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TRM2 - TECHNICAL REQUIREMENTS MANUAL UNIT 2

REMOVE MANUAL TABLE OF CONTENTS DATE: 03/30/2021

ADD MANUAL TABLE OF CONTENTS DATE: 03/31/2021

CATEGORY: DOCUMENTS TYPE: TRM2

ADD
NRR

ID: TEXT 3.2.1

ADD: REV: 19

REMOVE: REV:18

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SSS MANUAL

Manual Name: TRM2

Manual Title: TECHNICAL REQUIREMENTS MANUAL UNIT 2

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Title: MISCELLANEOUS BASES INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)

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Title: RADIOACTIVE EFFLUENTS BASES LIQUID EFFLUENTS CONCENTRATION

TEXT B3.11.1.2 0 11/19/2002

Title: RADIOACTIVE EFFLUENTS BASES LIQUID EFFLUENTS DOSE

TEXT B3.11.1.3 0 11/19/2002

Title: RADIOACTIVE EFFLUENTS BASES LIQUID WASTE TREATMENT SYSTEM

TEXT B3.11.1.4 0 11/19/2002

Title: RADIOACTIVE EFFLUENTS BASES LIQUID RADWASTE EFFLUENT MONITORING INSTRUMENTATION

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Title: LOADS CONTROL PROGRAM BASES HEAVY LOADS REQUIREMENTS

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Title: LOADS CONTROL PROGRAM BASES LIGHT LOADS REQUIREMENTS

3.2 Core Operating Limits Report (COLR)

3.2.1 Core Operating Limits Report (COLR)

TRO 3.2.1 The Core Operating Limits specified in the attached COLR shall be met.

APPLICABILITY: Specified in the referenced Technical Specifications.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Core Operating Limits not met.	A.1 Perform action(s) described in referenced Technical Specification.	Specified in referenced Technical Specifications.

TECHNICAL REQUIREMENT SURVEILLANCE

SURVEILLANCE	FREQUENCY
<p>-----NOTE-----</p> <p>No associated Surveillances. Surveillances are implemented in the applicable Technical Specifications.</p> <p>-----</p>	N/A

Susquehanna SES Unit 2 Cycle 21

CORE OPERATING LIMITS REPORT

**Nuclear Fuels
Engineering**

March 2021

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 2 Cycle 21 operation.

**SUSQUEHANNA STEAM ELECTRIC STATION
Unit 2 Cycle 21
CORE OPERATING LIMITS REPORT**

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1.0 INTRODUCTION

This CORE OPERATING LIMITS REPORT for Susquehanna Unit 2 Cycle 21 is prepared in accordance with the requirements of Susquehanna Unit 2, 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 APLHGR 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 References

