

CORE OPERATING LIMITS REPORT
FOR
LIMERICK GENERATING STATION UNIT 1
RELOAD 6, CYCLE 7

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INTRODUCTION AND SUMMARY

This report provides the cycle-specific parameter limits for: Maximum Average Planar Linear Heat Generation Rate (MAPLHGR); Minimum Critical Power Ratio (MCPR); ARTS MCPR thermal limit adjustments and multipliers; ARTS MAPLHGR thermal limit multipliers; Rod Block Monitor (RBM) data; MAPLHGR single loop operation (SLO) reduction factor; Linear Heat Generation Rate (LHGR); Turbine Bypass Valve parameters; Recirculation Pump Motor Generator (MG) Set Scoop Tube Stops; and Reactor Coolant System Recirculation Flow Upscale Trips for Limerick Generating Station Unit 1, Cycle 7. These values have been determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met.

This report is submitted in accordance with Technical Specification 6.9.1.9 of Reference 1. Preparation of this report was performed in accordance with PECO Energy Company, Fuel & Services Division Procedure FM-300.

The cycle-specific parameter limits presented in this report are applicable for operation at a rerated power level of 3458 MWt. This is the first cycle of power rerate operation at Limerick-1.

The data presented in this report is valid for all points and domains on the operating map including Maximum Extended Load Line Limit (MELLL) down to 81% of rated core flow during full power operation, Increased Core Flow (ICF) up to 110% of rated core flow, Feedwater Temperature Reduction (FWTR) up to 105°F during cycle extension operation and Feedwater Heater Out of Service (FWHOOS) up to 60°F feedwater temperature reduction at any time during the cycle prior to cycle extension operation.

MAPLHGR LIMITS

MAPLHGR curves for each Cycle 7 fuel type as a function of average planar exposure are given in Figures 1-5.

No reduction in MAPLHGR limits is required under ARTS during single loop operation (Table 3).

MCPR LIMITS

The MCPR value for use in Technical Specification 3.2.3 is given in Table 1. This table is valid for all Cycle 7 fuel types and operating domains. Information regarding the validity of these MCPR limits for SLO is also provided.

Bounding MCPR values are provided for inoperable Recirculation Pump Trip (RPTOOS) and for inoperable Steam Bypass System (TBVOOS). These two options represent the Equipment Out of Service (EOOS) condition.

Note in this table the term "EOR" refers to the cycle exposure at which operation at "rated conditions" is no longer possible (i.e., the cycle exposure at which cycle extension begins). The cycle exposure which represents "EOR" is given in the latest revision of the Cycle Management Report. This value can change

during the cycle due to changes in operating strategy.

ARTS THERMAL LIMIT ADMINISTRATION

ARTS provides for power- and flow-dependent thermal limit adjustments and multipliers which allow for a more reliable administration of the MCPR and MAPLHGR thermal limits. The flow-dependent multiplier MAPFAC(F) and flow-dependent adjustment MCPR(F) are sufficiently generic to apply to all fuel types and operating domains. The appropriate value of these flow-dependent parameters is chosen based on the maximum allowable core flow setting (for the mechanical stop) presented in Table 5. There are two sets of power-dependent MAPLHGR multipliers for with- and without-EOOS conditions. Also, there are two sets of power-dependent MCPR adjustments and multipliers for with- and without-EOOS conditions.

These adjustments and multipliers are shown in Figures 6 through 11. Thermal limits monitoring must be performed with the more limiting MCPR and MAPLHGR limit resulting from the power-/flow-biased calculation.

ROD BLOCK MONITOR SETPOINTS

The ARTS RBM provides for power-dependent RBM trips to replace the previous flow-dependent trips. The trip setpoints/allowable values and applicable RBM signal filter time constant data are shown in Table 2.

LINEAR HEAT GENERATION RATES

The LHGR value for each fuel type for use in Technical Specification 3.2.4 is given in Table 7.

STEAM BYPASS SYSTEM OPERABILITY

The operability requirements for the steam bypass system for use in Technical Specifications 3.7.8 and 4.7.8.C are found in Table 4. If these requirements cannot be met, then the MCPR, MCPR(P) and MAPFAC(P) limits for TBVOOS must be used.

RECIRCULATION PUMP TRIP OPERABILITY

If the recirculation pump trip is inoperable, then the MCPR, MCPR(P) and MAPFAC(P) limits for RPTOOS must be used.

RECIRCULATION PUMP MOTOR-GENERATOR (MG) SET SCOOP TUBE STOPS

The electrical and mechanical stops are set to limit the reactor core coolant flow rate during an event in which the recirculation flow rate increases to its maximum value. Technical Specification Surveillance Requirement number 4.4.1.1.2 requires that each pump MG set scoop tube mechanical and electrical stop shall be demonstrated OPERABLE, with overspeed setpoints less than or equal to specified values, at least once per 24 months. The settings of these stops may be changed during the cycle in accordance with changes in operational strategy. The values of these settings can be found in Table 5 of this COLR.

