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APR 17 2014

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUSQUEHANNA STEAM ELECTRIC STATION
SUBMITTAL OF UNIT 1 CYCLE 19 CORE
OPERATING LIMITS REPORT (COLR)
PLA-7153

Docket No. 50-387

Technical Specification Section 5.6.5 requires that the Core Operating Limits Report (COLR), including any mid-cycle supplements or revisions, be provided upon issuance to the NRC in accordance with 10 CFR 50.4. In compliance with this requirement, the Unit 1 Cycle 19 COLR is provided in the attachment to this letter.

If you should have any questions regarding this submittal, please contact Mr. John Tripoli at (570) 542-3100.

There are no regulatory commitments identified in this letter.

Jon Franke

Attachment: Unit 1 Cycle 19 COLR

Copy: NRC Region I
Mr. J. E. Greives, NRC Sr. Resident Inspector
Mr. J. A. Whited, NRC Project Manager
Mr. L. J. Winker, PA DEP/BRP

Attachment to PLA-7153

Unit 1 Cycle 19 COLR

Susquehanna SES
Unit 1 Cycle 19

CORE OPERATING LIMITS REPORT

Nuclear Fuels Engineering

April 2014

CORE OPERATING LIMITS REPORT
REVISION DESCRIPTION INDEX

Rev. No.	Affected Sections	Description/Purpose of Revision
0	ALL	Issuance of this COLR is in support of Unit 1 Cycle 19 operation.

SUSQUEHANNA STEAM ELECTRIC STATION
Unit 1 Cycle 19
CORE OPERATING LIMITS REPORT

Table of Contents

1.0 INTRODUCTION

This CORE OPERATING LIMITS REPORT for Susquehanna Unit 1 Cycle 19 is prepared in accordance with the requirements of Susquehanna Unit 1, Technical Specification 5.6.5. As required by Technical Specifications 5.6.5, core shutdown margin, the core operating limits, RBM setpoints, and OPRM setpoints presented herein were developed using NRC-approved methods and are established such that all applicable limits of the plant safety analysis are met.

2.0 DEFINITIONS

Terms used in this COLR but not defined in Section 1.0 of the Technical Specifications or Section 1.1 of the Technical Requirements Manual are provided below.

2.1 The AVERAGE PLANAR EXPOSURE at a specified height shall be equal to the total energy produced per unit length at the specified height divided by the total initial weight of uranium per unit length at that height.

2.2 The PELLET EXPOSURE shall be equal to the total energy produced per unit length of fuel rod at the specified height divided by the total initial weight of uranium per unit length of that rod at that height.

2.3 FDLRX is the ratio of the maximum LHGR calculated by the core monitoring system for each fuel bundle divided by the LHGR limit for the applicable fuel bundle type.

2.4 $LHGRFAC_f$ is a multiplier applied to the LHGR limit when operating at less than 108 Mlbm/hr core flow. The $LHGRFAC_f$ multiplier protects against both fuel centerline melting and cladding strain during anticipated system transients initiated from core flows less than 108 Mlbm/hr.

2.5 $LHGRFAC_p$ is a multiplier applied to the LHGR limit when operating at less than RATED THERMAL POWER. The $LHGRFAC_p$ multiplier protects against both fuel centerline melting and cladding strain during anticipated system transients initiated from partial power conditions.

2.6 MFLCPR is the ratio of the applicable MCPR operating limit for the applicable fuel bundle type divided by the MCPR calculated by the core monitoring system for each fuel bundle.

2.7 MAPRAT is the ratio of the maximum APLHGR calculated by the core monitoring system for each fuel bundle divided by the APLGHR limit for the applicable fuel bundle type.

2.8 OPRM is the Oscillation Power Range Monitor. The Oscillation Power Range Monitor (OPRM) will reliably detect and suppress anticipated stability related power oscillations while providing a high degree of confidence that the MCPR safety limit is not violated.

2.9 N_P is the OPRM setpoint for the number of consecutive confirmations of oscillation half-cycles that will be considered evidence of a stability related power oscillation.

2.10 S_P is the OPRM trip setpoint for the peak to average OPRM signal.

2.11 F_P is the core flow, in Mlbm / hr, below which the OPRM RPS trip is activated.

3.0 SHUTDOWN MARGIN

3.1 Technical Specification Reference

Technical Specification 3.1.1

3.2 Description

The SHUTDOWN MARGIN shall be equal to or greater than:

a) 0.38% $\Delta k/k$ with the highest worth rod analytically determined

OR

b) 0.28% $\Delta k/k$ with the highest worth rod determined by test

Since core reactivity will vary during the cycle as a function of fuel depletion and poison burnup, Beginning of Cycle (BOC) SHUTDOWN MARGIN (SDM) tests must also account for changes in core reactivity during the cycle. Therefore, the SDM measured at BOC must be equal to or greater than the applicable requirement from either 3.2.a or 3.2.b plus an adder, "R". The adder, "R", is the difference between the calculated value of maximum core reactivity (that is, minimum SDM) during the operating cycle and the calculated BOC core reactivity. If the value of "R" is zero (that is, BOC is the most reactive point in the cycle) no correction to the BOC measured value is required.

The SHUTDOWN MARGIN limits provided in 3.2a and 3.2b are applicable in MODES 1, 2, 3, 4, and 5. This includes core shuffling.

4.0 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

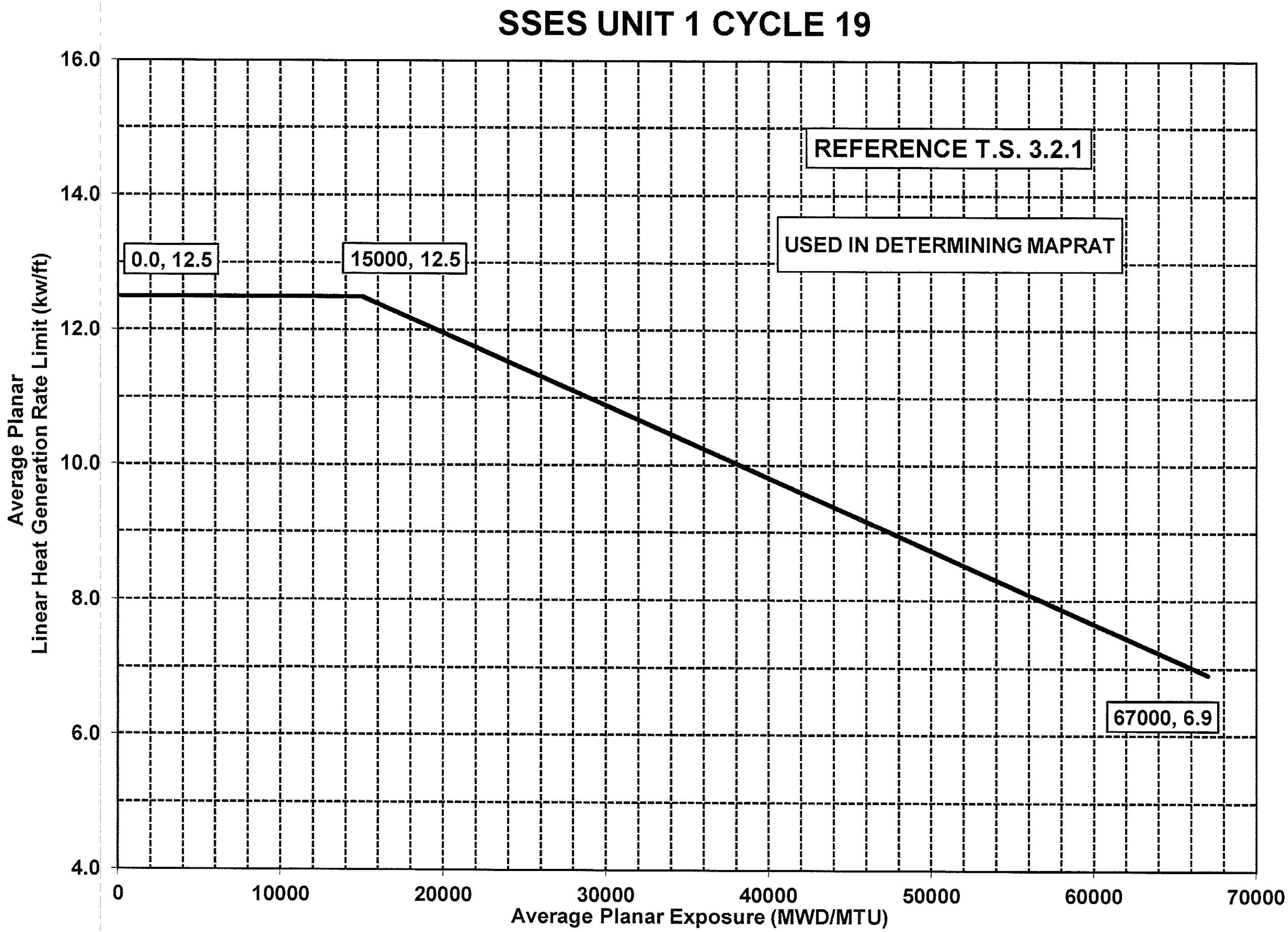
4.1 Technical Specification Reference

Technical Specification 3.2.1

4.2 Description

The APLHGRs for ATRIUM™-10 fuel shall not exceed the limit shown in Figure 4.2-1.

The APLHGR limits in Figure 4.2-1 are valid for Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, and Backup Pressure Regulator Operable and Inoperable in Two Loop operation. The APLHGR limits for Single Loop operation are provided in Section 8.0.



AVERAGE PLANAR LINEAR HEAT GENERATION RATE LIMIT VERSUS
AVERAGE PLANAR EXPOSURE - TWO LOOP OPERATION
ATRIUM™-10 FUEL
FIGURE 4.2-1

5.0 MINIMUM CRITICAL POWER RATIO (MCPR)

5.1 Technical Specification Reference

Technical Specification 3.2.2, 3.3.4.1, 3.7.6, and 3.7.8

5.2 Description

The MCPR limit is specified as a function of core power, core flow, average scram insertion time per Section 5.3 and plant equipment operability status. The MCPR limits for all fuel types (ATRIUM^{TM}-10) shall be the greater of the Flow-Dependent or the Power-Dependent MCPR, depending on the applicable equipment operability status.

a) Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

Figure 5.2-1: Flow-Dependent MCPR value determined from BOC to EOC

Figure 5.2-2: Power-Dependent MCPR value determined from BOC to EOC

b) Main Turbine Bypass Inoperable

Figure 5.2-3: Flow-Dependent MCPR value determined from BOC to EOC

Figure 5.2-4: Power-Dependent MCPR value determined from BOC to EOC

c) EOC-RPT Inoperable

Figure 5.2-5: Flow-Dependent MCPR value determined from BOC to EOC

Figure 5.2-6: Power-Dependent MCPR value determined from BOC to EOC

d) Backup Pressure Regulator Inoperable

Figure 5.2-7: Flow-Dependent MCPR value determined from BOC to EOC

Figure 5.2-8: Power Dependent MCPR value determined from BOC to EOC

The MCPR limits in Figures 5.2-1 through 5.2-8 are valid for Two Loop operation.

The MCPR limits for Single Loop operation are provided in Section 8.0.

5.3 <u>Average Scram Time Fraction</u>

If the average measured scram times are greater than the Realistic Scram times listed in Table 5.3-1 then the MCPR operating limits corresponding to the Maximum Allowable Average Scram Insertion Time must be implemented. Determining MCPR operating limits based on interpolation between scram insertion times is not permitted. The evaluation of scram insertion time data, as it relates to the attached table should be performed per Reactor Engineering procedures.

Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

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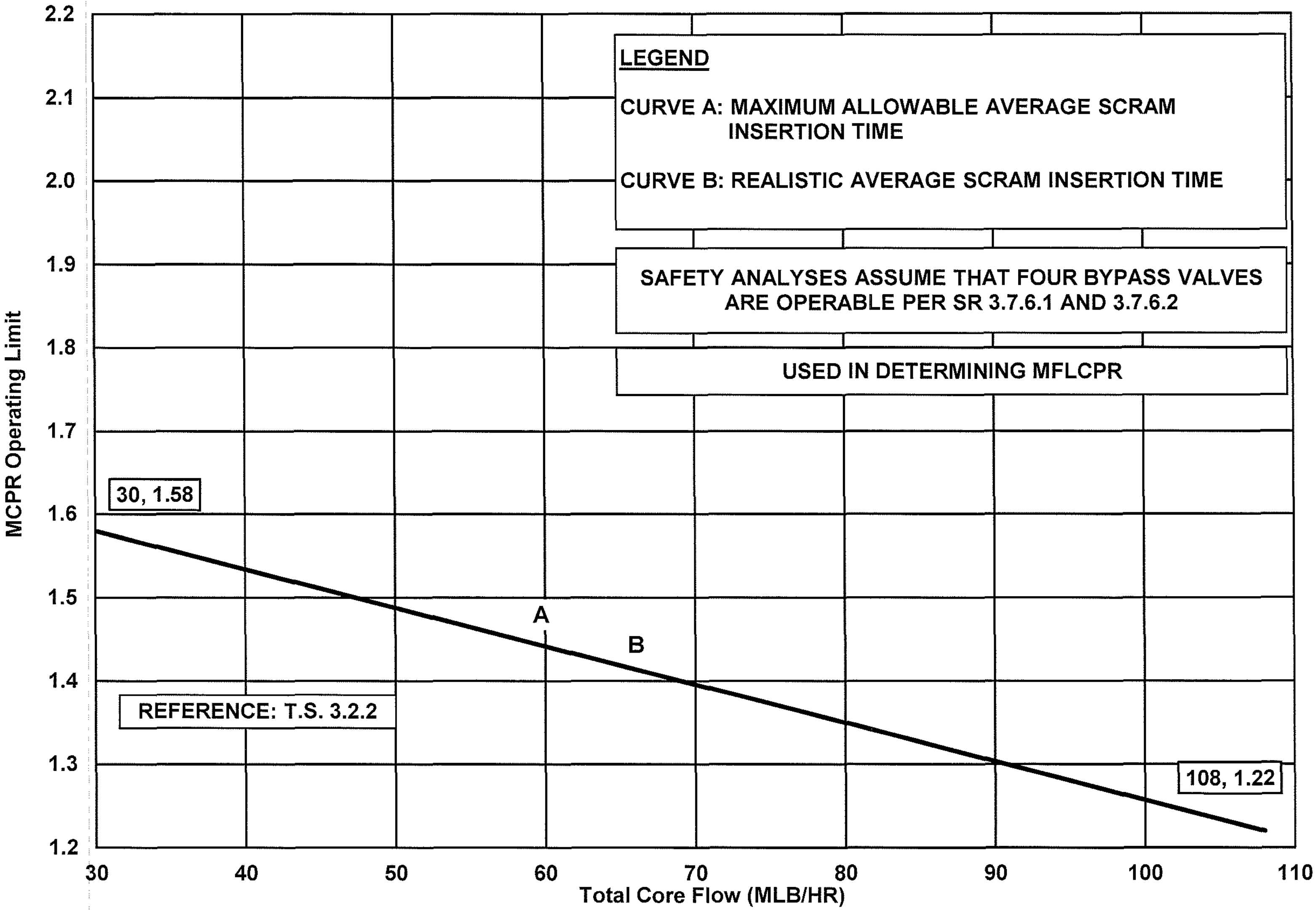
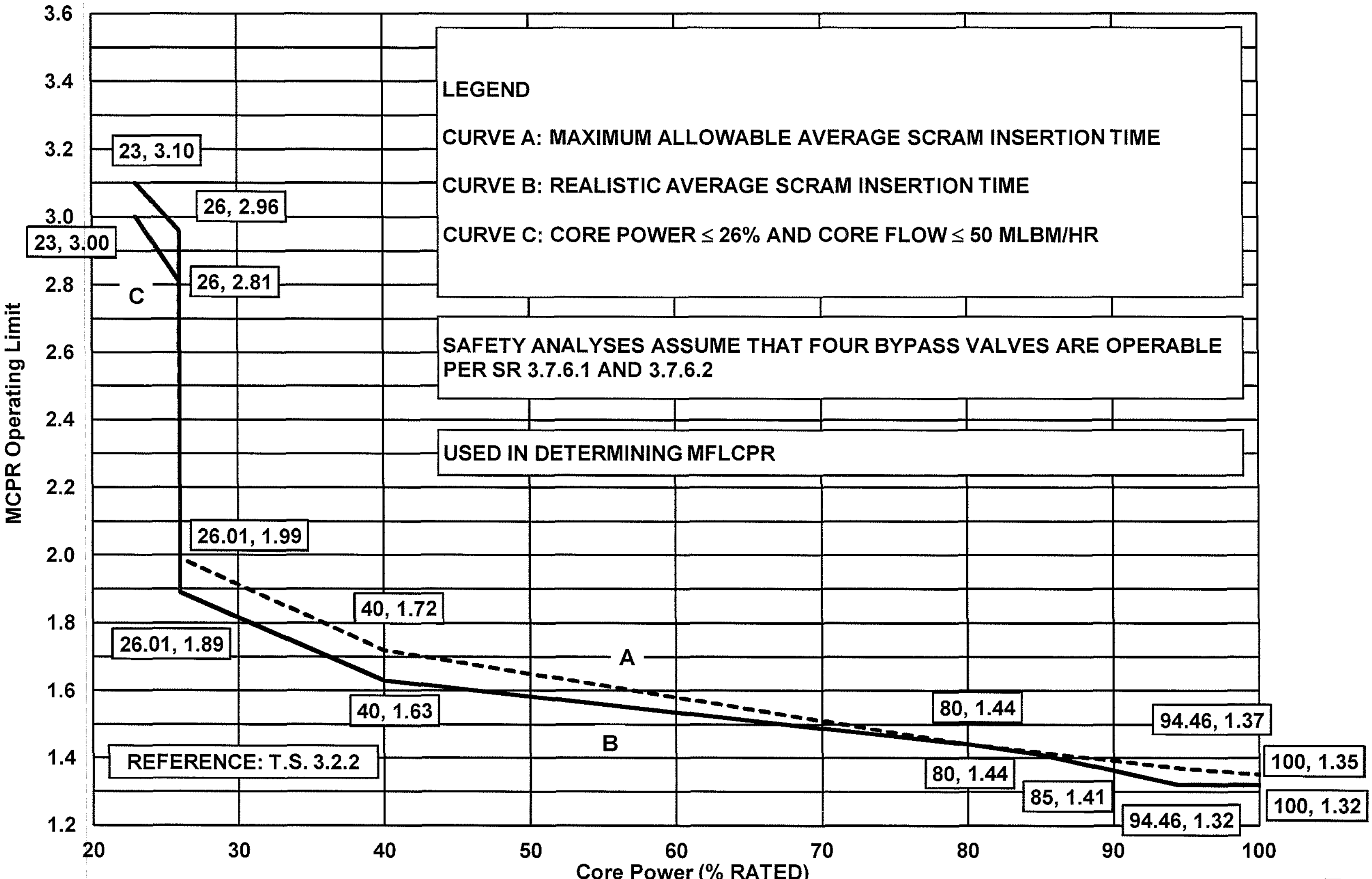


MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
TWO LOOP OPERATION (BOC TO EOC)
FIGURE 5.2-1

SSES UNIT 1 CYCLE 19



MCPR OPERATING LIMIT VERSUS CORE POWER
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
TWO LOOP OPERATION (BOC TO EOC)
FIGURE 5.2-2

Main Turbine Bypass Inoperable

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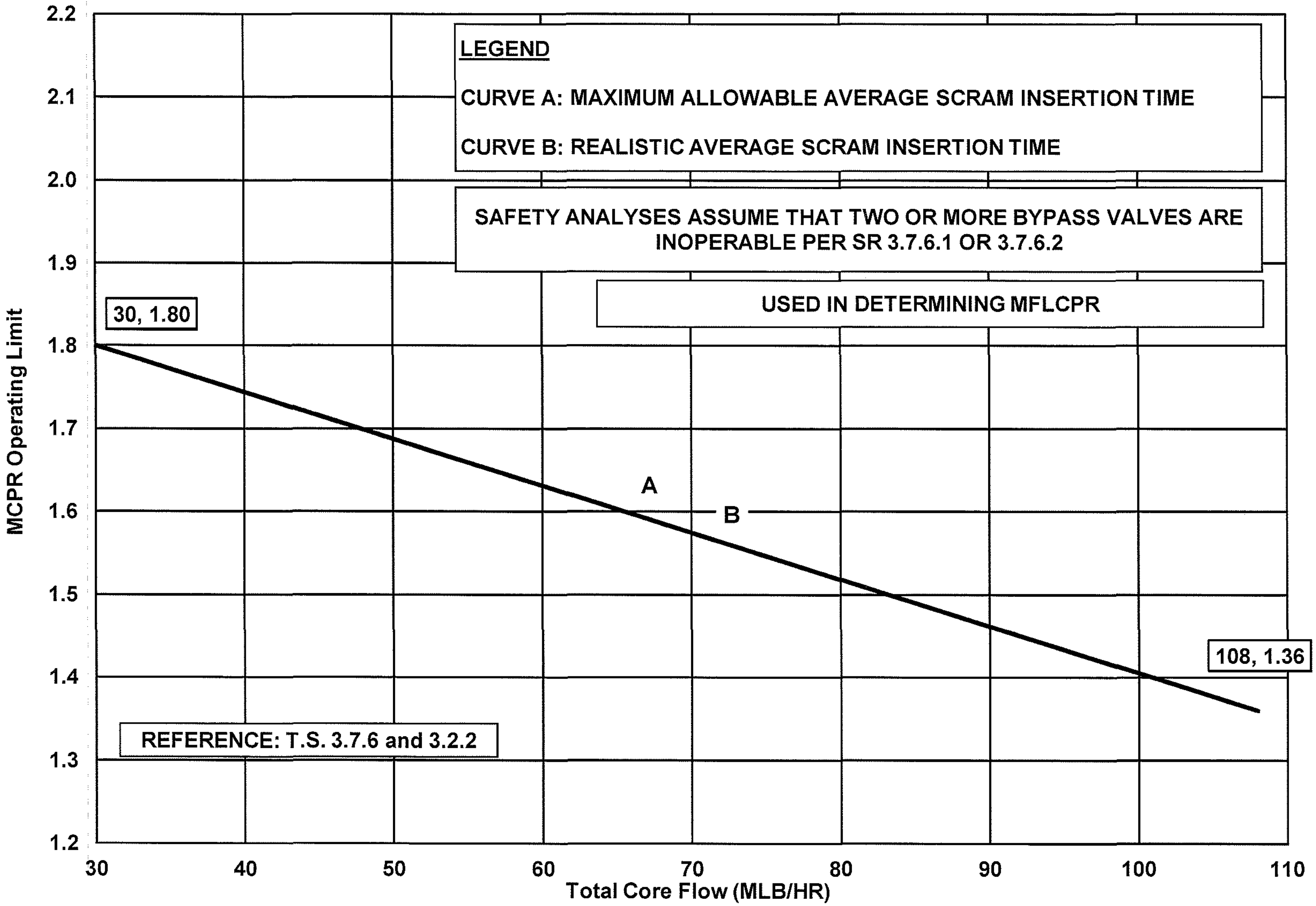
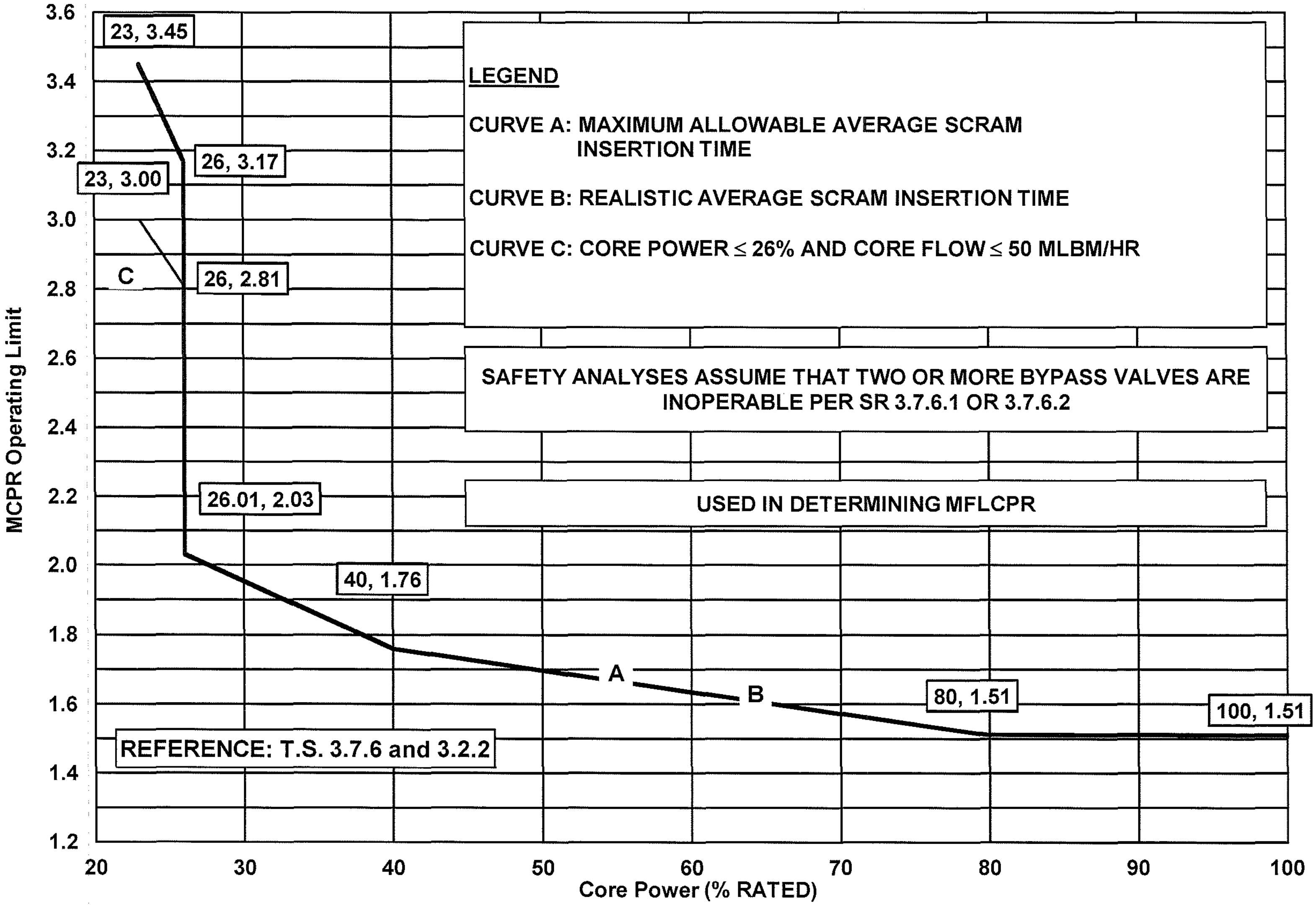


MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
FIGURE 5.2-3

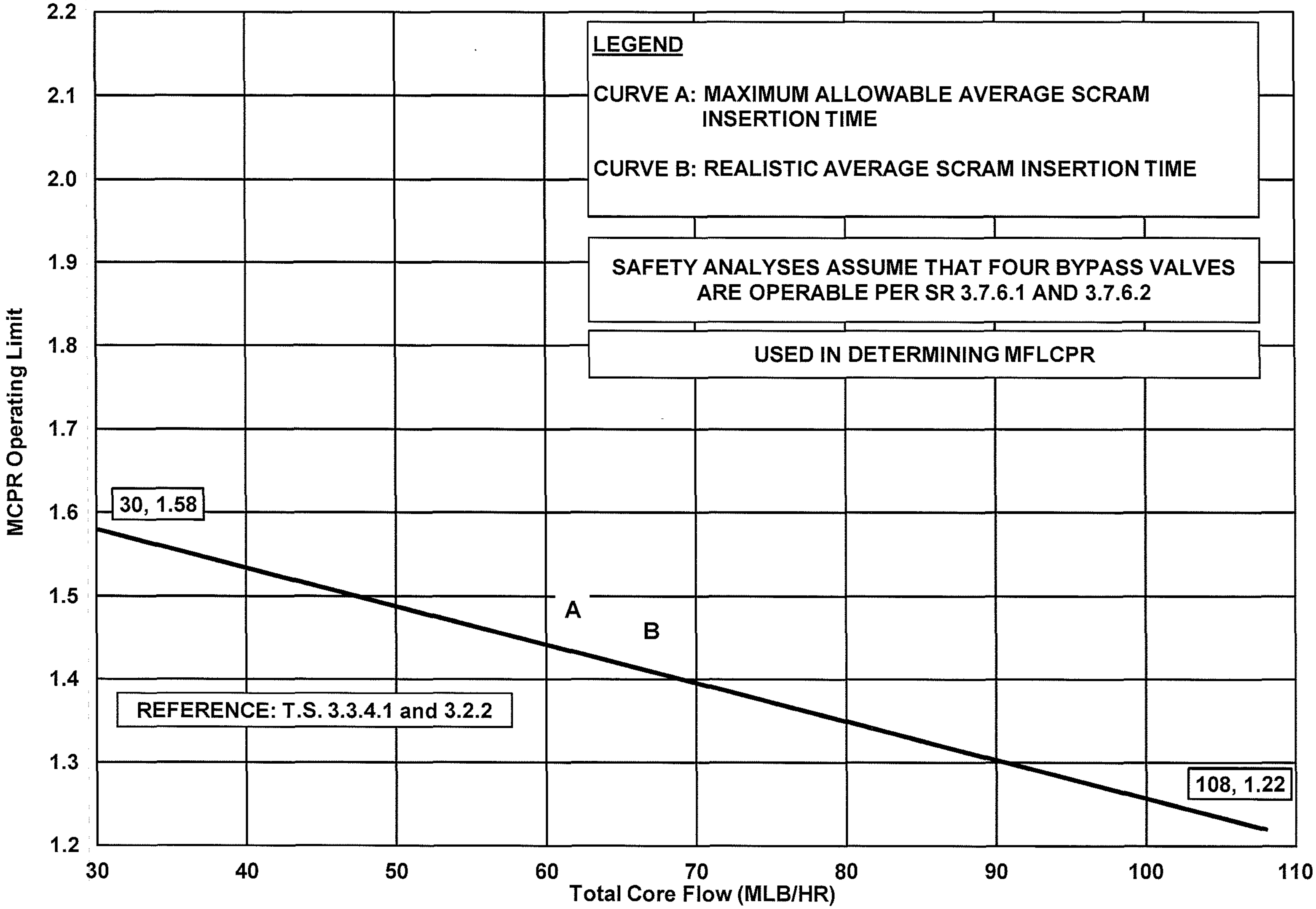
SSES UNIT 1 CYCLE 19



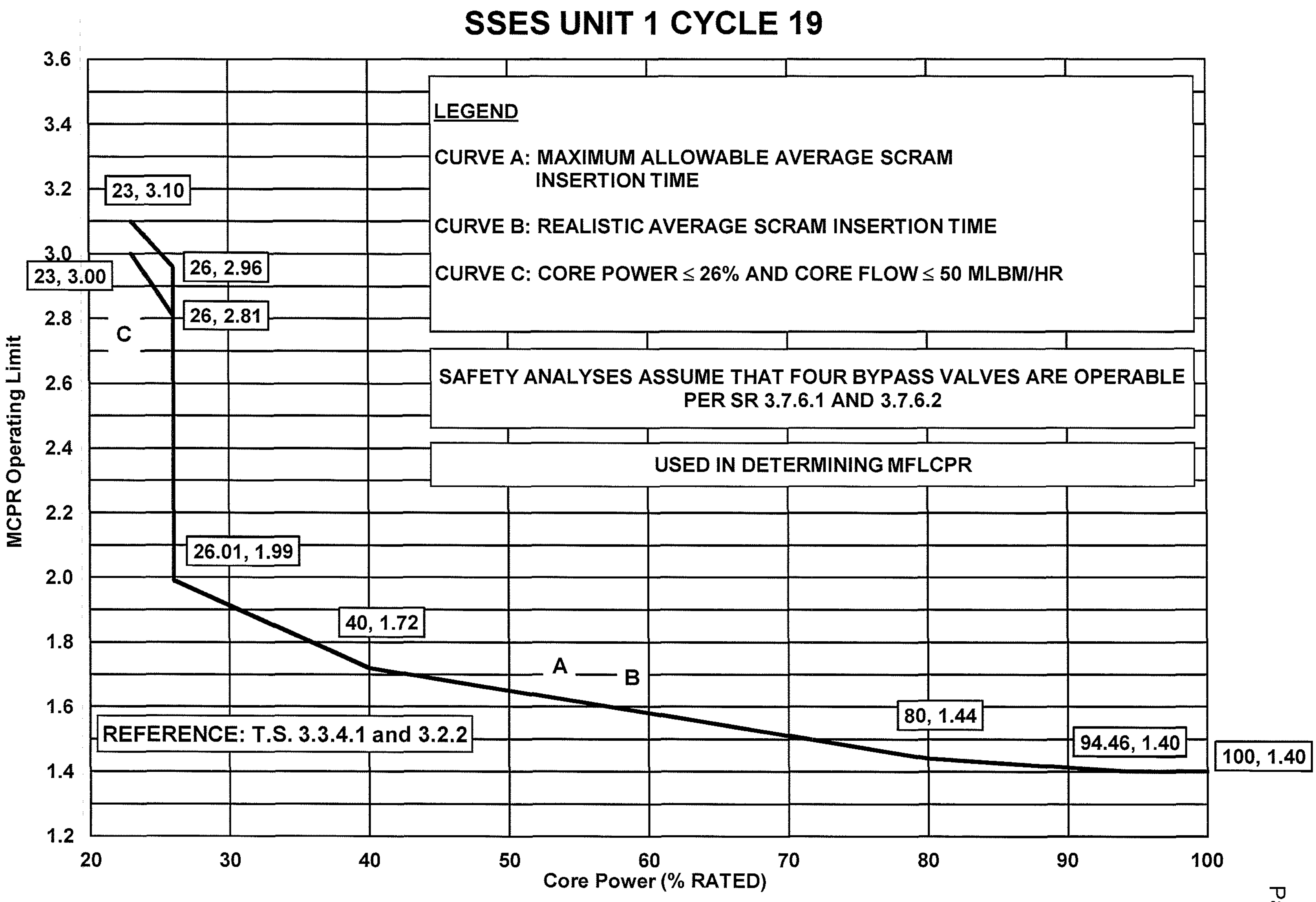
MCPR OPERATING LIMIT VERSUS CORE POWER
MAIN TURBINE BYPASS INOPERABLE
TWO LOOP OPERATION (BOC to EOC)
FIGURE 5.2-4

EOC-RPT
Inoperable

SSES UNIT 1 CYCLE 19



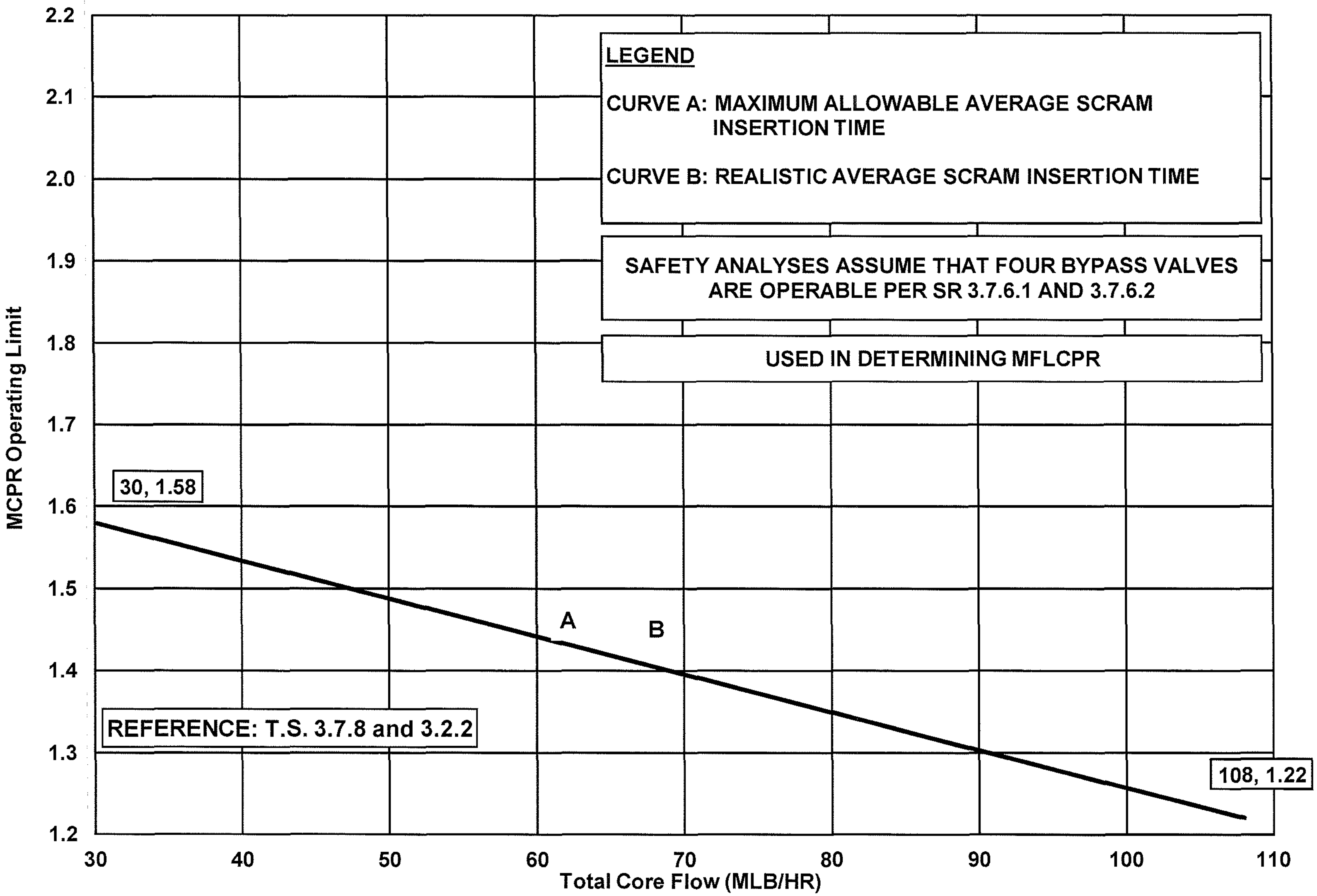
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
EOC-RPT INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
FIGURE 5.2-5



MCPR OPERATING LIMIT VERSUS CORE POWER
EOC-RPT INOPERABLE
TWO LOOP OPERATION (BOC to EOC)
FIGURE 5.2-6

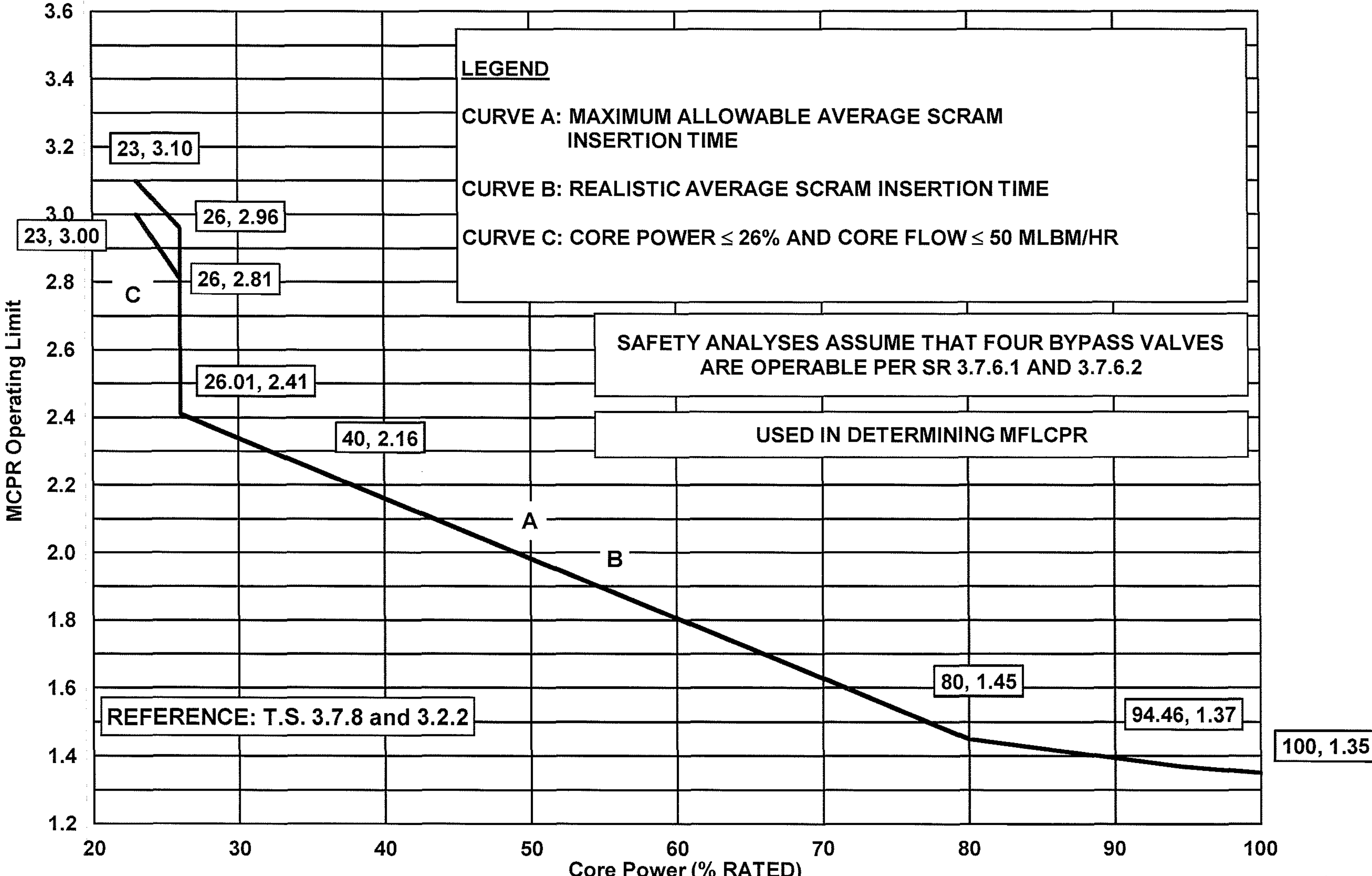
Backup Pressure Regulator Inoperable

SSES UNIT 1 CYCLE 19



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
BACKUP PRESSURE REGULATOR INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
FIGURE 5.2-7

