PL-NF-97-005
Rev. 3

Susquehanna SES
Unit 2 Cycle 9

CORE OPERATING LIMITS REPORT

Nuclear Fuels
Engineering

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CORE OPERATING LIMITS REPORT
REVISION DESCRIPTION INDEX

Rev. No.	Affected Sections	Description/Purpose of Revision
3		Revised MCPR Operating Limits The Two Loop BOC to EOC power and flow dependent MCPR Operating Limits were revised, and the Single Loop MCPR Operating Limits were removed from the COLR. The revised MCPR Operating Limits are documented in Reference 1.
	1.0	Removed Single Loop from the core operating limits included in this report.
	2.0	Revised Figures 2.2-1, 2.2-2, 2.2-3 to correct a typographical error on the figures (i.e., "PERMISSABLE" to "PERMISSIBLE")
	4.0	Revised MCPR OL Figures 4.2-1A, 4.2-2A, and 4.2-4. MCPR OL Figures 4.2-3A and 4.2-3B were removed, and Figure 4.2-3 was added. Table 4.3-1 was revised to include a new set of Realistic Scram Insertion Times.
	5.0	Revised Figures 5.2-1, 5.2-2, 5.2-3 to correct a typographical error on the figures (i.e., "PERMISSABLE" to "PERMISSIBLE")
	6.0	Removed Single Loop operating limits and added a note to the section stating Single Loop operation is prohibited.
	7.0	Updated Reference 1.

SUSQUEHANNA SES UNIT 2 CYCLE 9

CORE OPERATING LIMITS REPORT

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Pennsylvania Power & Light Company

SUSQUEHANNA STEAM ELECTRIC STATION
Unit 2 Cycle 9
CORE OPERATING LIMITS REPORT

1.0 INTRODUCTION

This CORE OPERATING LIMITS REPORT for Susquehanna Unit 2 Cycle 9 is prepared in accordance with the requirements of Susquehanna Unit 2, Technical Specification 6.9.3. As required by Technical Specifications 6.9.3.2 and 6.9.3.3, the core operating limits presented herein were developed using NRC-approved methods and are established such that all applicable limits of the plant safety analysis are met. Results from the reload analysis for Unit 2 Cycle 9 are documented in Reference 1.

The following cycle specific core operating limits are included in this report:

a. Average Planar Linear Heat Generation Rate (APLHGR)
(Technical Specification 3.2.1)

b. Linear Heat Generation Rate for Average Power
Range Monitor (APRM) Setpoints
(Technical Specification 3.2.2)

c. Minimum Critical Power Ratio (MCPR)
(Technical Specification 3.2.3)

d. Linear Heat Generation Rate (LHGR)
(Technical Specification 3.2.4)

2.0 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

2.1 Technical Specification Reference

Technical Specification 3.2.1

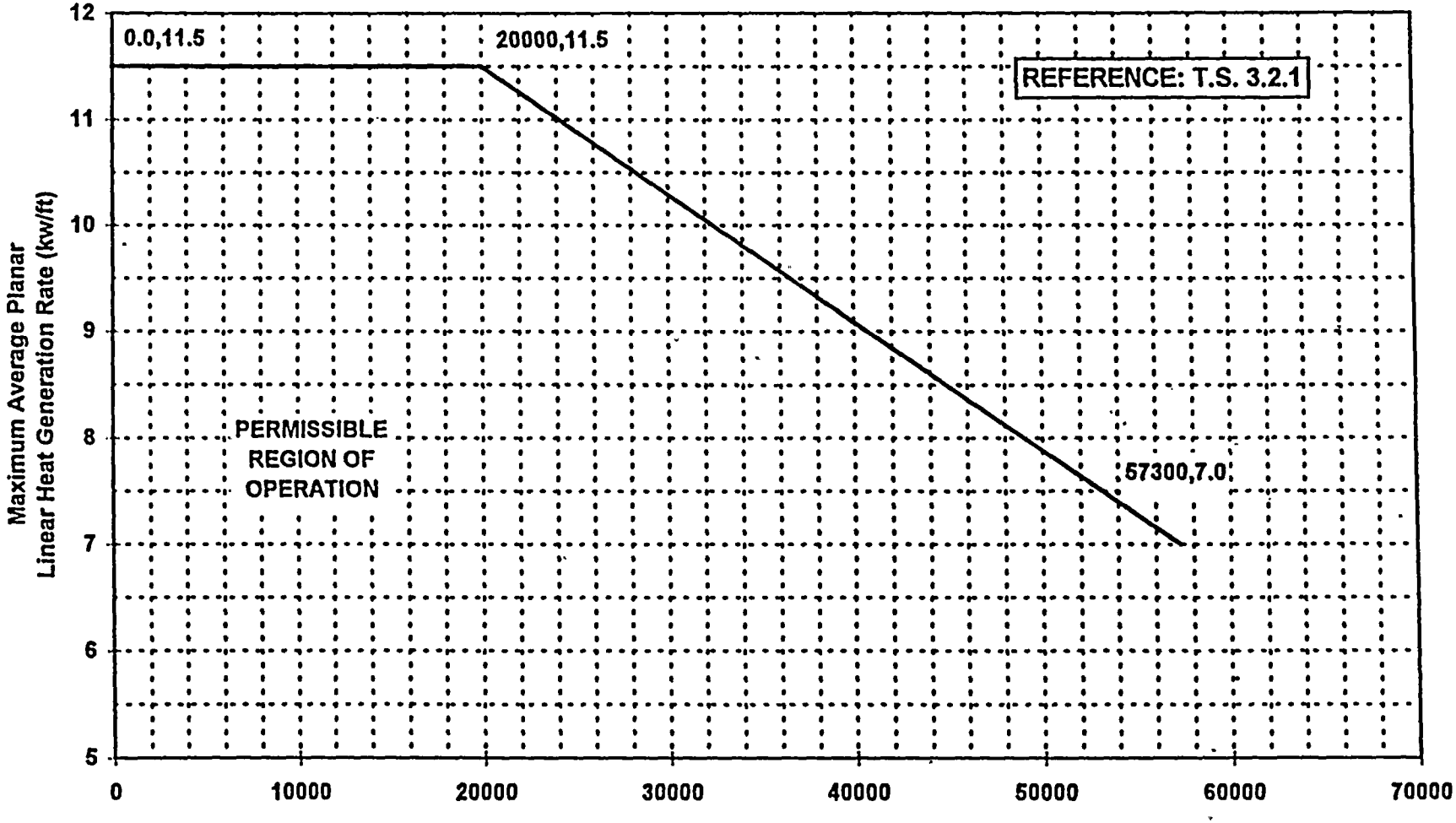
2.2 Description

The APLHGRs for SPC 9x9-2 fuel shall not exceed the limit shown in Figure 2.2-1.

The APLHGRs for SPC ATRIUM™-10 fuel shall not exceed the limit shown in Figure 2.2-2