CONTROL ROD BLOCK INSTRUMENTATION

REACTOR COOLANT SYSTEM RECIRCULATION FLOW UPSCALE TRIP

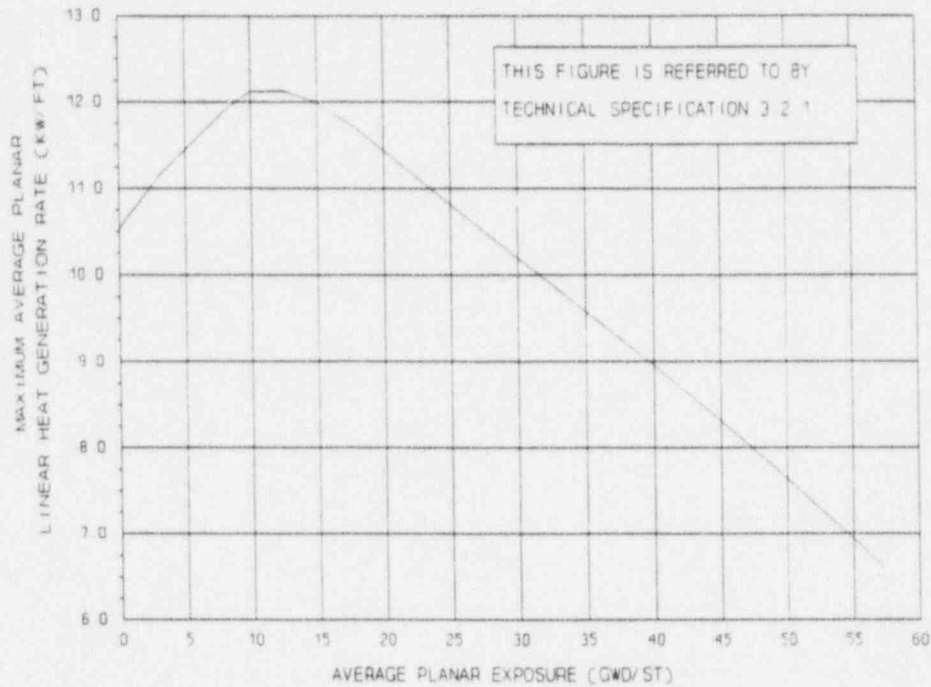
Technical Specification Limiting Condition for Operation number 3.3.6 requires control rod block instrumentation channels shall be OPERABLE with their trip setpoints consistent with the values shown in the Trip Setpoint column of Technical Specification Table 3.3.6-2. The Reactor Coolant System Recirculation Flow Upscale Trip is a cycle-specific value and as such is found in Table 6 of this COLR. Table 6 lists the Nominal Trip Setpoint and Allowable Value. These setpoints are set high enough to allow full utilization of the enhanced ICF domain up to 110% of rated core flow.

REFERENCES

- 1) "Technical Specifications and Bases for Limerick Generating Station Unit 1", Docket No. 50-352, License No. NPF-39.
- 2) "Supplemental Reload Licensing Report for Limerick Generating Station Unit 1 Reload 6 Cycle 7", General Electric Company Document No. 24A5185, Rev. 0, January 1996.
- 3) "Basis of MAPLHGR Technical Specifications for Limerick Unit 1", NEDE-31401-P, as amended.
- 4) "Maximum Extended Load Line Limit and ARTS Improvement Program Analyses for Limerick Generating Station Units 1 and 2", GE Nuclear Energy Document No. NEDC-32193P, Rev.2, October 1993.
- 5) Letter, G. V. Kumar to K. M. McGinnis, "Limerick ARTS Application with Equipment Out-of-Service(EOOS)", Dec. 10, 1993.
- 6) "Power Rerate Condition Setpoint Calculations for the Philadelphia Electric Company Limerick Generating Station Units 1 & 2", GE Document No. GE-NE-208-20-0993-2, August 1994.
- 7) PECO Energy Company Fuel and Services Division Limerick-1 Cycle 7 Reload Licensing Design Record File # 2107.
- 8) PECO Energy Calculation LE-0082, "GE NSSS Setpoints Required to Support Power Rerate", Rev. 4.
- 9) "Safety Review for Limerick Generating Station Units 1 and 2 110% Increased Core Flow Operation and Final Feedwater Temperature Reduction", NEDC-32224P, Rev. 1, October 1994.

FIGURE 1

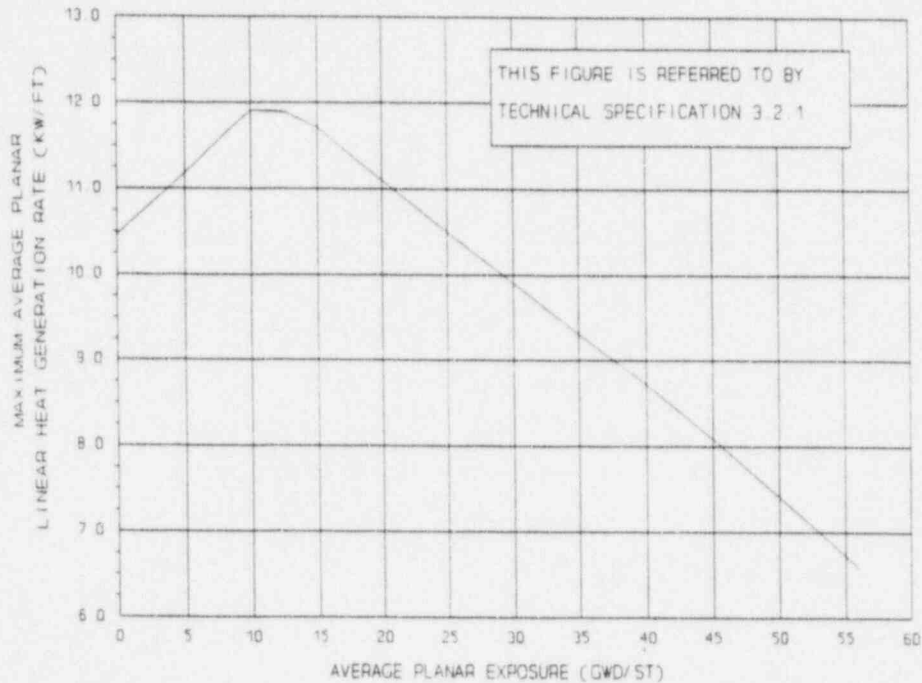
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P9CTB404 (GE13)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.53	10.0	12.12	40.0	8.96
1.0	10.74	12.5	12.13	45.0	8.31
2.0	10.93	15.0	11.99	50.0	7.64
3.0	11.14	17.5	11.74	55.0	6.94
4.0	11.30	20.0	11.43	57.35	6.60
5.0	11.44	25.0	10.81		
6.0	11.59	30.0	10.19		
8.0	11.90	35.0	9.58		