SSES UNIT 1 CYCLE 19



MCPR OPERATING LIMIT VERSUS CORE POWER
BACKUP PRESSURE REGULATOR INOPERABLE
TWO LOOP OPERATION (BOC to EOC)
FIGURE 5.2-8

Table 5.3-1

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

Control Rod Position	Average Scram Time to Position (seconds)		
45	0.470		0.520
39	0.630		0.860
25	1.500		1.910
5	2.700		3.440
Average Scram Insertion Time	Realistic		Maximum Allowable

6.0 LINEAR HEAT GENERATION RATE (LHGR)

6.1 Technical Specification Reference

Technical Specification 3.2.3, 3.3.4.1, 3.7.6, and 3.7.8

6.2 Description

The maximum LHGR for ATRIUM™-10 fuel shall not exceed the LHGR limit determined from Figure 6.2-1. The LHGR limit in Figure 6.2-1 is valid for Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, and Backup Pressure Regulator Operable and Inoperable.

To protect against both fuel centerline melting and cladding strain during anticipated system transients initiated from reduced power and flow conditions, power and flow dependent LHGR limit multipliers are provided. The following figures are applicable to EOC-RPT Operable and Inoperable and Backup Pressure Regulator Operable and Inoperable:

a) Main Turbine Bypass Operable

Figure 6.2-2: Flow-Dependent LHGR Limit Multiplier

Figure 6.2-3: Power-Dependent LHGR Limit Multiplier

b) Main Turbine Bypass Inoperable

Figure 6.2-4: Flow-Dependent LHGR Limit Multiplier

Figure 6.2-5: Power-Dependent LHGR Limit Multiplier

The LGHR limit and LHGR limit multipliers in Figures 6.2-1 through 6.2-5 are valid for both Two Loop and Single Loop operation.

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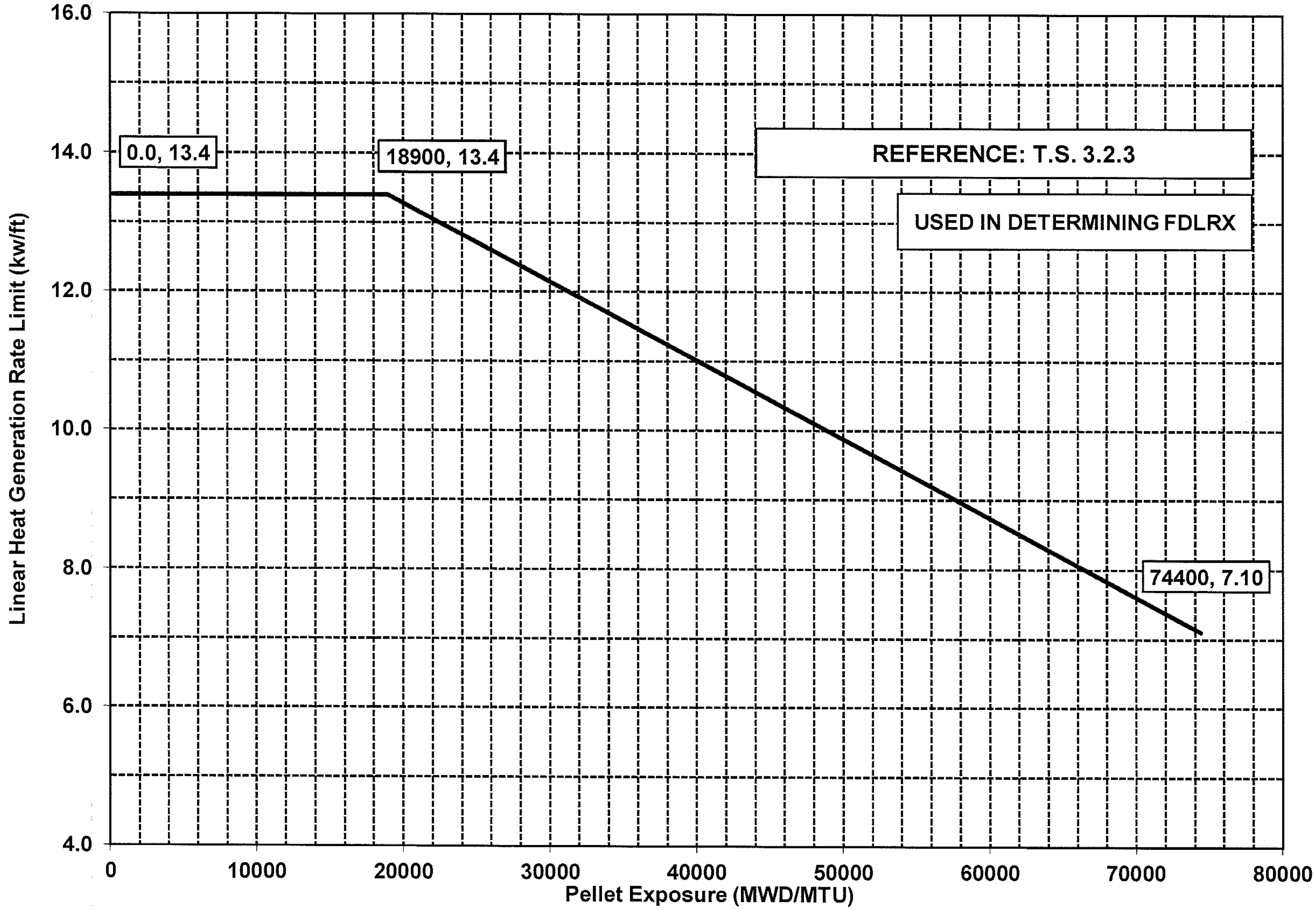
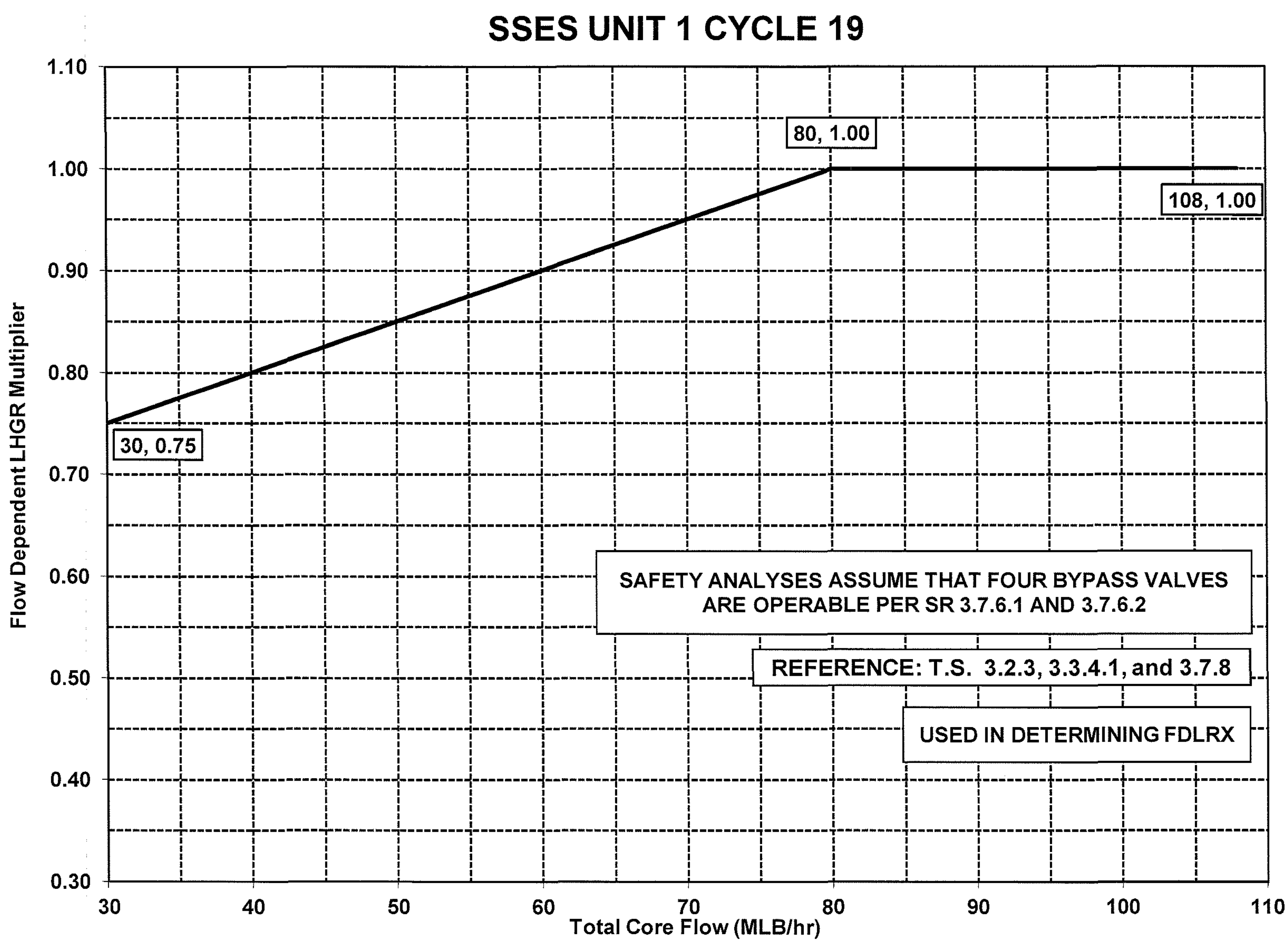


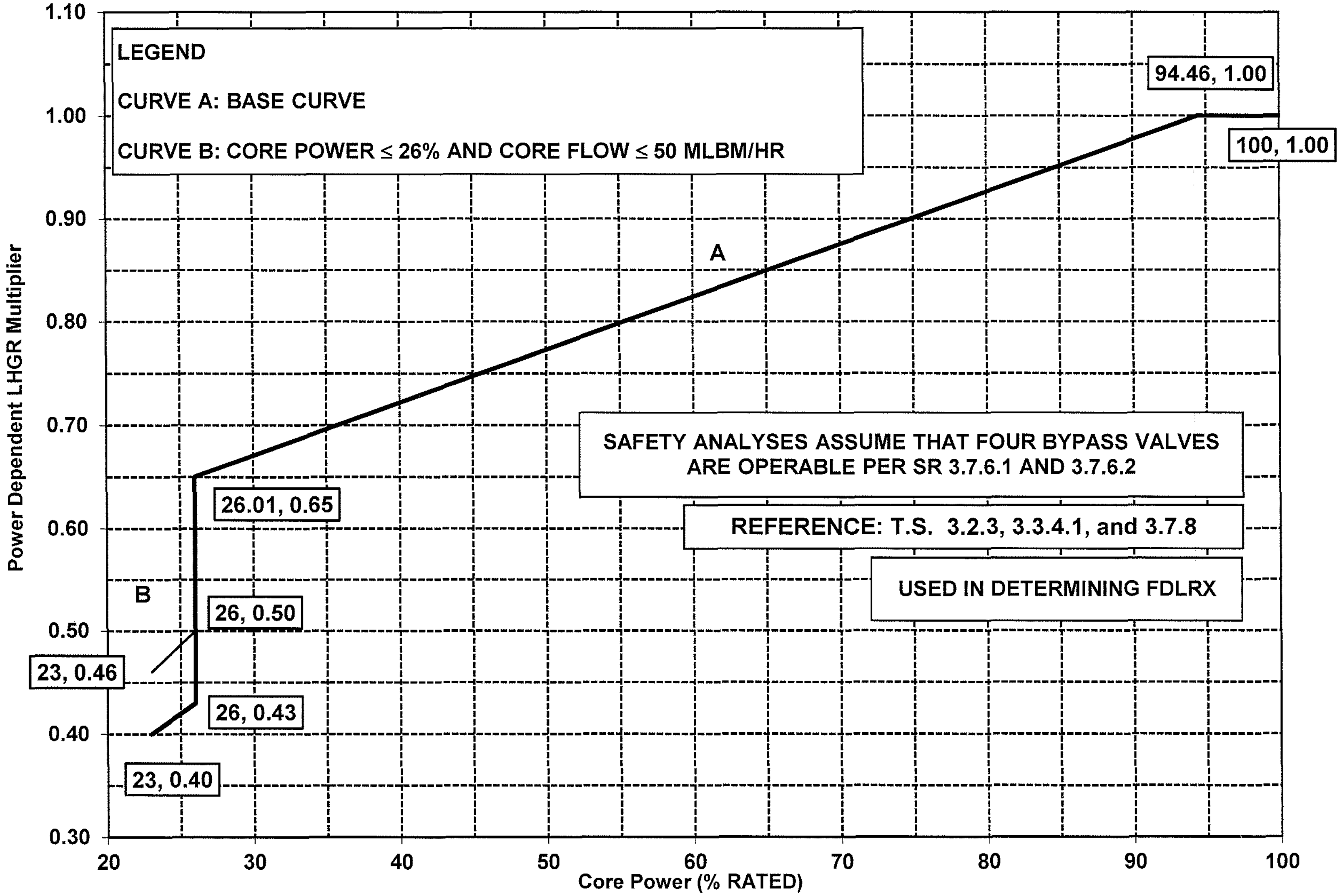
LINEAR HEAT GENERATION RATE LIMIT VERSUS PELLET EXPOSURE
ATRIUM^{TM}-10 FUEL
FIGURE 6.2-1