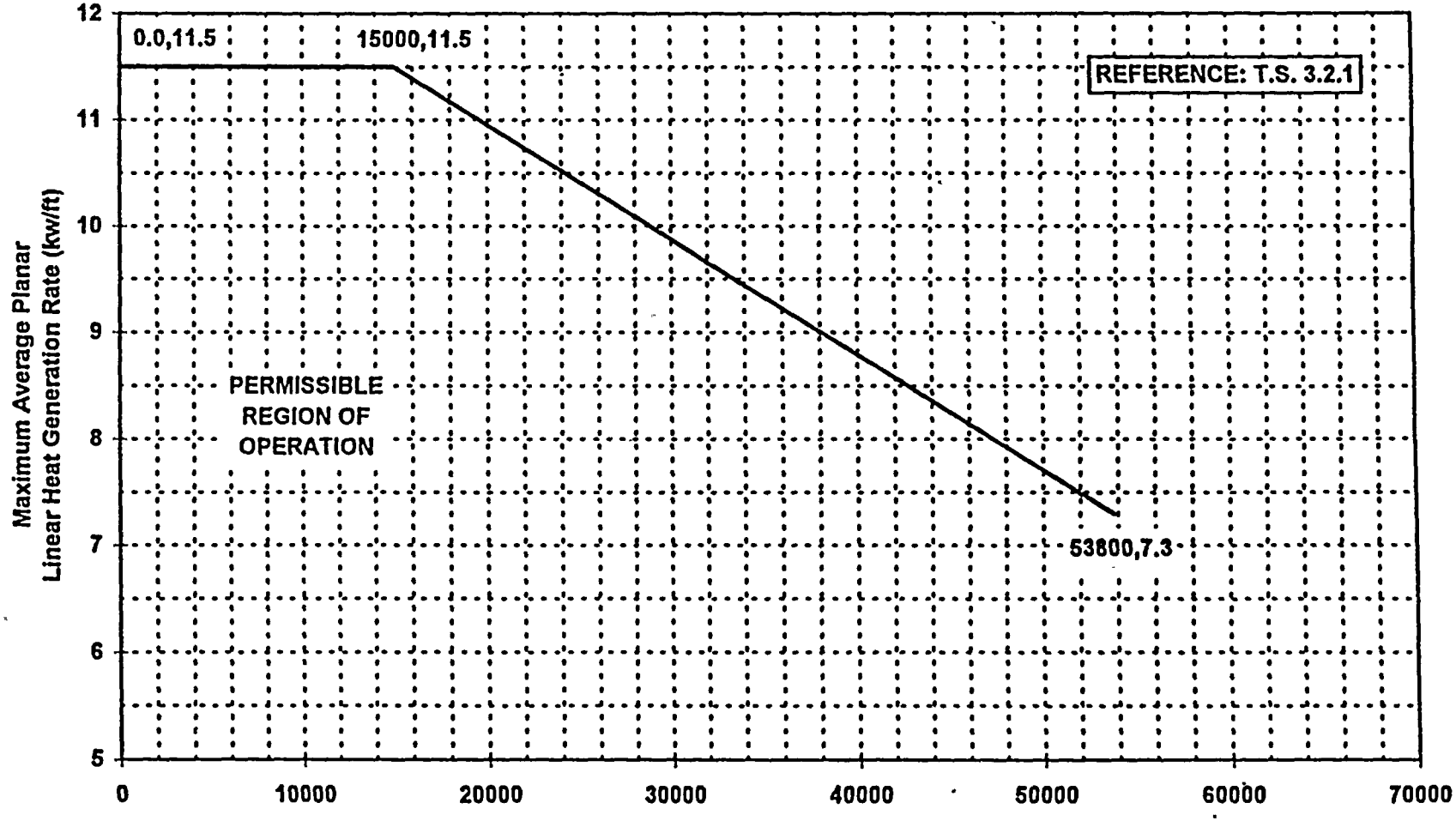
The APLHGRs for GE12 fuel shall not exceed the limit shown in Figure 2.2-3.

SSES UNIT 2 CYCLE 9



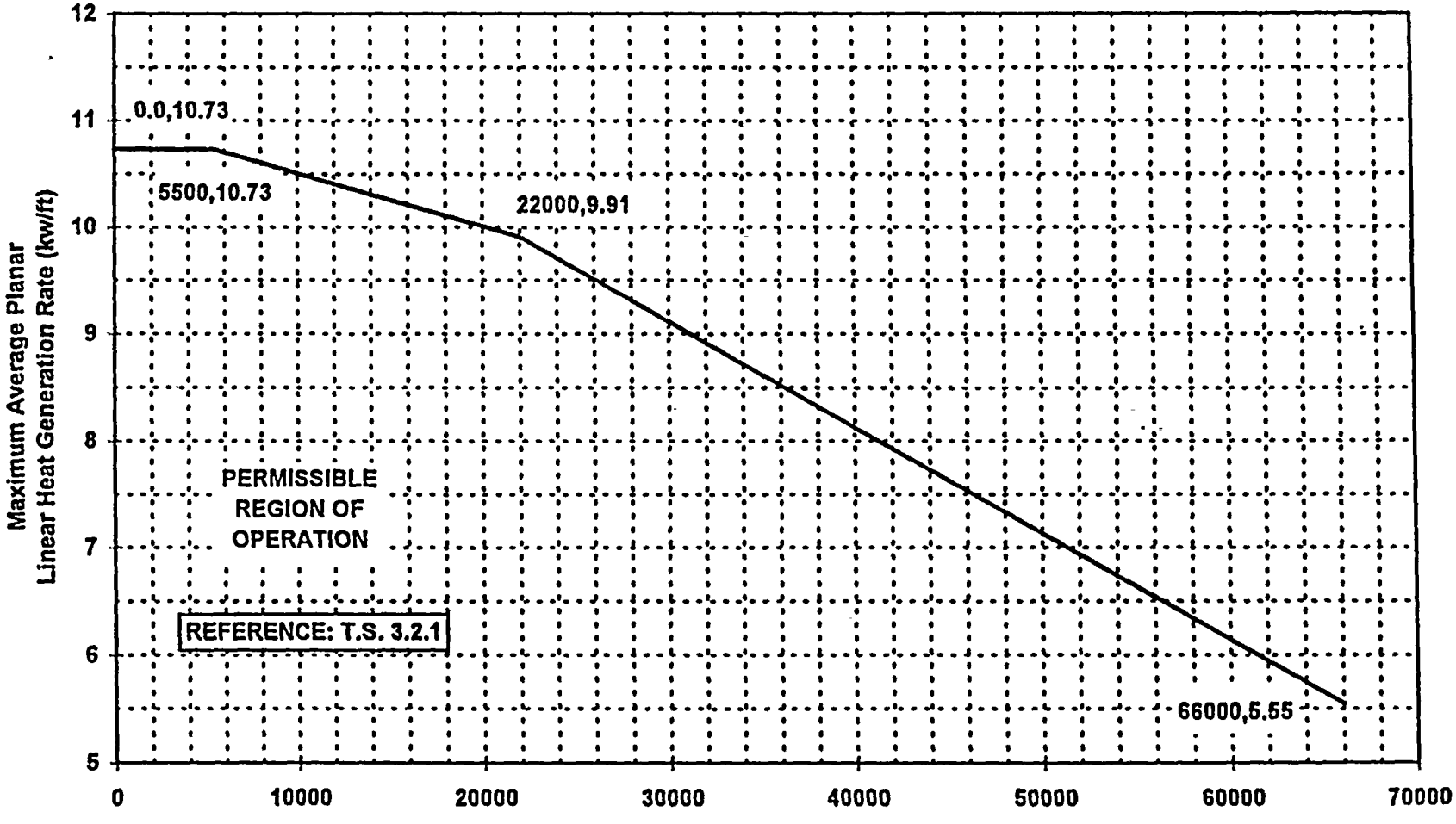
MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
SPC 9X9-2 FUEL
FIGURE 2.2-1

SSES UNIT 2 CYCLE 9



MAXIMUM AVERAGE PLANAR LINEAR HEAT
GENERATION RATE (MAPLHGR) VERSUS
AVERAGE PLANAR EXPOSURE
SPC ATRIUM™ -10 FUEL
FIGURE 2.2-2

