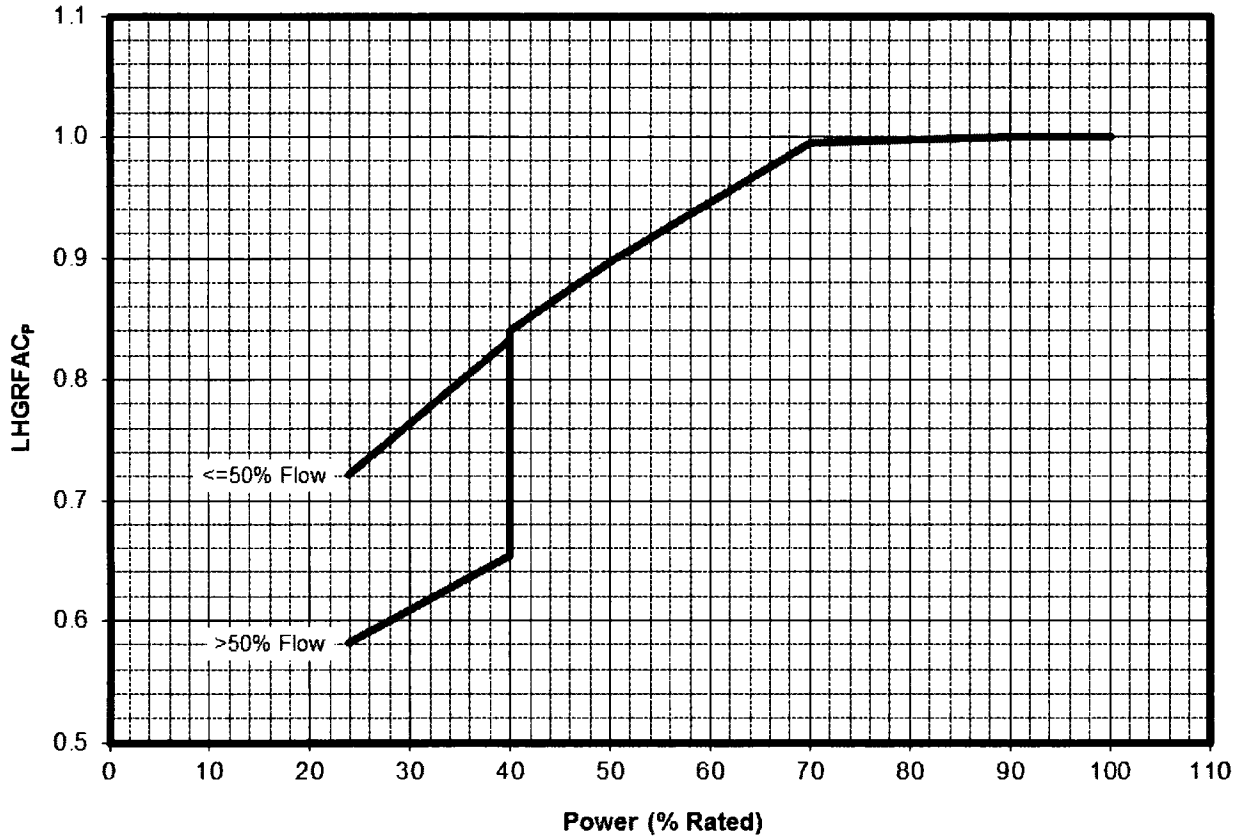
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-1c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 1

EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GNF2 GNF2



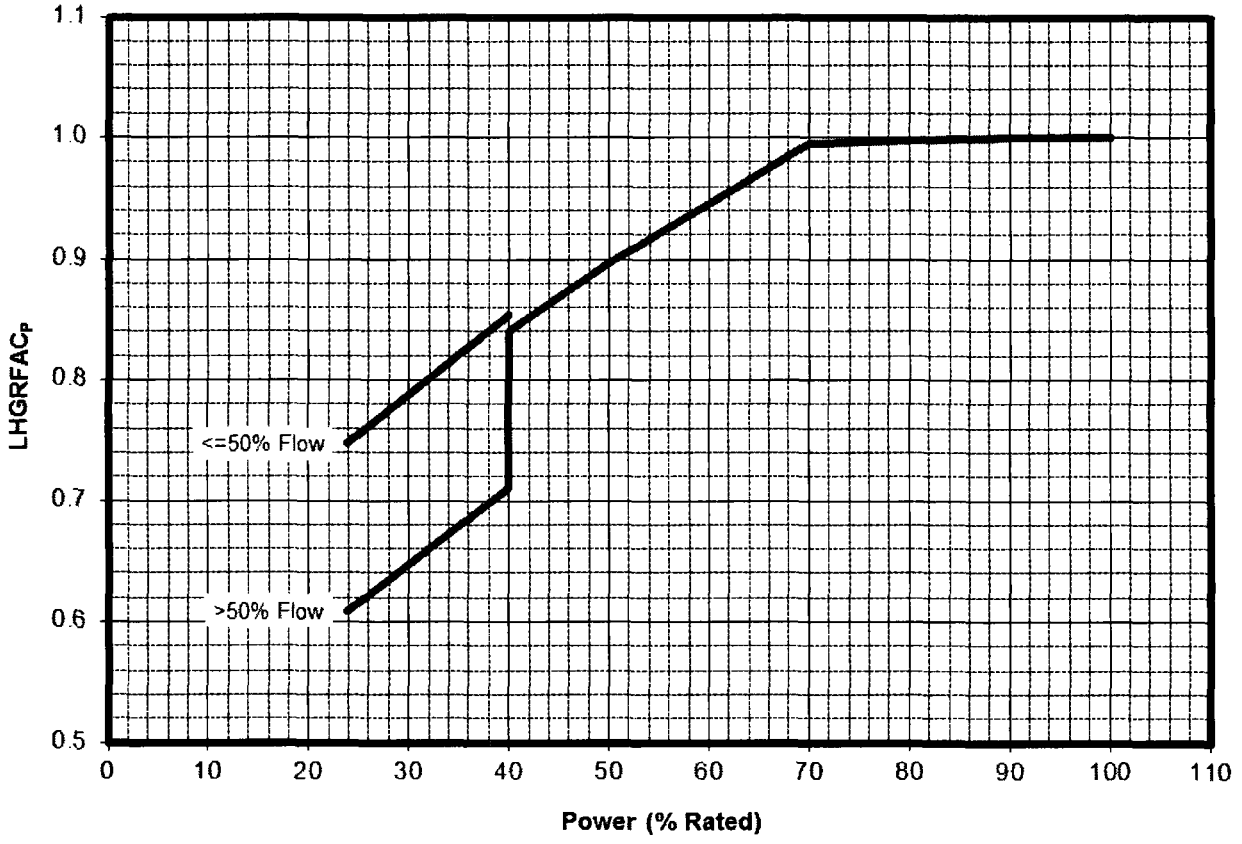
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-1d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 1

EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GE14 GE14



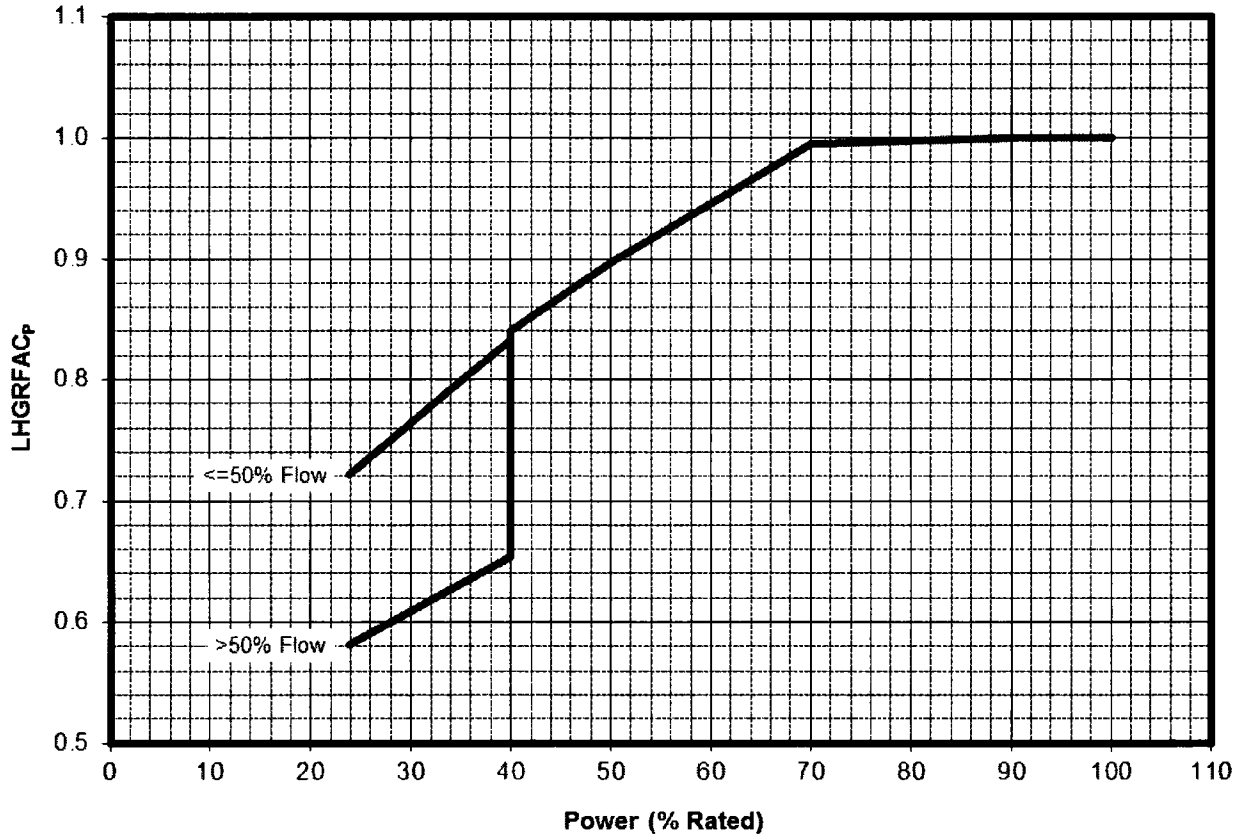
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-2a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 2

EXPOSURE RANGE: BOC TO MOC

FUEL TYPE: GNF2 GNF2



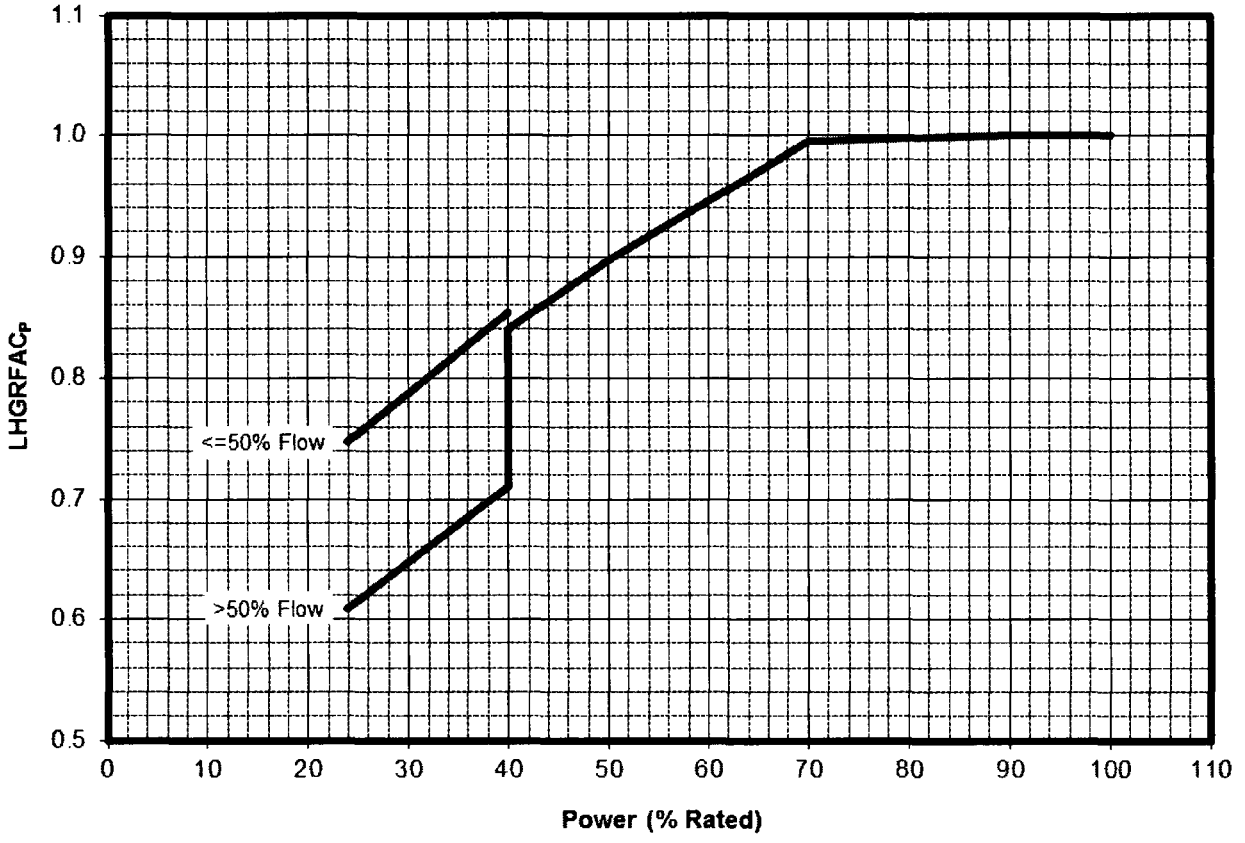
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-2b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 2

EXPOSURE RANGE: BOC TO MOC

FUEL TYPE: GE14 GE14



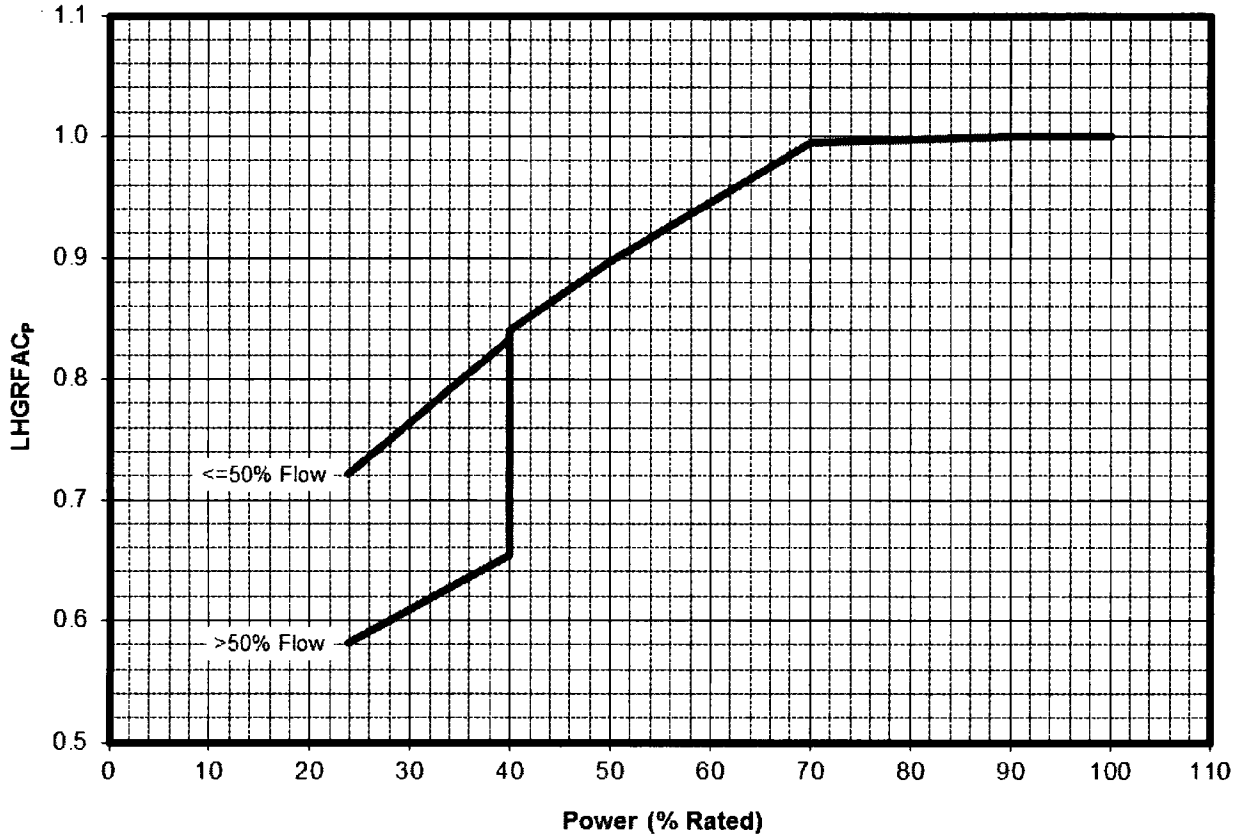
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-2c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 2