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 References

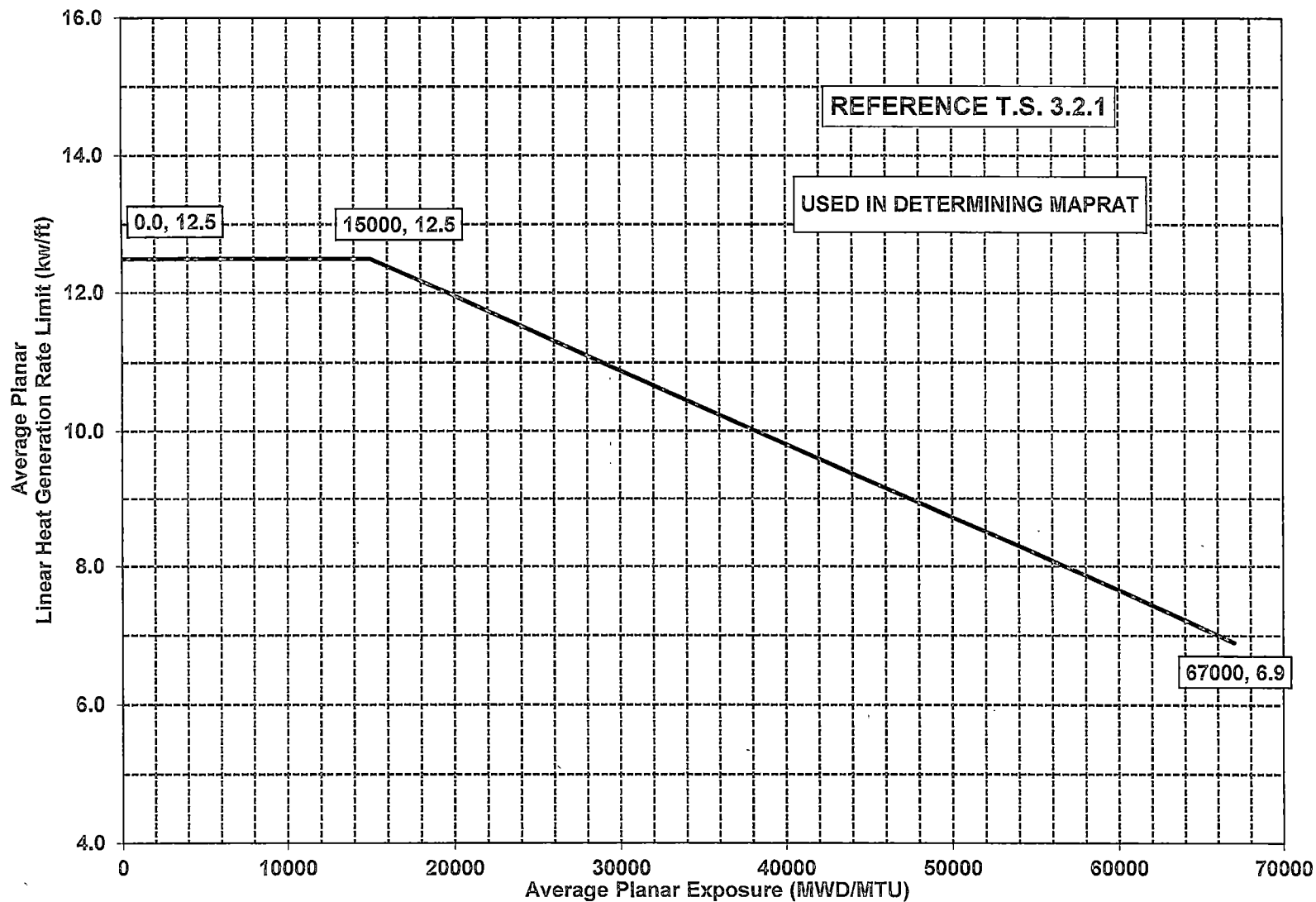
Technical Specification 3.2.1

4.2 Description

The APLHGRs for ATRIUM™-10 fuel shall not exceed the limit shown in Figure 4.2-1A. The APLHGRs for ATRIUM™ 11 fuel shall not exceed the limit shown in Figure 4.2-1B.