SSES UNIT 2 CYCLE 9



MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE

GE12

FIGURE 2.2-3

3.0. LINEAR HEAT GENERATION RATE FOR APRM SETPOINTS

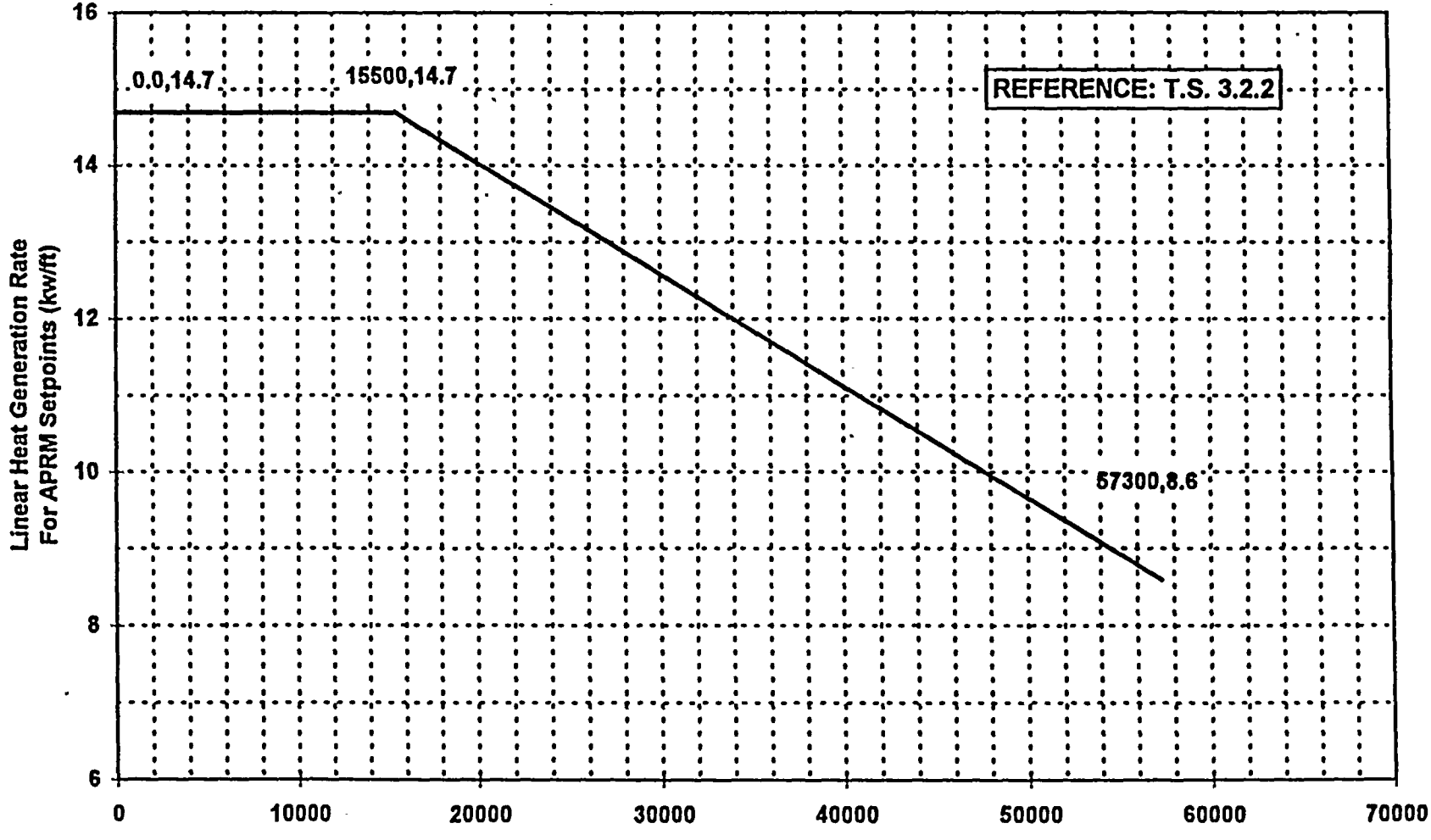
3.1 Technical Specification Reference

Technical Specification 3.2.2.

3.2 Description

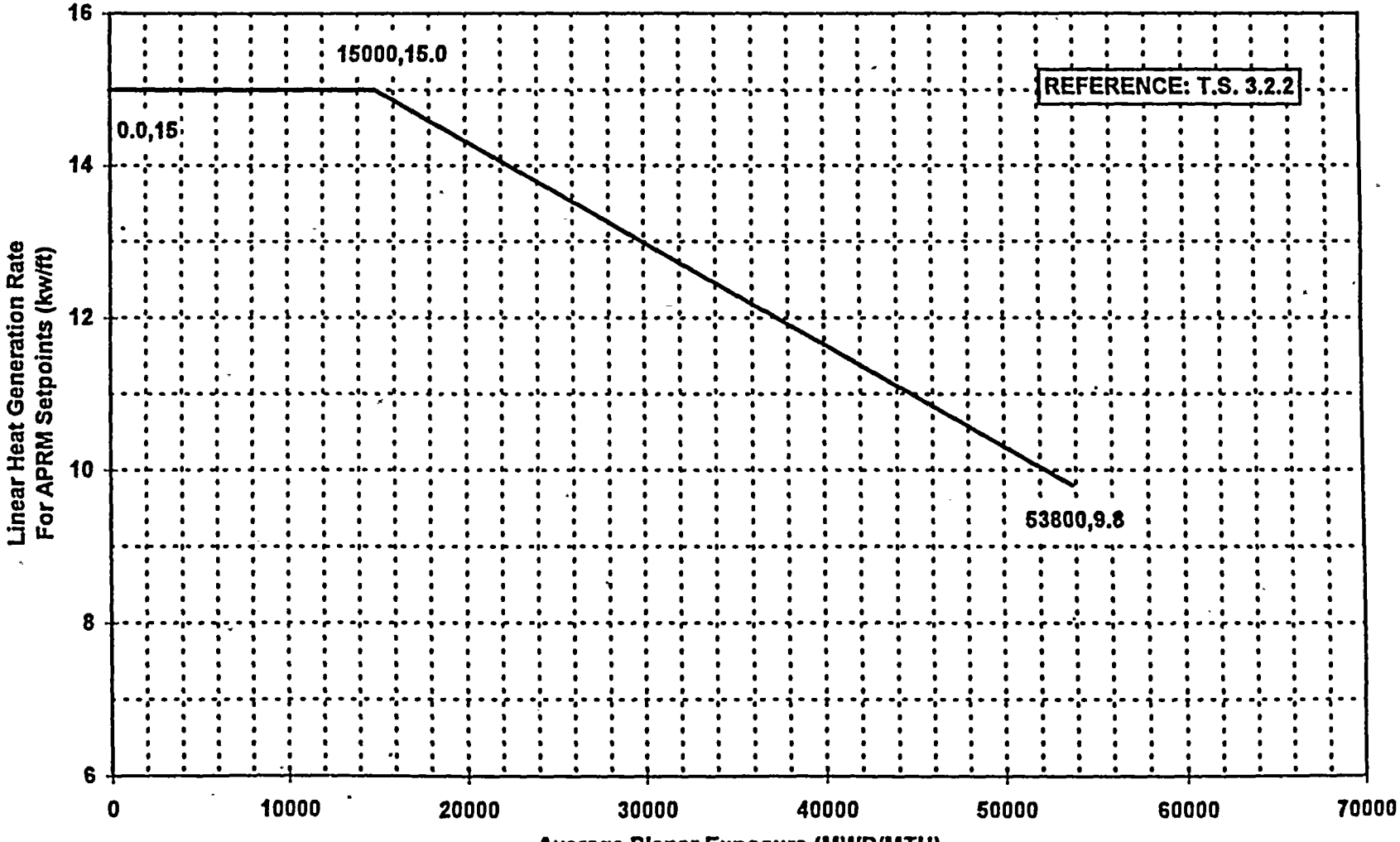
The APRM flow biased simulated thermal power-upscale scram trip setpoint and flow biased neutron flux-upscale control rod block trip setpoint shall be established according to the relationships specified in Technical Specification 3.2.2. For those relationships, the maximum Fraction of Limiting Power Density (FLPD) for use in determination of "T", is the actual LHGR divided by the LHGR limit. The LHGR limit for SPC 9x9-2 fuel shall be taken from Figure 3.2-1. The LHGR limit for SPC ATRIUM™-10 fuel shall be taken from Figure 3.2-2. The LHGR limit for GE12 fuel shall be taken from Figure 3.2-3. The final value of "T" shall be the lesser of the "T" values calculated for each fuel type.