FIGURE 2

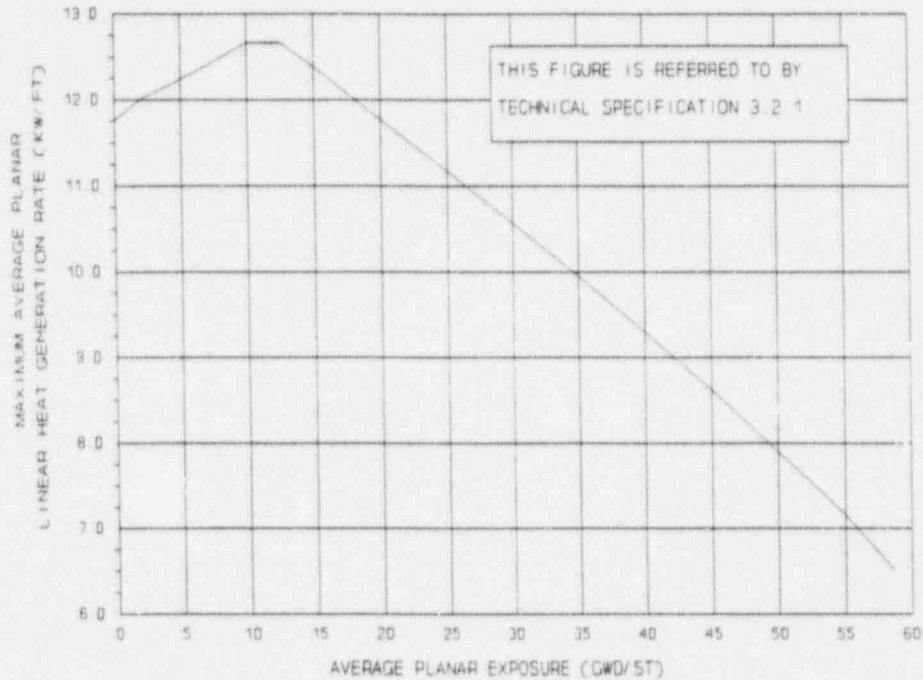
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P9CUB384 (GE11)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.46	12.5	11.90	35.0	9.31
2.0	10.75	15.0	11.71	40.0	8.71
4.0	11.03	17.5	11.41	45.0	8.08
6.0	11.33	20.0	11.10	50.0	7.41
8.0	11.63	25.0	10.50	55.0	6.72
10.0	11.91	30.0	9.91	56.1	6.56

FIGURE 3

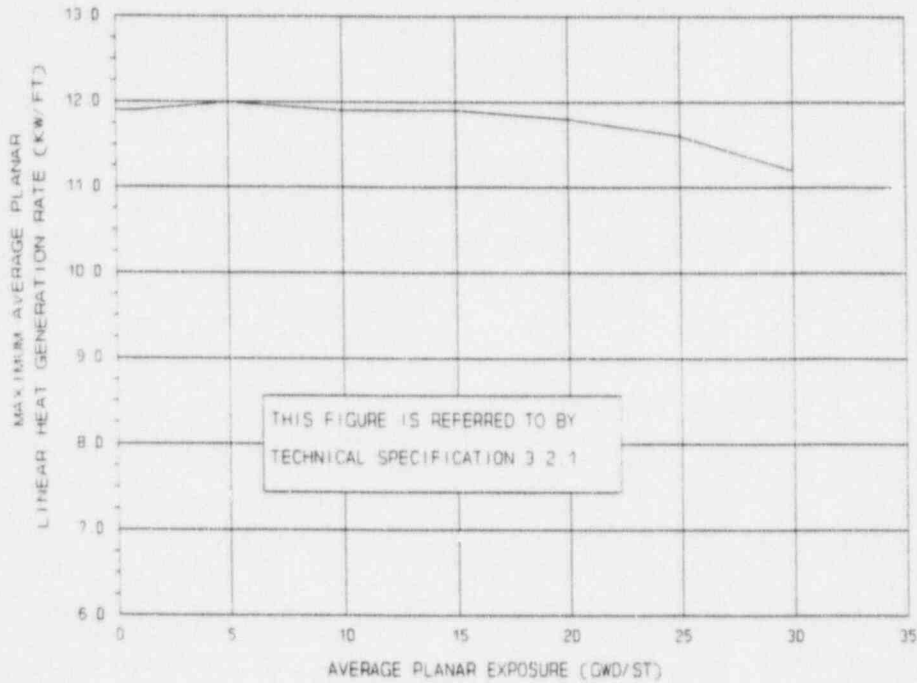
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P9CUB331 (GE11)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	11.76	12.5	12.67	35.0	9.95
2.0	12.01	15.0	12.39	40.0	9.30
4.0	12.16	17.5	12.08	45.0	8.62
6.0	12.32	20.0	11.77	50.0	7.90
8.0	12.49	25.0	11.17	55.0	7.16
10.0	12.67	30.0	10.57	58.7	6.52