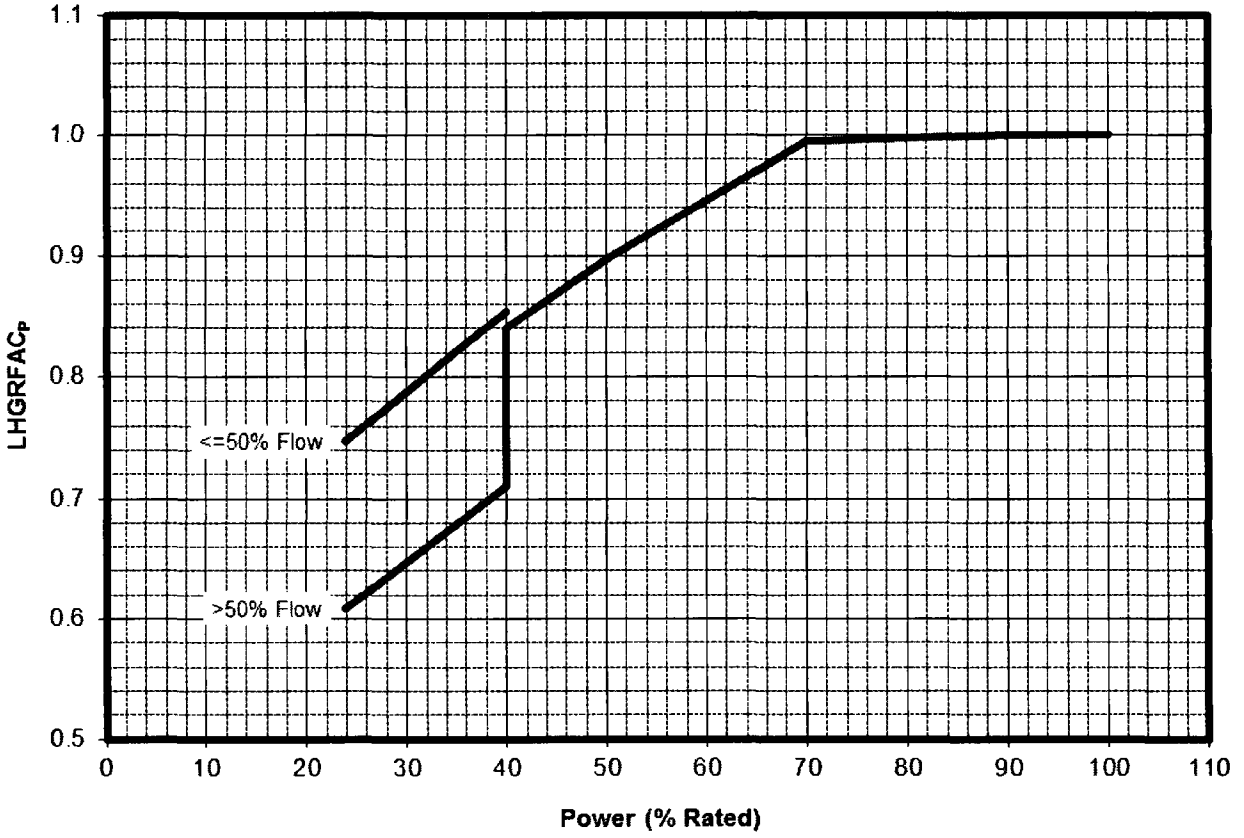
EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GNF2 GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

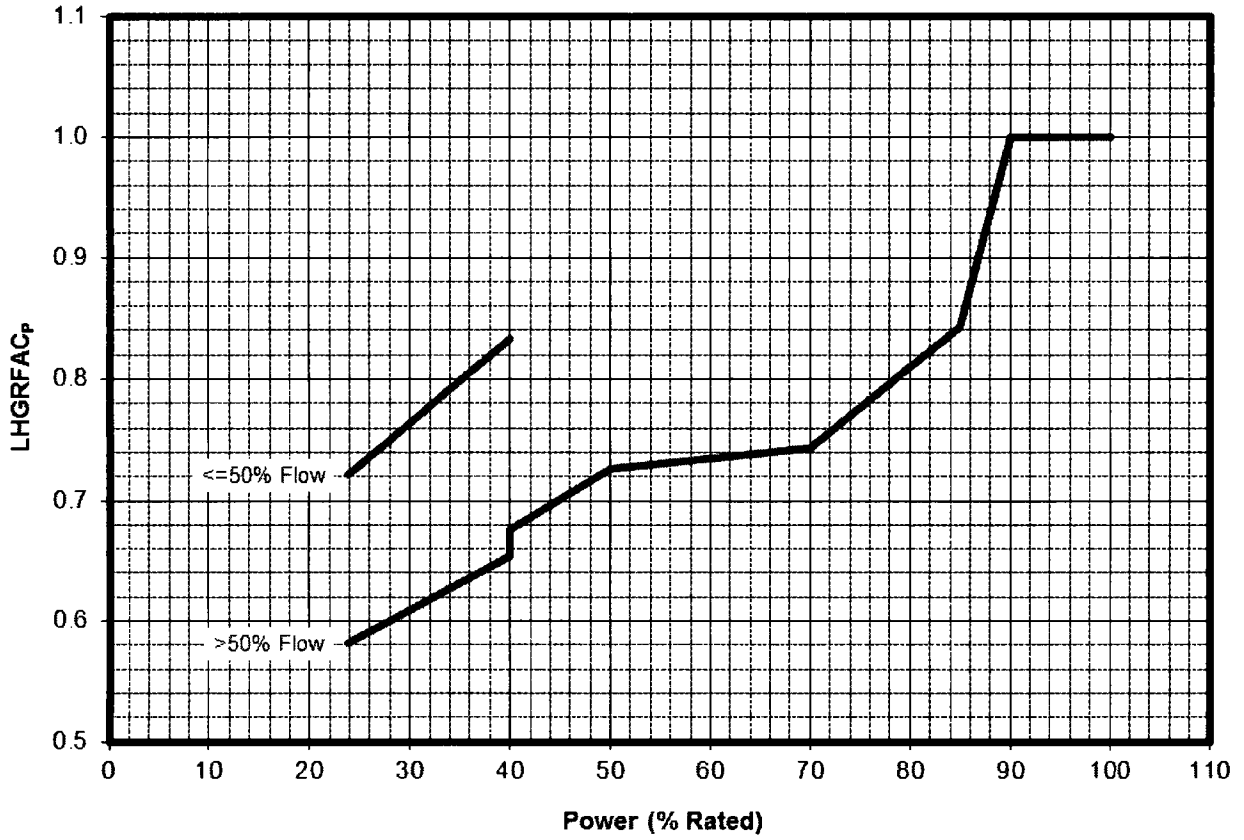
FIGURE 8.3-2d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 2
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14 GE14



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

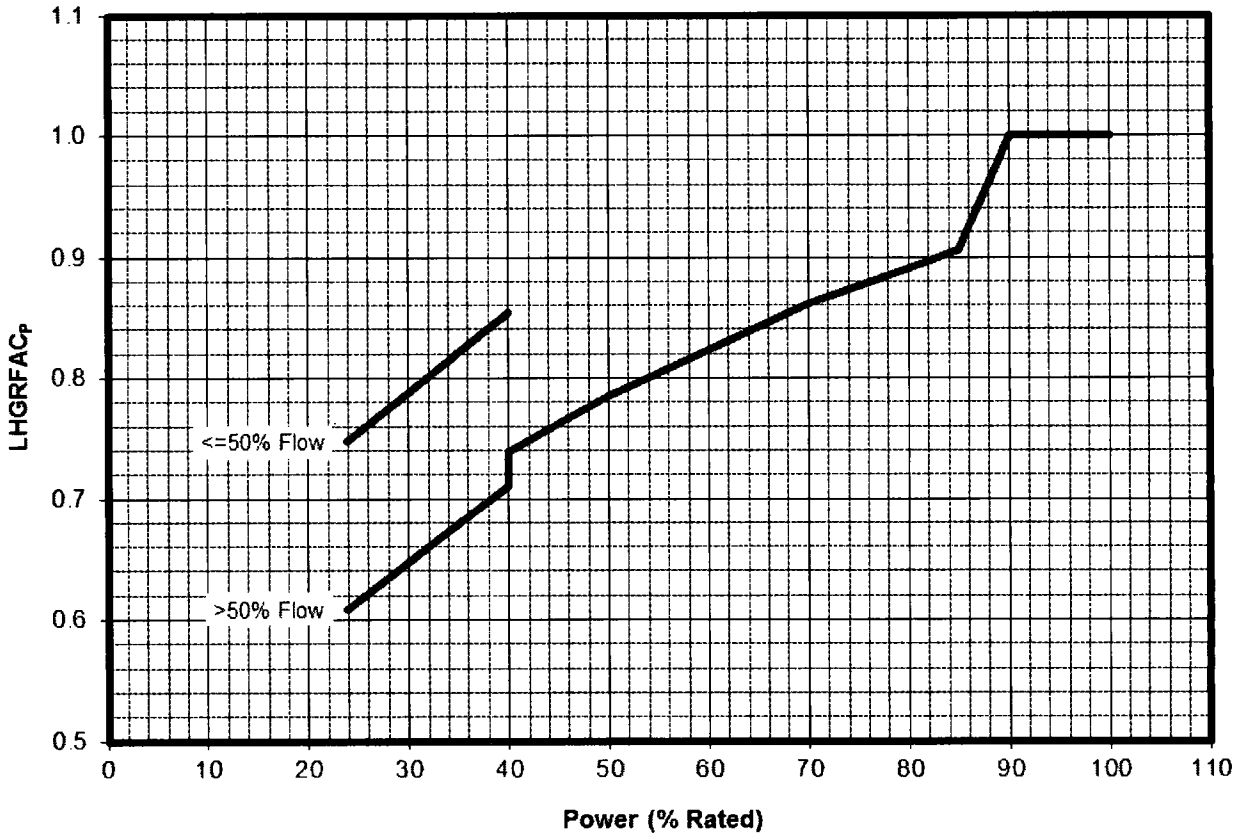
FIGURE 8.3-3a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION:	3
EXPOSURE RANGE:	BOC TO MOC
FUEL TYPE: GNF2	GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.676
50.0		0.726
70.0		0.744
85.0		0.843
90.0		1.000
100.0		1.000

FIGURE 8.3-3b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 3
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14 GE14



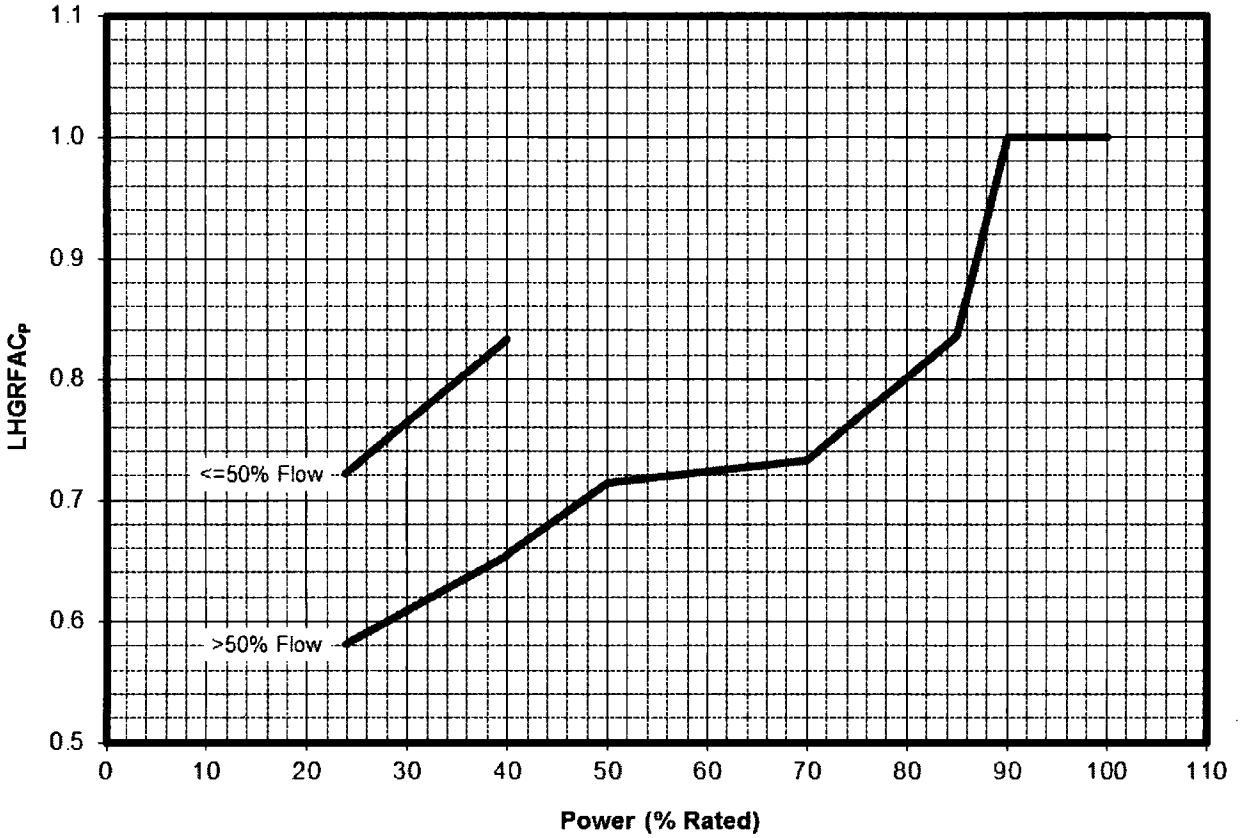
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.739
50.0		0.785
70.0		0.861
85.0		0.905
90.0		1.000
100.0		1.000