Main Turbine Bypass Operable



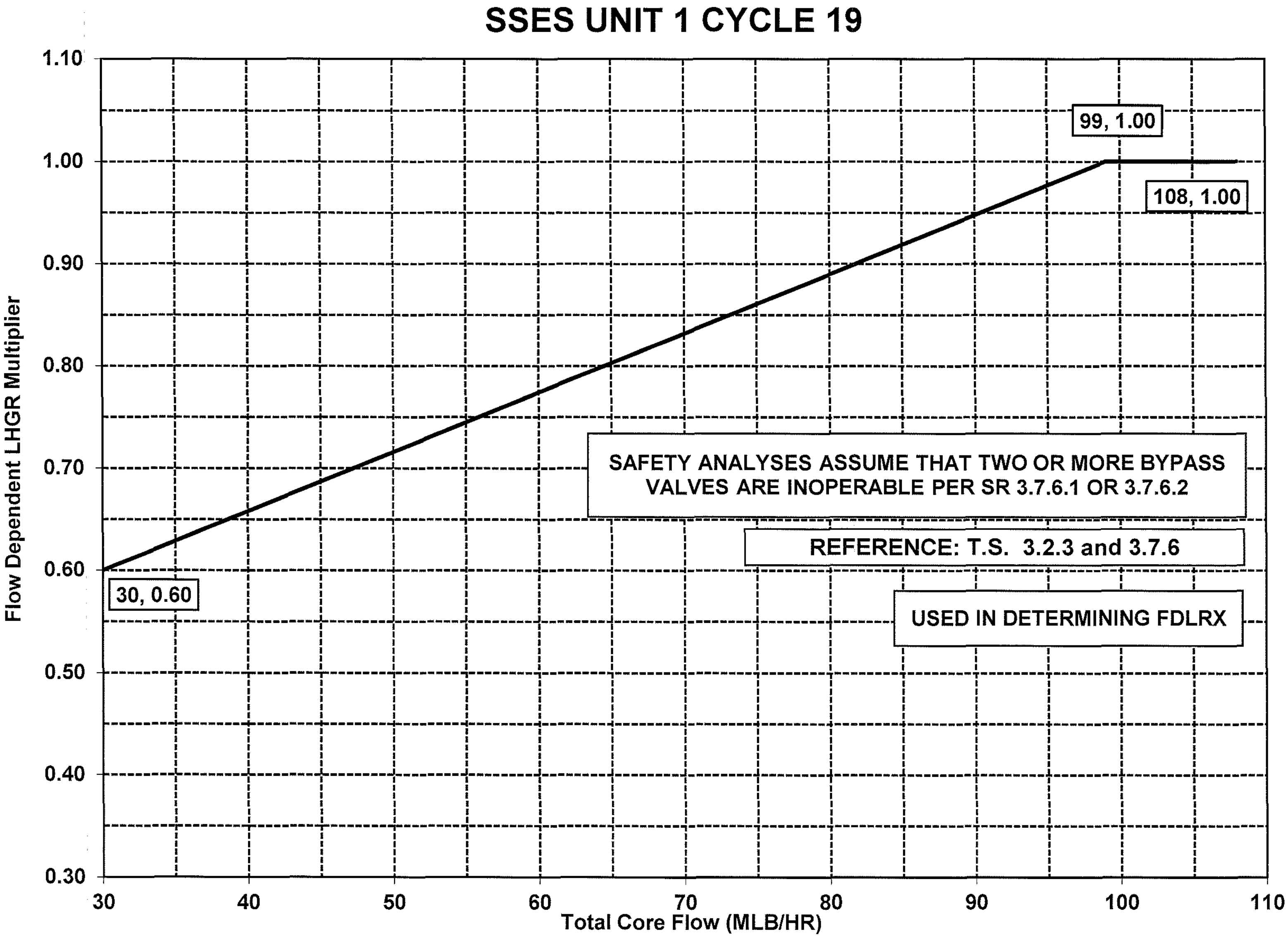
FLOW DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS OPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-2

SSES UNIT 1 CYCLE 19



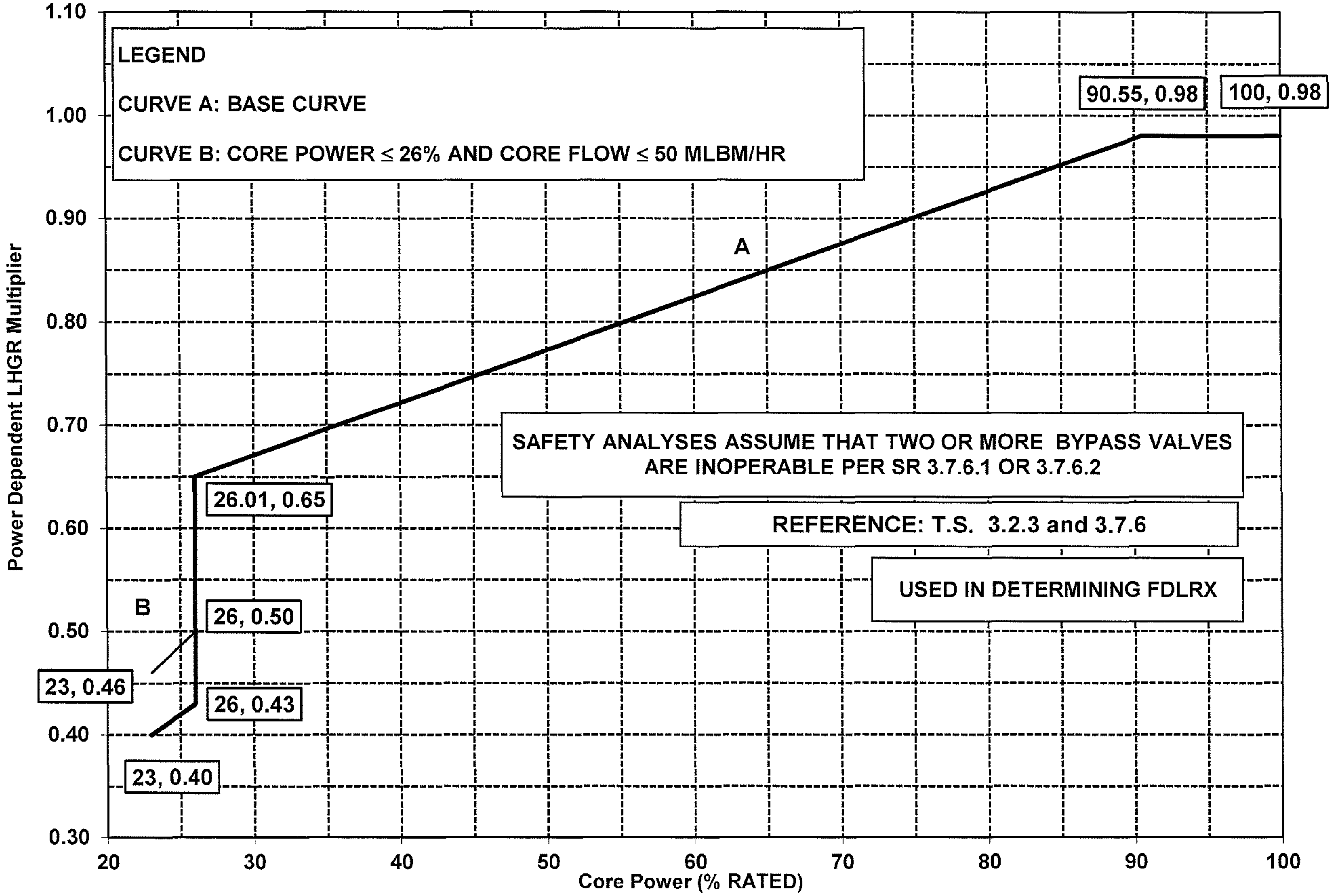
POWER DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS OPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-3

Main Turbine Bypass Inoperable



FLOW DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS INOPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-4

SSES UNIT 1 CYCLE 19



POWER DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS INOPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-5

7.0 ROD BLOCK MONITOR (RBM) SETPOINTS AND OPERABILITY REQUIREMENTS

7.1 Technical Specification Reference

Technical Specification 3.3.2.1

7.2 Description

The RBM Allowable Value and Trip Setpoints for;

a) Low Power Range Setpoint,
b) Intermediate Power Range Setpoint,
c) High Power Range Setpoint,
d) Low Power Range - Upscale,
e) Intermediate Power Range - Upscale, and
f) High Power Range - Upscale

shall be established as specified in Table 7.2-1. The RBM setpoints are valid for Two Loop and Single Loop Operation, Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, and Backup Pressure Regulator Operable and Inoperable.

The RBM system design objective is to block erroneous control rod withdrawal initiated by the operator before fuel design limits are violated. If the full withdrawal of any control rod would not violate a fuel design limit, then the RBM system is not required to be operable. Table 7.2-2 provides RBM system operability requirements to ensure that fuel design limits are not violated.

Table 7.2-1
RBM Setpoints

Function	Allowable Value[1]	Nominal Trip Setpoint
Low Power Range Setpoint	28.0	24.9
Intermediate Power Range Setpoint	63.0	61.0
High Power Range Setpoint	83.0	81.0
Low Power Range – Upscale	123.4	123.0
Intermediate Power Range - Upscale	117.4	117.0
High Power Range – Upscale	107.6	107.2

(1) Power setpoint function (Low, Intermediate, and High Power Range Setpoints) determined in percent of RATED THERMAL POWER. Upscale trip setpoint function (Low, Intermediate, and High Power Range - Upscale) determined in percent of reference level.

Table 7.2-2
RBM System Operability Requirements

Thermal Power (% of Rated)	MCPR [2,3]
≥ 28 and < 90	< 1.76
≥ 90 and < 95	< 1.47
≥ 95	< 1.70

(2) Applicable to Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, and Backup Pressure Regulator Operable and Inoperable.

(3) Applicable to both Two Loop and Single Loop Operation.

8.0 RECIRCULATION LOOPS - SINGLE LOOP OPERATION

8.1 Technical Specification Reference

Technical Specification 3.2.1, 3.2.2, 3.2.3, 3.3.4.1, 3.4.1, 3.7.6, and 3.7.8

8.2 Description

APLHGR

The APLHGR limit for ATRIUM™-10 fuel shall be equal to the APLHGR Limit from Figure 8.2-1.

The APLHGR limits in Figure 8.2-1 are valid for Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, and Backup Pressure Regulator Operable and Inoperable in Single Loop operation.

Minimum Critical Power Ratio Limit

The MCPR limit is specified as a function of core power, core flow, and plant equipment operability status. The MCPR limits for all fuel types (ATRIUM™-10) shall be the greater of the Flow-Dependent or the Power-Dependent MCPR, depending on the applicable equipment operability status.

a) Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

Figure 8.2-2: Flow-Dependent MCPR value determined from BOC to EOC

Figure 8.2-3: Power-Dependent MCPR value determined from BOC to EOC

b) Main Turbine Bypass Inoperable

Figure 8.2-4: Flow-Dependent MCPR value determined from BOC to EOC

Figure 8.2-5: Power-Dependent MCPR value determined from BOC to EOC

c) EOC-RPT Inoperable

Figure 8.2-6: Flow-Dependent MCPR value determined from BOC to EOC

Figure 8.2-7: Power-Dependent MCPR value determined from BOC to EOC

d) Backup Pressure Regulator Inoperable

Figure 8.2-8: Flow-Dependent MCPR value determined from BOC to EOC

Figure 8.2-9: Power-Dependent MCPR value determined from BOC to EOC

The MCPR limits in Figures 8.2-2 through 8.2-9 are valid only for Single Loop operation.

Linear Heat Generation Rate Limit

The LHGR limits for Single Loop Operation are defined in Section 6.0.

RBM Setpoints and Operability Requirements

The RBM setpoints and operability requirements for Single Loop Operation are defined in Section 7.0.