SSES UNIT 2 CYCLE 9



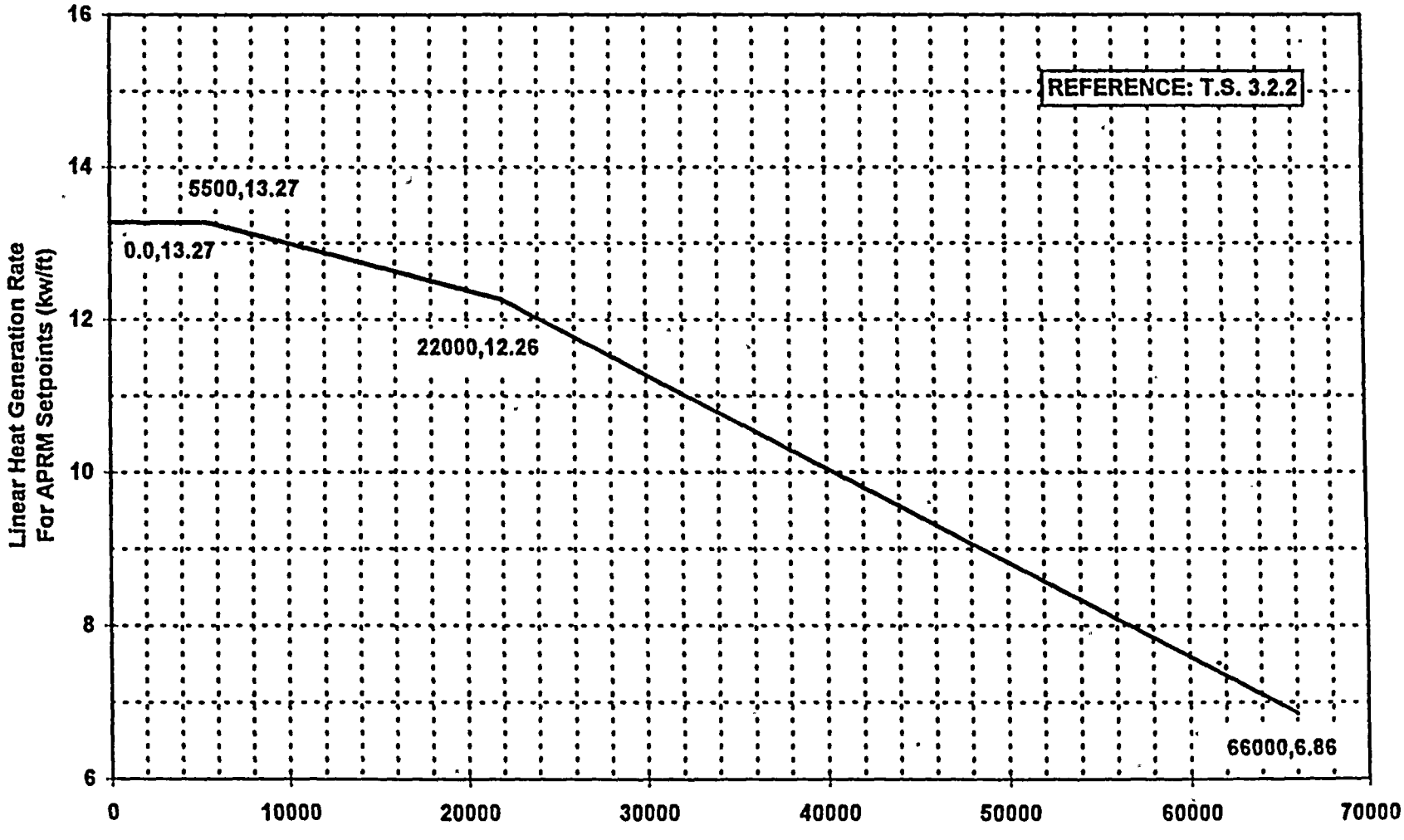
LINEAR HEAT GENERATION RATE FOR APRM SETPOINTS
VERSUS AVERAGE PLANAR EXPOSURE
SPC 9X9-2 FUEL
FIGURE 3.2-1

SSES UNIT 2 CYCLE 9



LINEAR HEAT GENERATION RATE FOR APRM SETPOINTS
VERSUS AVERAGE PLANAR EXPOSURE
SPC ATRIUM™-10 FUEL
FIGURE 3.2-2

SSES UNIT 2 CYCLE 9



LINEAR HEAT GENERATION RATE FOR APRM SETPOINTS
VERSUS AVERAGE PLANAR EXPOSURE
GE12
FIGURE 3.2-3

4.0 MINIMUM CRITICAL POWER RATIO (MCPR)

4.1 Technical Specification Reference

Technical Specification 3.2.3.

4.2 Description

The MCPR limit is specified as a function of core power, core flow, cycle exposure, average scram insertion time per Section 4.3 and plant equipment operability status. The MCPR limits for all fuel types (SPC 9x9-2, SPC ATRIUM™-10, and GE12) shall be the greater of

a) The Flow-Dependent MCPR value determined from one of the following figures as appropriate:

Figure 4.2-1A: BOC to EOC

Figure 4.2-1B: BOC to 10290 MWD/MTU

(Note that even though Figure 4.2-1A is more limiting than Figure 4.2-1B, Figure 4.2-1B may be used for cycle exposures between BOC and 10290 MWD/MTU.)

OR

b) The Power-Dependent MCPR value determined from one of the following figures, as appropriate:

Figure 4.2-2A: EOC-RPT and Main Turbine Bypass Operable from BOC to EOC.

Figure 4.2-2B: EOC-RPT and Main Turbine Bypass Operable from BOC to 10290 MWD/MTU.

(Note that even though Figure 4.2-2A is more limiting than Figure 4.2-2B, Figure 4.2-2B may be used for cycle exposures between BOC and 10290 MWD/MTU.)

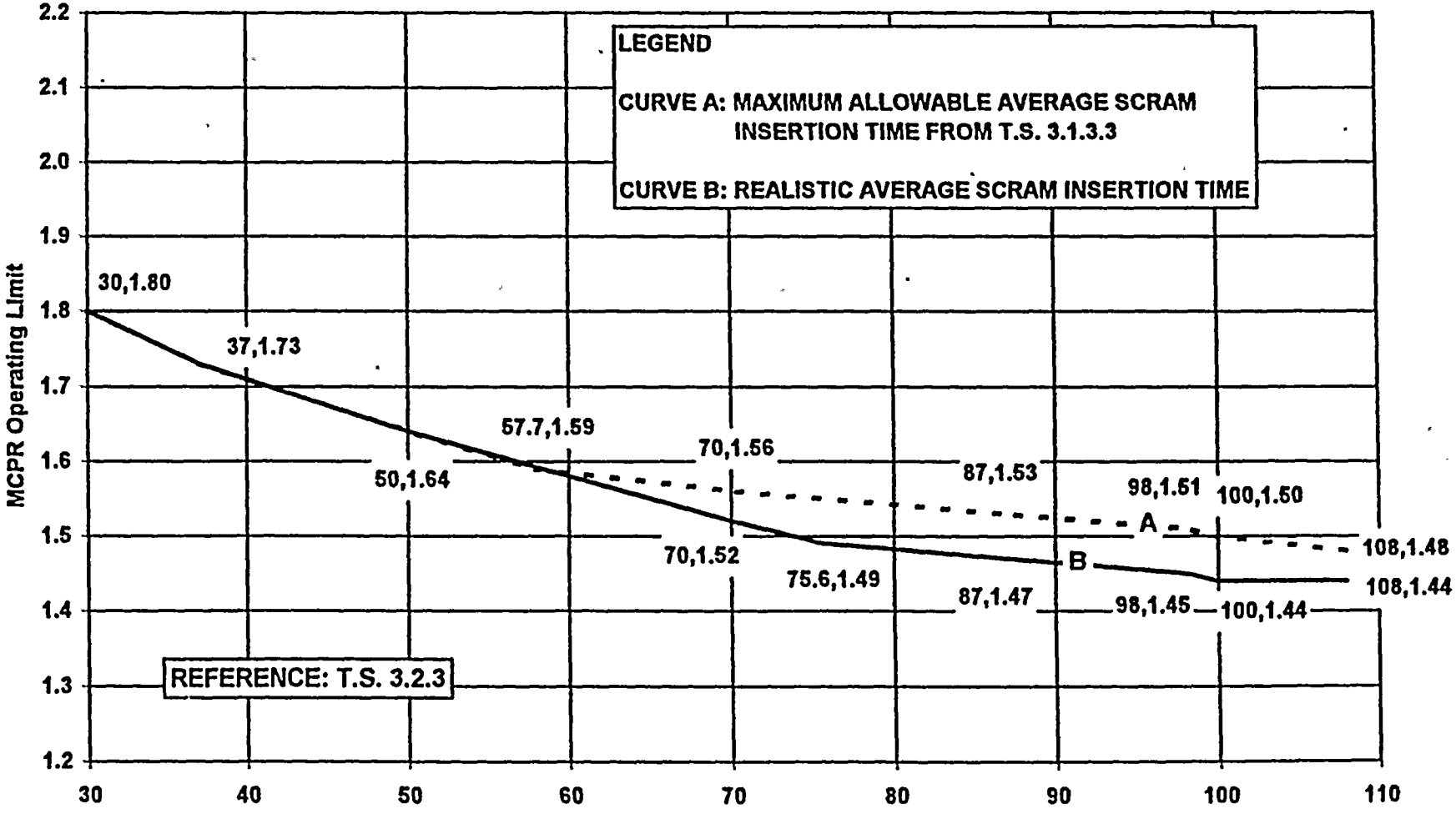
Figure 4.2-3: EOC-RPT Operable / Main Turbine Bypass Inoperable from BOC to EOC