FIGURE 8.3-3c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 3

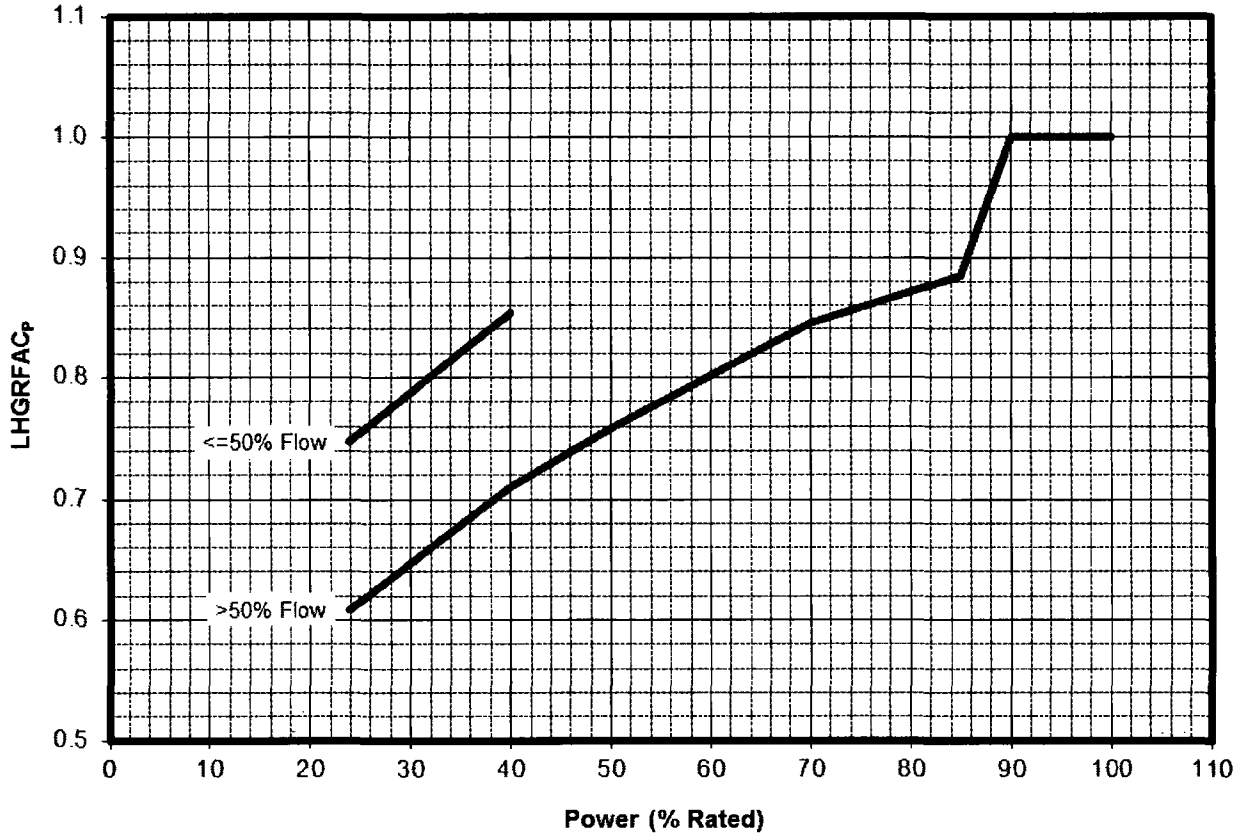
EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GNF2 GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.655
50.0		0.714
70.0		0.732
85.0		0.835
90.0		1.000
100.0		1.000

FIGURE 8.3-3d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 3
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14 GE14



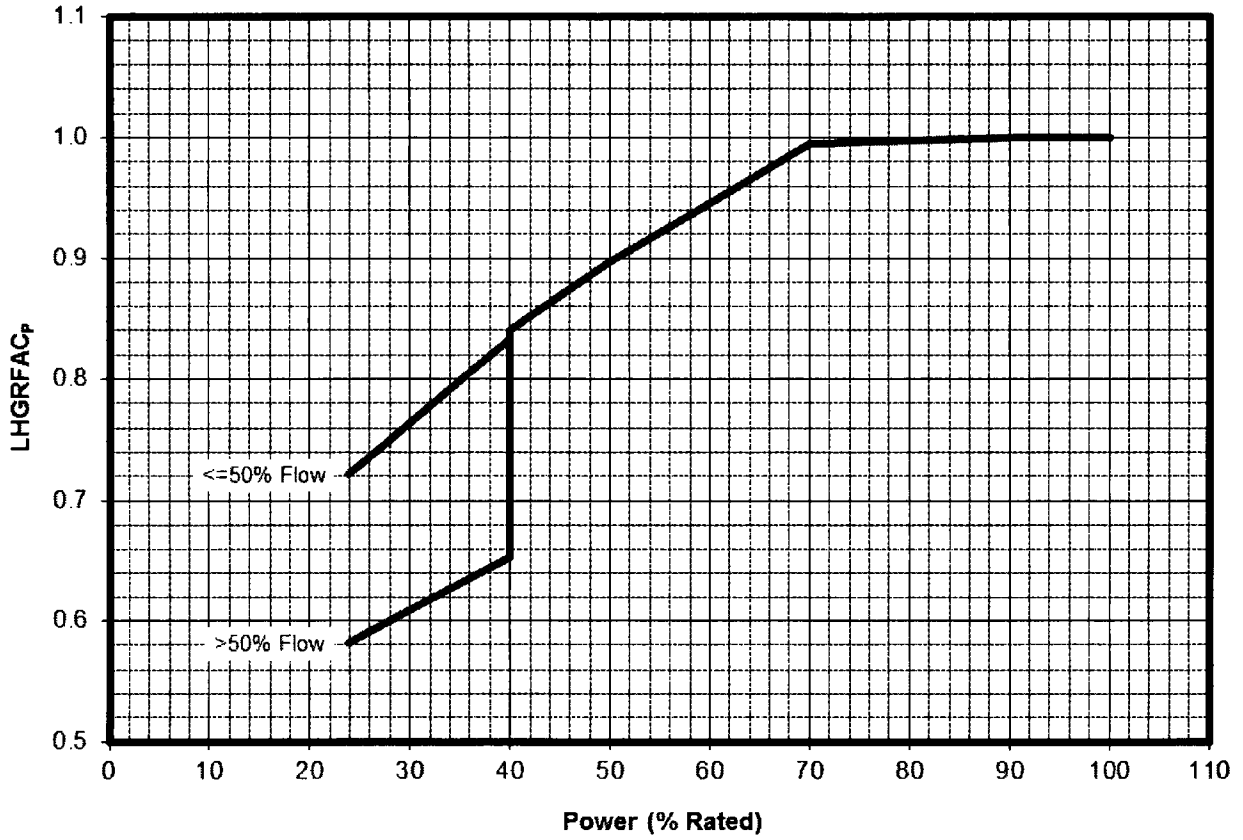
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.711
50.0		0.758
70.0		0.845
85.0		0.885
90.0		1.000
100.0		1.000

FIGURE 8.3-4a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 4

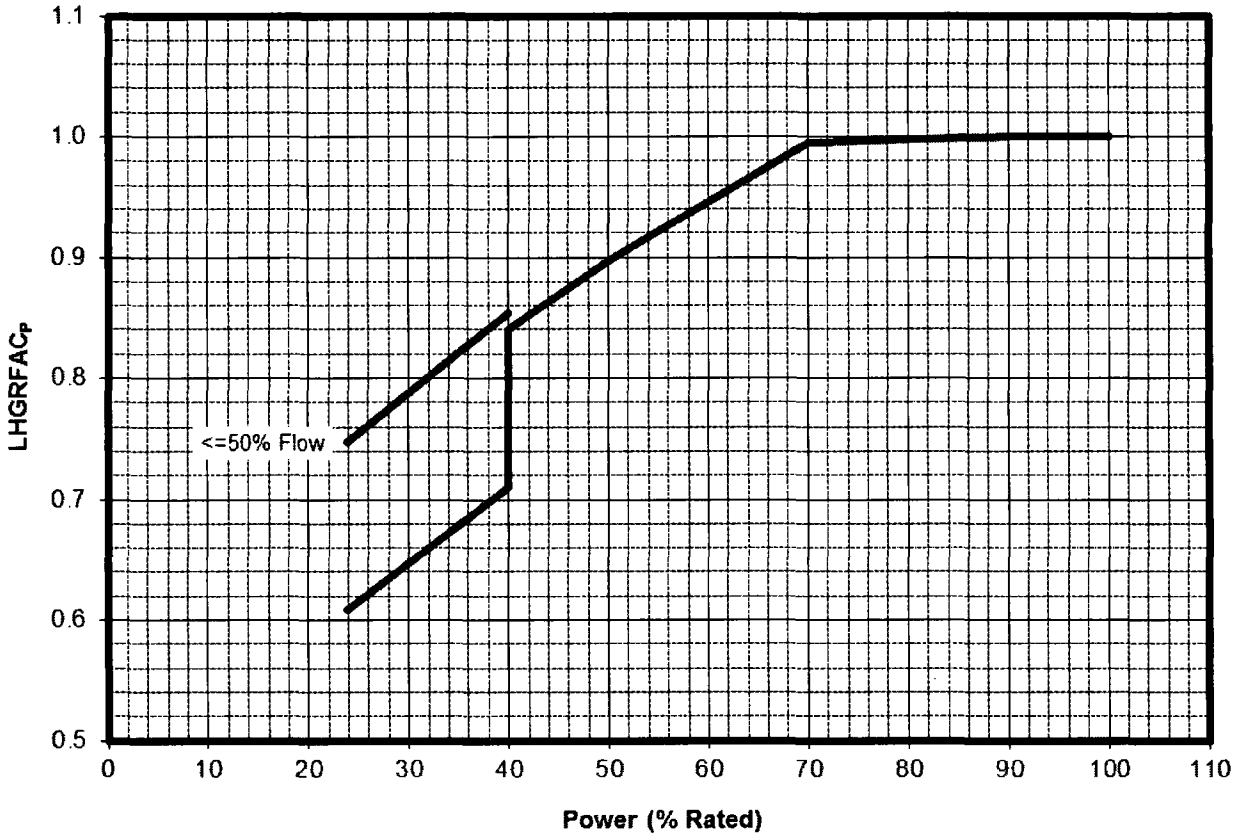
EXPOSURE RANGE: BOC TO MOC

FUEL TYPE: GNF2 GNF2



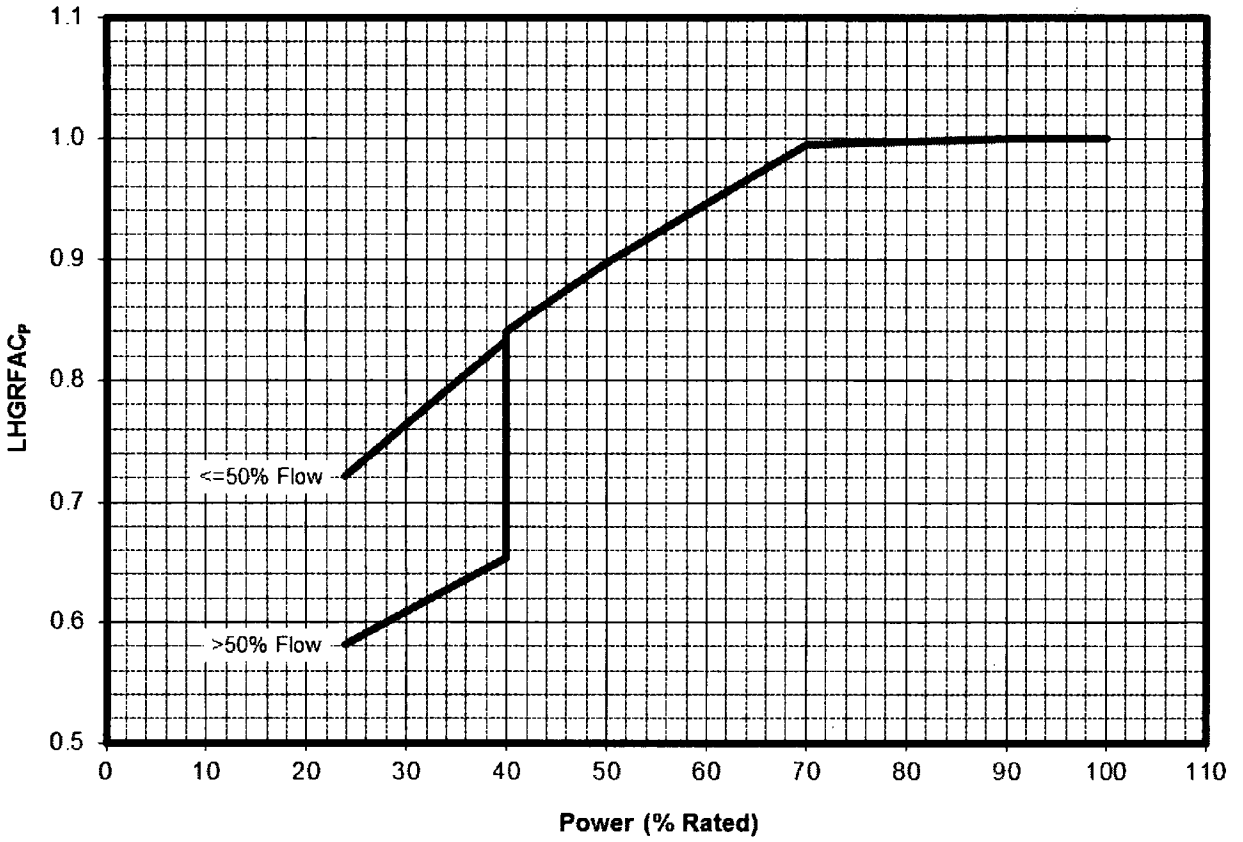
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-4b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 4
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14 GE14



