CORE OPERATING LIMITS REPORT

FOR

LIMERICK GENERATING STATION UNIT 2

RELOAD 2, CYCLE 3

Prepared By: J. L. McHale Date: 5/17/93

J. L. McHale
Engineer

Reviewed By: A. M. Olson Date: 5/17/93

A. M. Olson
Independent Reviewer

Approved By: J. M. Carmody Date: 5/18/93

J. M. Carmody
Branch Head
Nuclear Design Branch

LIST OF EFFECTIVE PAGES

Page(s)	Revision
1-30	1

INTRODUCTION AND SUMMARY

This report provides the cycle-specific parameter limits for: Average Planar Linear Heat Generation Rate (APLHGR); Minimum Critical Power Ratio (MCPR); Flow Adjustment Factor (K_f); Linear Heat Generation Rate (LHGR); Rod Block Monitor Flow Biased Upscale and High Flow Clamped Setpoints; and Turbine Bypass Valve parameters for Limerick Generating Station Unit 2, Cycle 3, Reload 2. 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 Fuel Management Section Procedure FM-105.

APLHGR LIMITS

The limiting APLHGR value for the most limiting lattice (excluding natural uranium) of each fuel type as a function of average planar exposure is given in Figures 1 through 10. These figures are used when hand calculations are required as specified in Technical Specification 3.2.1. The ABB Atom, Inc. (ABB) and Siemens Power Corporation (SPC) Qualification Fuel Bundles (QFBs) were previously monitored to the GE9B-P8CWB325-9GZ2 MAPLHGR limits (see Rev. 0 of the L2R2 COLR). The MAPLHGR limits for the ABB and SPC QFBs have been increased (i.e. relaxed) by 7% and 8%, respectively, in accordance with the information provided in References 7 and 8. The reduction factors for use during single recirculation loop operation are given in Table 1. The reduction factor for the ABB SVEA-96 was provided in Reference 7 as 0.83. Due to a very conservative evaluation of single-loop-operation, ABB required that the reduction factor be reduced proportionately with the 7% increase in the MAPLHGR limit (i.e. 0.89/1.07=0.83) to maintain margins. However, the single-loop reduction factor for the GE9B fuel is 0.88 (not 0.89 as originally assumed in the analysis), therefore a reduction factor of 0.82 (0.88/1.07) will be applied to the ABB QFBs. It should be noted that the assumptions of a 0.89 reduction factor in the single-loop analysis was conservative.

MCPR LIMITS

The MCPR value for use in Technical Specification 3.2.3 for each fuel type is given in Figures 11 through 20. The K_f core flow adjustment factor for use in Technical Specification 3.2.3 is given in Figure 21.

The MCPR values shown in these figures are the bounding values for all operating points on the power flow map including Extended

Load Line (ELL) down to 87% of rated core flow, Increased Core Flow (ICF) up to 105% of rated core flow, Feedwater Temperature Reduction (FWTR) up to 60°F during any part of the cycle and Power Coastdown operation. The figures labelled "Increased Core Flow and Feedwater Temperature Reduction" represent these bounding operating limits.

Bounding MCPR values are also provided for inoperable Recirculation Pump Trip (RPT) or inoperable Steam Bypass System (TBVOOS).

ROD BLOCK MONITOR SETPOINTS

The N value for the rod block monitor flow biased upscale and high flow clamped setpoints for use in Technical Specification 3.3.6 is given in Table 2.

LINEAR HEAT GENERATION RATES

The LHGR value for use in Technical Specification 3.2.4 for each fuel type is given in Table 3. The ABB and SPC QFBs were previously monitored conservatively to the GE9B LHGR limits (see Rev. 0 of the L2R2 COLR). The LHGR limits of the SPC QFBs have been increased by 10%, in accordance with the information provided in References 8. The LHGR limits of the ABB QFBs have been placed at the analytically determined limits, as documented in Reference 9.

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, the MCPR limits for inoperable Steam Bypass System, known as Turbine Bypass Valve Out of Service (TBVOOS), must be used.

QUALIFICATION FUEL BUNDLES

LGS Unit 2 Cycle 3 will be the second cycle of irradiation for the QFBs. The thermal limits for the ABB and SPC QFBs are specified in References 5 thru 9. Specific values for all thermal limits are given for the GE11 QFBs (LUA304). The GE11 QFBs and GE11 Reload 2 bundles (GE11) have the same MCPR values throughout Cycle 3.

REFERENCES

1) "Technical Specifications and Bases for Limerick Generating Station Unit 2", Docket No. 50-353 Appendix A to License No. NPF-85.

2) "Supplemental Reload Licensing Report for Limerick Generating Station Unit 2, Reload 2, Cycle 3", General Electric Company Document No. 23A7200, Rev. 0.

3) "Basis of MAPLHGR Technical Specifications for Limerick 2", NEDC-31930-P, April 1991.

4) "Lattice-Dependent MAPLHGR Report for Limerick Generating Station Unit 2 Reload 2 Cycle 3", General Electric Company Document No. 23A7200AA, Rev. 0.

5) ABB Atom Report BR 91-042, "Supplemental Lead Fuel Assembly Licensing Report, SVEA-96 LFAs for Limerick-2, Summary", January 1991.

6) ANF-90-193(P), "Limerick-2 9x9-9X+ Qualification Fuel Assembly Safety Analysis Report", January 1991.

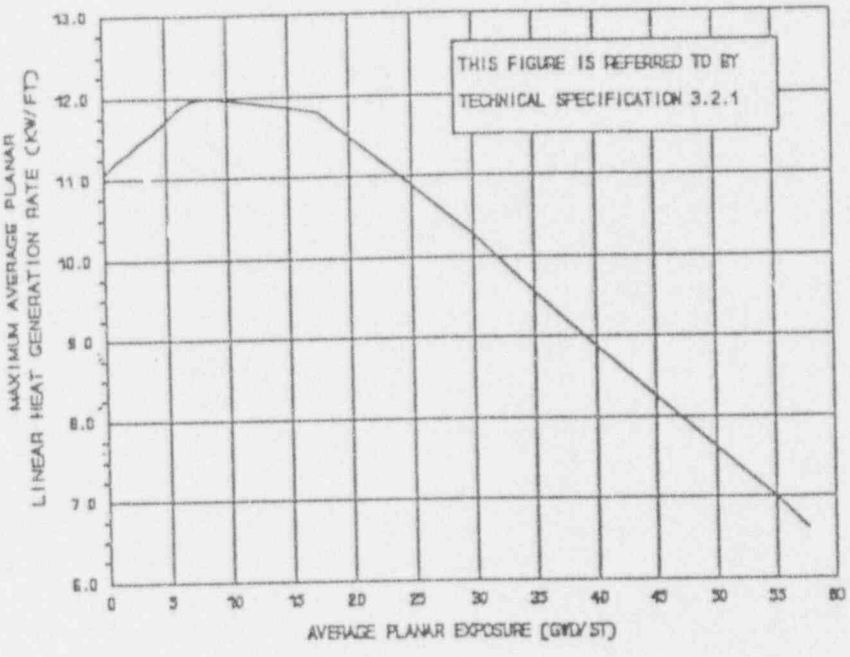
7) Letter, W. R. Harris to A. M. Olson, "Revised LGS-2 SVEA-96 Lead Fuel Assembly (LFA) LOCA Limits", April 26, 1993.

8) Letter, H. G. Shaw to Manager Fuel Management Section, "Relaxation of LHGR and MAPLHGR limits for the 9x9-9X + Qualification Fuel Assemblies (QFAs) for Limerick", May 13, 1993.

9) "Supplemental Lead Fuel Assembly Licensing Report - SVEA-96 LFAs for Limerick 2", ABB Report UK 90-512, September 1991.

Figure 1

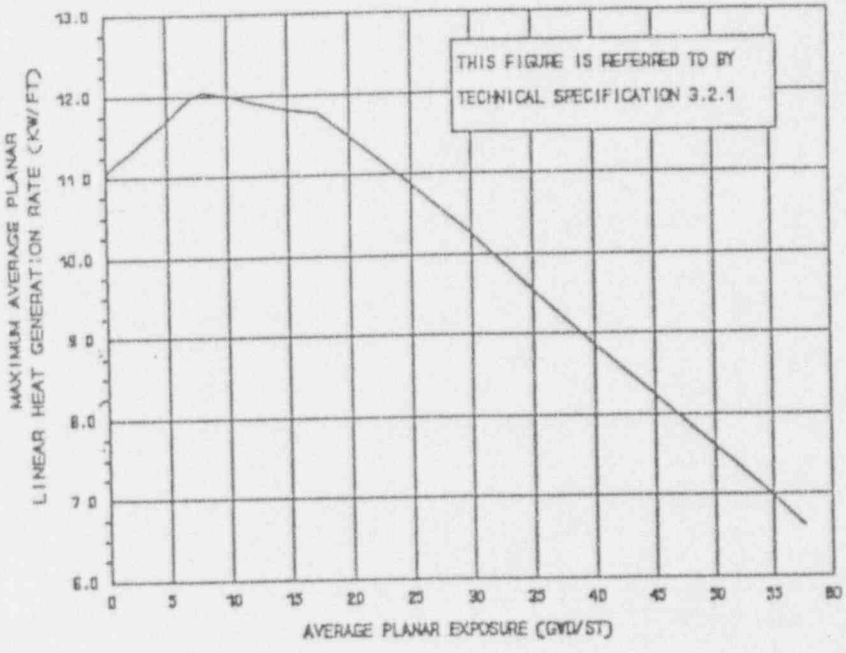
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE
FUEL TYPE P9CUB354-12GZ2 (GE11)