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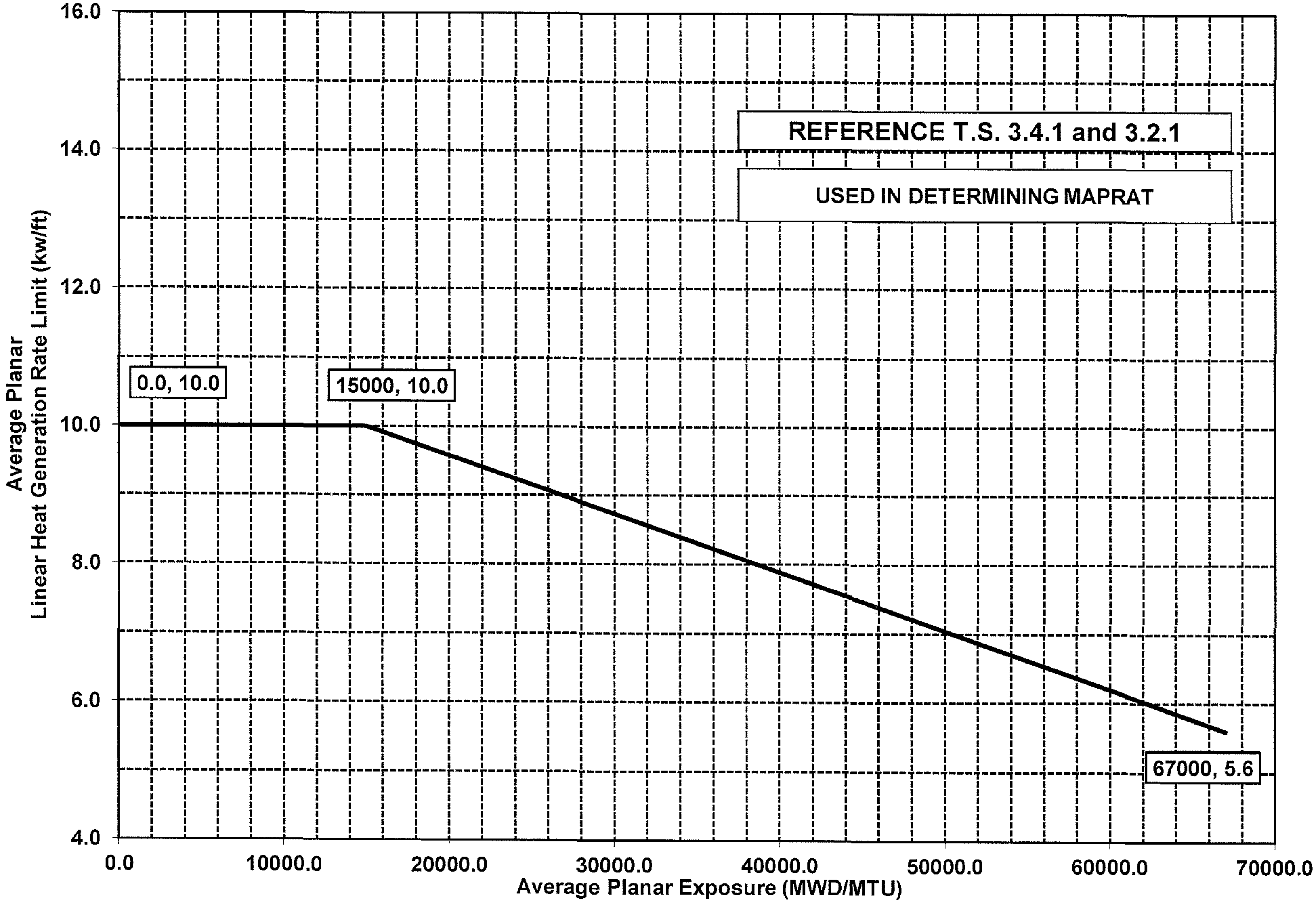

AVERAGE PLANAR LINEAR HEAT GENERATION RATE LIMIT VERSUS
AVERAGE PLANAR EXPOSURE - SINGLE LOOP OPERATION
ATRIUM™-10 FUEL
FIGURE 8.2-1

Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

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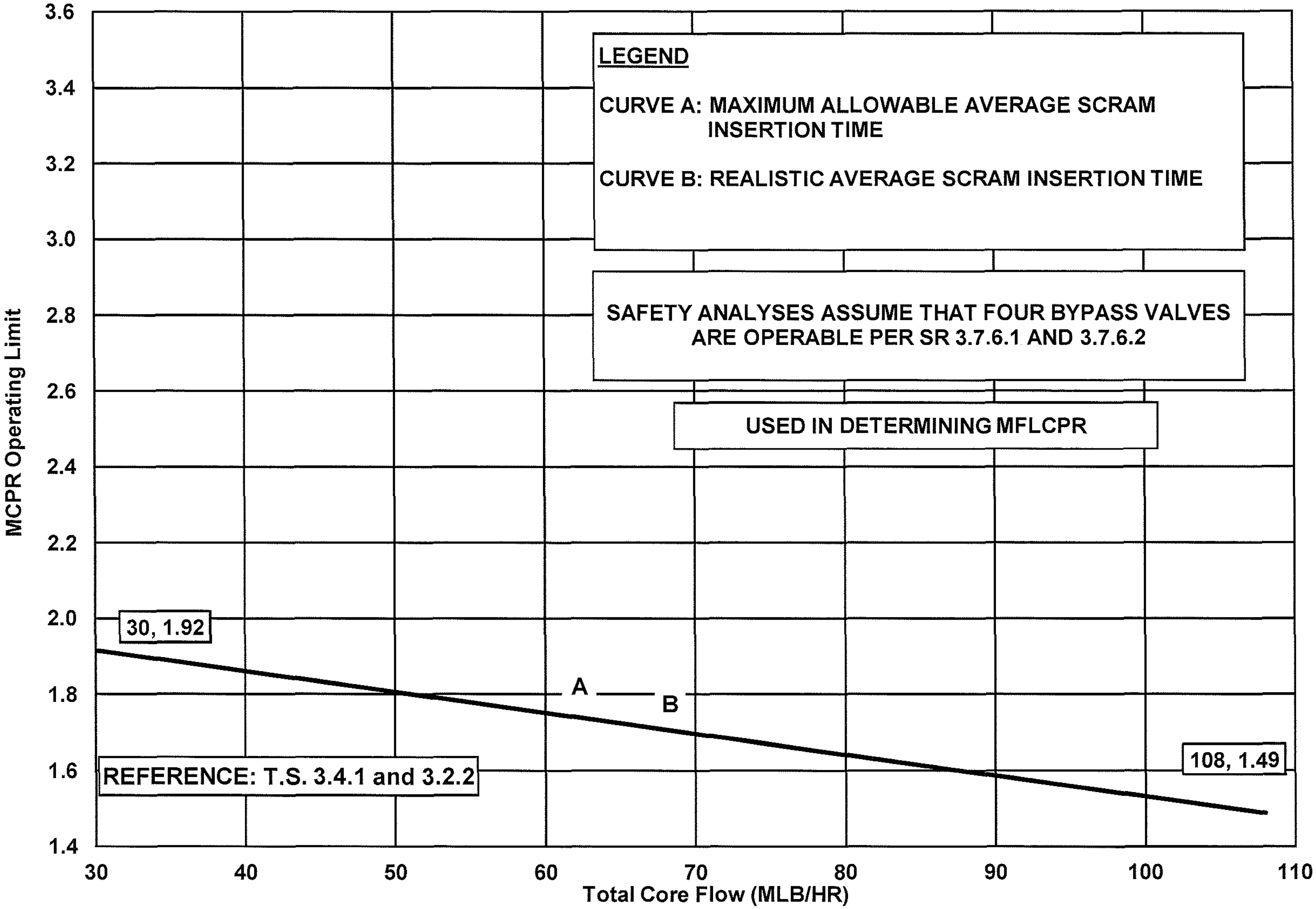

MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-2

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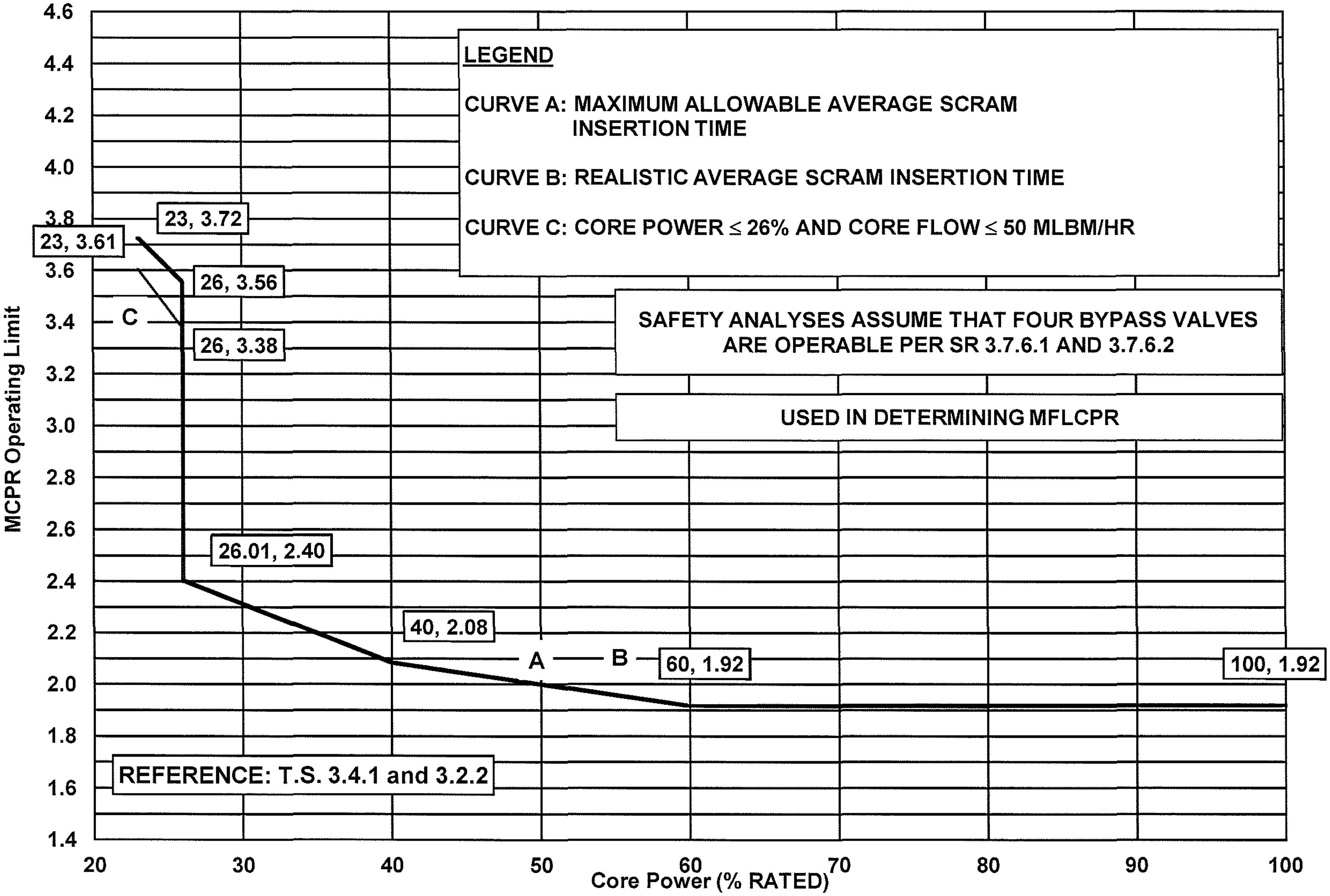
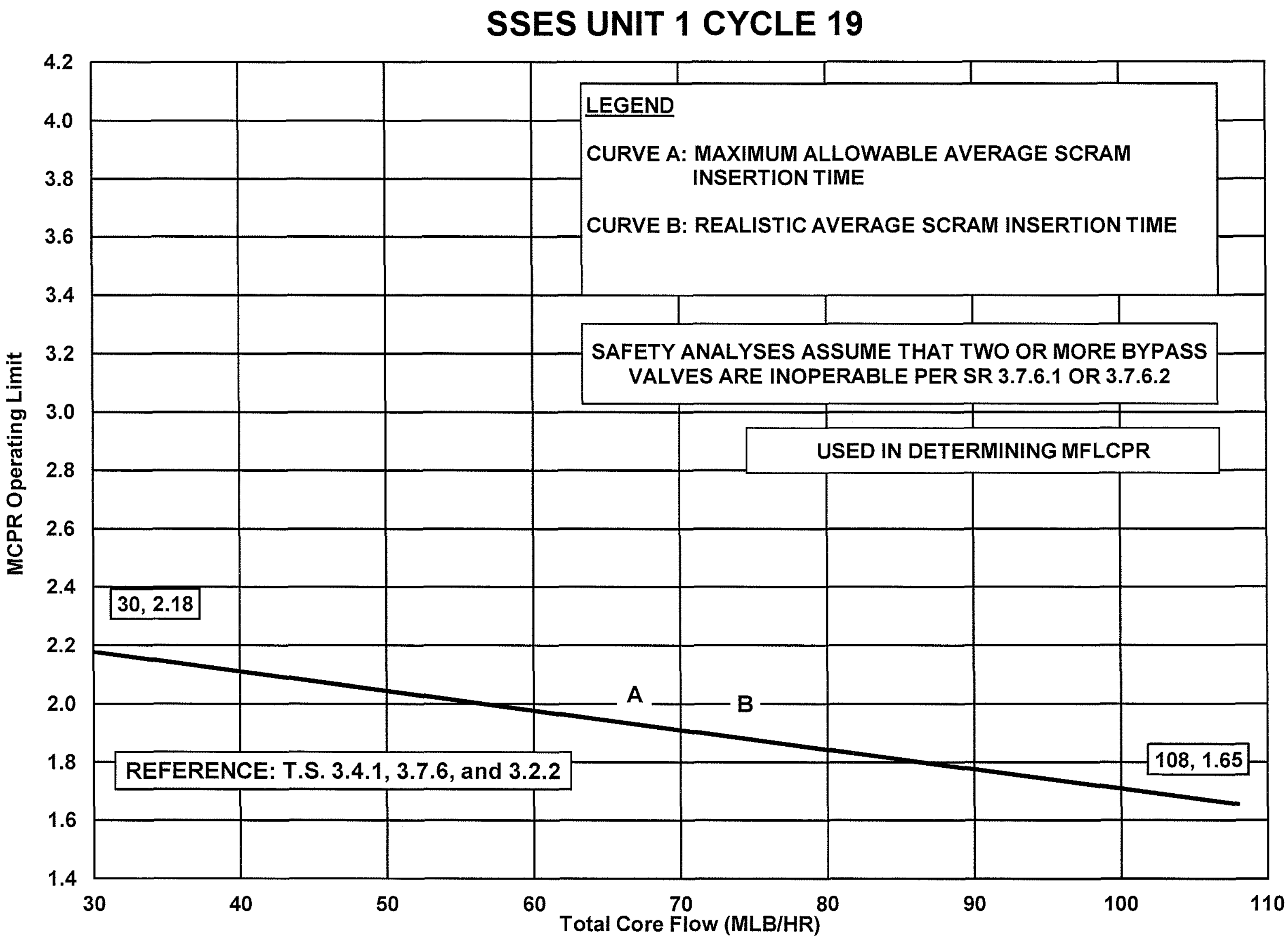