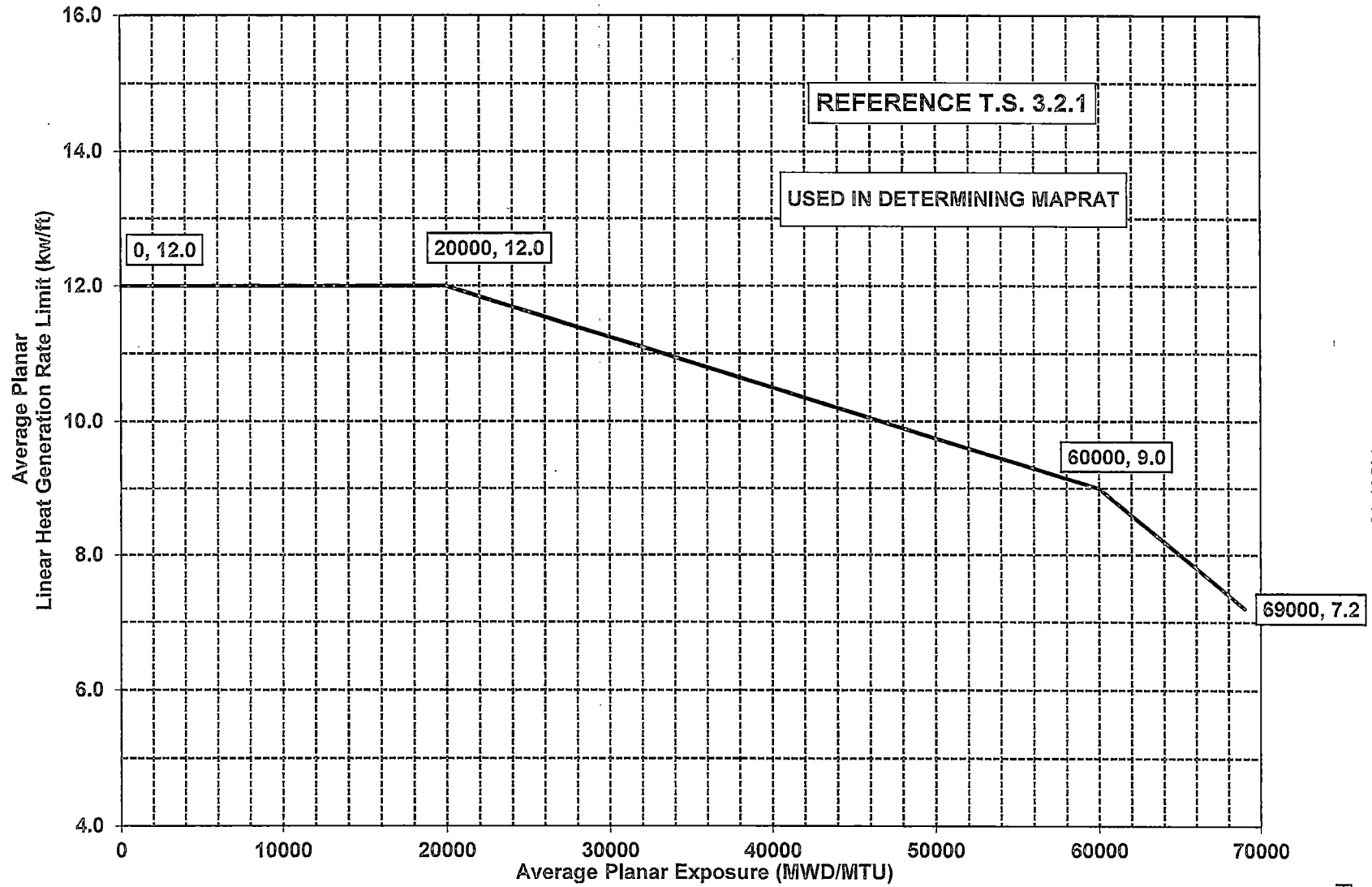
The APLHGR limits in Figures 4.2-1A and 4.2-1B are valid in Two Loop operation for Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, Backup Pressure Regulator Operable and Inoperable, and with one Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) closed. The APLHGR limits for Single Loop operation are provided in Section 8.0.

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

SSSES UNIT 2 CYCLE 21



AVERAGE PLANAR LINEAR HEAT GENERATION RATE LIMIT VERSUS
AVERAGE PLANAR EXPOSURE - TWO LOOP OPERATION
: ATRIUM™ 11 FUEL
FIGURE 4.2-1B

5.0 MINIMUM CRITICAL POWER RATIO (MCPR)

5.1 References

Technical Specification 3.2.2, 3.3.4.1, 3.7.6, and 3.7.8

Technical Requirements Manual 3.3.7

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™-10 and ATRIUM™ 11) 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 5.2-1A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-1B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 5.2-2A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-2B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

b) Main Turbine Bypass Inoperable

Figure 5.2-3A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-3B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 5.2-4A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-4B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

c) EOC-RPT Inoperable

Figure 5.2-5A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-5B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 5.2-6A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-6B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

d) Backup Pressure Regulator Inoperable

Figure 5.2-7A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-7B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 5.2-8A: Power Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-8B: Power Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

e) One Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) Closed

Figure 5.2-9A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-9B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 5.2-10A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 5.2-10B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

The MCPR limits in Figures 5.2-1A/5.2-1B through 5.2-10A/5.2-10B are valid for Two Loop operation.