Figure 4.2-4: EOC-RPT Inoperable / Main Turbine Bypass Operable from BOC to EOC

4.3 Average Scram Time Fraction

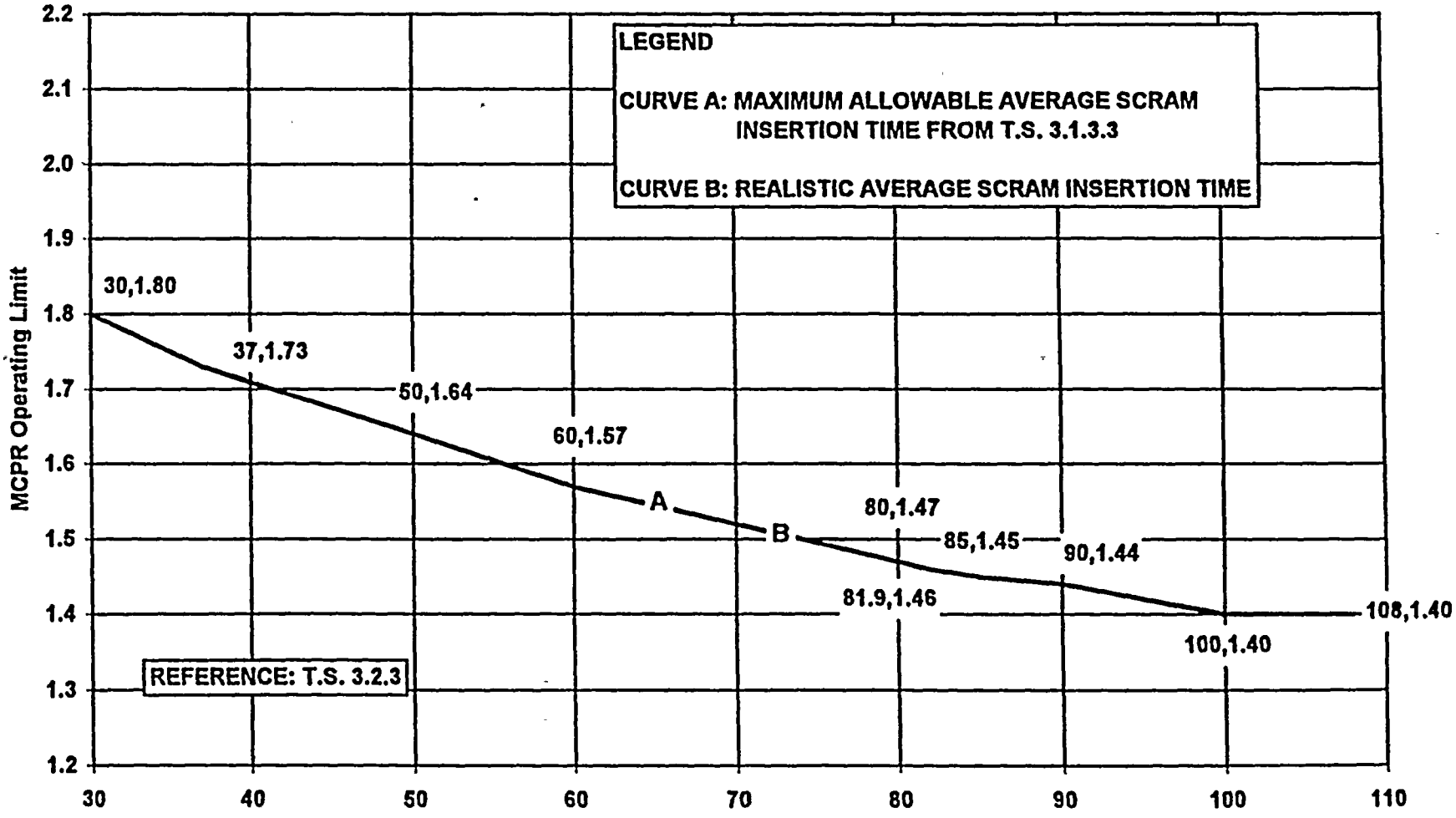
Table 4.3-1 provides the relationship between average scram time to control rod position and scram time fraction. The evaluation of scram insertion time data, as it relates to the attached table should be performed per Reactor Engineering procedures.