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	11.05	7.0	11.95	25.0	10.89
0.2	11.09	8.0	11.97	30.0	10.27
1.0	11.19	9.0	11.97	35.0	9.55
2.0	11.31	10.0	11.96	40.0	8.87
3.0	11.44	12.5	11.91	45.0	8.24
4.0	11.56	15.0	11.87	50.0	7.62
5.0	11.70	17.5	11.79	55.0	7.00
6.0	11.84	20.0	11.49	57.7	6.62

Figure 2

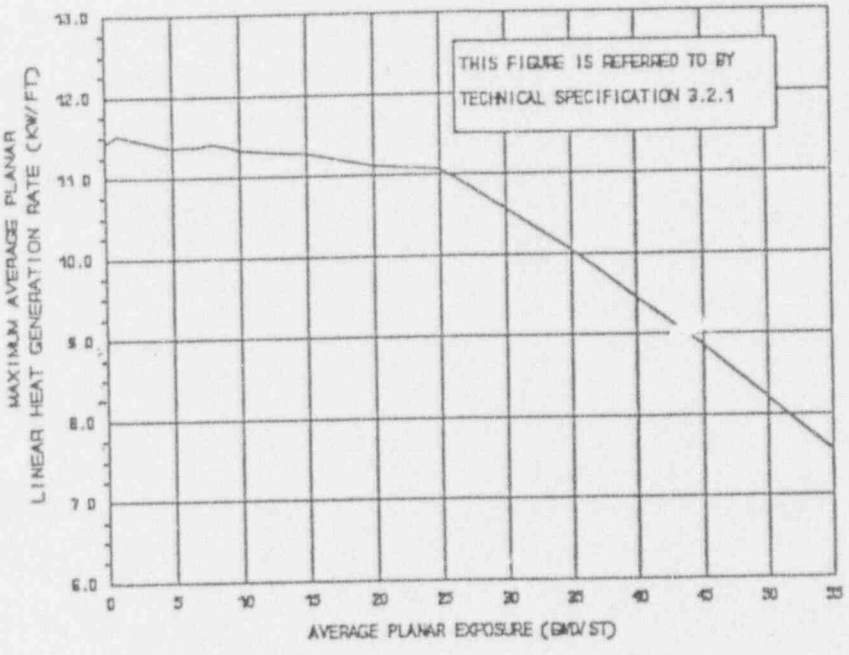
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE
FUEL TYPE P9CUB354-13GZ2 (GE11)



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	11.04	7.0	11.97	25.0	10.87
0.2	11.08	8.0	12.05	30.0	10.25
1.0	11.18	9.0	12.02	35.0	9.54
2.0	11.30	10.0	11.99	40.0	8.86
3.0	11.43	12.5	11.89	45.0	8.22
4.0	11.56	15.0	11.82	50.0	7.60
5.0	11.69	17.5	11.77	55.0	6.99
6.0	11.83	20.0	11.47	57.7	6.61

Figure 3

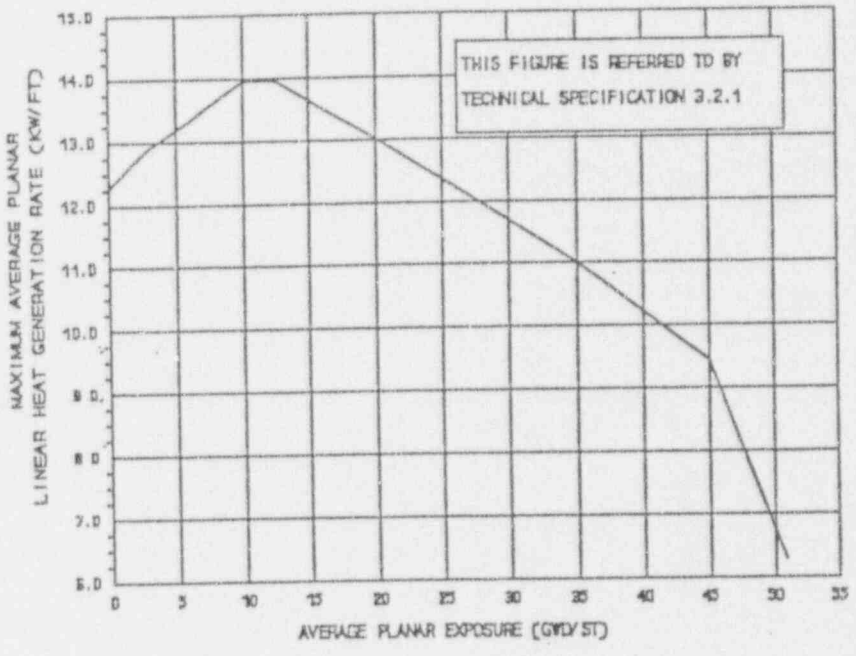
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE P9CUB304-LUA (GE11)



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	11.42	7.0	11.38	25.0	11.07
0.2	11.44	8.0	11.40	30.0	10.56
1.0	11.52	9.0	11.37	35.0	10.05
2.0	11.48	10.0	11.33	40.0	9.45
3.0	11.44	12.5	11.30	45.0	8.85
4.0	11.39	15.0	11.27	50.0	8.21
5.0	11.35	17.5	11.20	55.0	7.56
6.0	11.37	20.0	11.12		

Figure 4

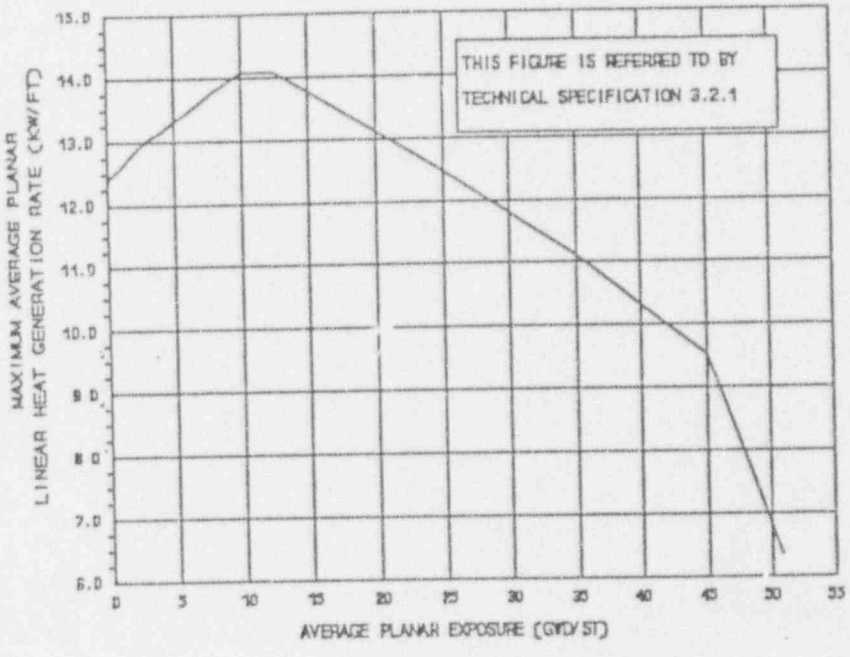
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE ABB SVEA-96 (QFB)



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	12.23	6.0	13.33	20.0	13.01
0.2	12.31	7.0	13.49	25.0	12.36
1.0	12.47	8.0	13.65	35.0	11.01
2.0	12.70	9.0	13.81	45.0	9.44
3.0	12.89	10.0	13.95	50.9	6.29
4.0	13.03	12.5	13.95		
5.0	13.18	15.0	13.64		

Figure 5

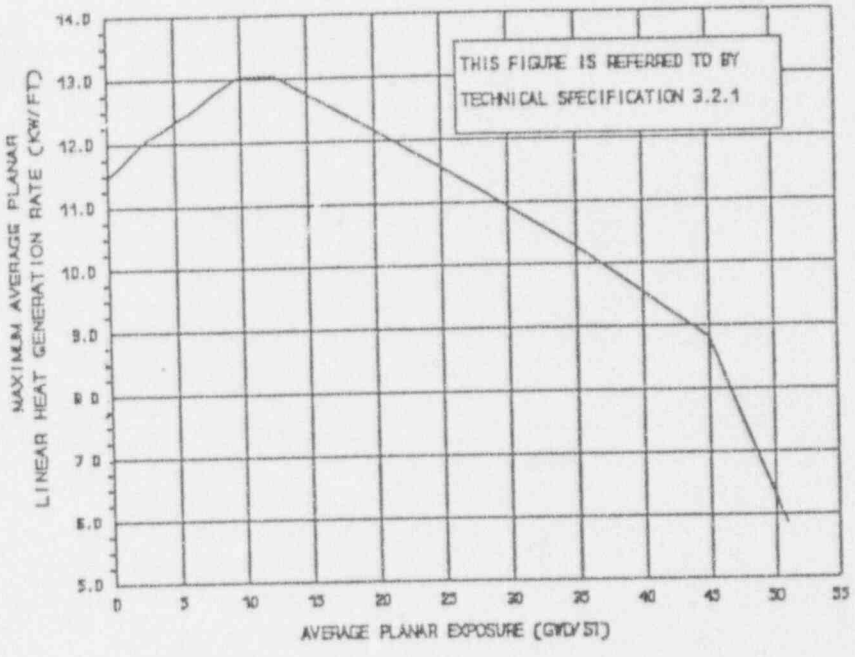
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE SPC 9x9-9X + (QFB)