FIGURE 4

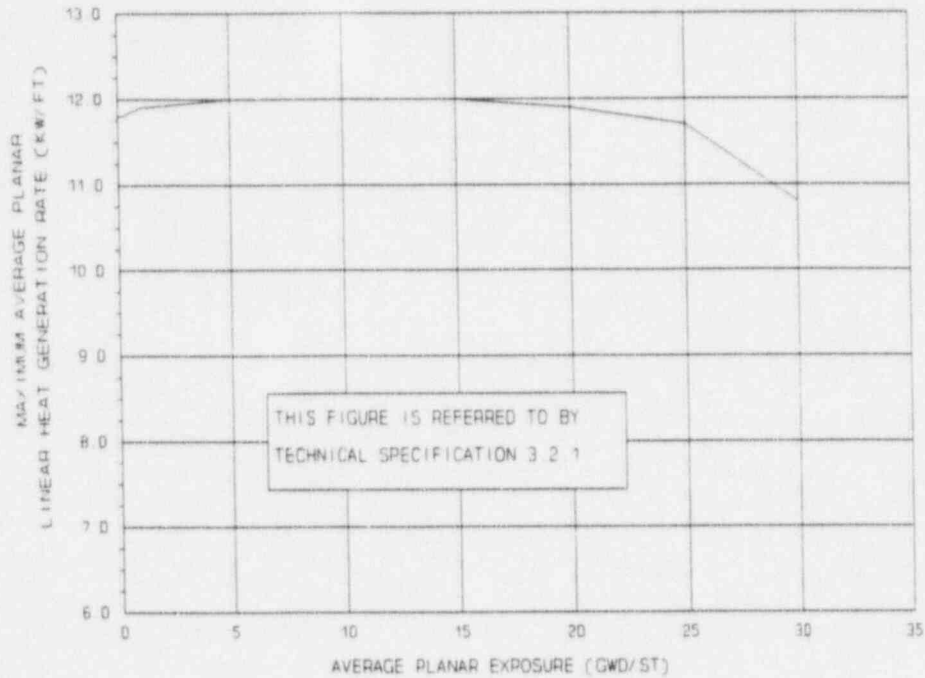
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CIB219 (GE6)



<u>Avg Plan Exposure (GWd/ST)</u>	<u>MAPLHGR (kW/ft)</u>	<u>Avg Plan Exposure (GWd/ST)</u>	<u>MAPLHGR (kW/ft)</u>	<u>Avg Plan Exposure (GWd/ST)</u>	<u>MAPLHGR (kW/ft)</u>
0.0	11.9	5.0	12.0	20.0	11.8
0.2	11.9	10.0	11.9	25.0	11.6
1.0	11.9	15.0	11.9	30.0	11.2

FIGURE 5

MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CIB176 (GE6)



<u>Avg Plan Exposure (GWd/ST)</u>	<u>MAPLHGR (kW/ft)</u>	<u>Avg Plan Exposure (GWd/ST)</u>	<u>MAPLHGR (kW/ft)</u>	<u>Avg Plan Exposure (GWd/ST)</u>	<u>MAPLHGR (kW/ft)</u>
0.0	11.8	5.0	12.0	20.0	11.9
0.2	11.8	10.0	12.0	25.0	11.7
1.0	11.9	15.0	12.0	30.0	10.8

FIGURE 6

POWER DEPENDENT MAPLHGR MULTIPLIER MAPFAC(P)
 THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1
 THIS FIGURE IS VALID IF RPT AND TBV ARE IN SERVICE