MCPR OPERATING LIMIT VERSUS CORE POWER
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-3

Main Turbine Bypass Inoperable



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS INOPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-4

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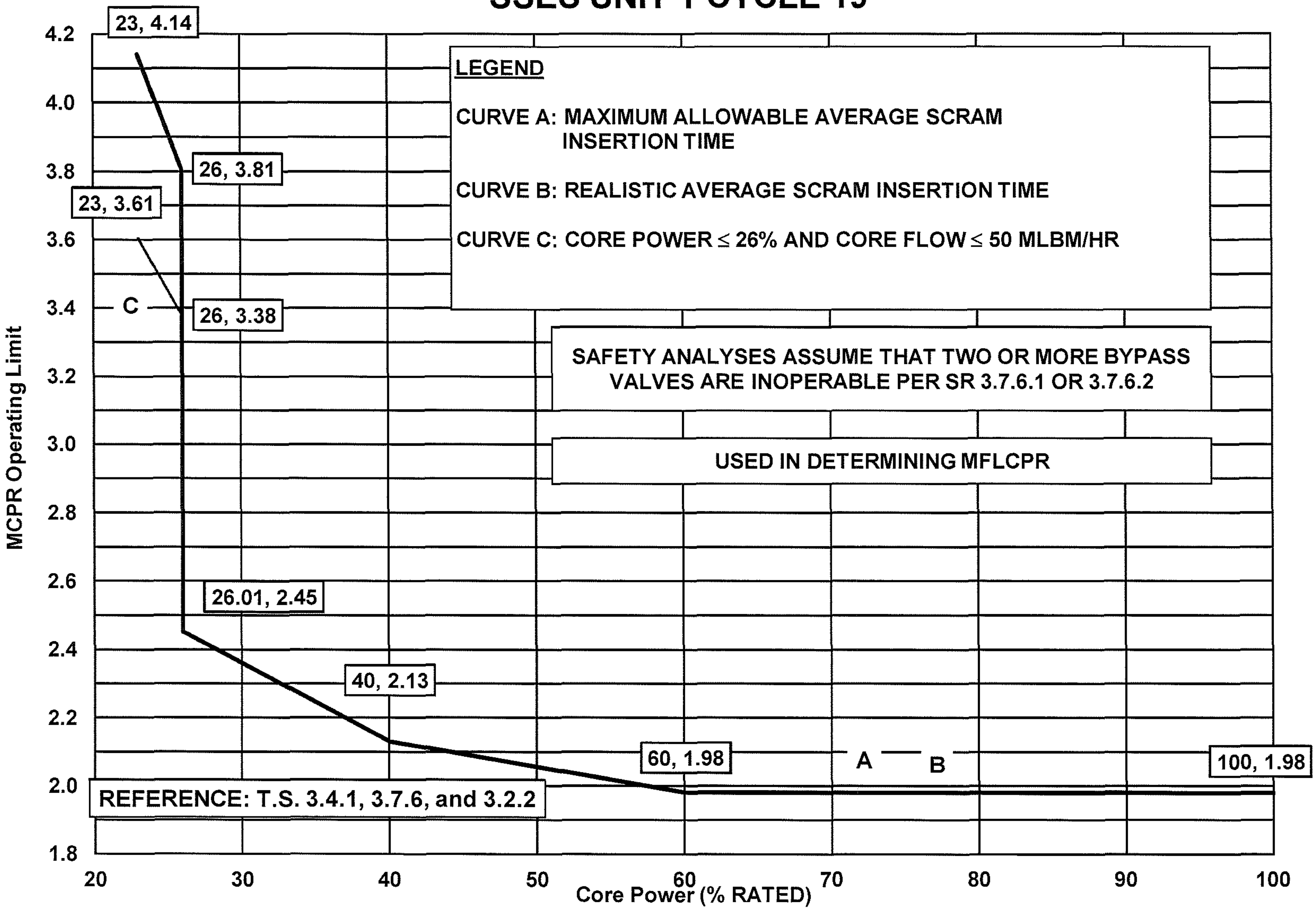
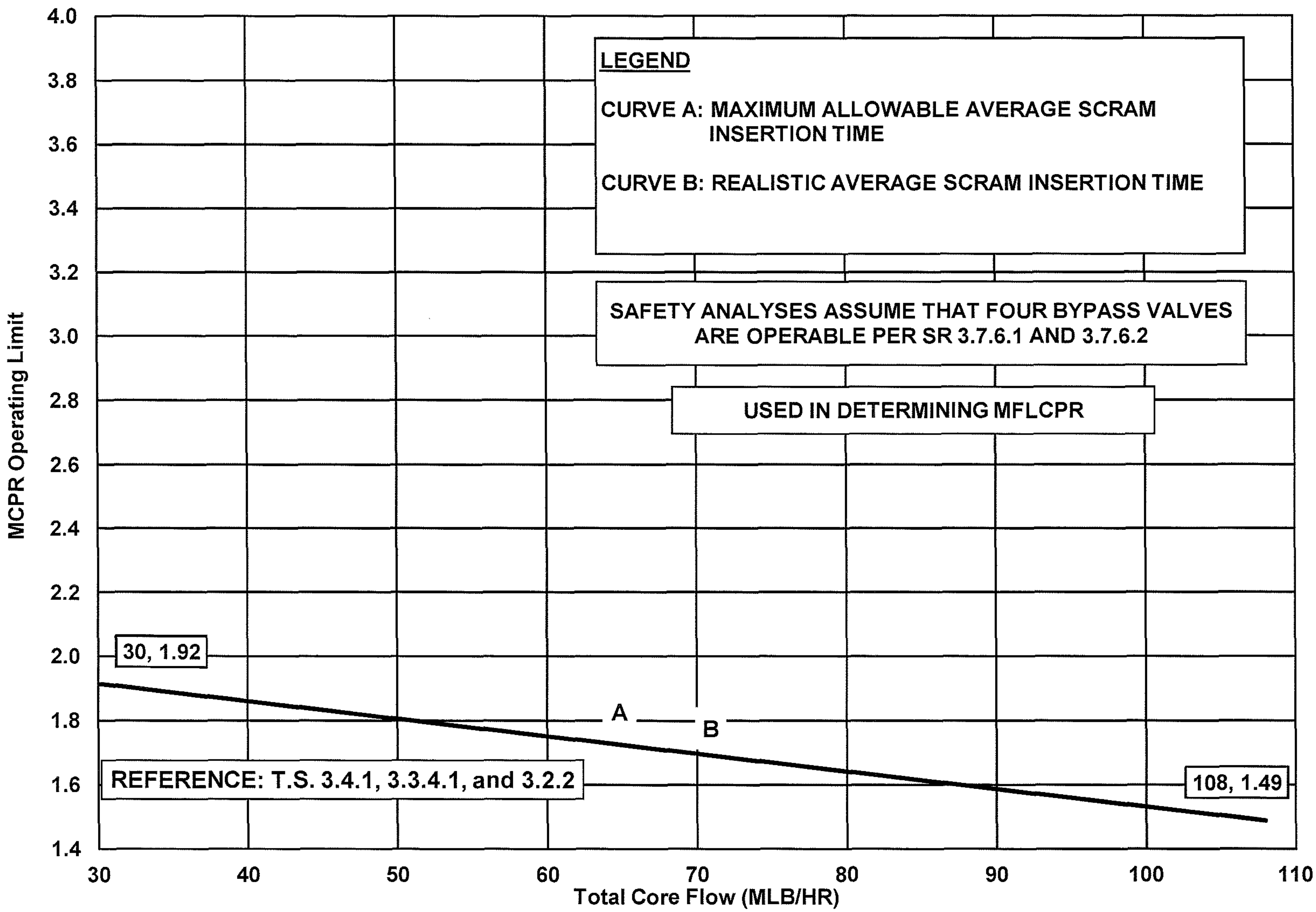


MCPR OPERATING LIMIT VERSUS CORE POWER
MAIN TURBINE BYPASS INOPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-5

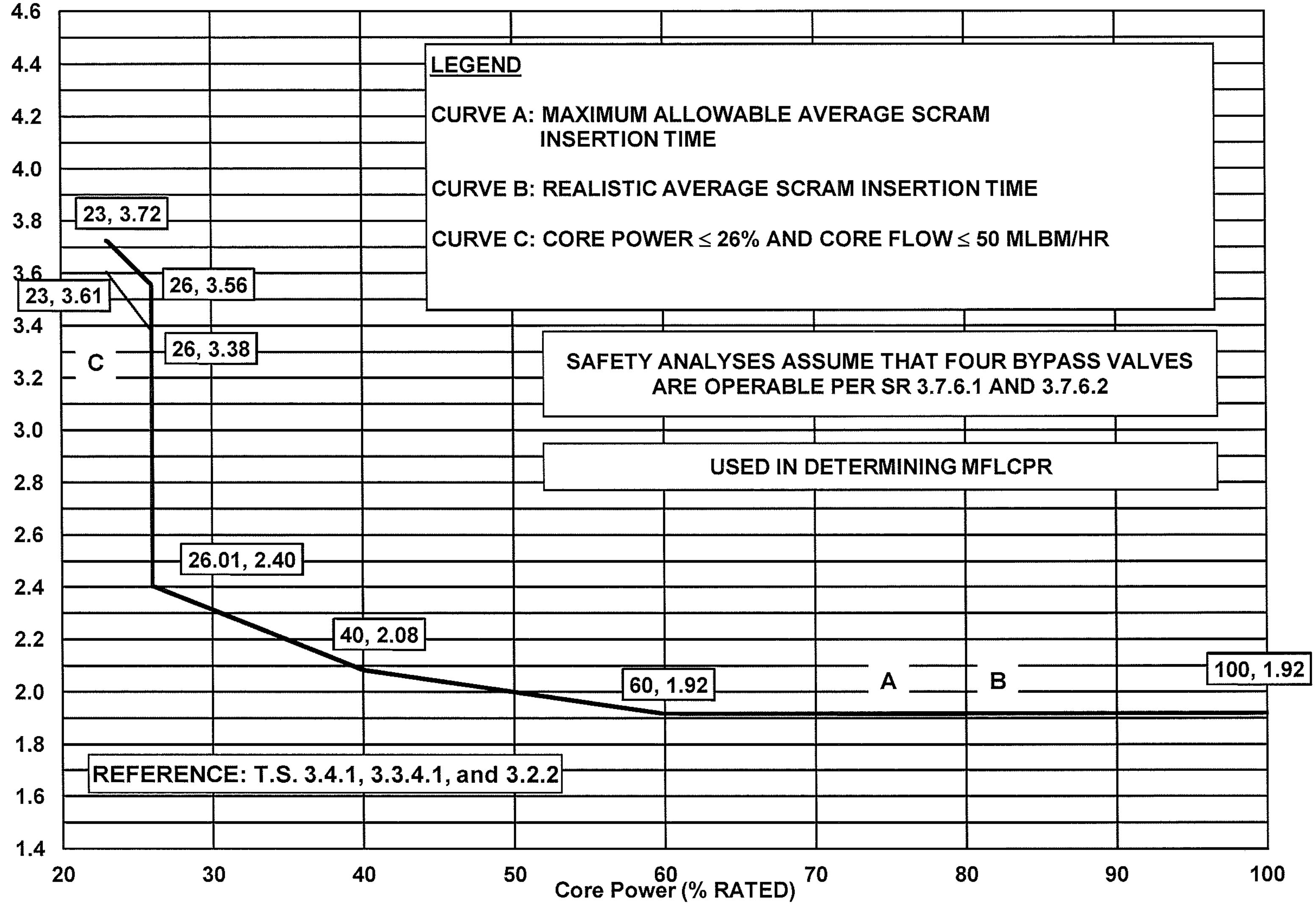
EOC-RPT Inoperable

SSES UNIT 1 CYCLE 19



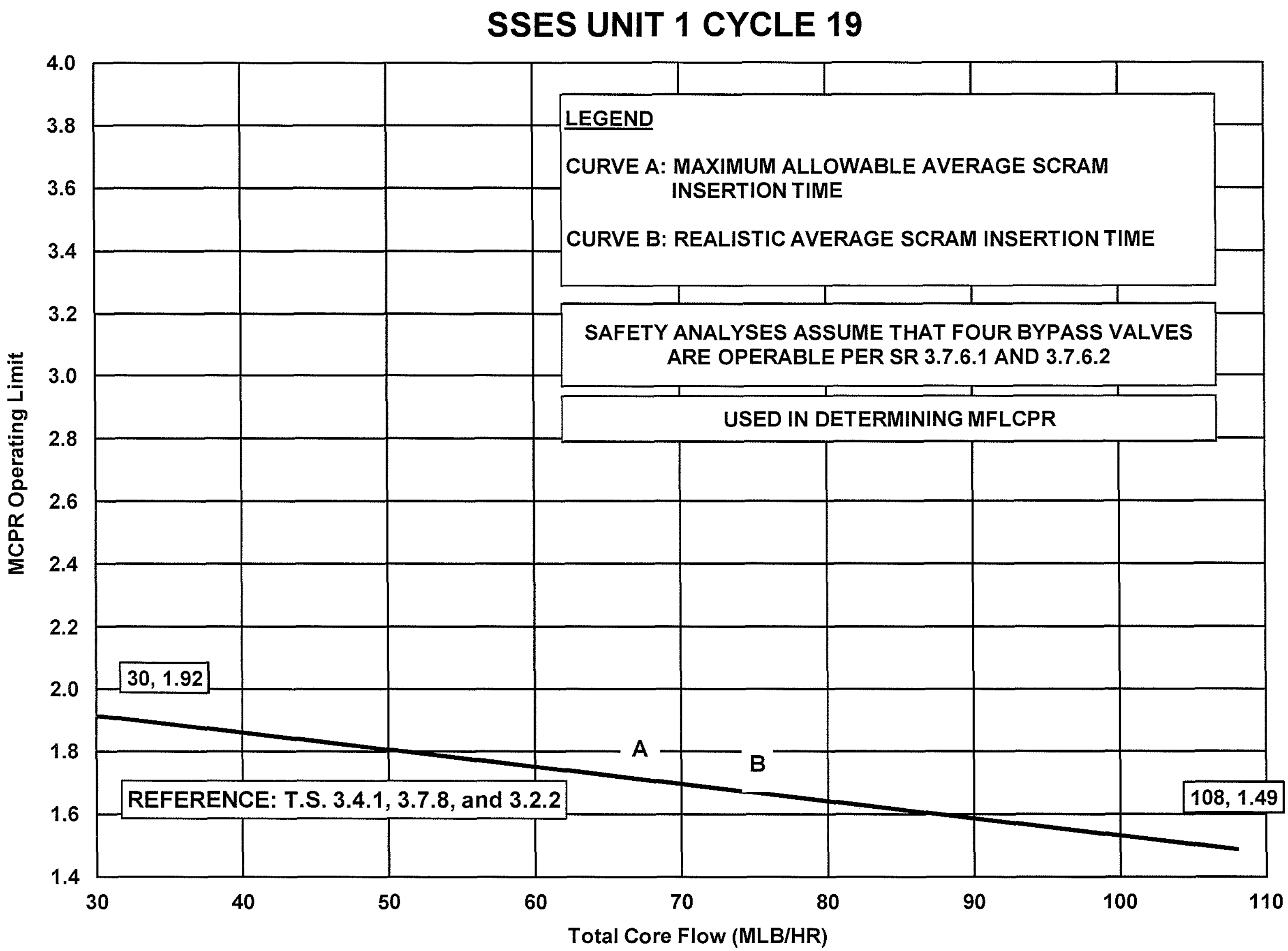
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
EOC-RPT INOPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-6