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	12.34	6.0	13.46	20.0	13.13
0.2	12.42	7.0	13.62	25.0	12.47
1.0	12.58	8.0	13.78	35.0	11.11
2.0	12.82	9.0	13.94	45.0	9.53
3.0	13.01	10.0	14.08	50.9	6.35
4.0	13.15	12.5	14.08		
5.0	13.31	15.0	13.77		

Figure 6

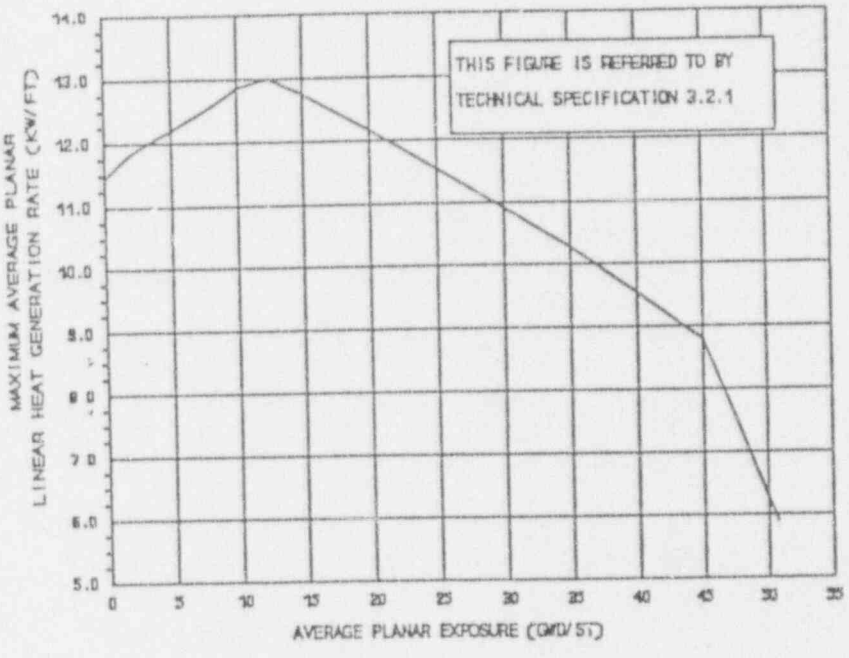
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CWB325-9GZ2 (GE9B, GE8x8NB)



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	11.43	6.0	12.46	20.0	12.16
0.2	11.50	7.0	12.61	25.0	11.55
1.0	11.65	8.0	12.76	35.0	10.29
2.0	11.87	9.0	12.91	45.0	8.82
3.0	12.05	10.0	13.04	50.9	5.88
4.0	12.18	12.5	13.04		
5.0	12.32	15.0	12.75		

Figure 7

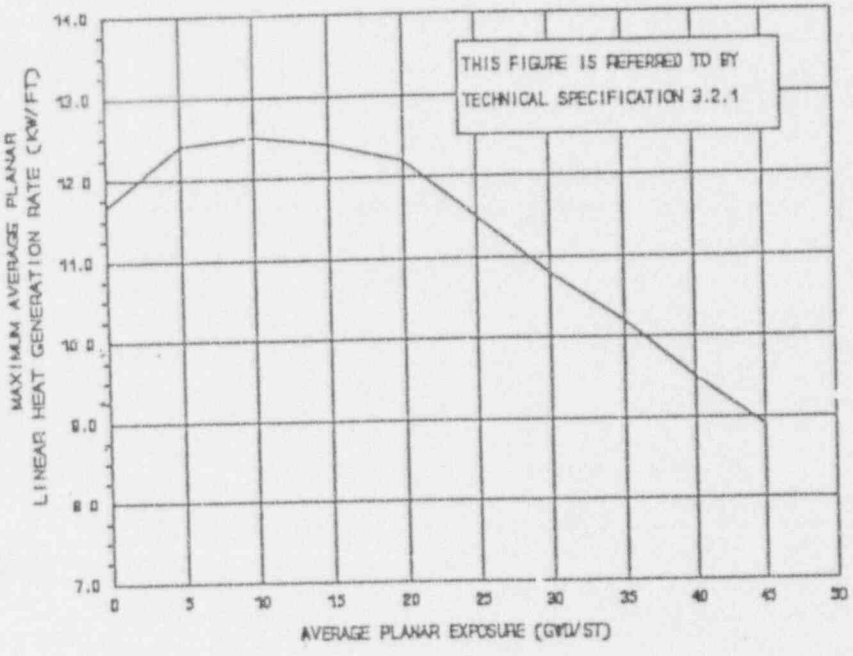
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CWB325-9GZ1 (GE9B, GE8x8NB)



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	11.42	6.0	12.31	20.0	12.16
0.2	11.48	7.0	12.43	25.0	11.54
1.0	11.63	8.0	12.56	35.0	10.29
2.0	11.83	9.0	12.70	45.0	8.79
3.0	11.95	10.0	12.86	50.8	5.89
4.0	12.07	12.5	12.99		
5.0	12.19	15.0	12.75		

Figure 8

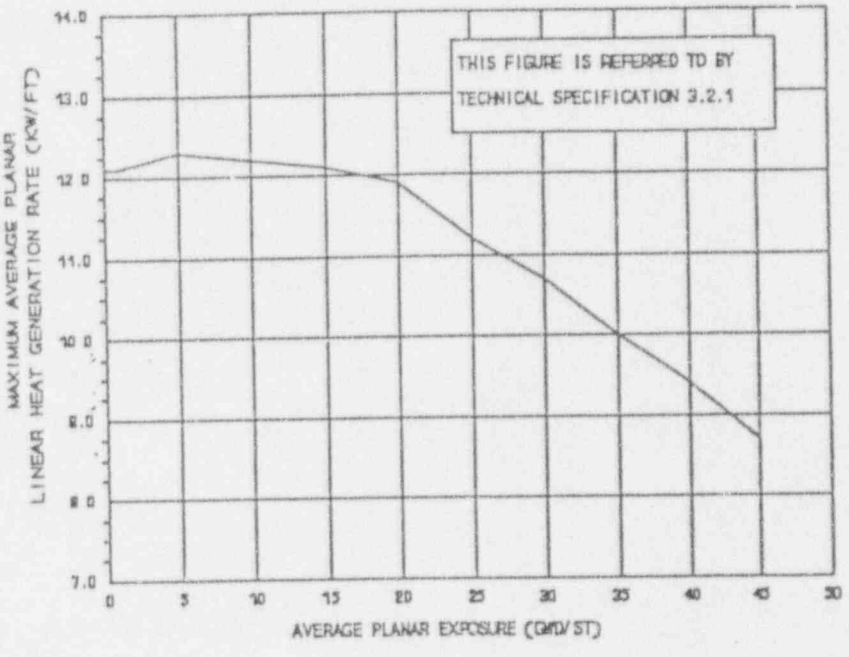
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CIB278 (GE7B, BP8x8R)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.2	11.7	15.0	12.4	35.0	10.2
1.0	11.8	20.0	12.2	40.0	9.5
5.0	12.4	25.0	11.5	45.0	8.9
10.0	12.5	30.0	10.8		