SSES UNIT 2 CYCLE 9



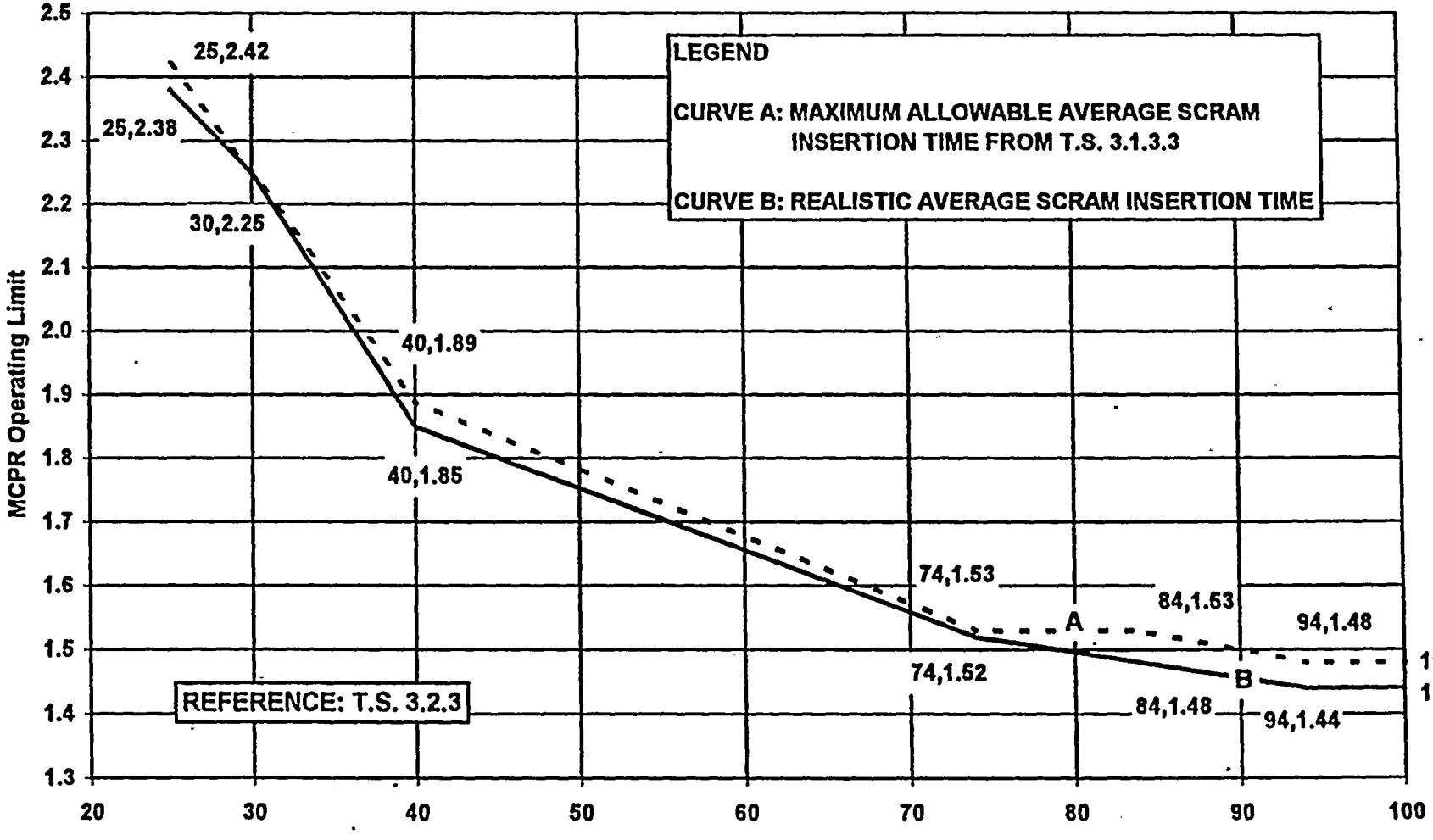
TWO LOOP FLOW DEPENDENT MCPR OPERATING LIMIT
(BOC TO EOC)
FIGURE 4.2-1A

SSES UNIT 2 CYCLE 9



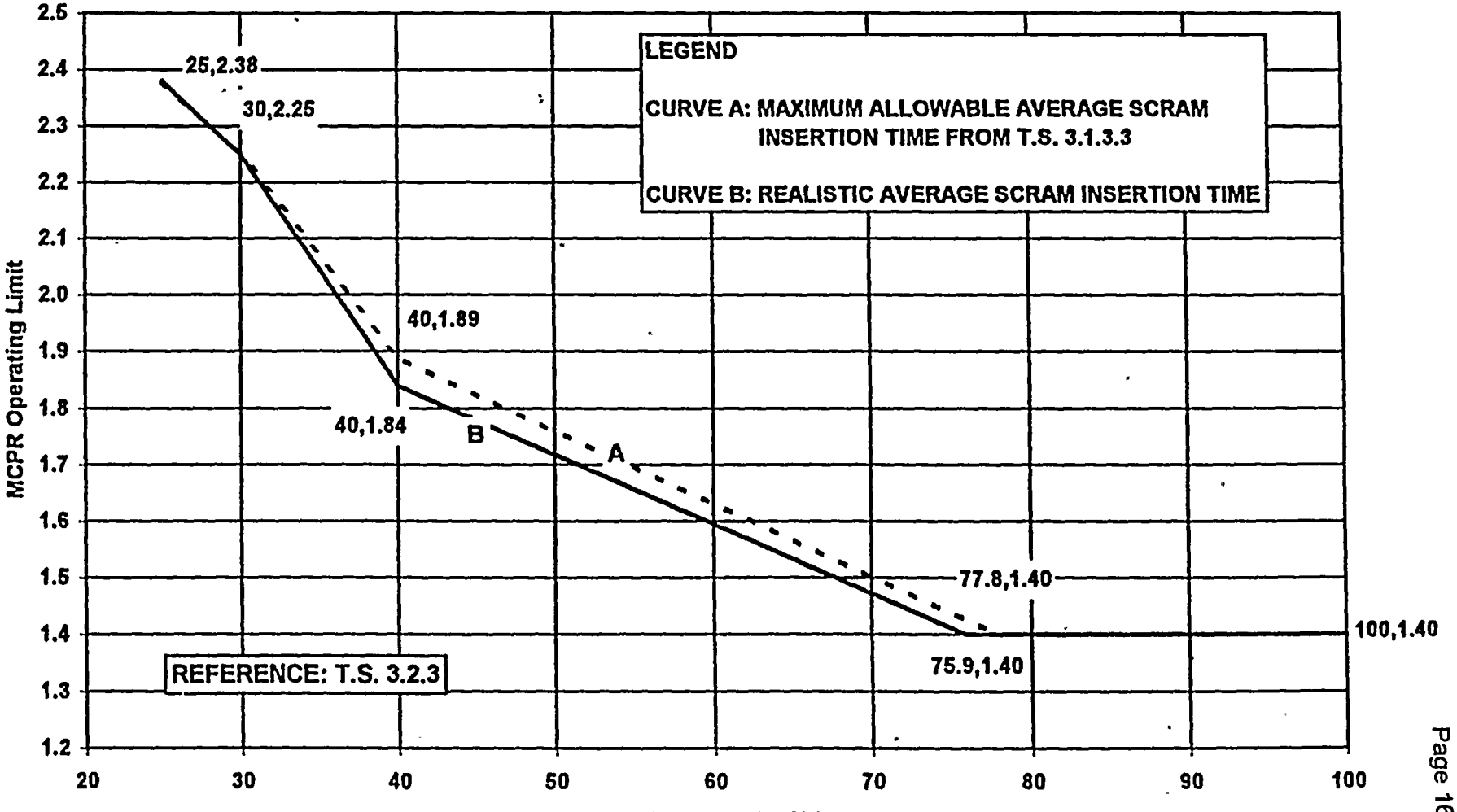
TWO LOOP FLOW DEPENDENT MCPR OPERATING LIMIT
(BOC TO 10290 MWD/MTU)
FIGURE 4.2-1B

SSES UNIT 2 CYCLE 9



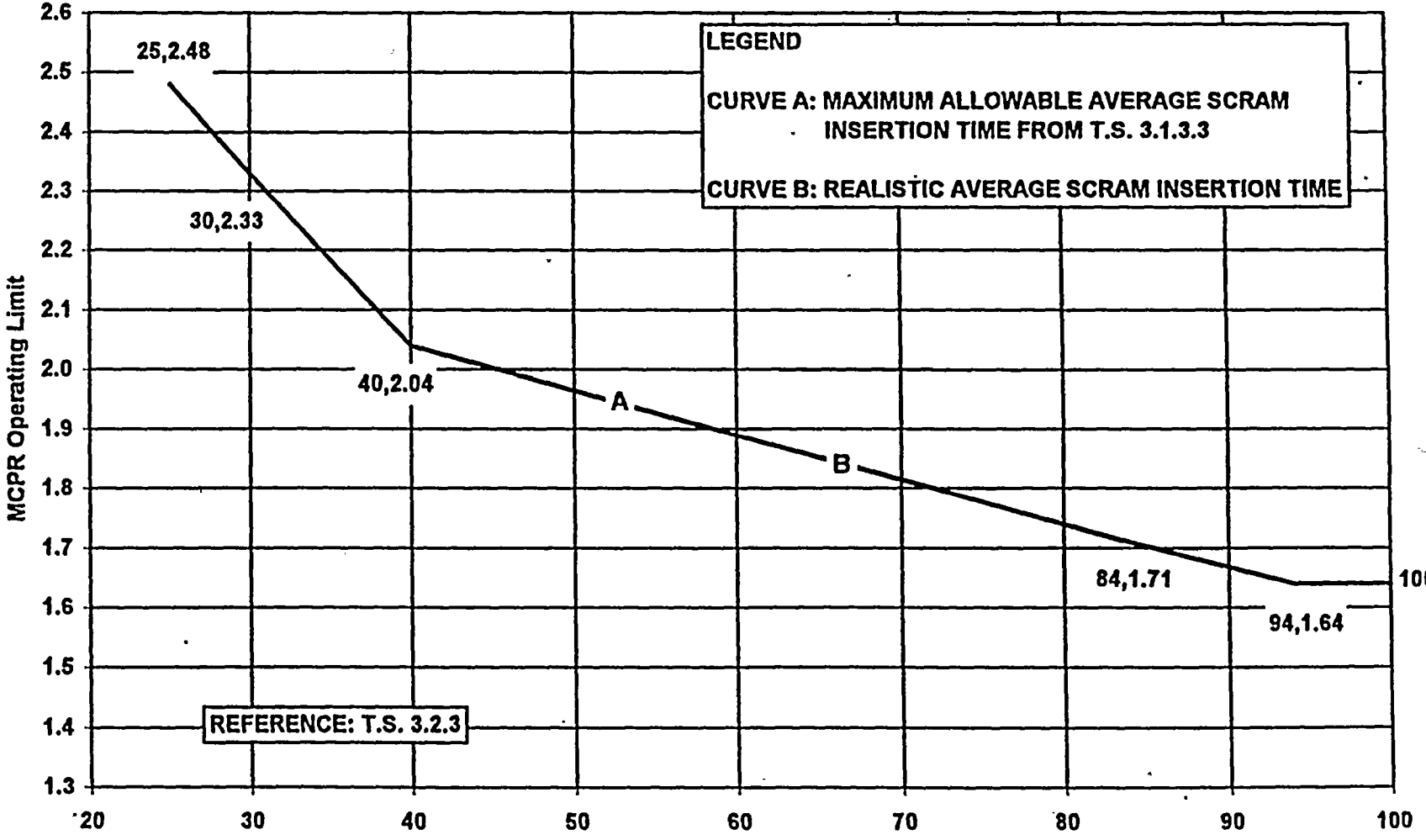
TWO LOOP POWER DEPENDENT MCPR OPERATING LIMIT
EOC-RPT AND MAIN TURBINE BYPASS OPERABLE
(BOC to EOC)
FIGURE 4.2-2A