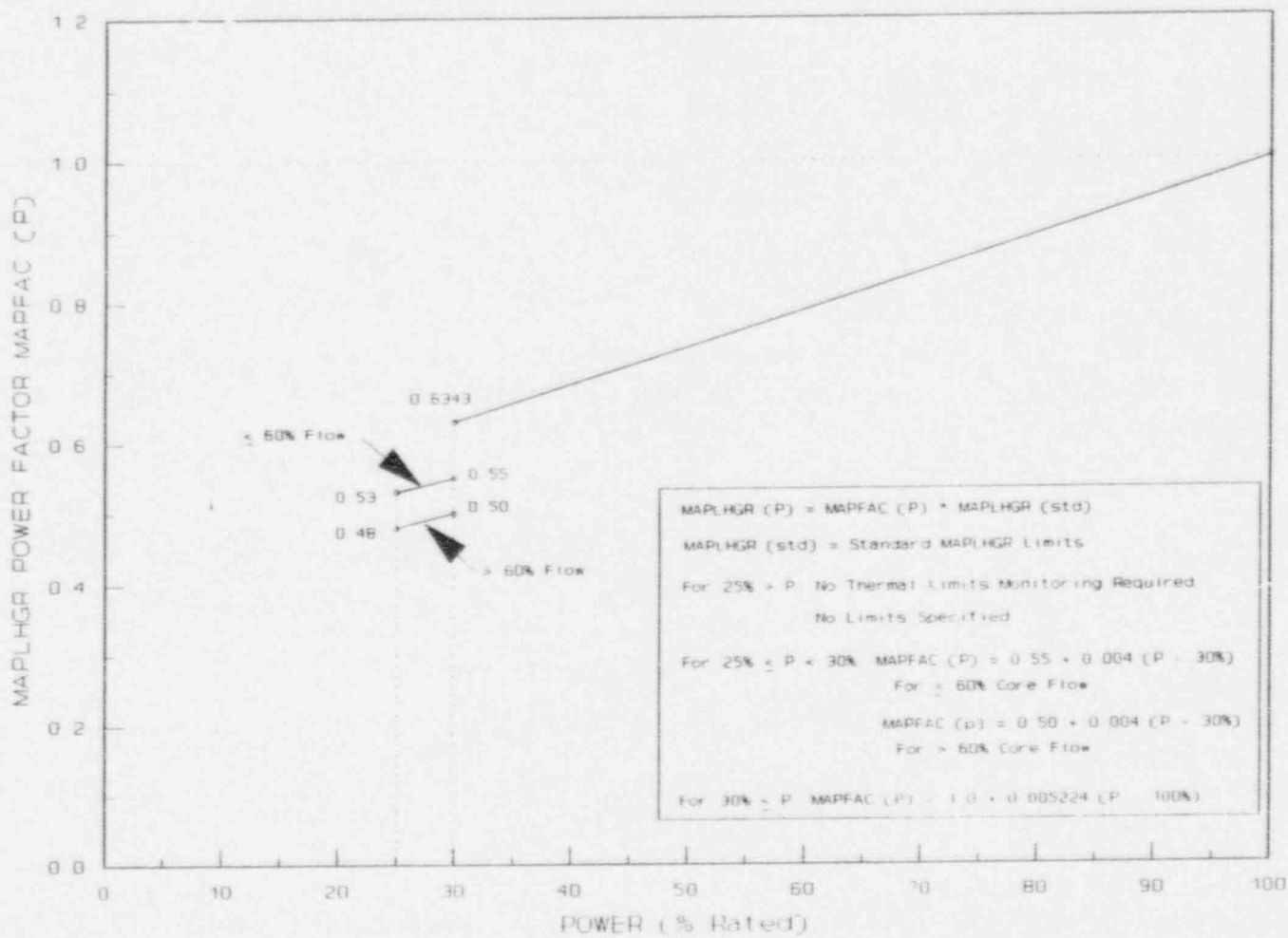


FIGURE 7

POWER DEPENDENT MAPLHGR MULTIPLIER MAPFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1
THIS FIGURE IS VALID FOR RPTOOS OR TBVOOS

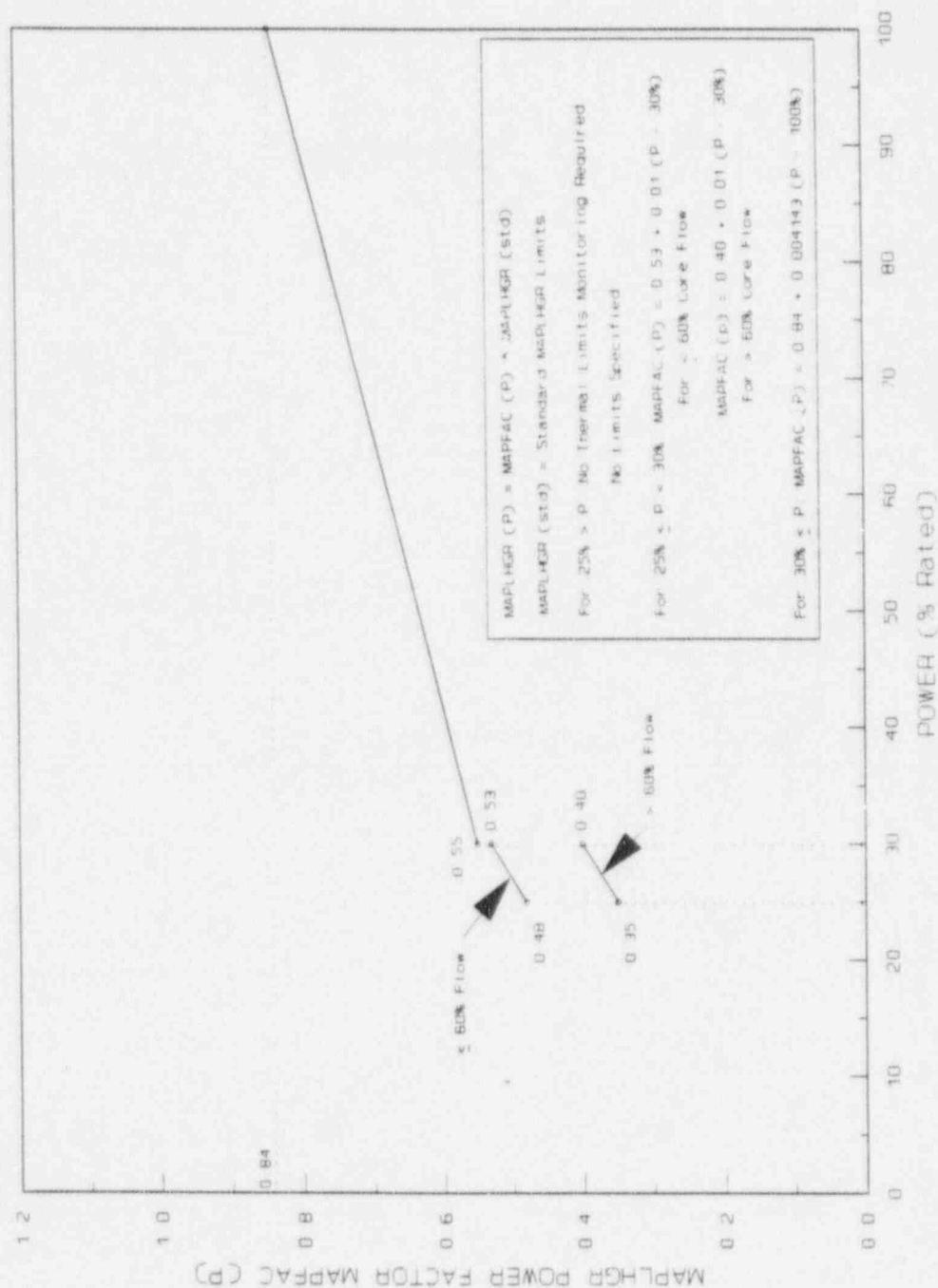


FIGURE 8

FLOW DEPENDENT MAPLHGR MULTIPLIER MAPFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1
THIS FIGURE IS VALID FOR ALL OPERATING DOMAINS