Figure 9

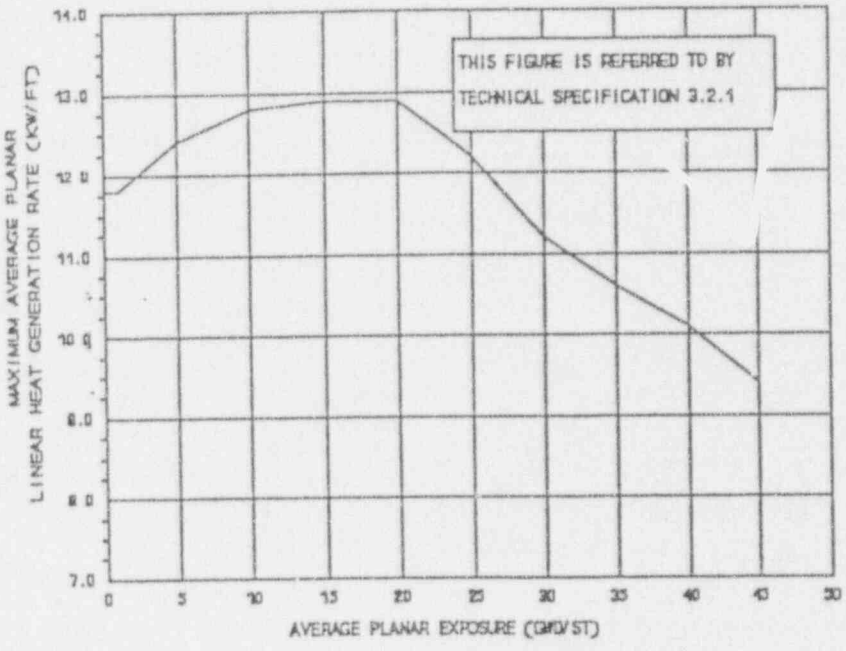
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CIB248 (GE7B, BP8x8R)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.2	12.1	15.0	12.1	35.0	10.0
1.0	12.1	20.0	11.9	40.0	9.4
5.0	12.3	25.0	11.2	45.0	8.7
10.0	12.2	30.0	10.7		

Figure 10

MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE
FUEL TYPE P8CIB163 (GE7B, BP8x8R)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.2	11.8	15.0	12.9	35.0	10.6
1.0	11.8	20.0	12.9	40.0	10.1
5.0	12.4	25.0	12.2	45.0	9.4
10.0	12.8	30.0	11.2		

FIGURE 11

MCPR vs. TAU
FUEL TYPE GE11 (INCLUDING LUA304)
(INCREASED CORE FLOW AND FEEDWATER TEMPERATURE REDUCTION)

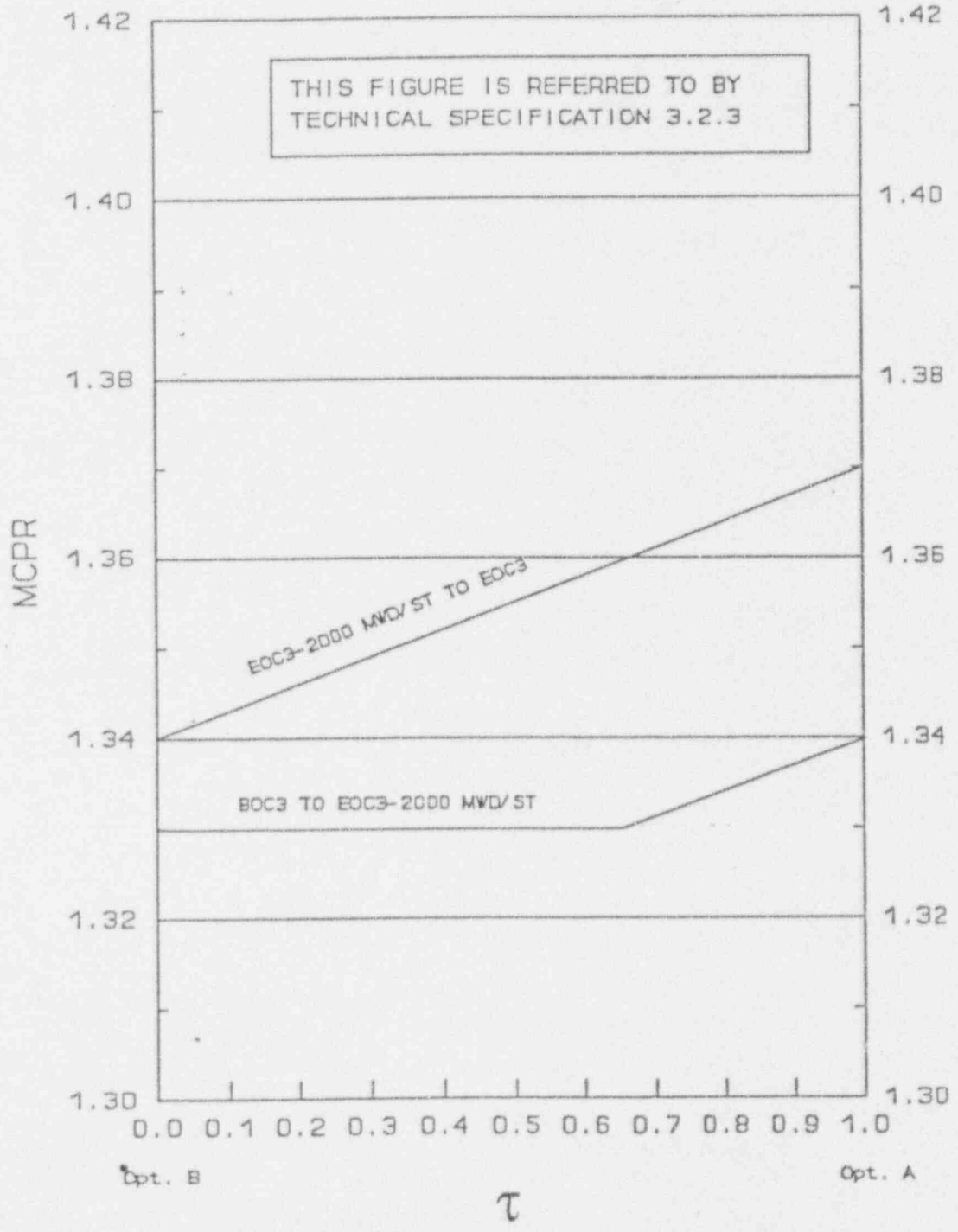


FIGURE 12

MCPR vs. TAU
FUEL TYPE GE11 (INCLUDING LUA304)
(TBVOOS)

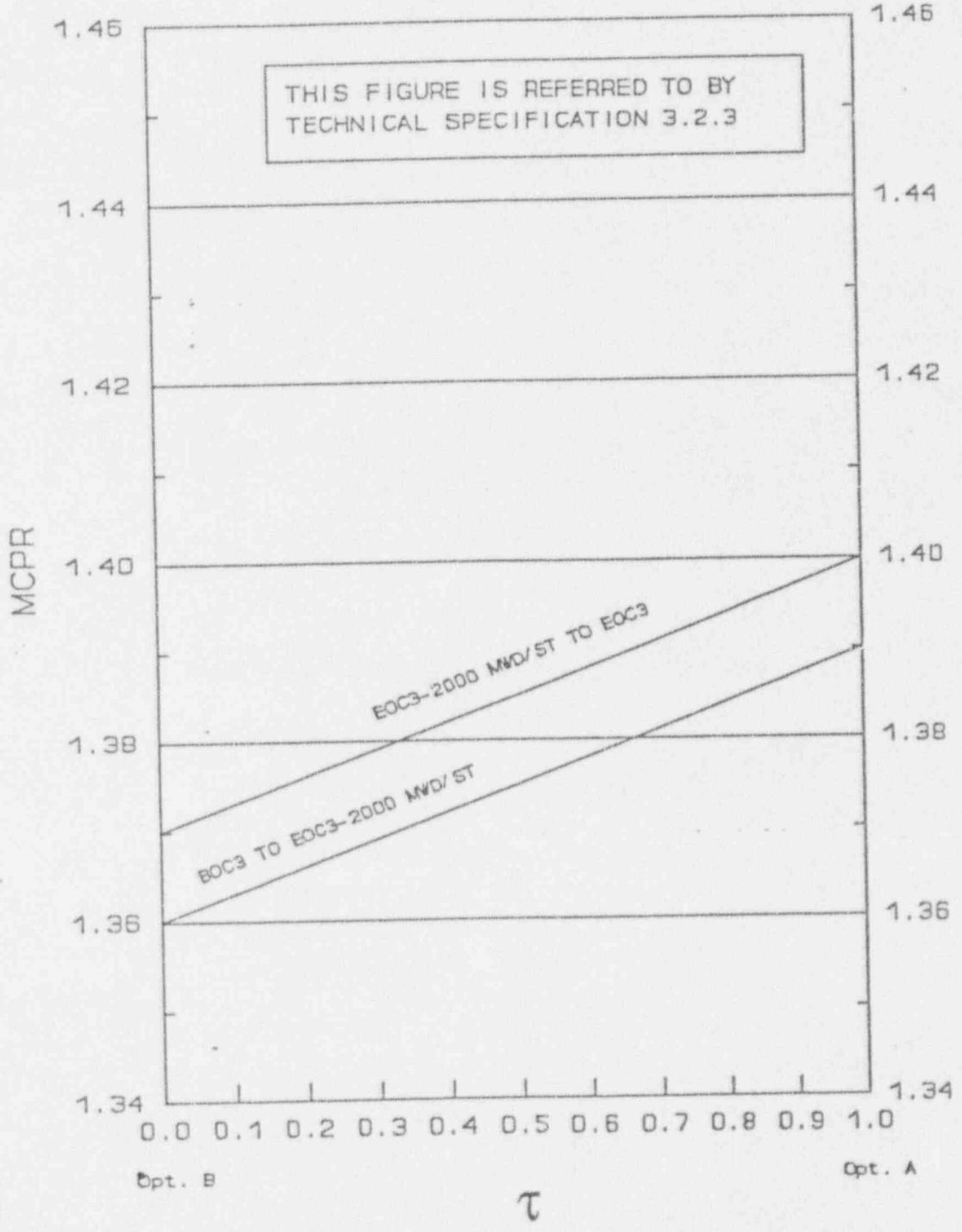


FIGURE 13

MCPR vs. TAU
FUEL TYPE GE11 (INCLUDING LUA304)
(WITHOUT RPT)