SSES UNIT 2 CYCLE 9



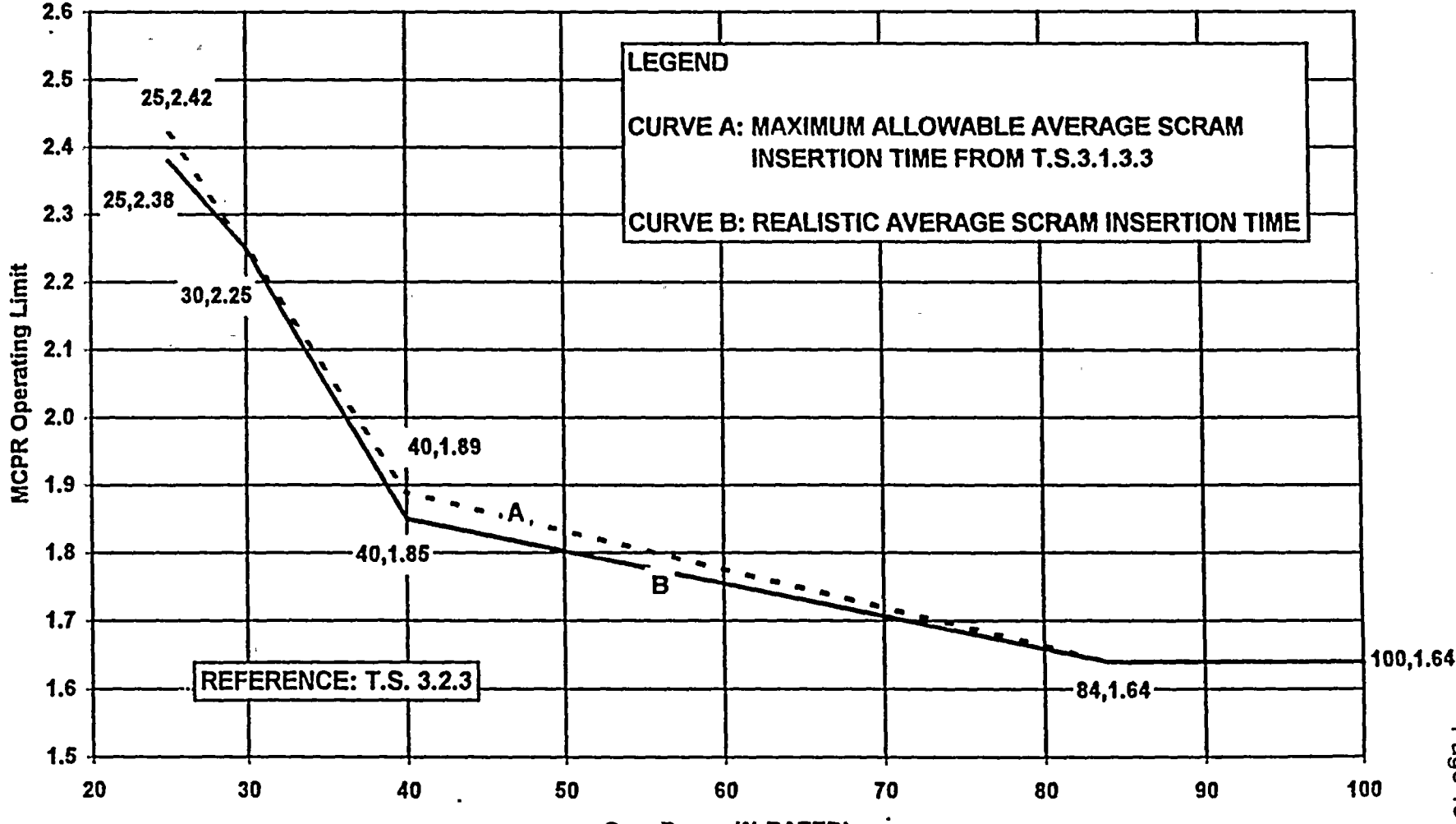
TWO LOOP POWER DEPENDENT MCPR OPERATING LIMIT
EOC-RPT AND MAIN TURBINE BYPASS OPERABLE
(BOC to 10290 MWD/MTU)
FIGURE 4.2-2B

SSES UNIT 2 CYCLE 9



TWO LOOP POWER DEPENDENT MCPR OPERATING LIMIT
EOC-RPT OPERABLE / MAIN TURBINE BYPASS INOPERABLE
(BOC to EOC)
FIGURE 4.2-3

SSES UNIT 2 CYCLE 9



TWO LOOP POWER DEPENDENT MCPR OPERATING LIMIT
EOC-RPT INOPERABLE / MAIN TURBINE BYPASS OPERABLE
(BOC to EOC)
FIGURE 4.2-4

Table 4.3-1

Average Scram Time Fraction Table For Use With Scram Time Dependent MCPR Operating Limits

Control Rod Position	Average Scram Time to Position (seconds)					
45	0.430	0.430	0.430	0.430	0.430	0.430
39	0.630	0.676	0.722	0.768	0.814	0.860
25	1.500	1.586	1.672	1.758	1.844	1.930
5	2.700	2.858	3.016	3.174	3.332	3.490
Scram Time Fraction	0.000	0.200	0.400	0.600	0.800	1.000
Average Scram Insertion Time	Realistic					Maximum Allowable

5.0 LINEAR HEAT GENERATION RATE (LHGR)

5.1 Technical Specification Reference

Technical Specification 3.2.4

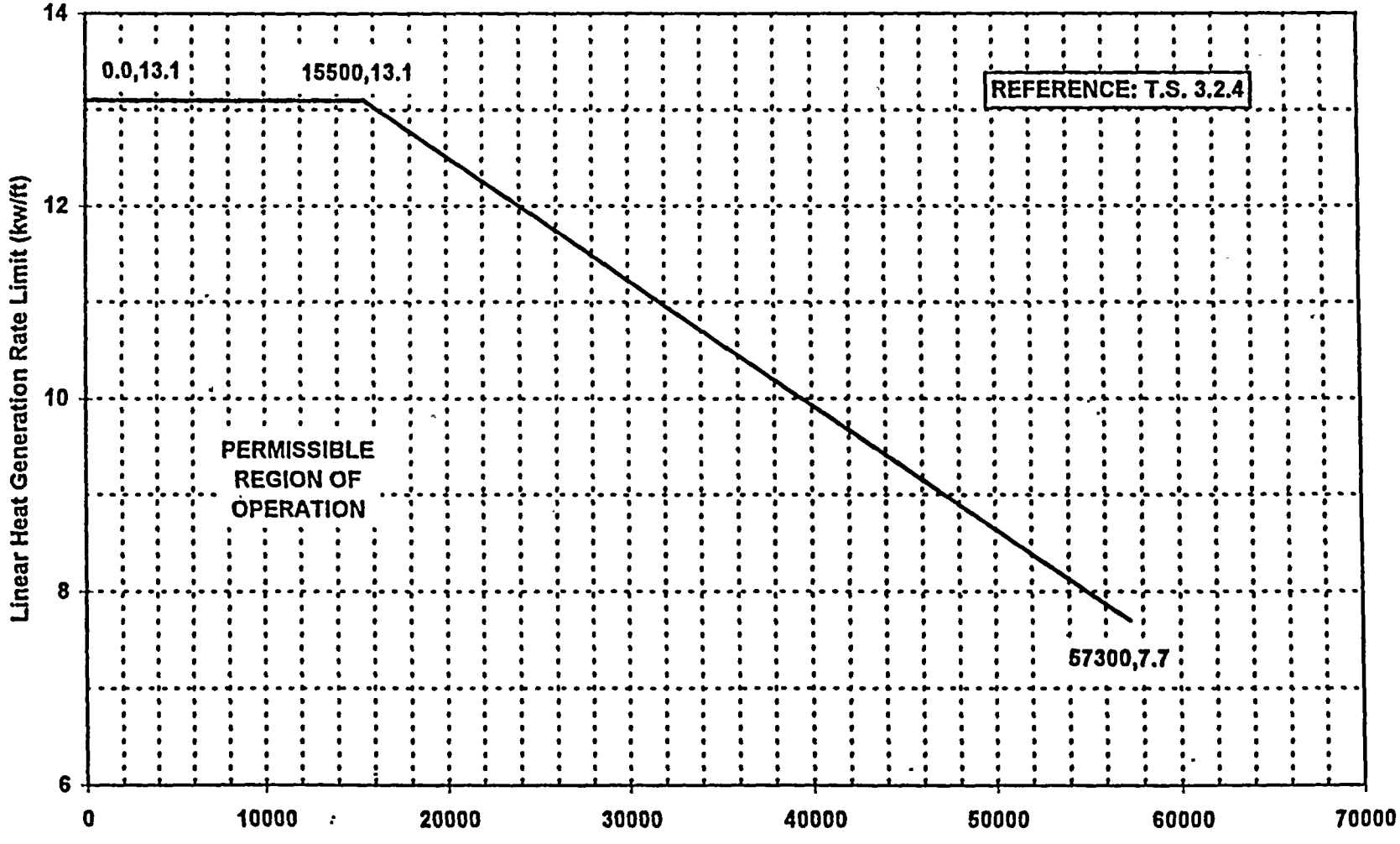
5.2 Description

The LHGR for SPC 9x9-2 fuel shall not exceed the LHGR limit determined from Figure 5.2-1.

The LHGR for SPC ATRIUM™-10 fuel shall not exceed the LHGR limit determined from Figure 5.2-2.