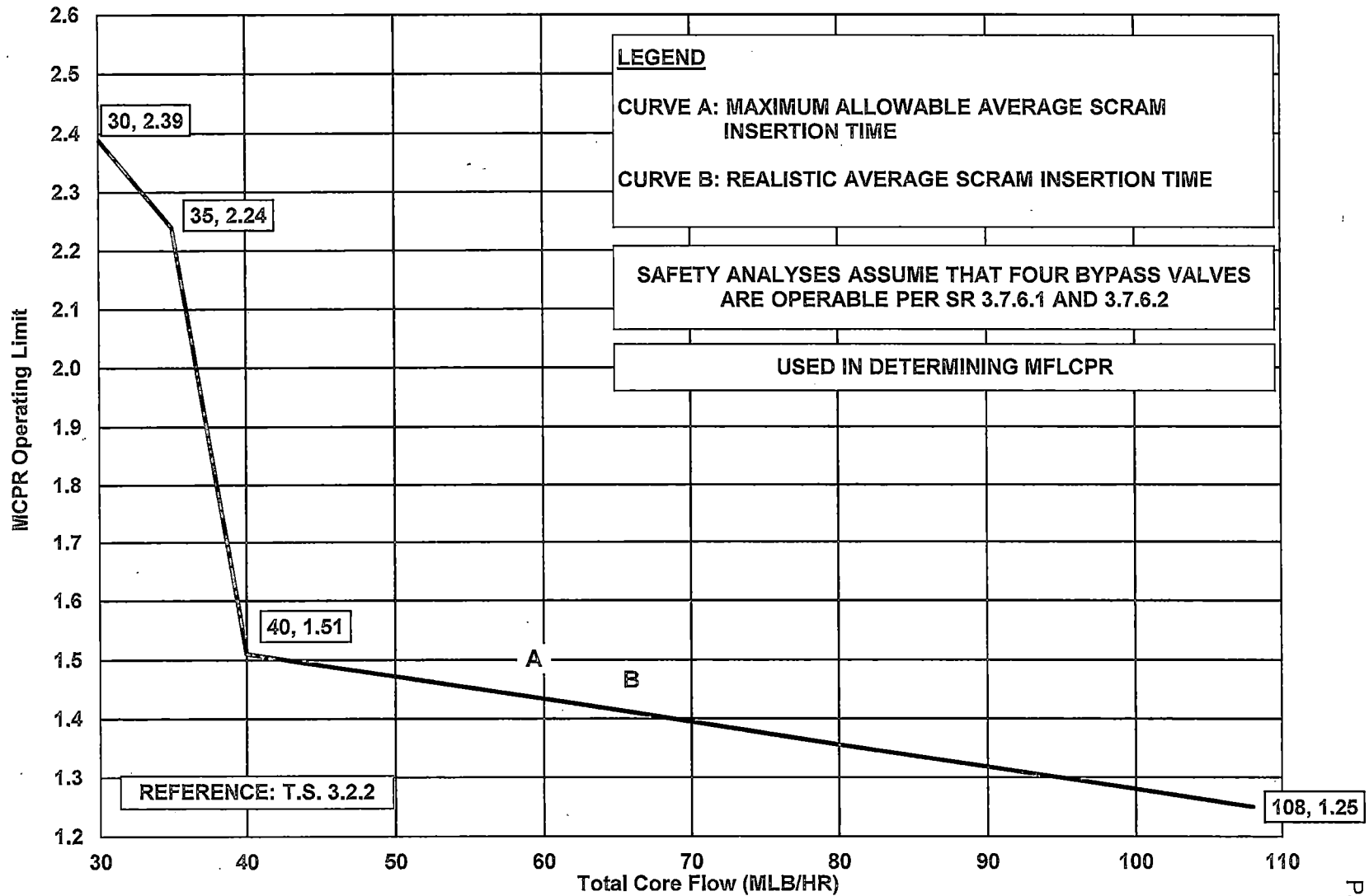
The MCPR limits for Single Loop operation are provided in Section 8.0.