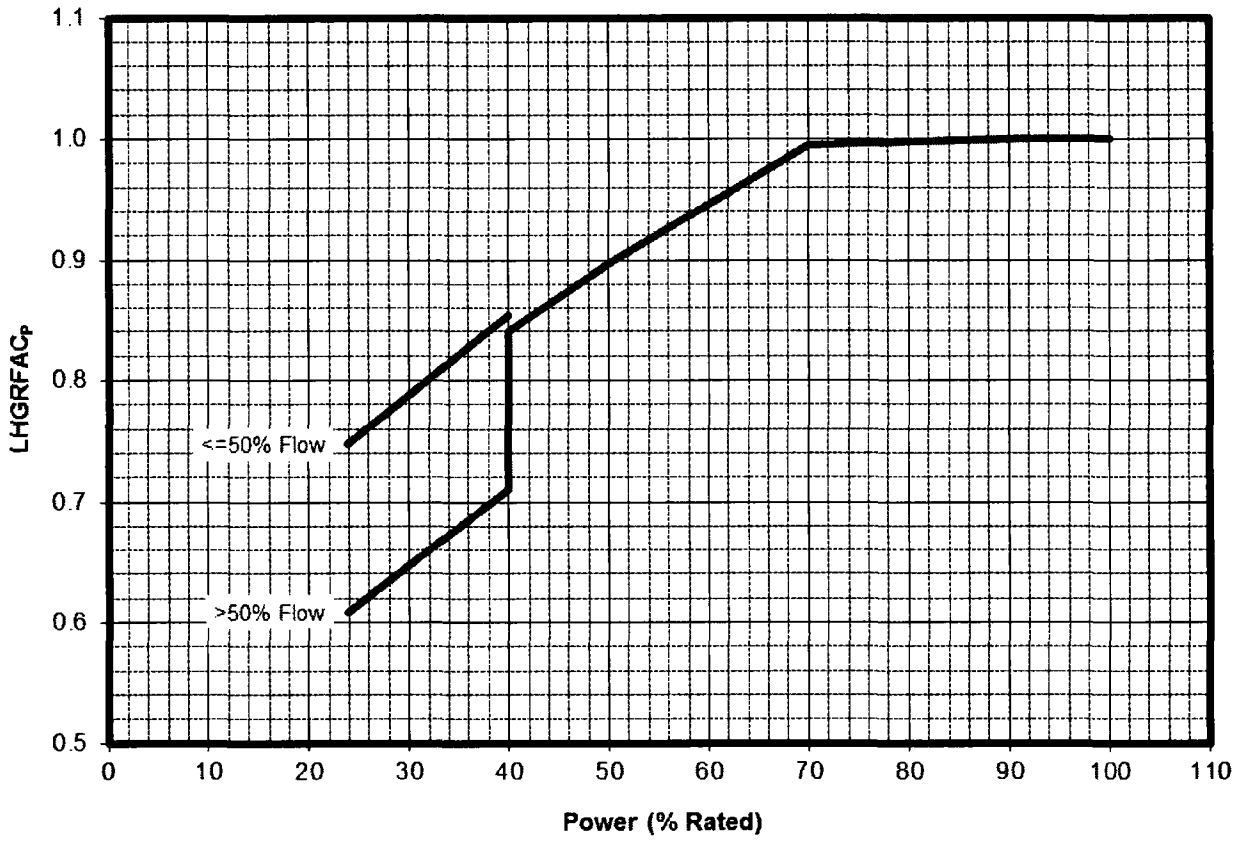
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-4c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 4
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2 GNF2



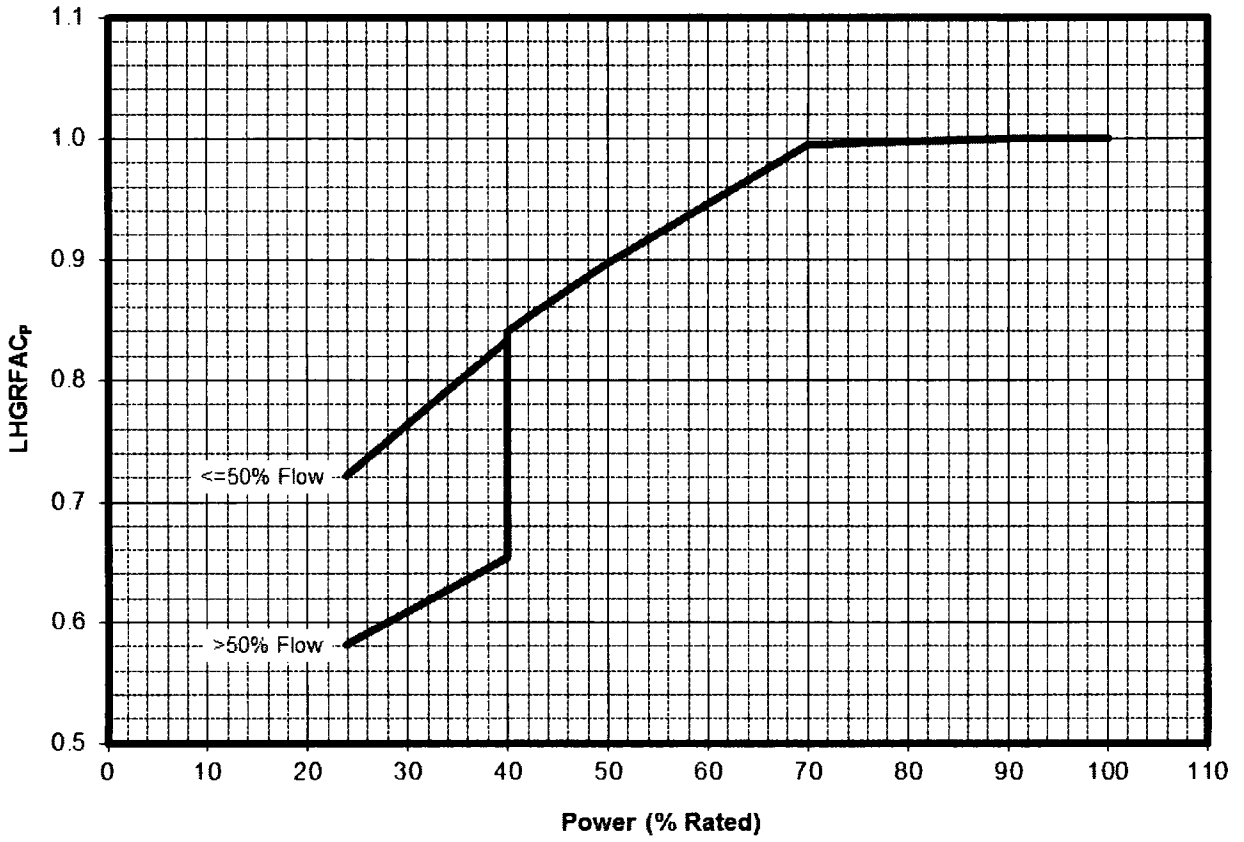
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-4d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 4
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14 GE14



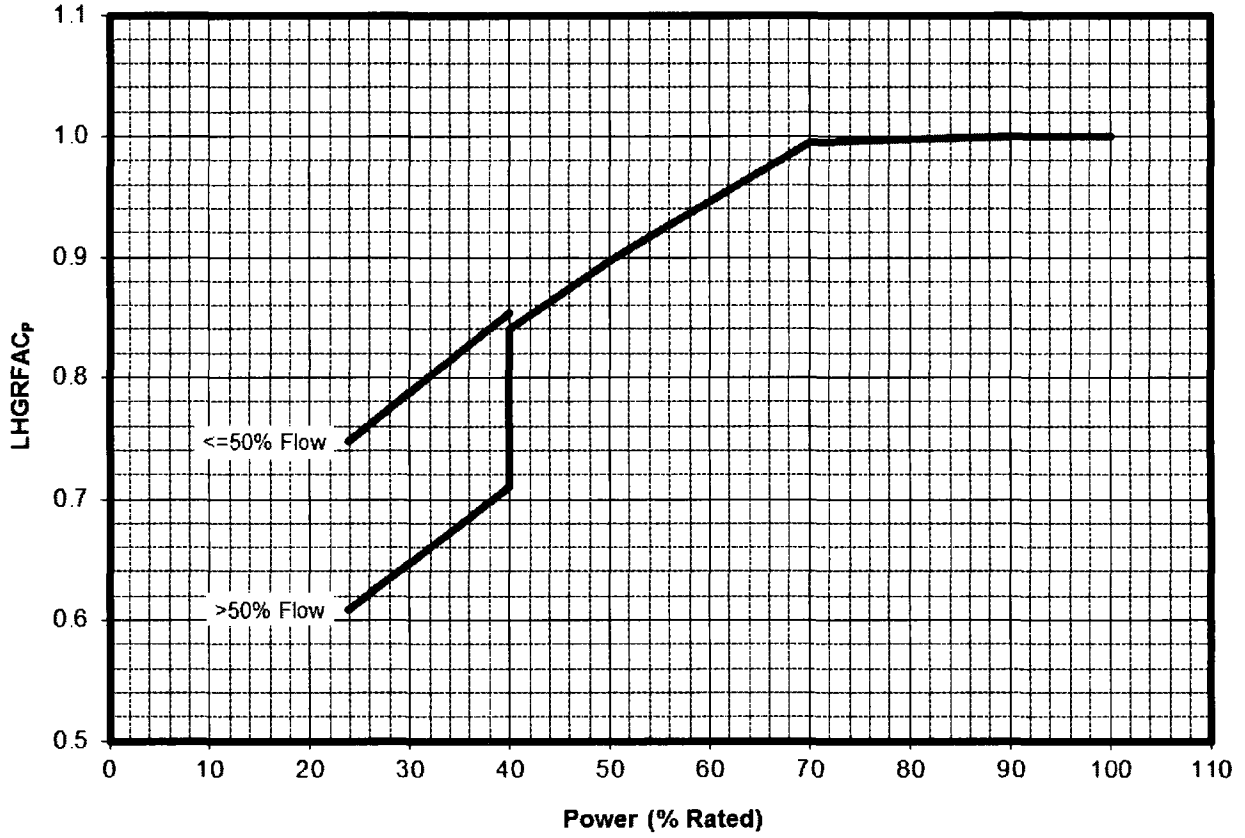
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-5a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 5
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2 GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-5b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 5
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14 GE14



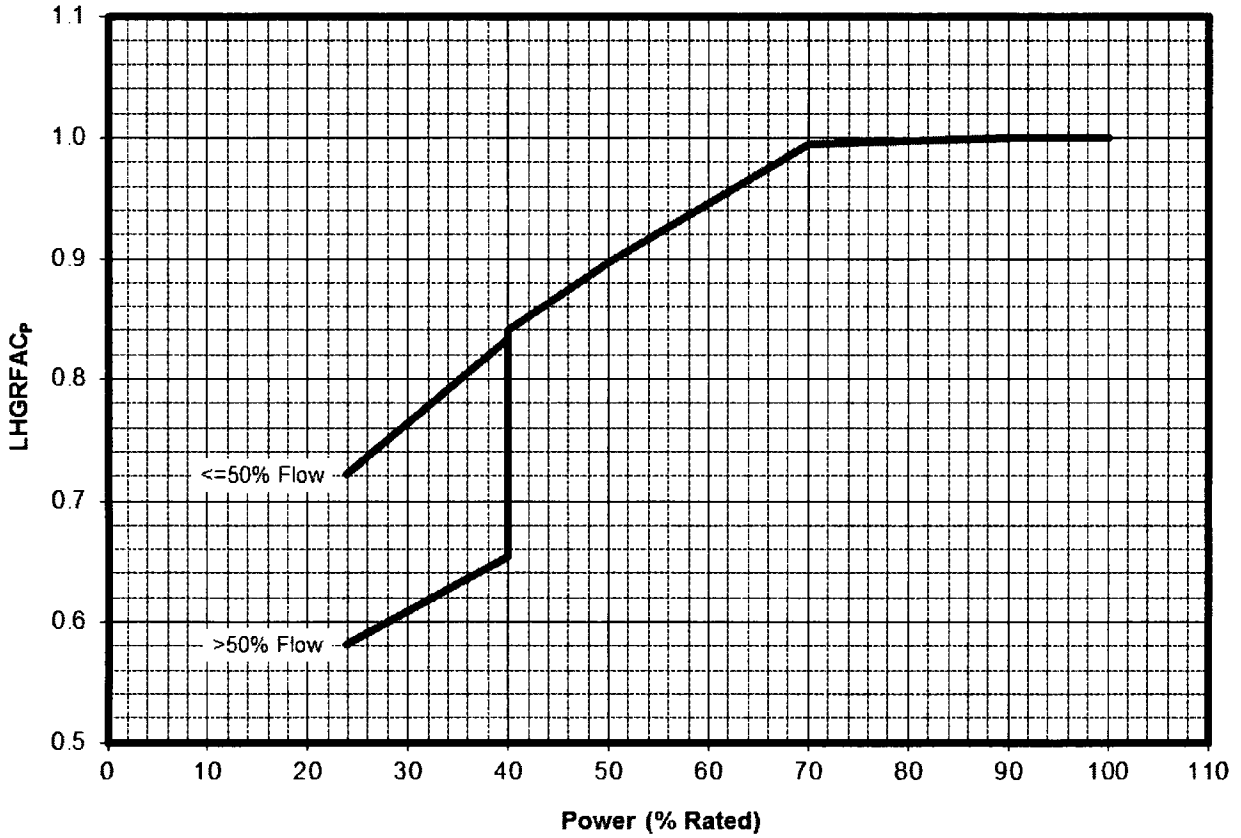
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-5c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 5

EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GNF2 GNF2



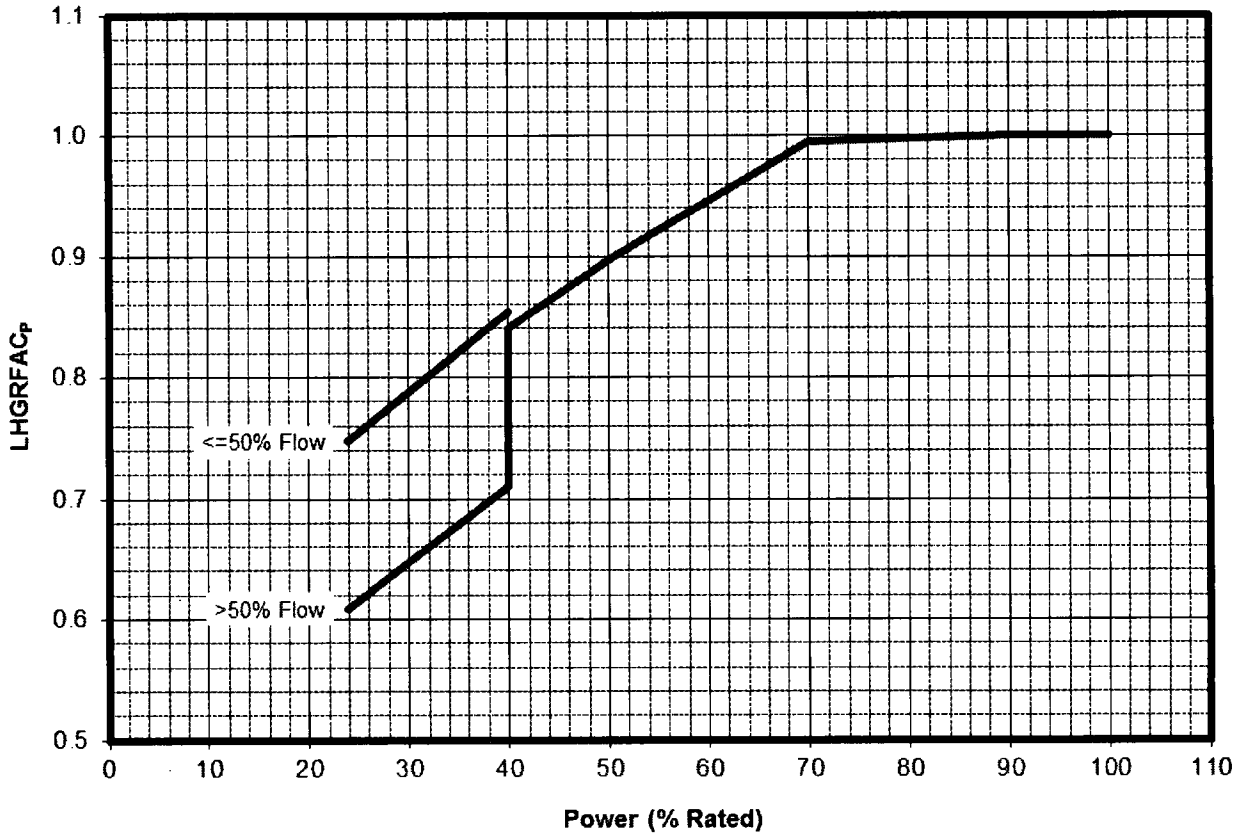
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-5d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 5

EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GE14 GE14



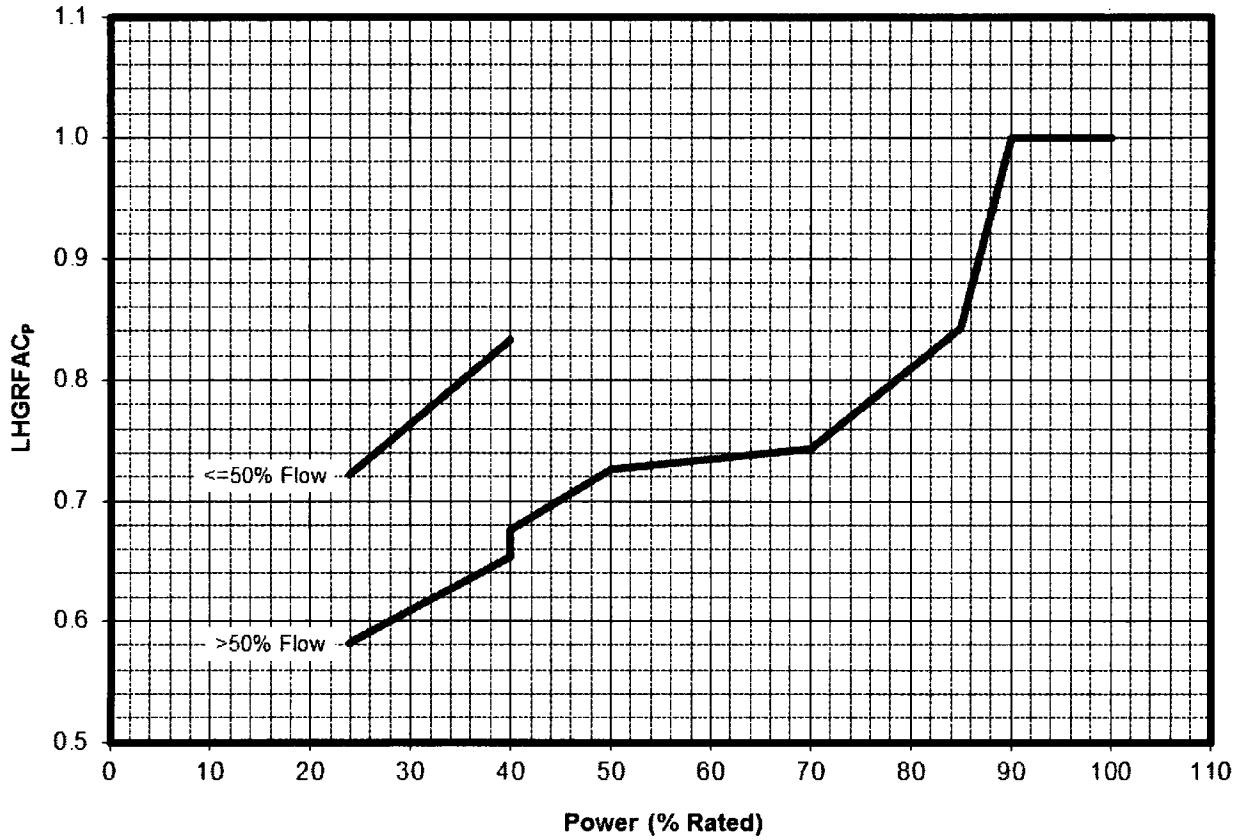
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.840
50.0		0.897
70.0		0.995
85.0		0.999
90.0		1.000
100.0		1.000

FIGURE 8.3-6a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 6

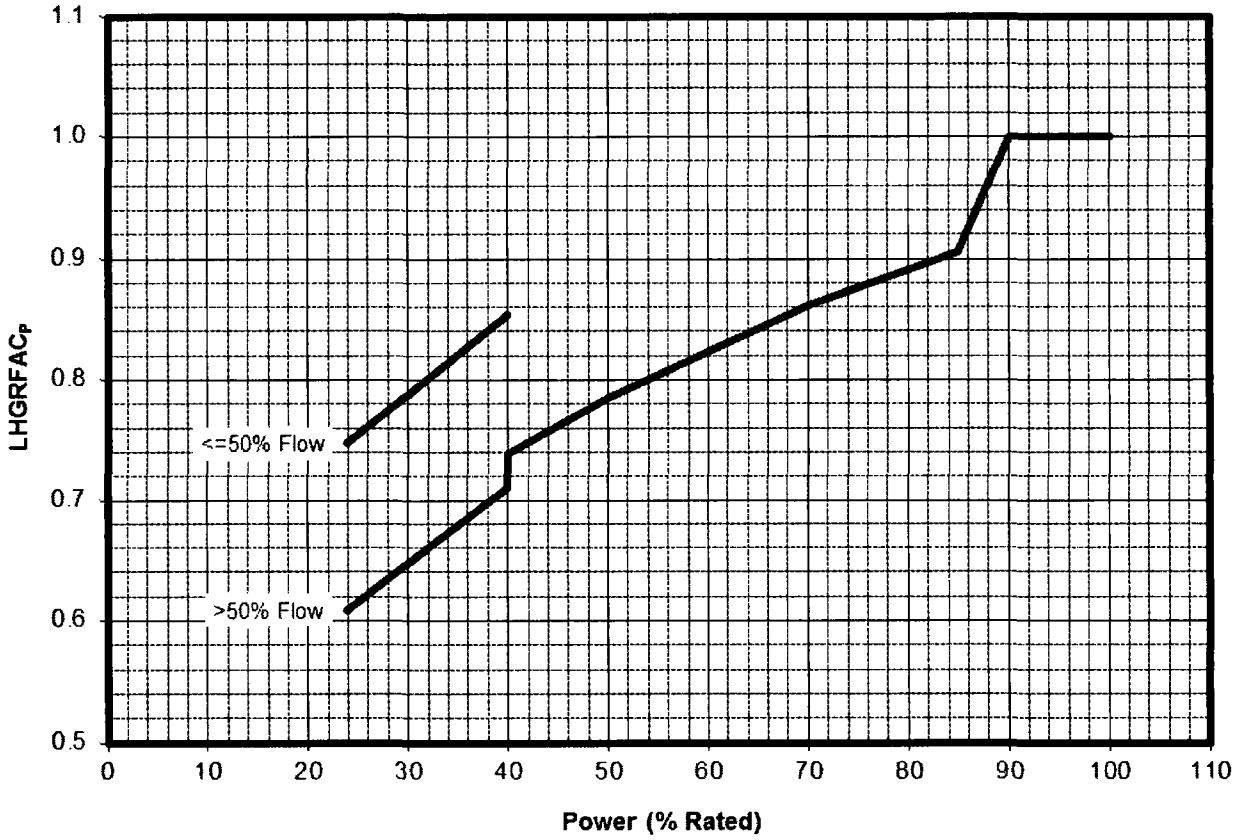
EXPOSURE RANGE: BOC TO MOC

FUEL TYPE: GNF2 GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.676
50.0		0.726
70.0		0.744
85.0		0.843
90.0		1.000
100.0		1.000

FIGURE 8.3-6b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 6
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14 GE14



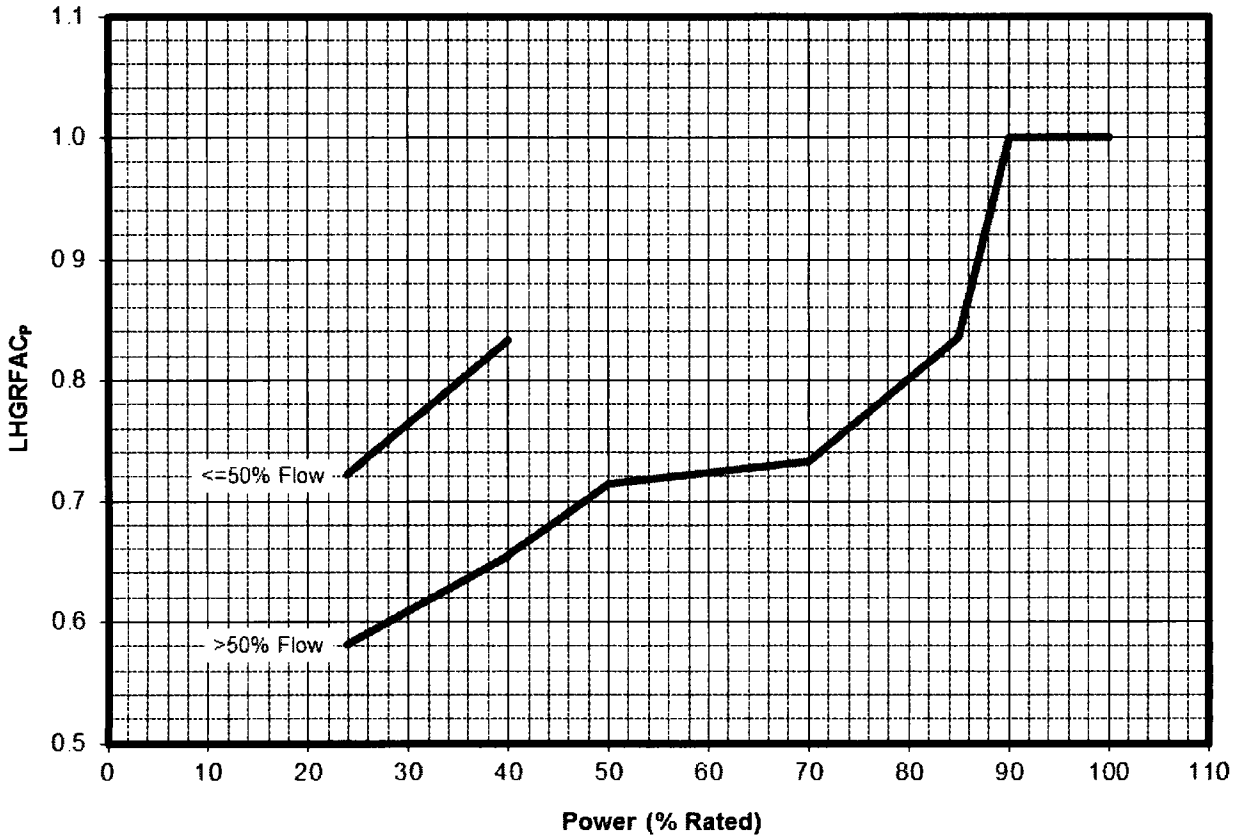
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.739
50.0		0.785
70.0		0.861
85.0		0.905
90.0		1.000
100.0		1.000

FIGURE 8.3-6c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 6

EXPOSURE RANGE: MOC TO EOC

FUEL TYPE: GNF2 GNF2



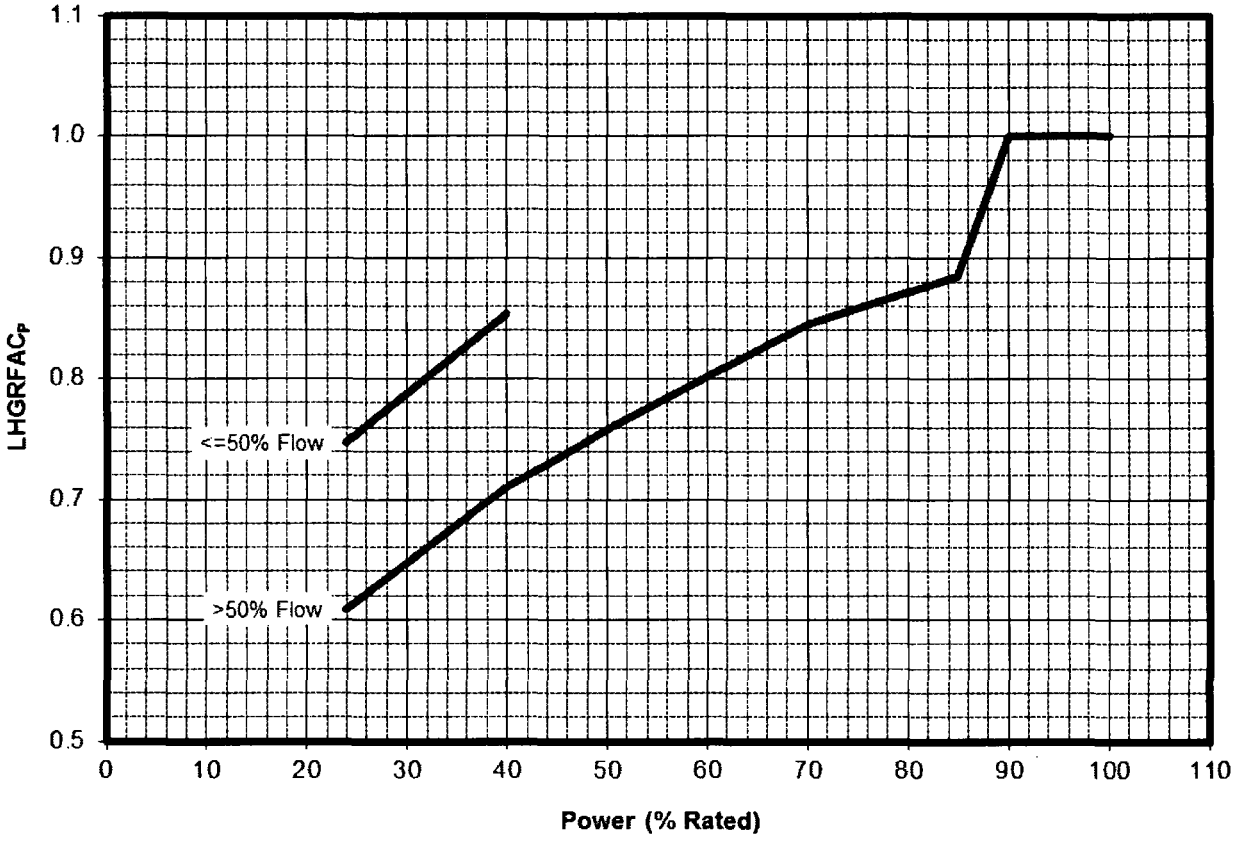
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.655
50.0		0.714
70.0		0.732
85.0		0.835
90.0		1.000
100.0		1.000