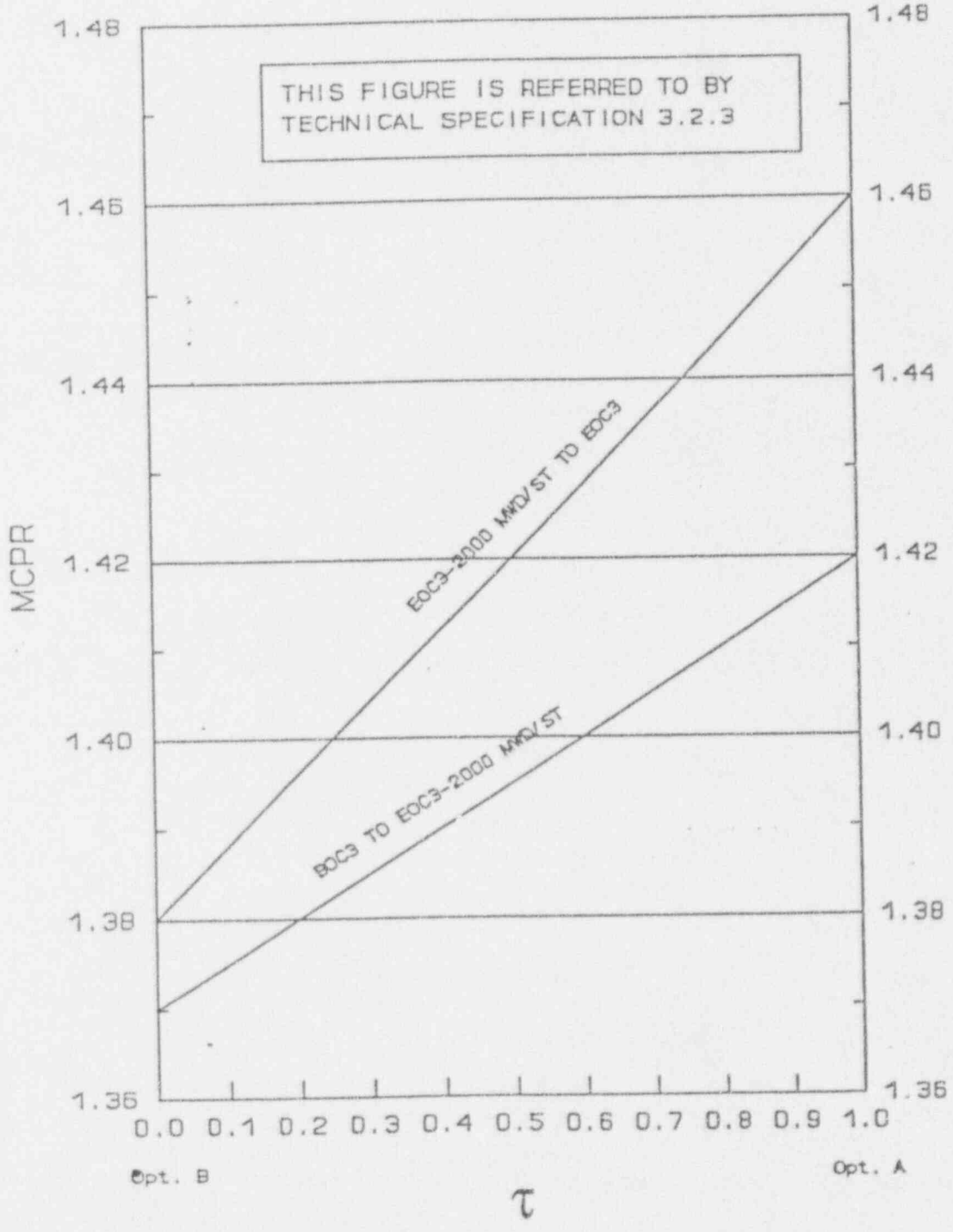


FIGURE 14

MCPR vs. TAU
FUEL TYPES GE8X8NB (GE9B) and BP8X8R (GE7B)
(INCREASED CORE FLOW AND FEEDWATER TEMPERATURE
REDUCTION, and TBVOOS, and WITHOUT RPT)

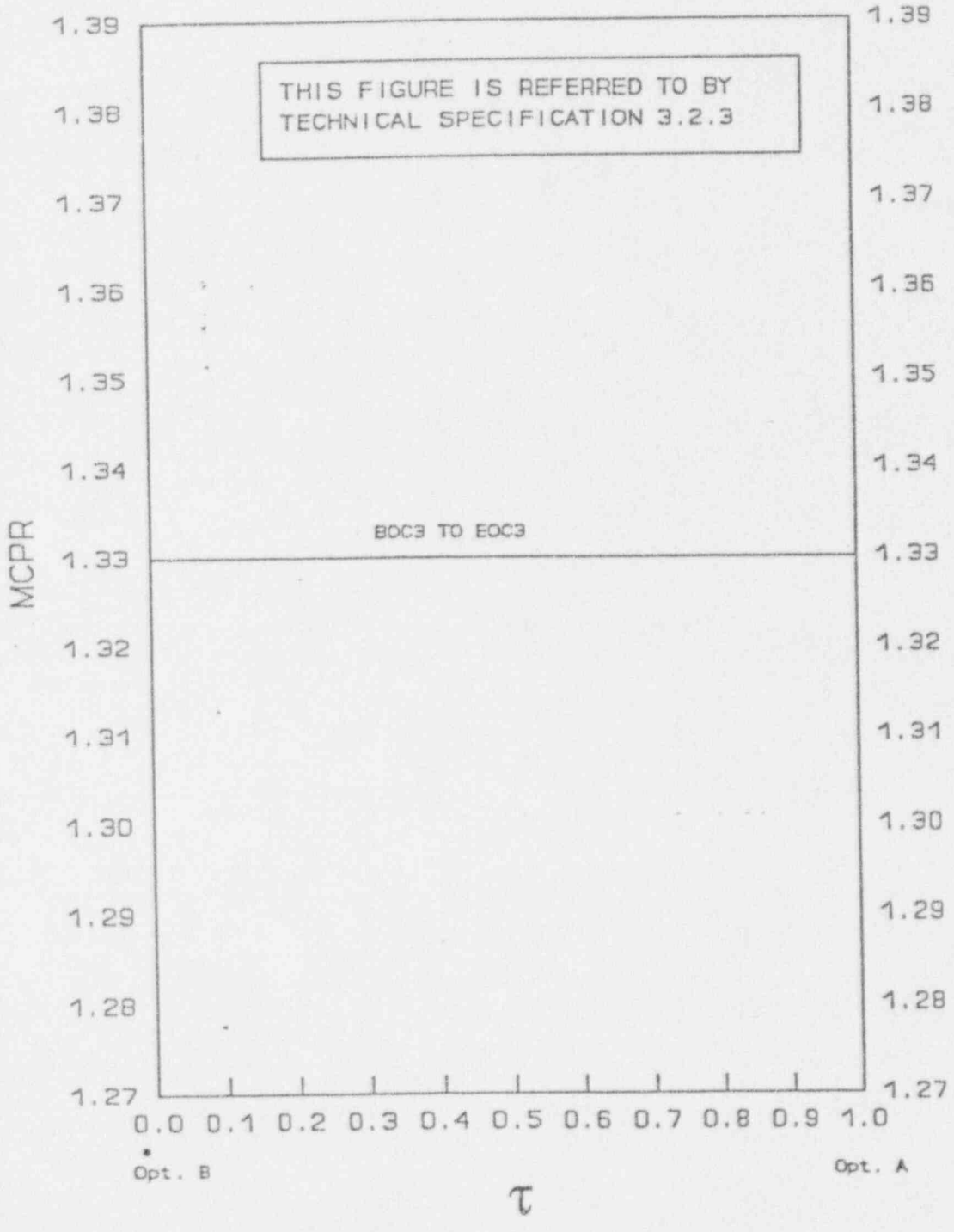


FIGURE 15

MCPR vs. TAU
FUEL TYPE ABB SVEA-96 QFB
(INCREASED CORE FLOW AND FEEDWATER TEMPERATURE REDUCTION)