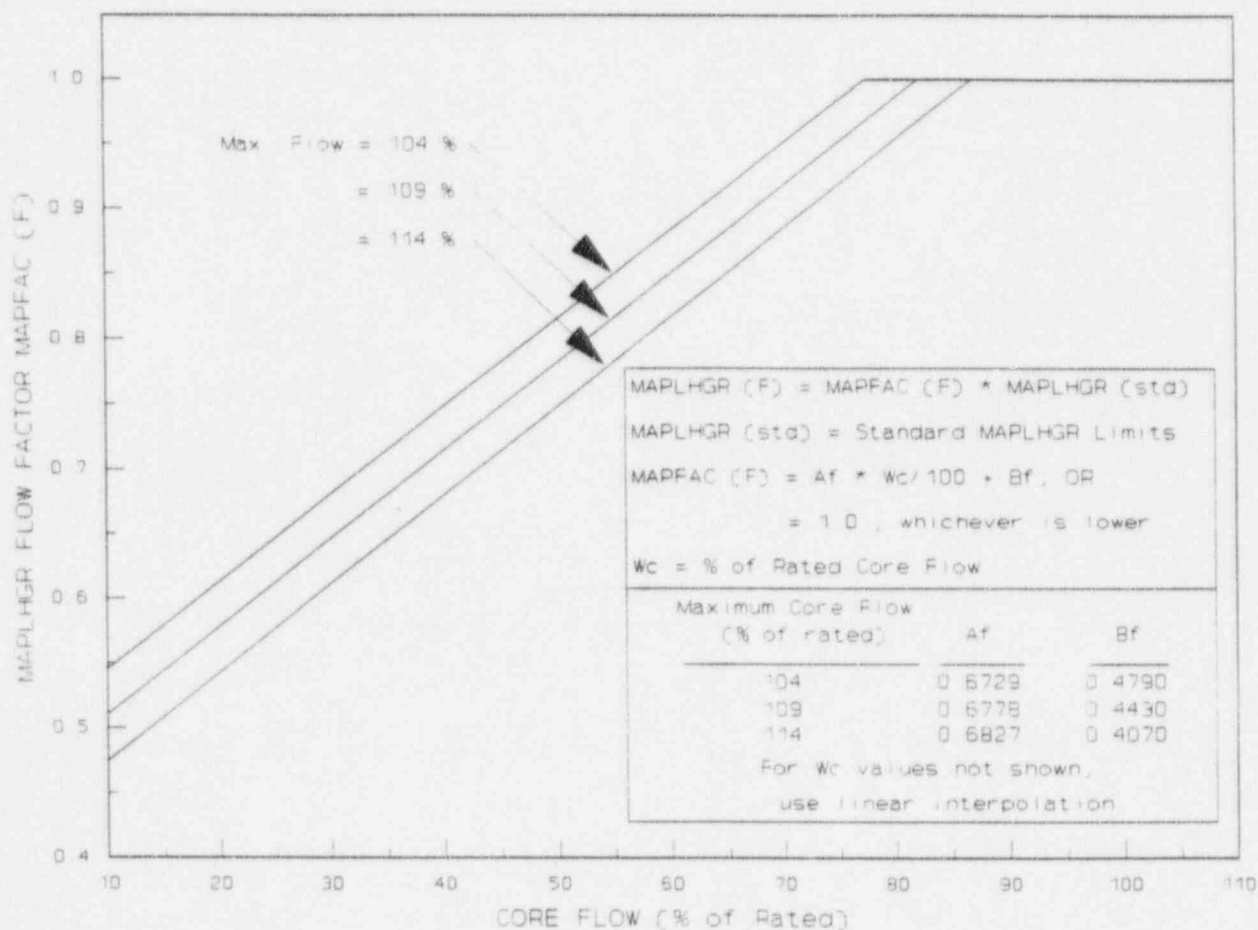


FIGURE 9

POWER DEPENDENT MCPR LIMIT ADJUSTMENTS AND MULTIPLIERS
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3
THIS FIGURE IS VALID IF RPT AND TBV ARE IN SERVICE