5.3 Average Scram Time Fraction

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.

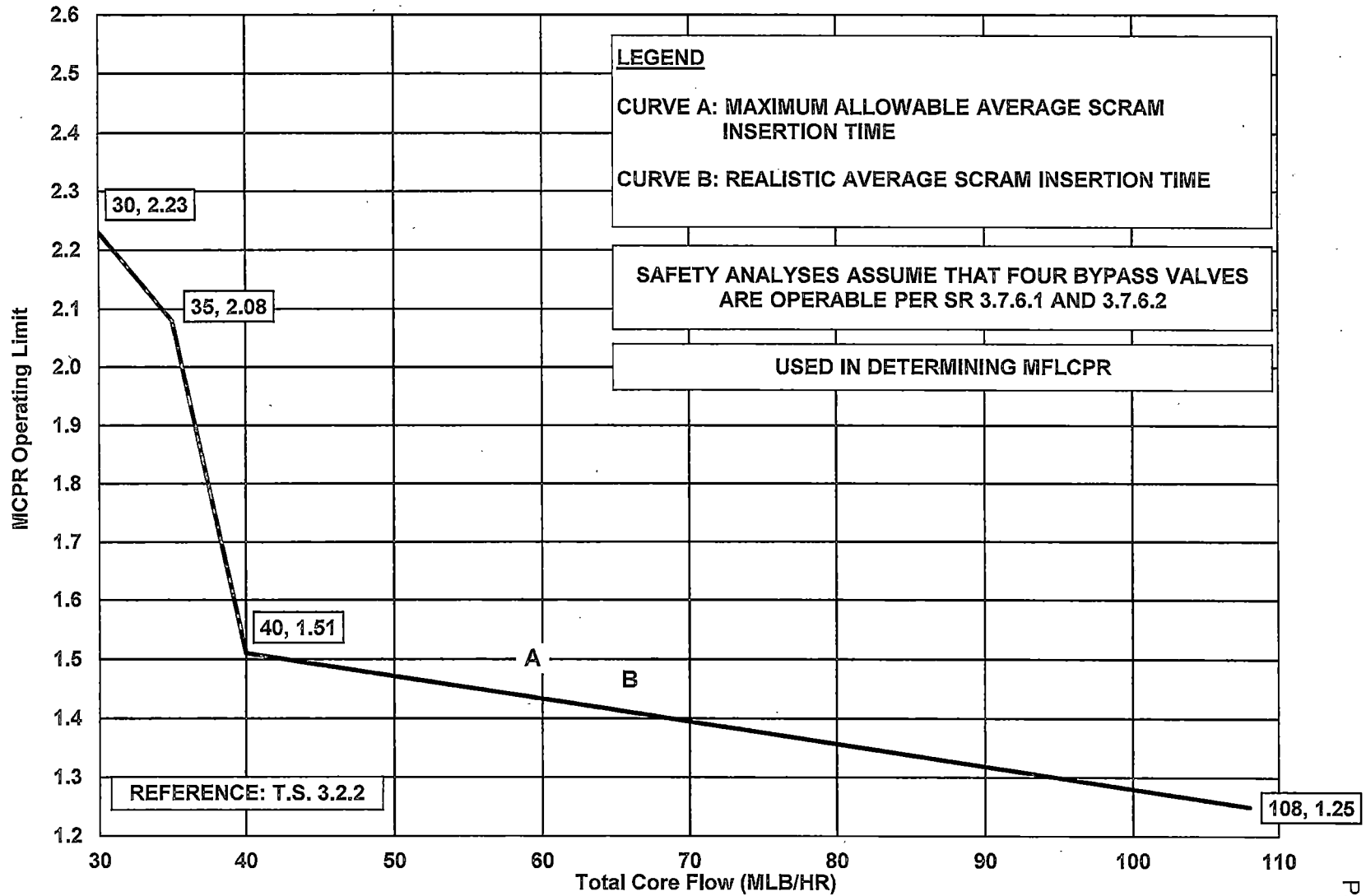
Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