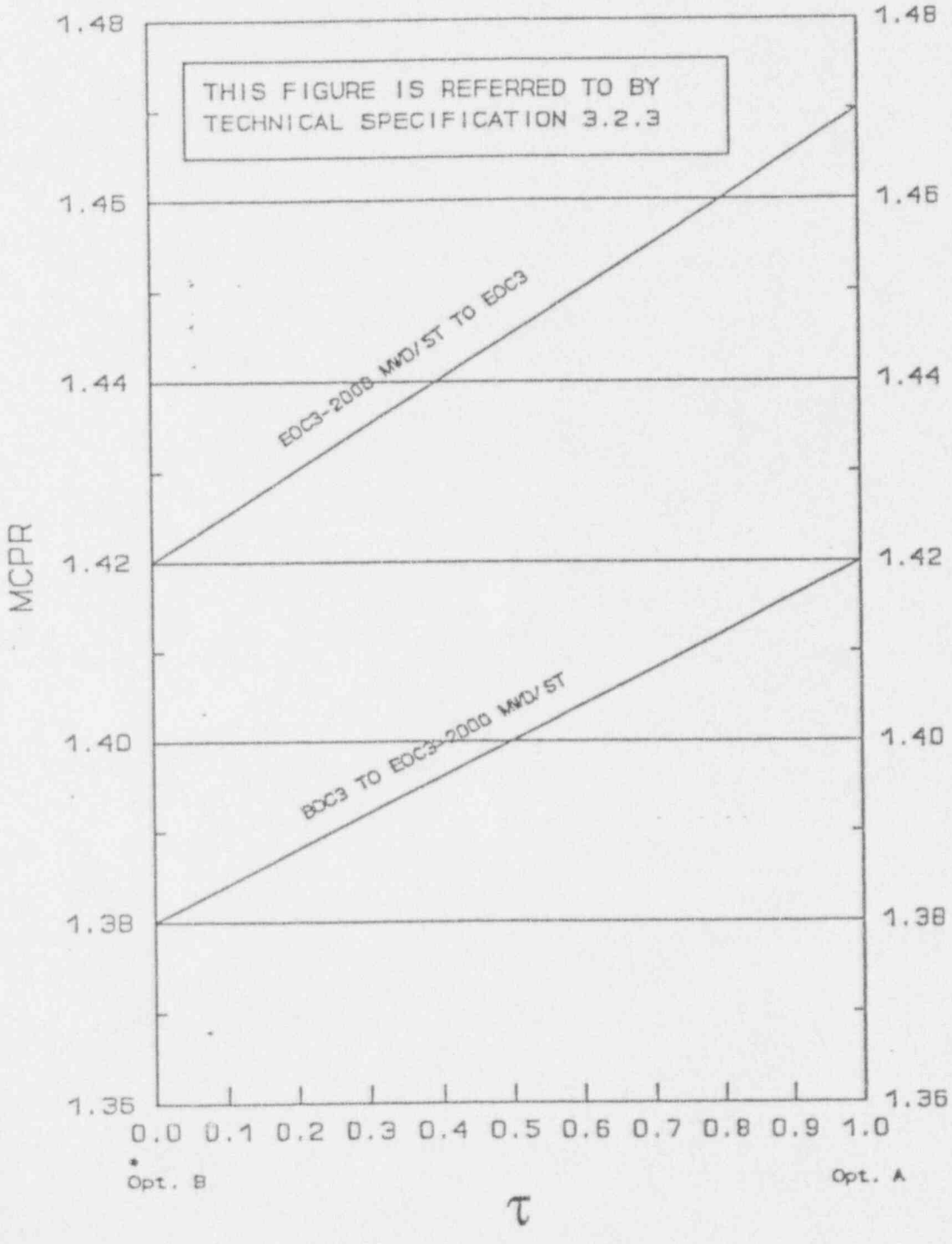


FIGURE 16

MCPR vs. TAU
FUEL TYPE ABB SVEA-96 QFB
(without RPT)

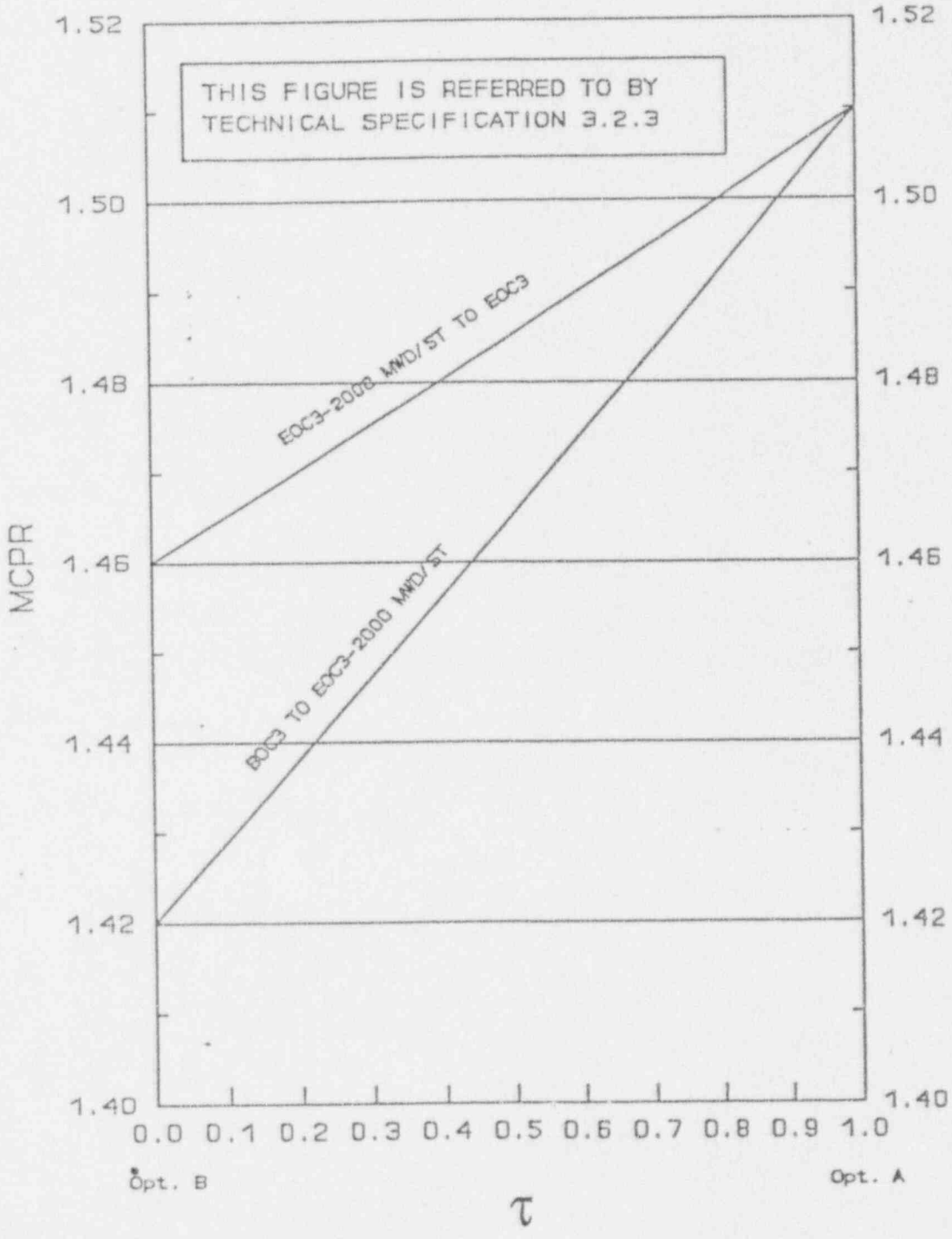


FIGURE 17

MCPR vs. TAU
FUEL TYPE ABB SVEA-96 QFB
(TBVOOS)