SSES UNIT 1 CYCLE 19



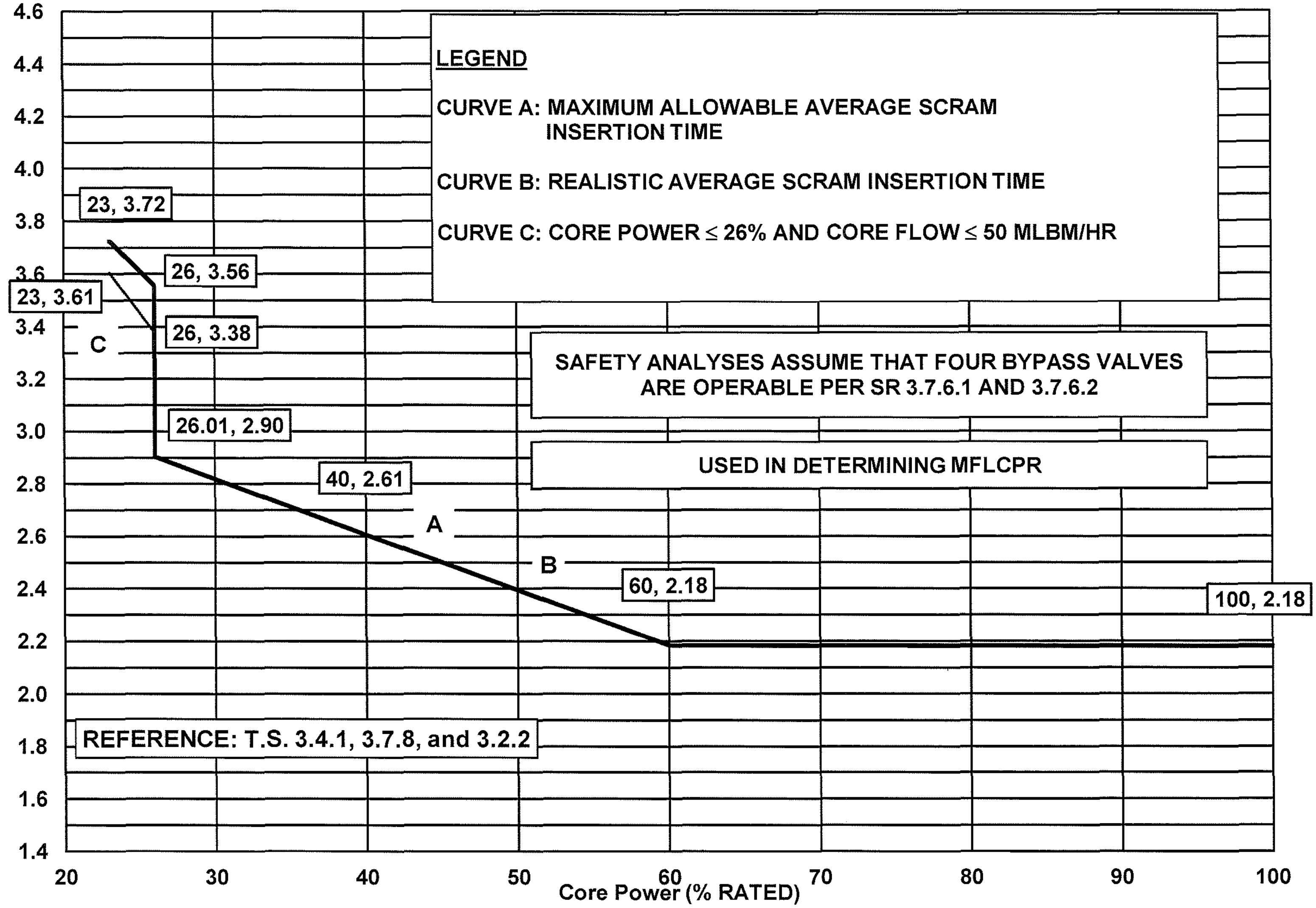
MCPR OPERATING LIMIT VERSUS CORE POWER
EOC-RPT INOPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-7

Backup Pressure Regulator Inoperable



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
BACKUP PRESSURE REGULATOR INOPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-8

SSES UNIT 1 CYCLE 19



MCPR OPERATING LIMIT VERSUS CORE POWER
BACKUP PRESSURE REGULATOR INOPERABLE
SINGLE LOOP OPERATION (BOC to EOC)
FIGURE 8.2-9

9.0 POWER / FLOW MAP

9.1 Technical Specification Reference

Technical Specification 3.3.1.1

9.2 Description

Monitor reactor conditions to maintain THERMAL POWER / core flow outside of Stability Regions I and II of the Power / Flow map, Figure 9.1.

If the OPRM Instrumentation is OPERABLE per TS 3.3.1.1, Region I of the Power / Flow map is considered an immediate exit region.

If the OPRM Instrumentation is inoperable per TS 3.3.1.1, Region I of the Power / Flow map is considered an immediate scram region.

Region II of the Power / Flow map is considered an immediate exit region regardless of the operability of the OPRM Instrumentation.

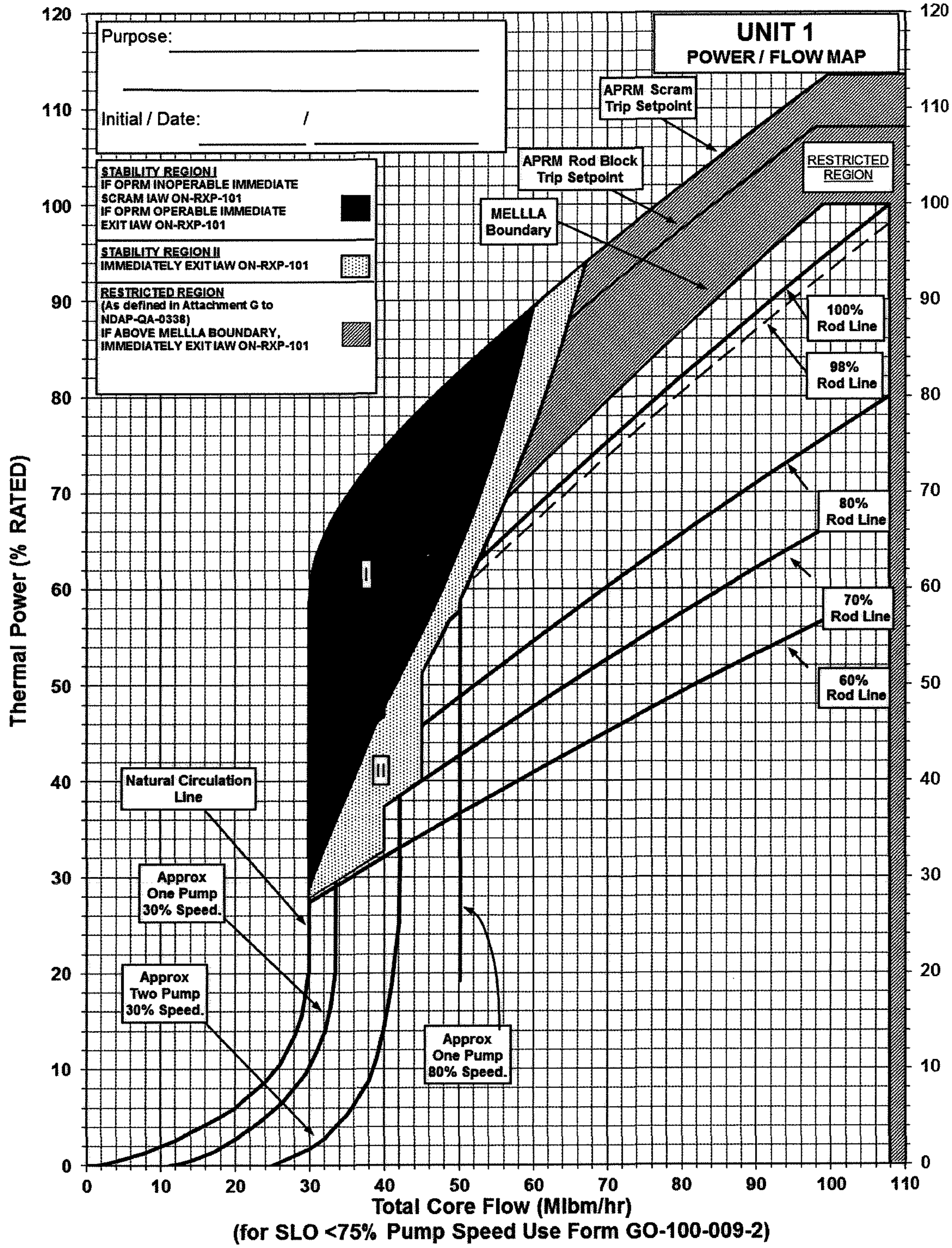


Figure 9.1
SSES Unit 1 Cycle 19 Power / Flow Map

10.0 OPRM SETPOINTS

10.1 Technical Specification Reference

Technical Specification 3.3.1.1

10.2 Description

Setpoints for the OPRM Instrumentation are established that will reliably detect and suppress anticipated stability related power oscillations while providing a high degree of confidence that the MCPR Safety limit is not violated. The setpoints are described in Section 2.0 and are listed below:

S_P = 1.11

N_P = 15

F_P = 60 Mlbm / hr

11.0 REFERENCES

11.1 The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. XN-NF-81-58(P)(A), Revision 2 and Supplements 1 and 2, "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," Exxon Nuclear Company, March 1984.

2. EMF-2361(P)(A), Revision 0, "EXEM BWR-2000 ECCS Evaluation Model," Framatome ANP, May 2001.

3. EMF-2292(P)(A), Revision 0, "ATRIUM™-10: Appendix K Spray Heat Transfer Coefficients," Siemens Power Corporation, September 2000.

4. XN-NF-84-105(P)(A), Volume 1 and Volume 1 Supplements 1 and 2, "XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis," Exxon Nuclear Company, February 1987.

5. XN-NF-80-19(P)(A), Volume 1 and Supplements 1 and 2, "Exxon Nuclear Methodology for Boiling Water Reactors: Neutronic Methods for Design and Analysis," Exxon Nuclear Company, March 1983.

6. XN-NF-80-19(P)(A), Volumes 2, 2A, 2B, and 2C "Exxon Nuclear Methodology for Boiling Water Reactors: EXEM BWR ECCS Evaluation Model," Exxon Nuclear Company, September 1982.

7. XN-NF-80-19(P)(A), Volume 3 Revision 2 "Exxon Nuclear Methodology for Boiling Water Reactors Thermex: Thermal Limits Methodology Summary Description," Exxon Nuclear Company, January 1987.

8. XN-NF-80-19(P)(A), Volume 4, Revision 1, "Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads," Exxon Nuclear Company, June 1986.

9. XN-NF-85-67(P)(A), Revision 1, "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," Exxon Nuclear Company, Inc., September 1986.

10. ANF-524(P)(A), Revision 2 and Supplements 1 and 2, "Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors," November 1990.

11. NE-092-001A, Revision 1, "Licensing Topical Report for Power Uprate With Increased Core Flow," Pennsylvania Power & Light Company, December 1992 and NRC SER (November 30, 1993).

13. EMF-2209(P)(A), Revision 3, “SPCB Critical Power Correlation,” AREVA NP, September 2009.

14. EMF-85-74(P)(A), Revision 0, Supplement 1(P)(A) and Supplement 2(P)(A), “RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model,” Siemens Power Corporation, February 1998.

15. EMF-2158(P)(A), Revision 0, “Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/Microburn-B2,” Siemens Power Corporation, October 1999.

16. EMF-CC-074(P)(A), Volume 4, Revision 0, “BWR Stability Analysis - Assessment of STAIF with Input from MICROBURN-B2,” Siemens Power Corporation, August 2000.

17. NEDO-32465-A, “BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications,” August 1996.

18. ANF-913(P)(A), Volume 1 Revision 1 and Volume 1 Supplements 2, 3, and 4, “COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses,” Advanced Nuclear Fuels Corporation, August 1990.

19. ANF-1358(P)(A), Revision 3, “The Loss of Feedwater Heating Transient in Boiling Water Reactors,” Framatome ANP, September 2005.