FIGURE 8.3-6d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 6

EXPOSURE RANGE: MOC TO EOC

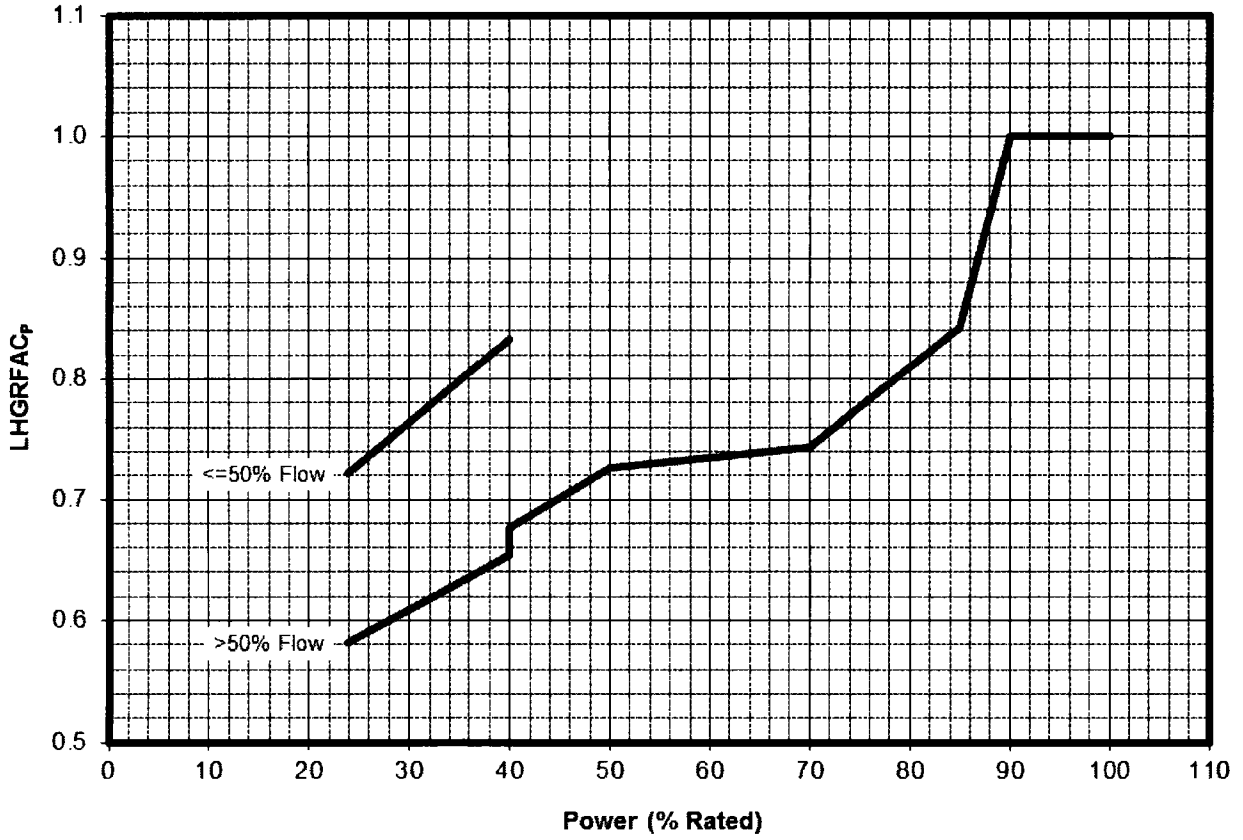
FUEL TYPE: GE14 GE14



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.711
50.0		0.758
70.0		0.845
85.0		0.885
90.0		1.000
100.0		1.000

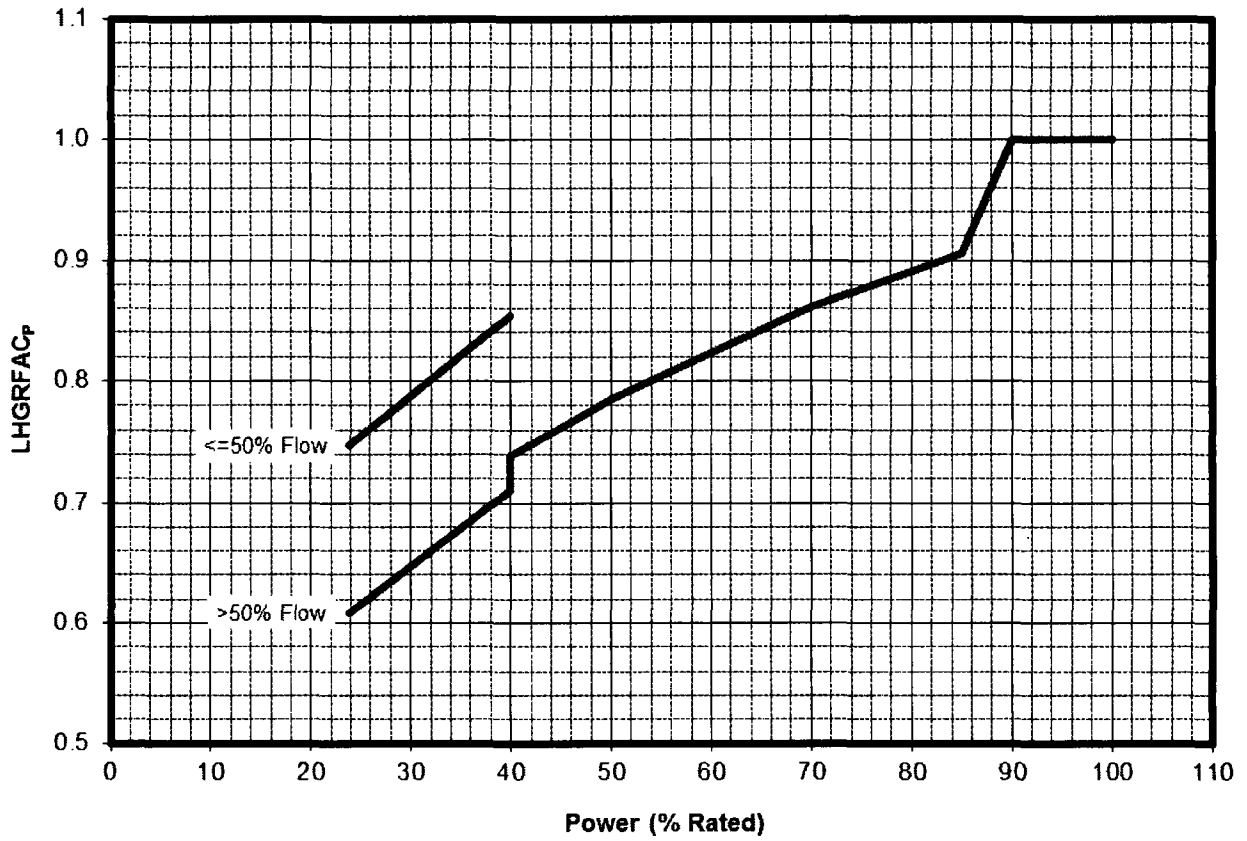
FIGURE 8.3-7a. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)

APPLICATION CONDITION: 7
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GNF2 GNF2



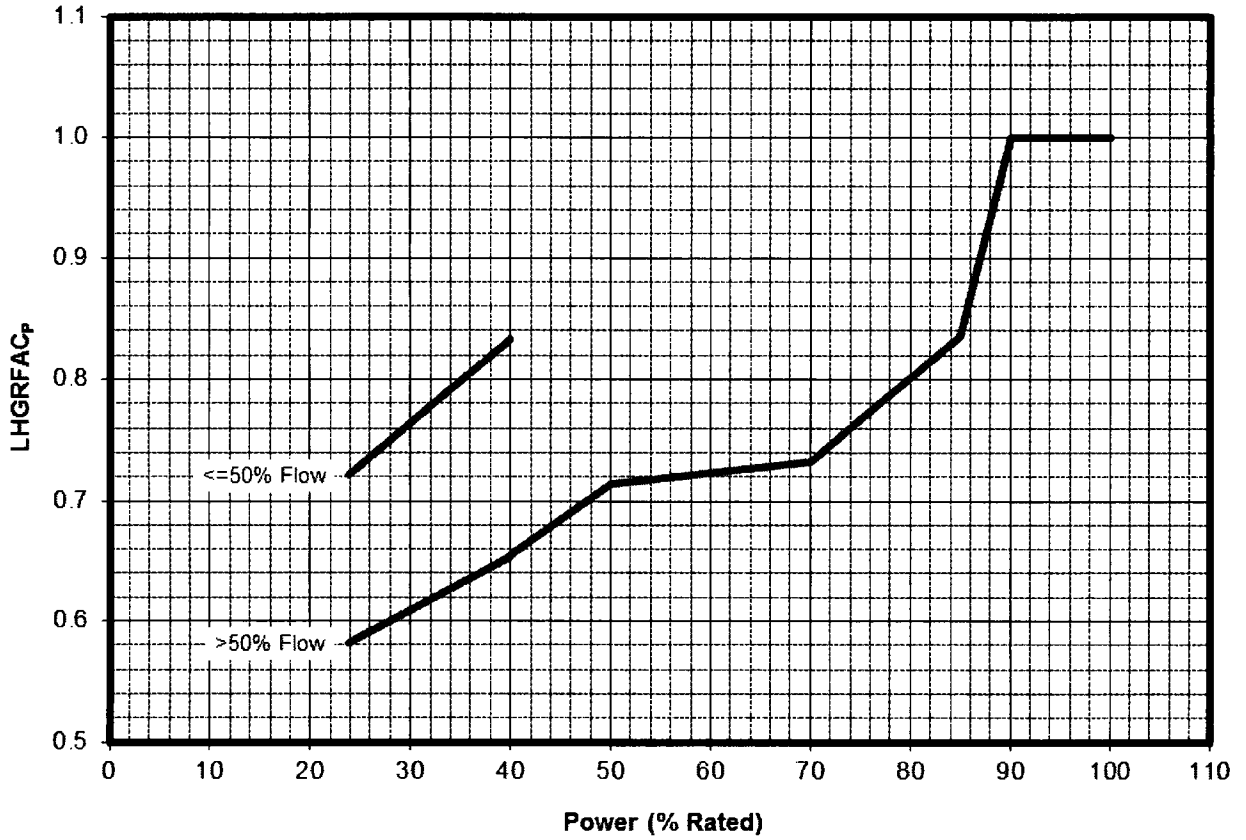
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.676
50.0		0.726
70.0		0.744
85.0		0.843
90.0		1.000
100.0		1.000

FIGURE 8.3-7b. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: BOC TO MOC
FUEL TYPE: GE14 GE14



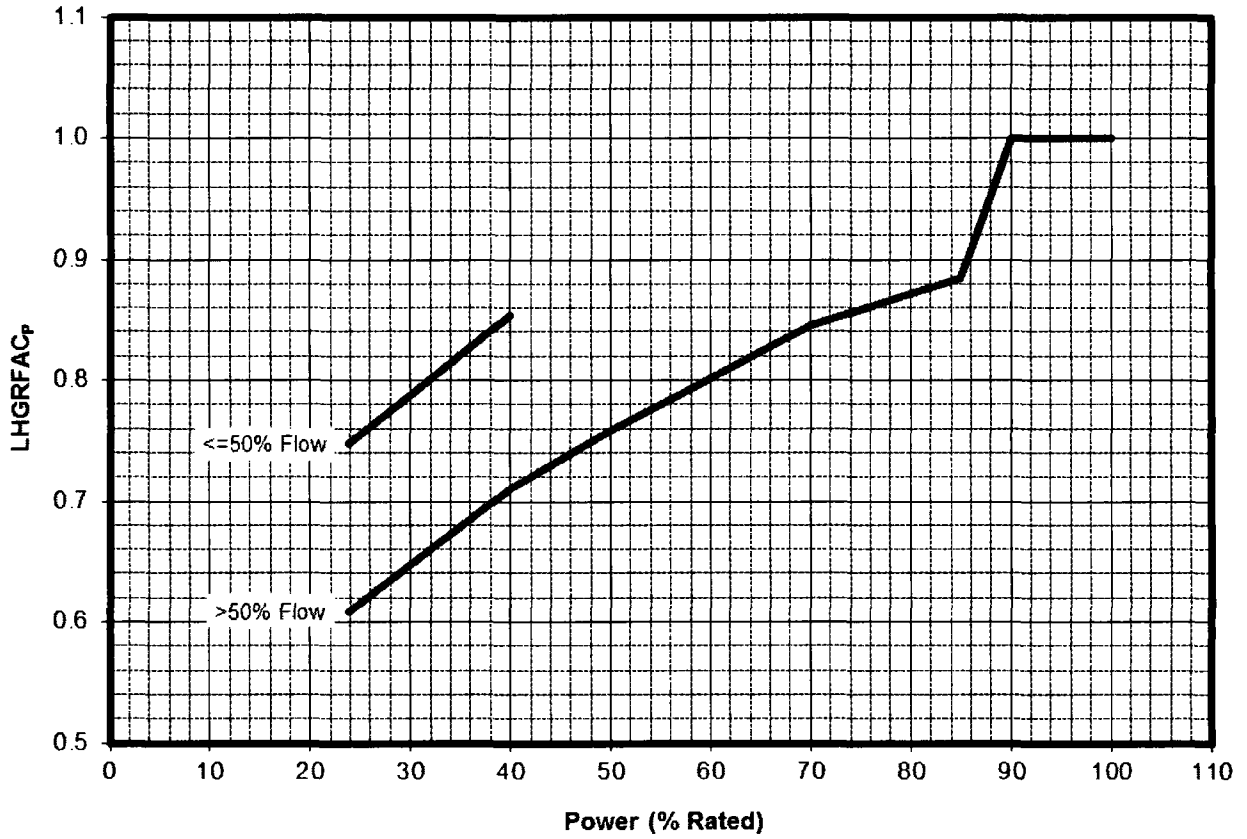
Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.739
50.0		0.785
70.0		0.861
85.0		0.905
90.0		1.000
100.0		1.000

FIGURE 8.3-7c. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GNF2 GNF2



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.721	0.581
40.0	0.833	0.654
40.0		0.655
50.0		0.714
70.0		0.732
85.0		0.835
90.0		1.000
100.0		1.000

FIGURE 8.3-7d. LHGR MULTIPLIER VERSUS CORE POWER ($LHGRFAC_P$)
APPLICATION CONDITION: 7
EXPOSURE RANGE: MOC TO EOC
FUEL TYPE: GE14 GE14



Power (% Rated)	<=50% Flow	>50% Flow
23.8	0.747	0.609
40.0	0.854	0.710
40.0		0.711
50.0		0.758
70.0		0.845
85.0		0.885
90.0		1.000
100.0		1.000

Figure 9.1-1: Monitored Region Boundary (Case 1)

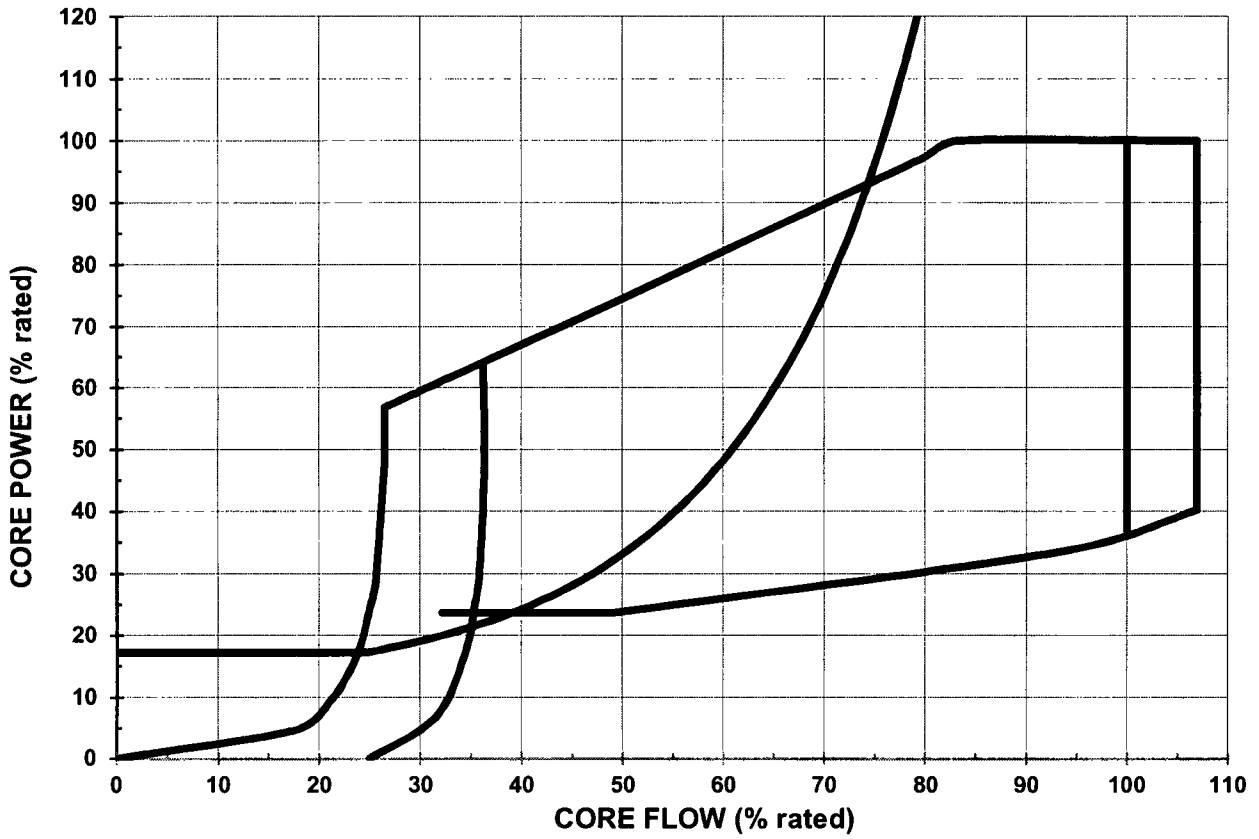


Figure 9.1-2: Monitored Region Boundary (Case 2)