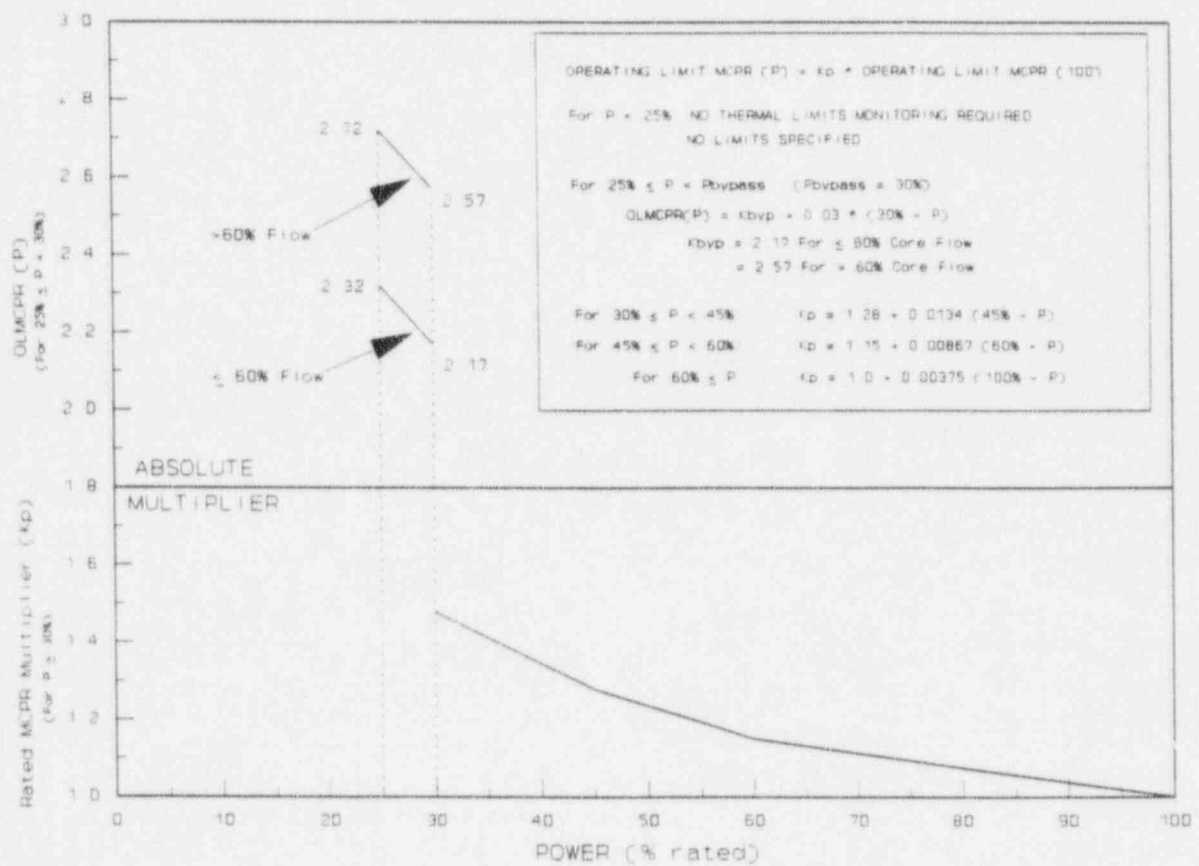


FIGURE 10

POWER DEPENDENT MCPR LIMIT ADJUSTMENTS AND MULTIPLIERS
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3
THIS FIGURE IS VALID FOR RPTOOS OR TBVOOS

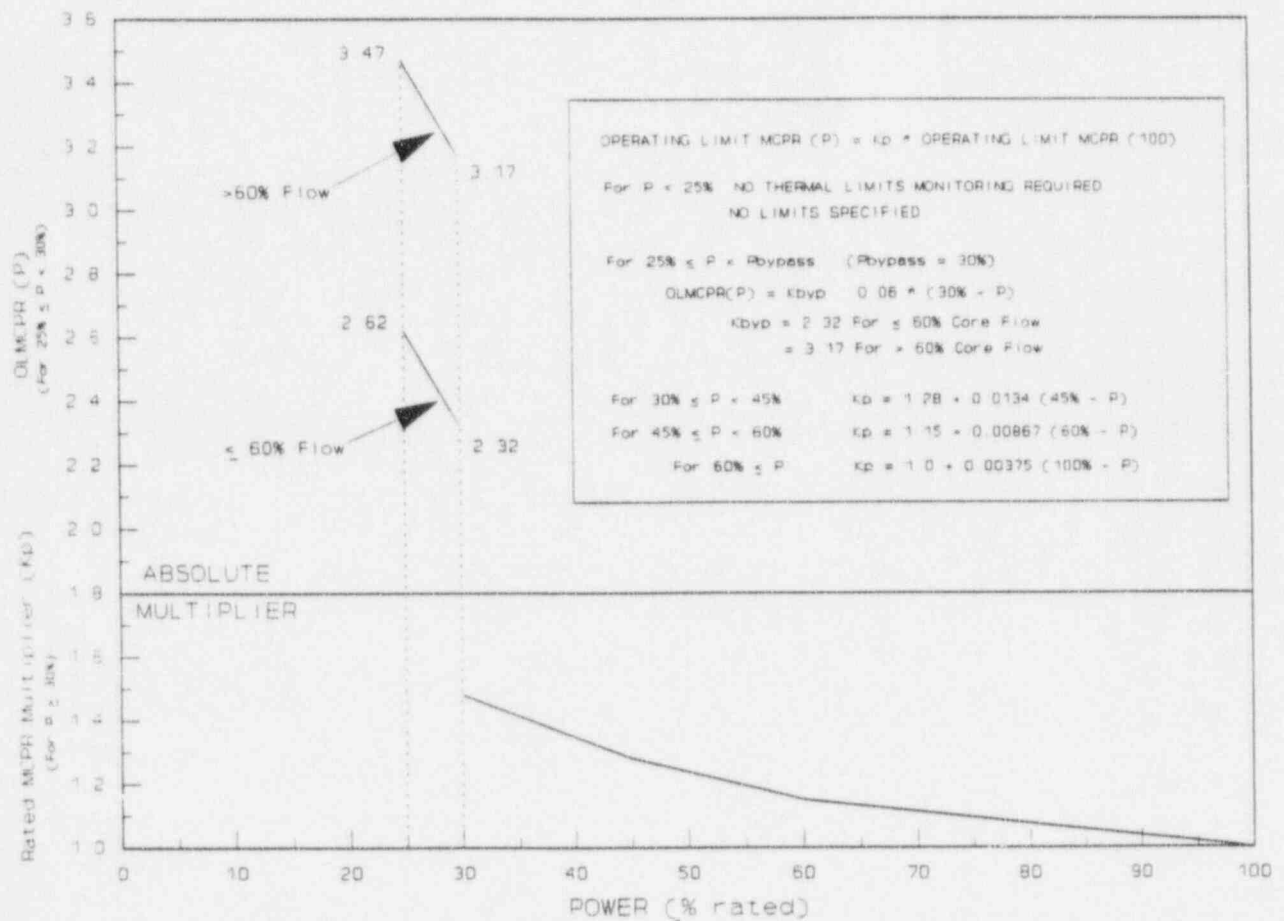


FIGURE 11

FLOW DEPENDENT MCPR LIMITS MCPR(F)
 THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.3
 THIS FIGURE IS VALID FOR ALL OPERATING DOMAINS