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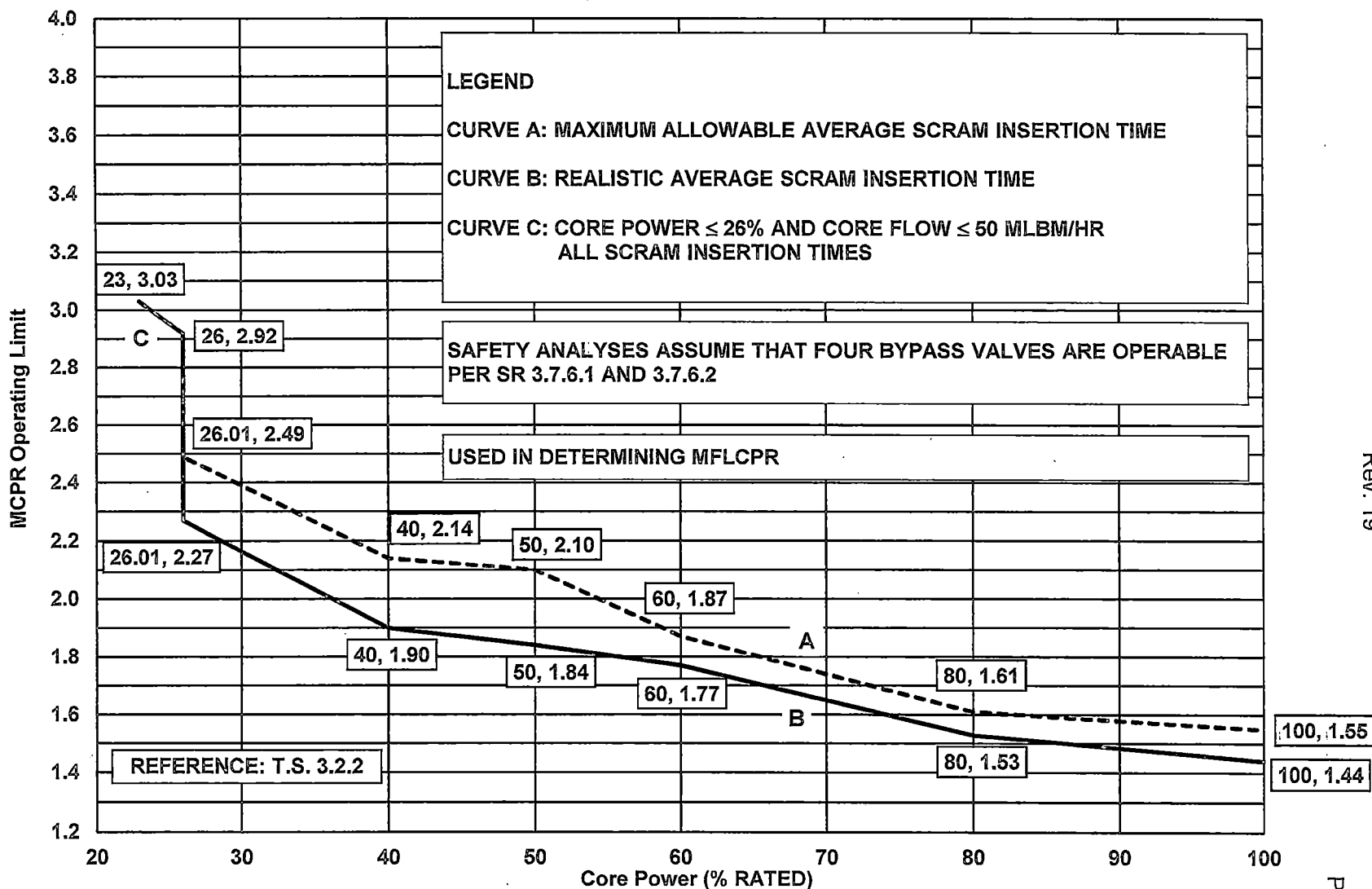
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-1A