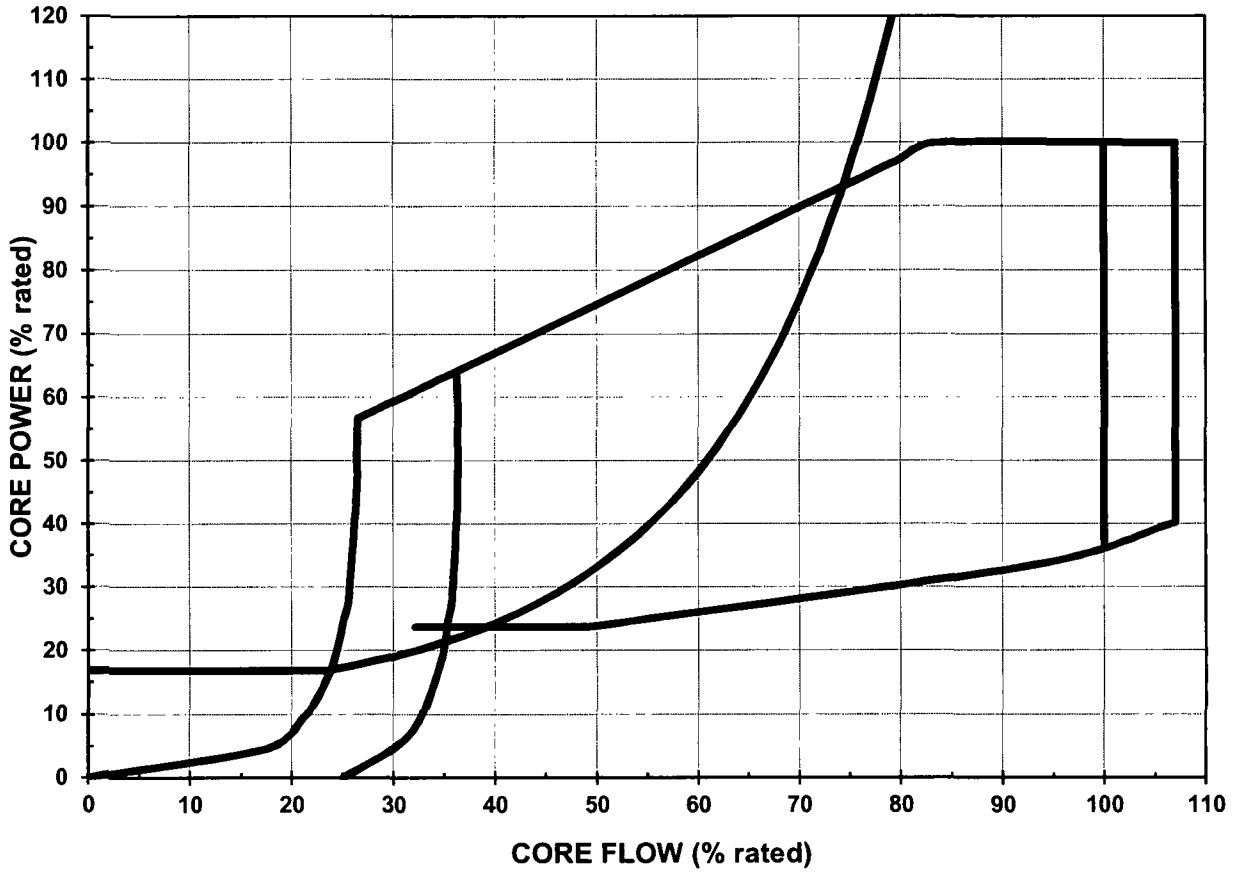


Figure 9.1-3: APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Two Recirculation Loop Operation – Case 1)

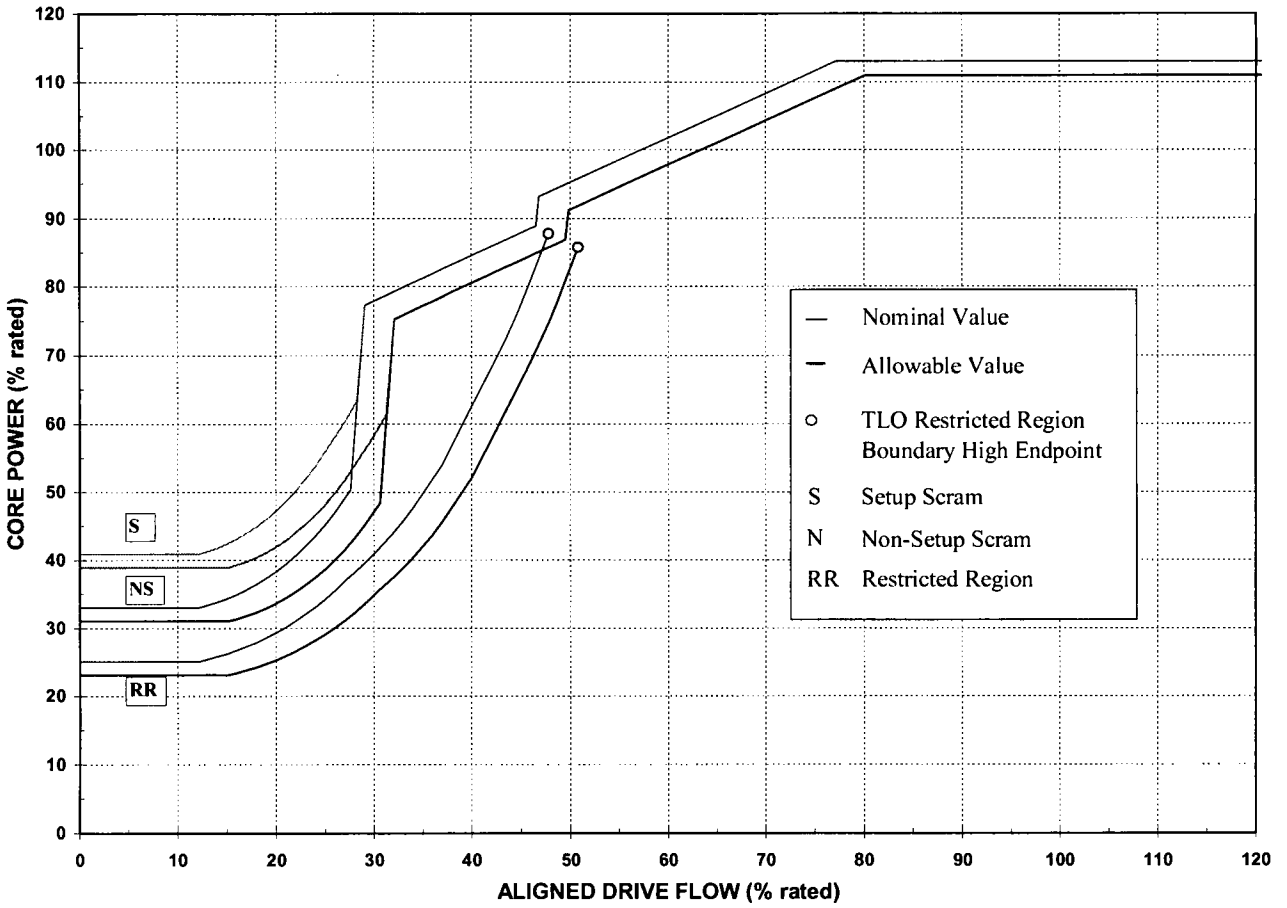


Figure 9.1-4: APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Two Recirculation Loop Operation – Case 2)

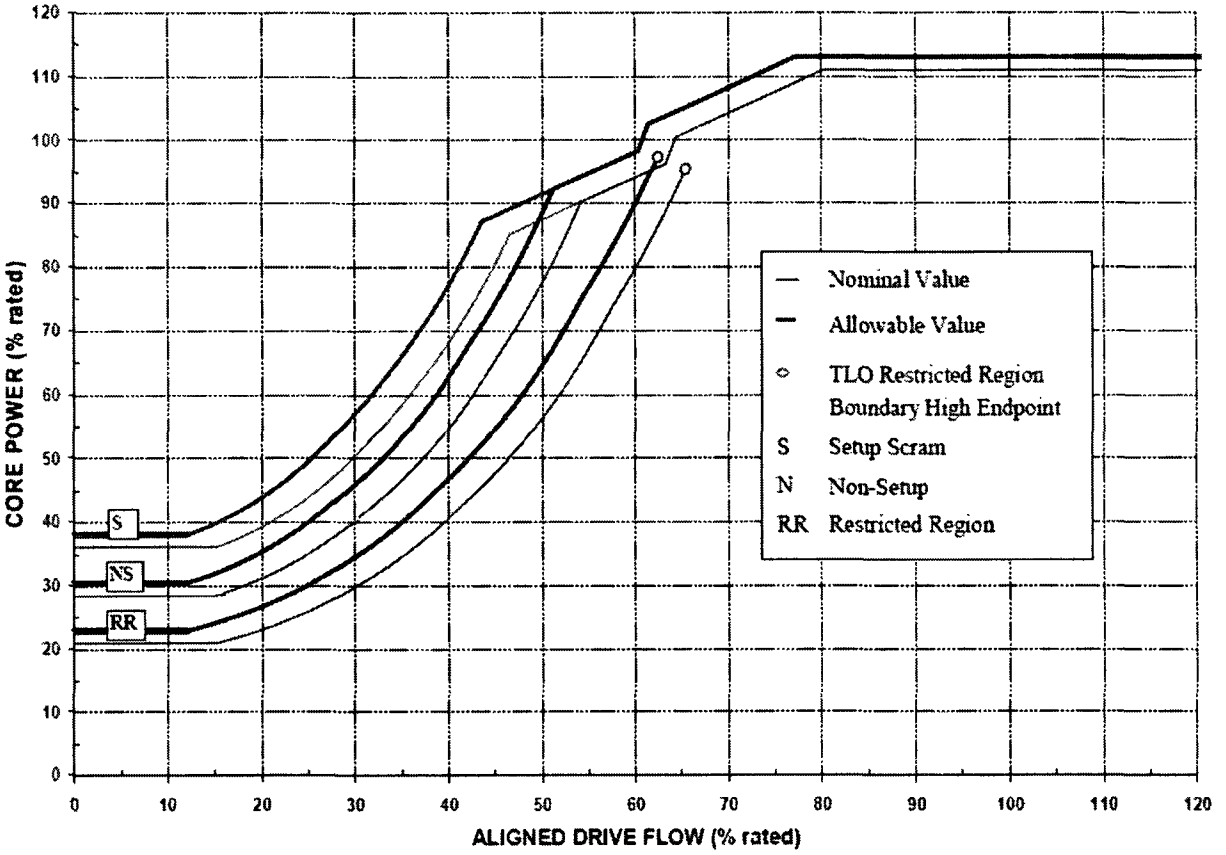


Figure 9.1-5: APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Single Recirculation Loop Operation – Case 1)

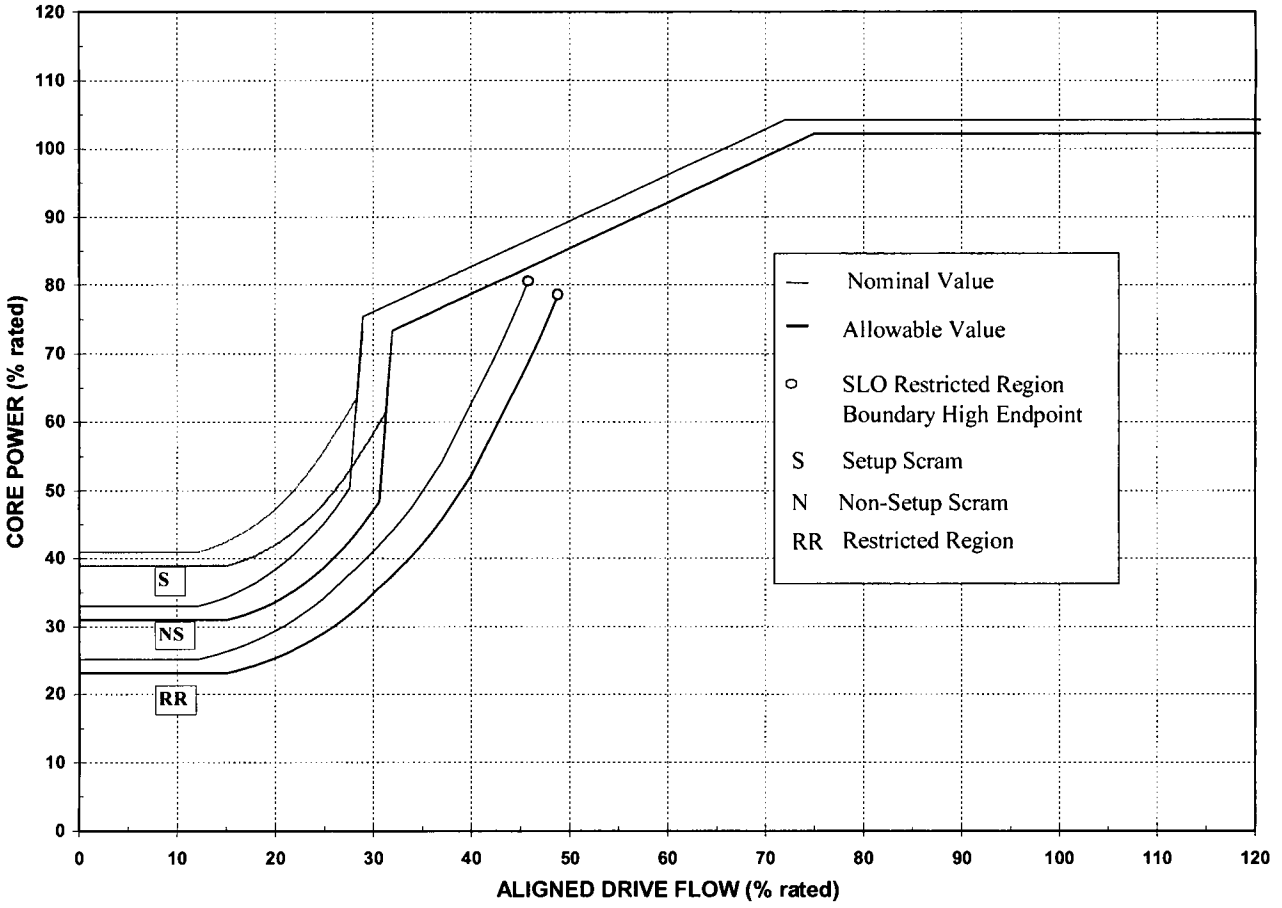


Figure 9.1-6: APRM Flow Biased Simulated Thermal Power – High Scram Setpoints and Restricted Region Boundary (Single Recirculation Loop Operation – Case 2)