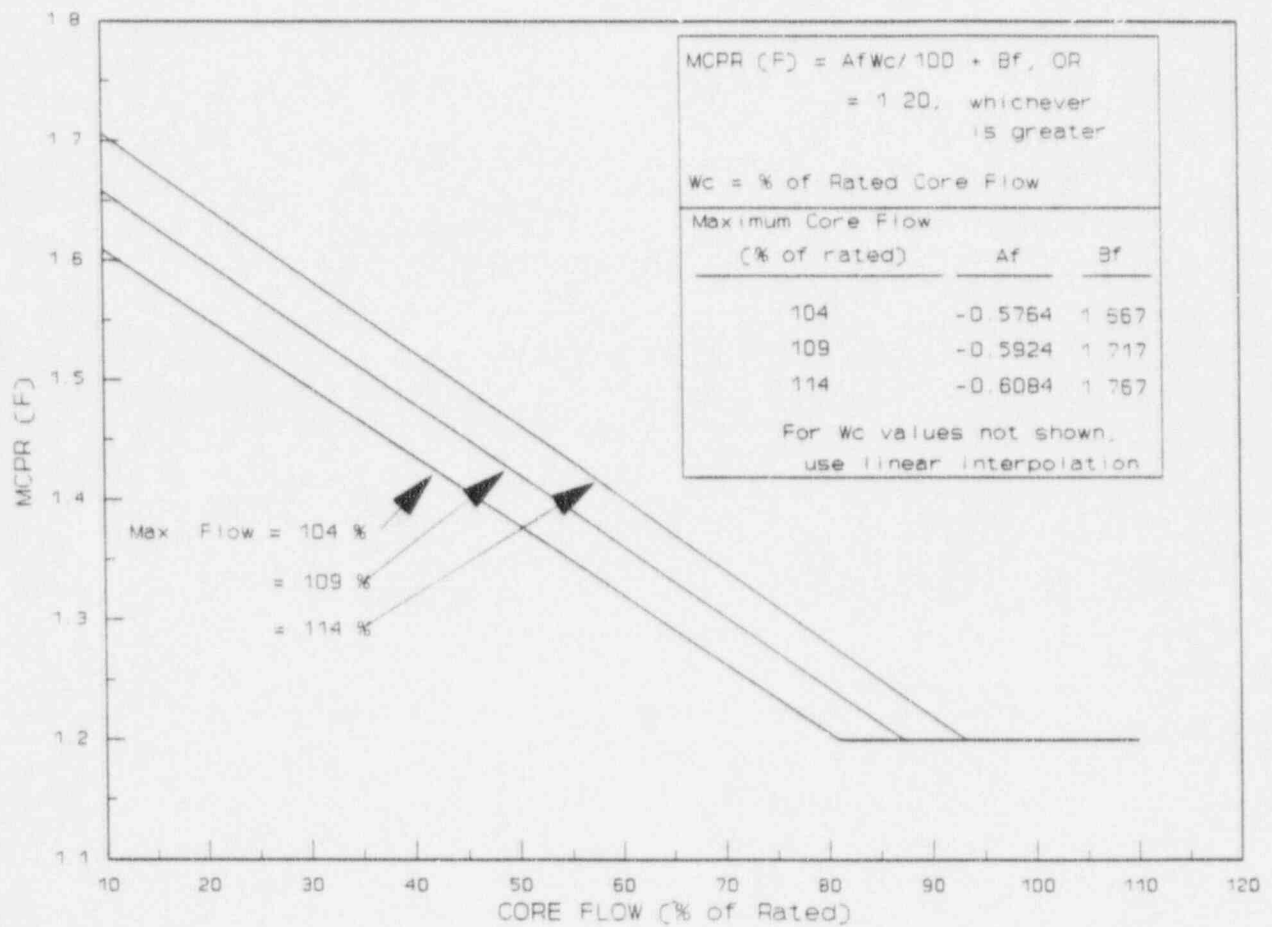


TABLE 1

OPERATING LIMIT MINIMUM CRITICAL POWER RATIO (OLMCPR)

Use in conjunction with Figures 9, 10, and 11.

This Table is valid for two-loop operation.

Add 0.02 to the OLMCPR when in Single Loop Operation.

This Table is valid for all Cycle 7 fuel types.

This Table is referred to by Technical Specification 3.2.3.

Cycle Exposure Range	TBV In Service and RPT In Service		TBV Out of Service		RPT Out of Service	
	Opt B (Tau = 0)	Opt A (Tau = 1.0)	Opt B (Tau = 0)	Opt A (Tau = 1.0)	Opt B (Tau = 0)	Opt A (Tau = 1.0)
BOC to EOR - 2000 $\frac{MWd}{st}$	1.29	1.32	1.36	1.39	1.36	1.41
EOR - 2000 $\frac{MWd}{st}$ to EOC	1.32	1.35	1.37	1.40	1.38	1.46

Notes: 1) When Tau does not equal 0 or 1.0, determine OLMCPR via linear interpolation.

TABLE 2

ROD BLOCK MONITOR DATA

	Nominal Trip Setpoint	Allowable Value
LTSP	117.1%	118.3%
ITSP	112.3%	113.5%
HTSP	107.3%	108.5%
DTSP	92%	89%

These setpoints are based on an RWE Rated MCPR limit of 1.27 and are consistent with an RBM filter time constant between 0.1 seconds and 0.55 seconds.

LTSP - Low trip setpoint
ITSP - Intermediate trip setpoint
HTSP - High trip setpoint
DTSP - Downscale trip setpoint

TABLE 3

MAPLHGR SINGLE LOOP OPERATION (SLO) REDUCTION FACTOR

SLO reduction factor = **1.00** for all Cycle 7 fuel types.

TABLE 4

TURBINE BYPASS VALVE PARAMETERS

TURBINE BYPASS SYSTEM RESPONSE TIME

Maximum delay time before start of bypass valve opening following generation of the turbine bypass valve flow signal	0.10 sec
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Maximum time after generation of a turbine bypass valve flow signal for bypass valve position to reach 80% of full flow (includes the above delay time)	0.30 sec
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MINIMUM REQUIRED BYPASS VALVES TO MAINTAIN SYSTEM OPERABILITY

Number of valves = 7

TABLE 5

Recirculation Pump Motor-Generator (MG) Set Scoop Tube Stops

Mechanical $\leq 109\%$

Electrical $\leq 107\%$

TABLE 6

**Control Rod Block Instrumentation
Reactor Coolant System Recirculation Flow Upscale Trip**

Nominal Trip Setpoint $\leq 113.4\%$

Allowable Value $\leq 115.6\%$

TABLE 7

Linear Heat Generation Rate Limits

<u>Fuel Type</u>	<u>Maximum LHGR (kW/ft)</u>
GE13	14.4
GE11	14.4
GE6	13.4