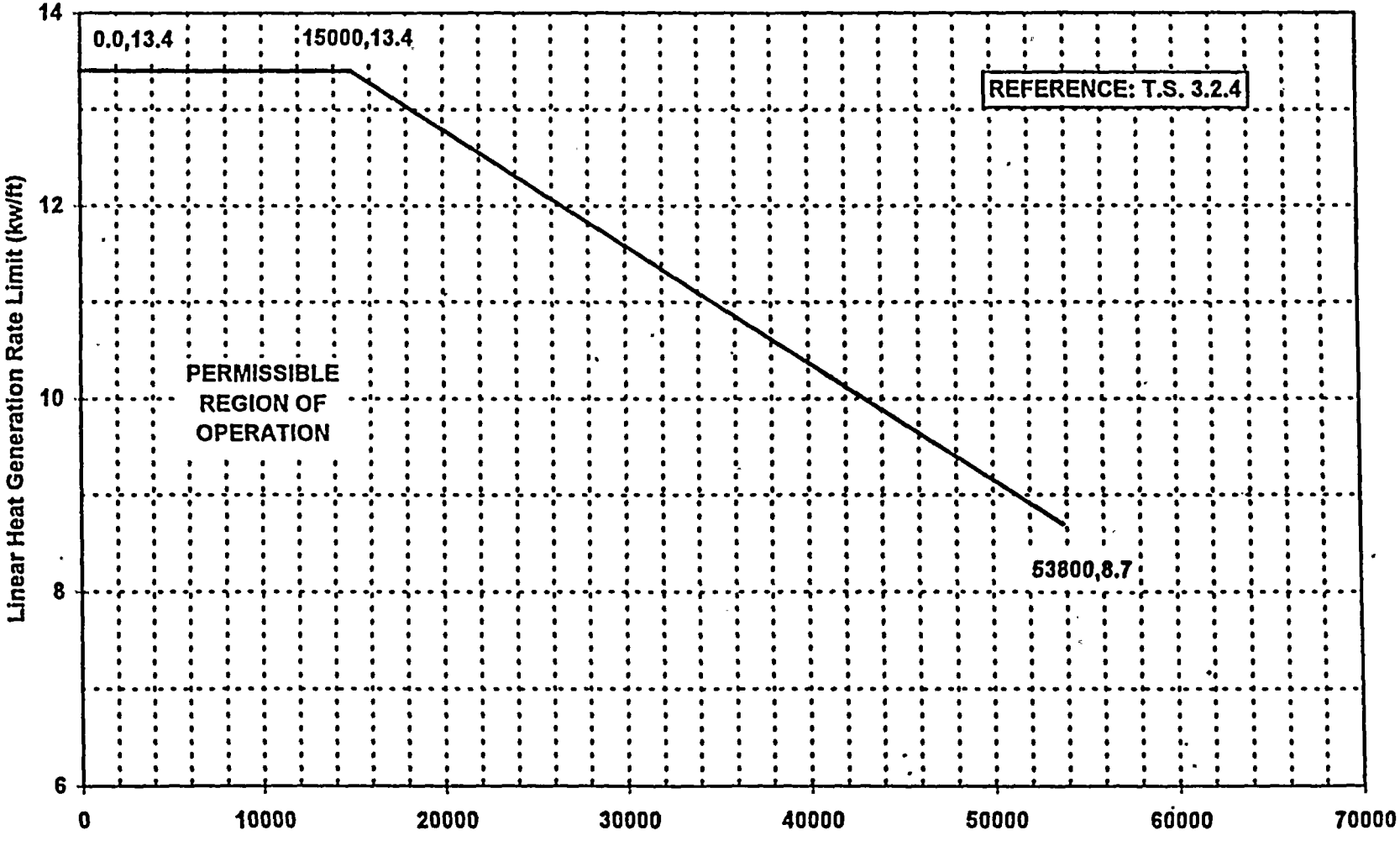
The LHGR for GE12 fuel shall not exceed the LHGR limit determined from Figure 5.2-3.

SSES UNIT 2 CYCLE 9



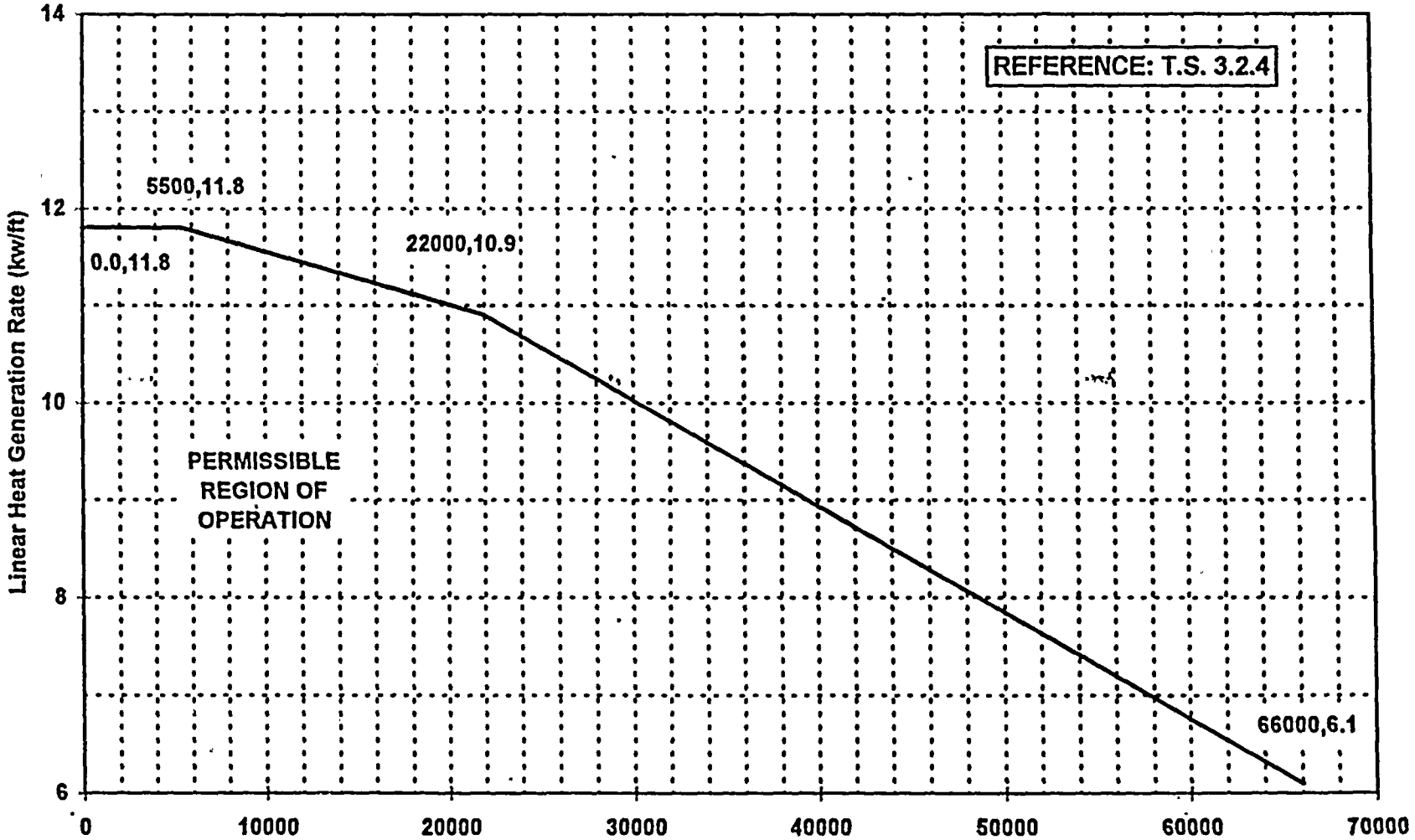
LINEAR HEAT GENERATION RATE (LHGR) LIMIT
VERSUS AVERAGE PLANAR EXPOSURE
SPC 9X9-2 FUEL
FIGURE 5.2-1

SSES UNIT 2 CYCLE 9



LINEAR HEAT GENERATION RATE (LHGR) LIMIT
VERSUS AVERAGE PLANAR EXPOSURE
SPC ATRIUM™-10 FUEL
FIGURE 5.2-2

SSES UNIT 2 CYCLE 9



LINEAR HEAT GENERATION RATE (LHGR) LIMIT
VERSUS AVERAGE PLANAR EXPOSURE
GE12
FIGURE 5.2-3

6.0 RECIRCULATION LOOPS - SINGLE LOOP OPERATION

6.1 Technical Specification Reference

Technical Specification 3.4.1.1.2

Current administrative controls do not permit operation in single loop.

7.0 REFERENCE

1. PL-NF-97-003, Rev. 3, "Susquehanna SES Unit 2 Cycle 9 Reload Summary Report," June 1998.

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