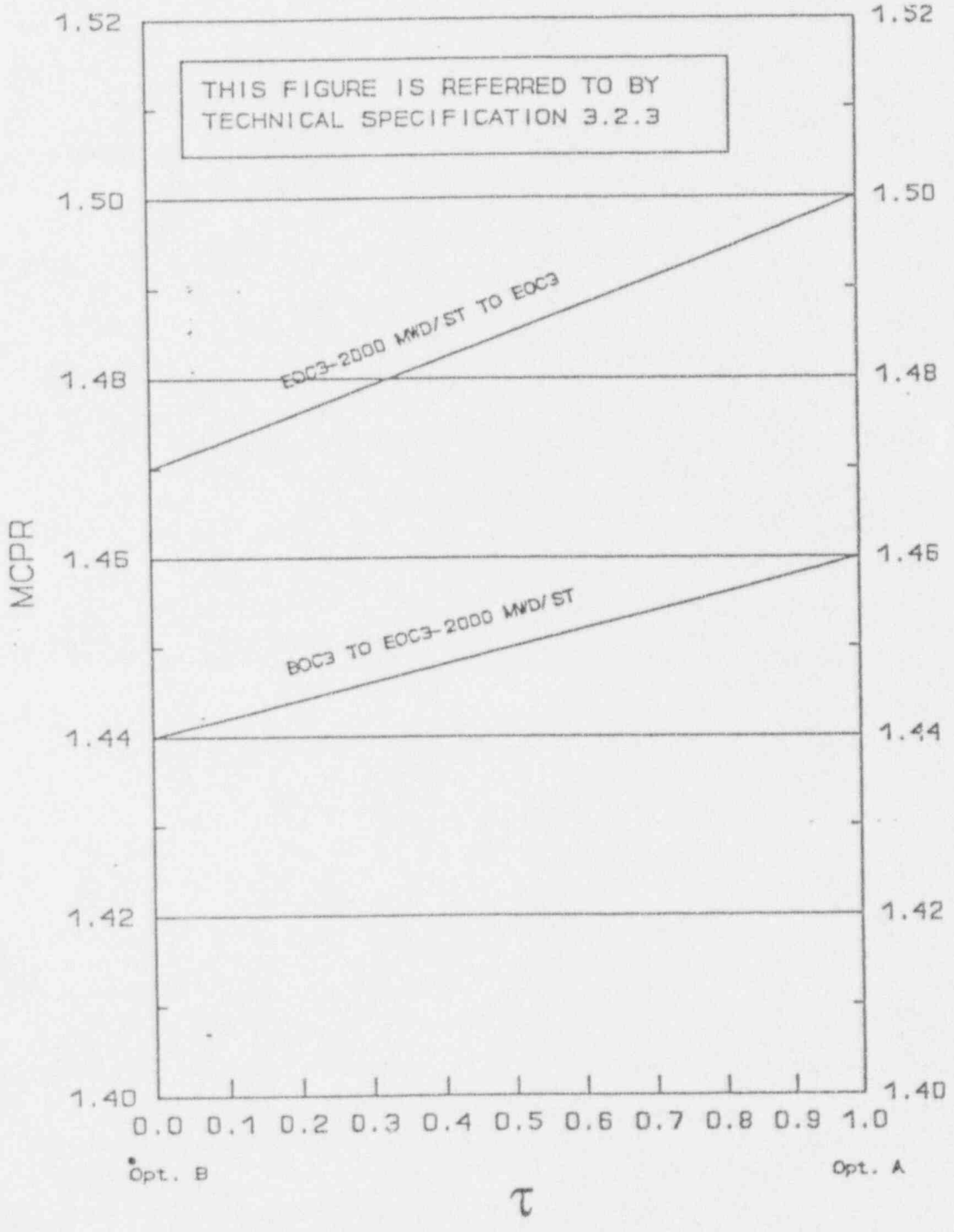


FIGURE 18

MCPR vs. TAU
FUEL TYPE SPC 9x9-9X + QFB
(INCREASED CORE FLOW AND FEEDWATER TEMPERATURE REDUCTION)

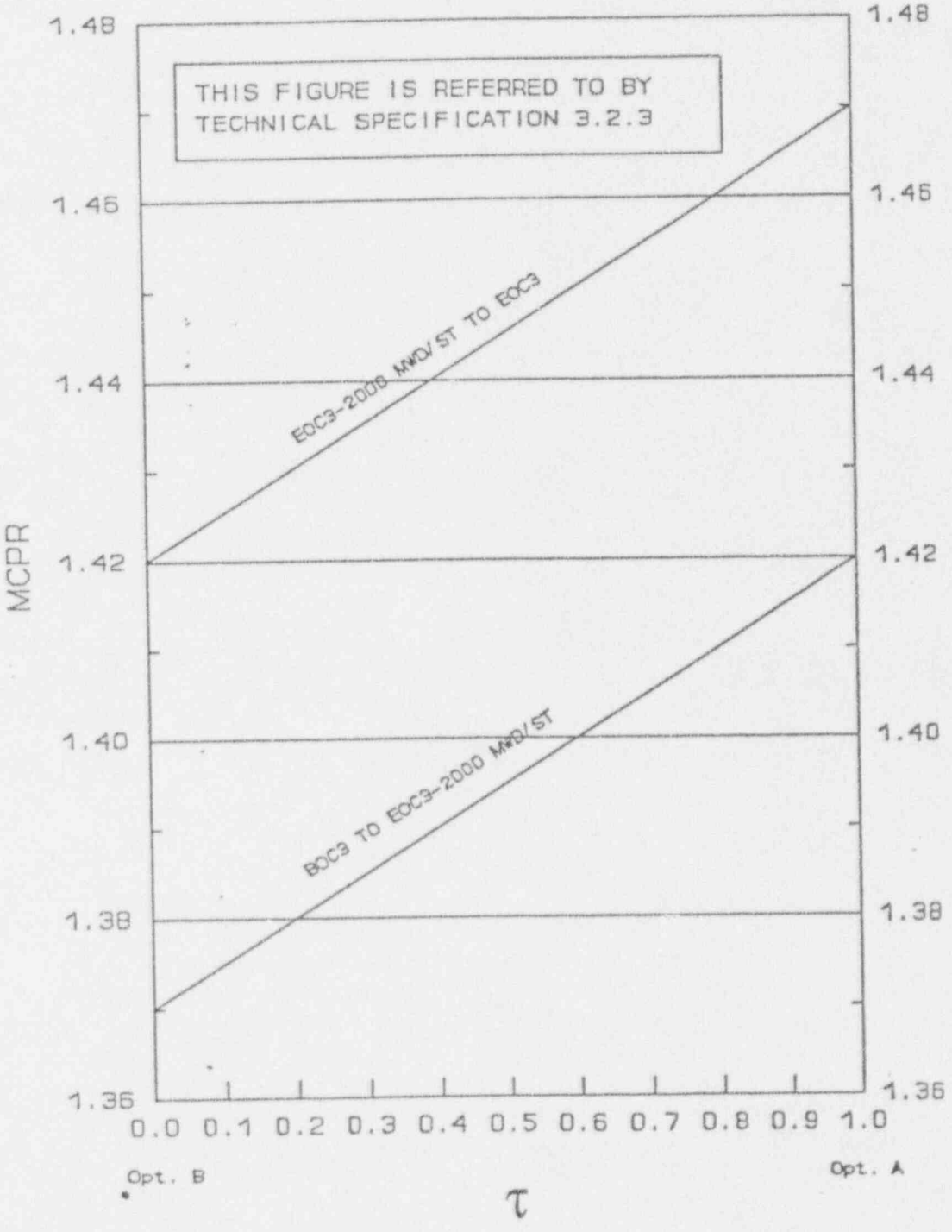


FIGURE 19

MCPR vs. TAU
FUEL TYPE SPC 9x9-9X + QFB
(WITHOUT RPT)

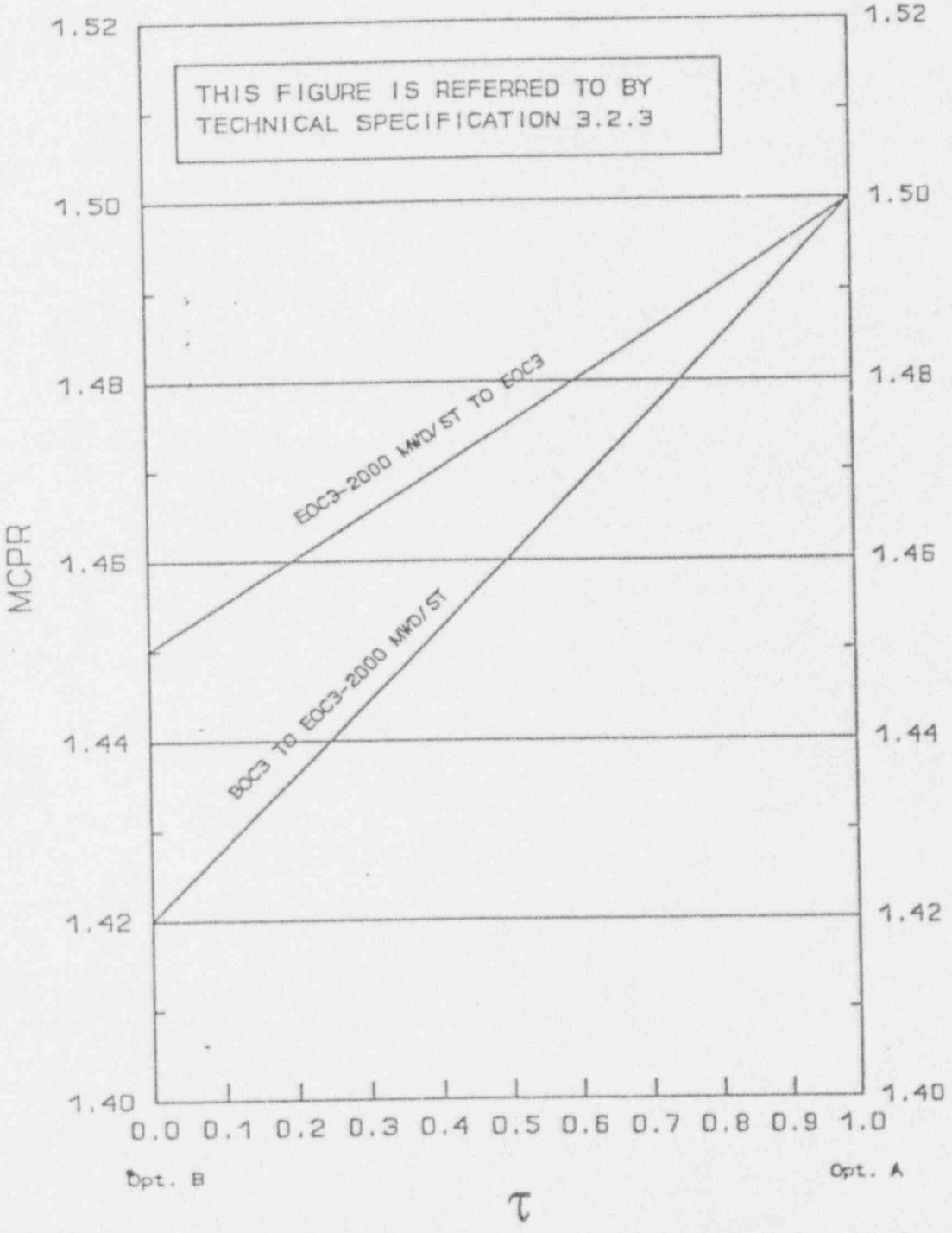


FIGURE 20

MCPR vs. TAU
FUEL TYPE SPC 9x9-9X + QFB
(TBVOOS)