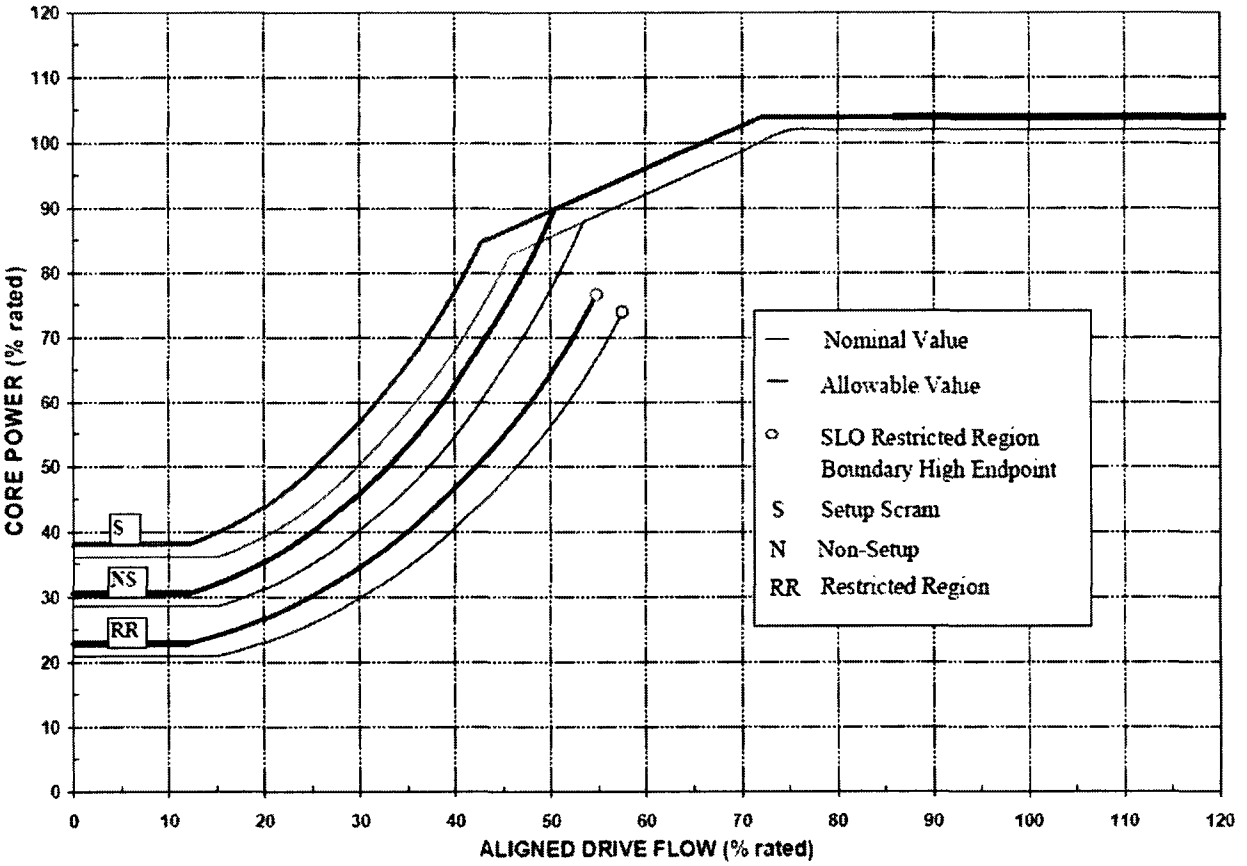


Figure 9.1-7: APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Two Recirculation Loop Operation - Case 1)

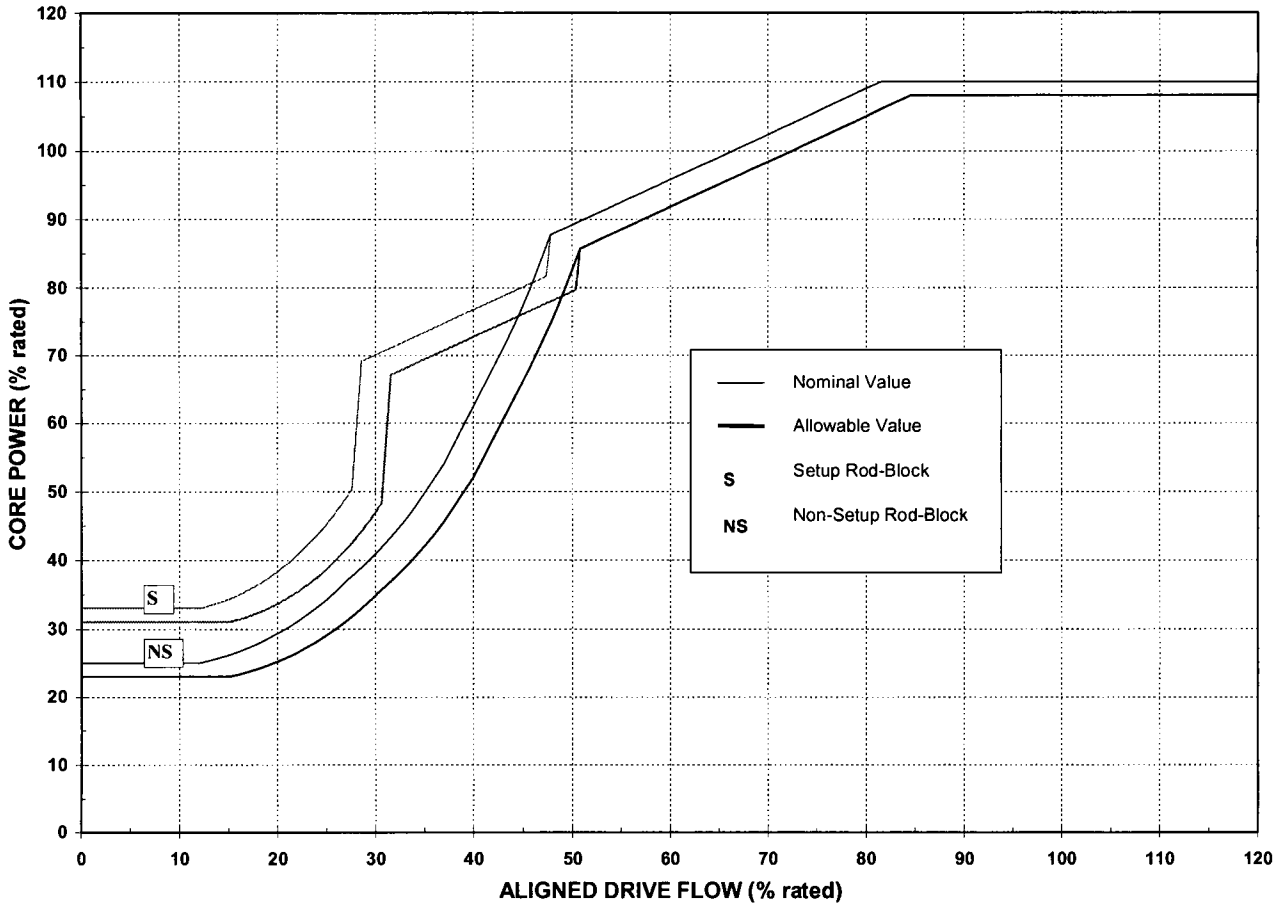


Figure 9.1-8: APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Two Recirculation Loop Operation - Case 2)

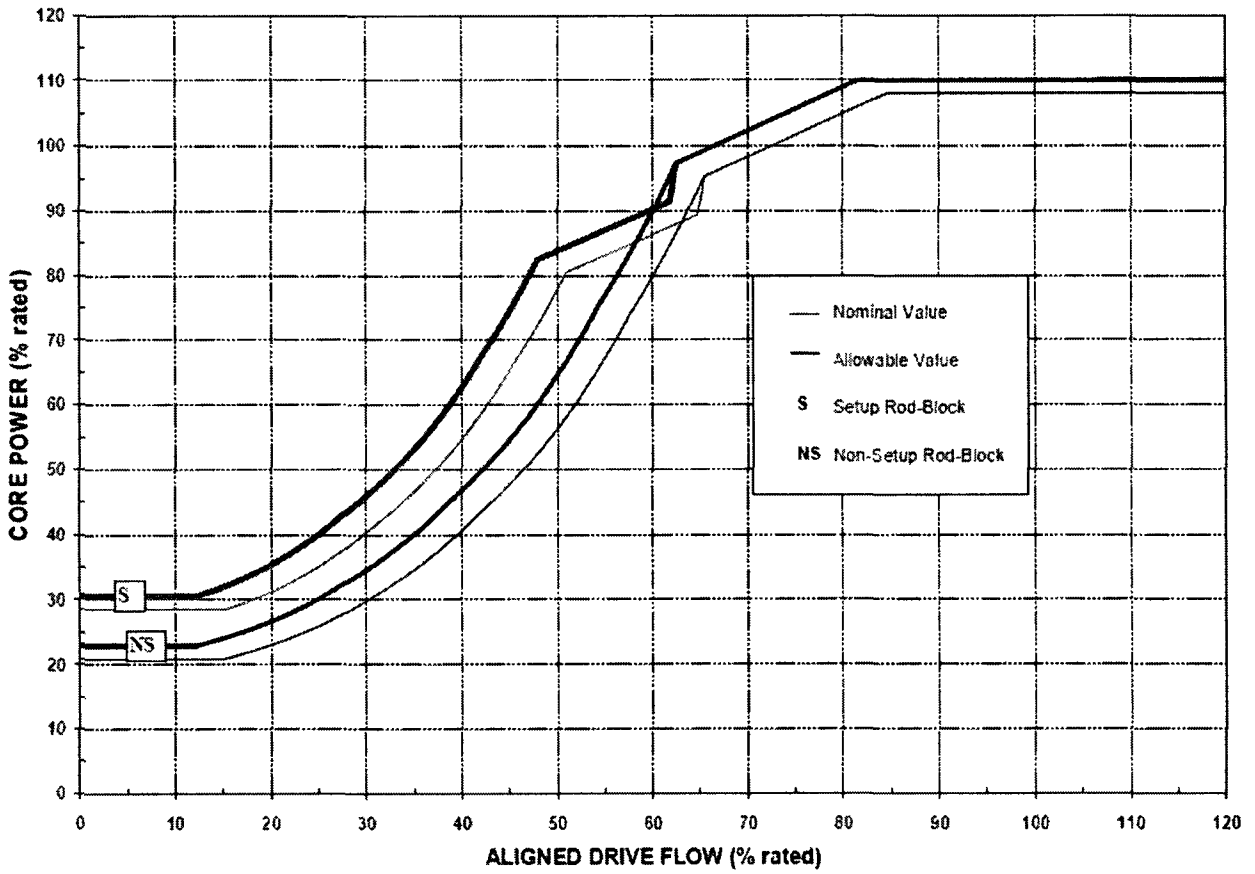


Figure 9.1-9: APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Single Recirculation Loop Operation - Case 1)

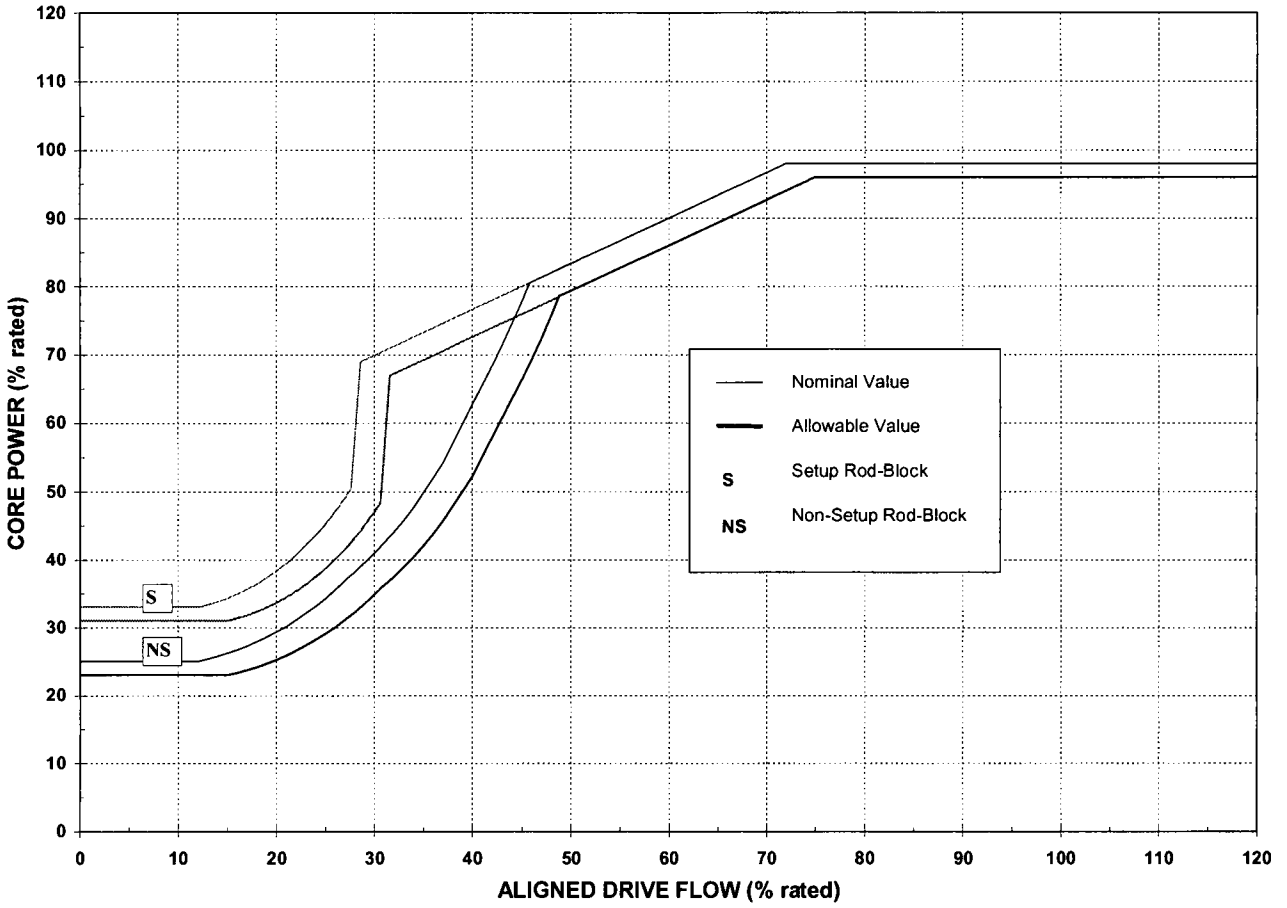


Figure 9.1-10: APRM Flow Biased Neutron Flux - High Rod-Block Setpoints (Single Recirculation Loop Operation - Case 2)