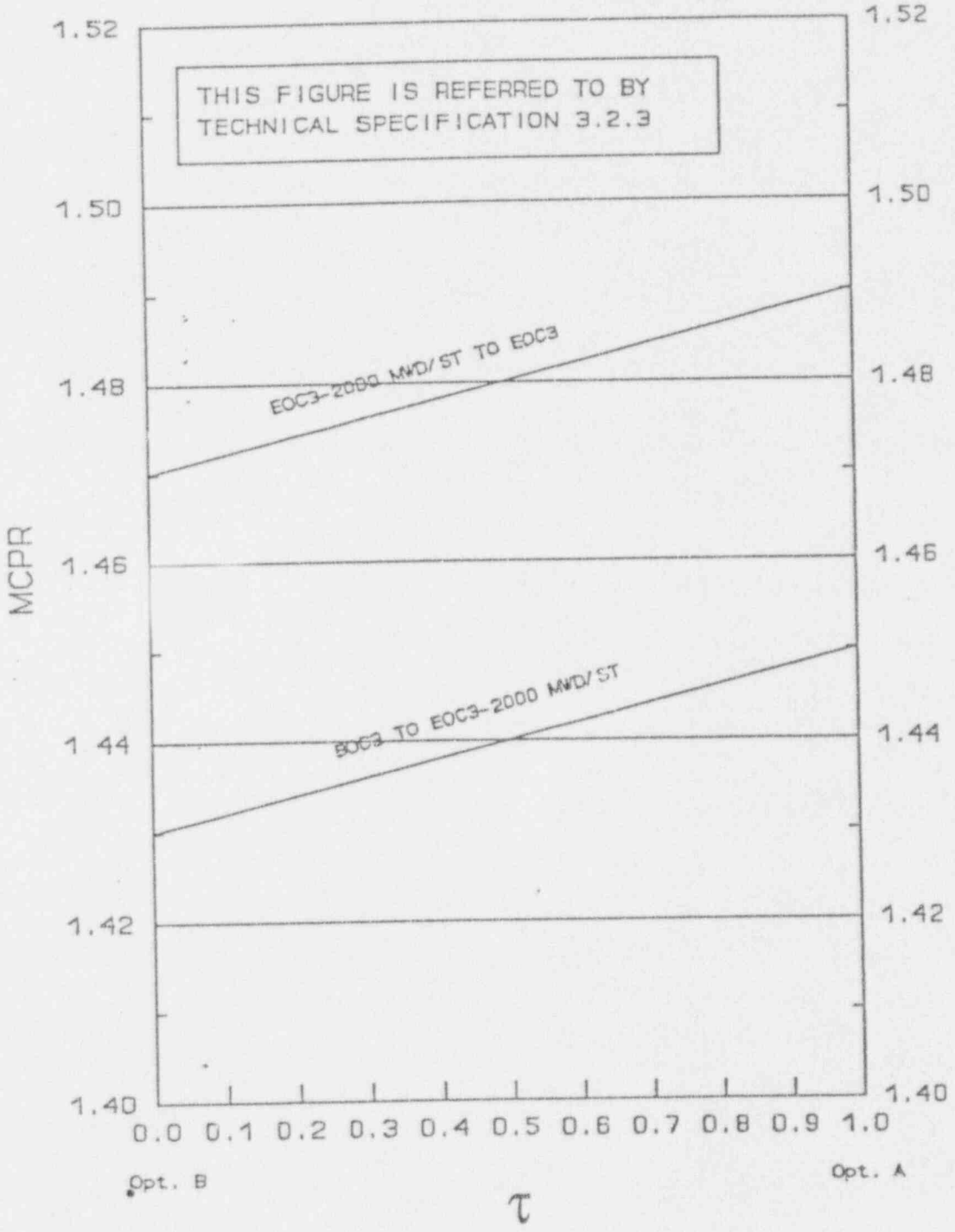


FIGURE 21

K_f Factor vs. Core Flow

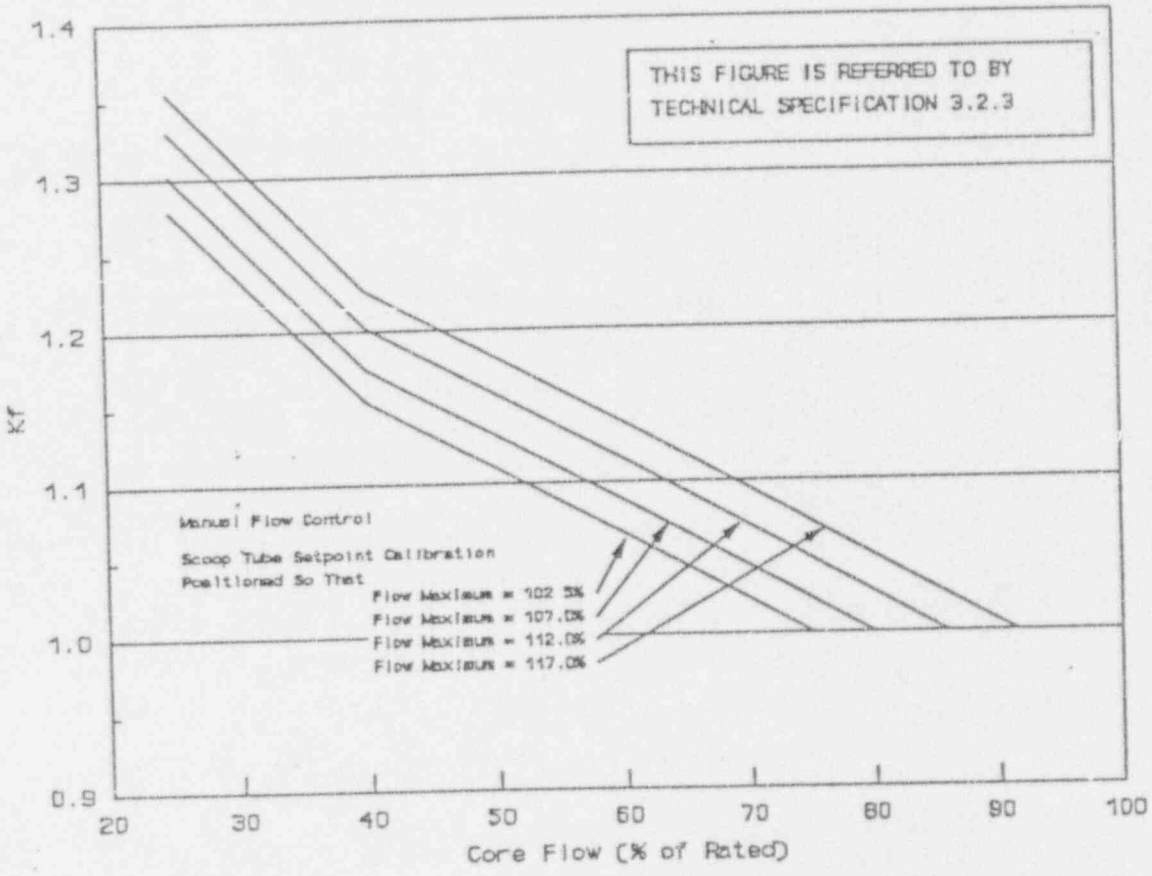


TABLE 1

SINGLE LOOP REDUCTION FACTORS

0.82	GE11 fuel
0.89	GE7B fuel
0.88	GE9B and SPC 9x9-9X + fuel
0.82	ABB SVEA-96 fuel

TABLE 2

ROD BLOCK MONITOR SETPOINT

N = 110

TABLE 3

LINEAR HEAT GENERATION RATE LIMITS

FUEL TYPE	MAXIMUM VALUE
GE7B	13.4 kW/ft
GE9B	14.4 kW/ft
GE11	14.4 kW/ft
ABB SVEA-96 (QFB)	17.7 kW/ft
SPC 9x9-9X + (QFB)	15.8 kW/ft

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	0.1 sec
Maximum time after generation of a turbine bypass valve flow signal for bypass valve position to reach 80% of full stroke (includes the above delay time)	0.3 sec

MINIMUM REQUIRED BYPASS VALVES TO MAINTAIN SYSTEM OPERABILITY

Number of valves = 7