SSS UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 5.2-1B

SSSES UNIT 2 CYCLE 21

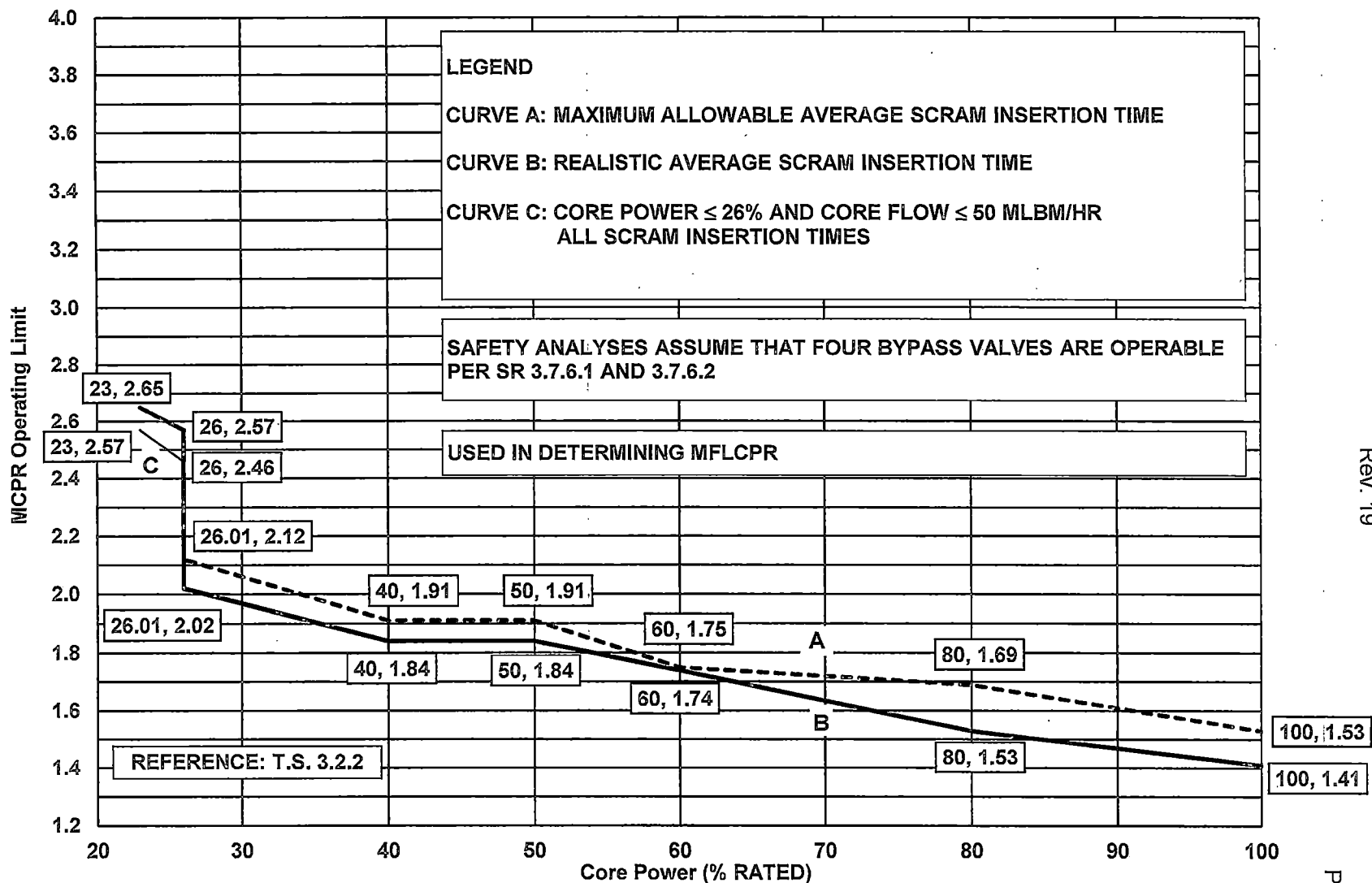


MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-2A

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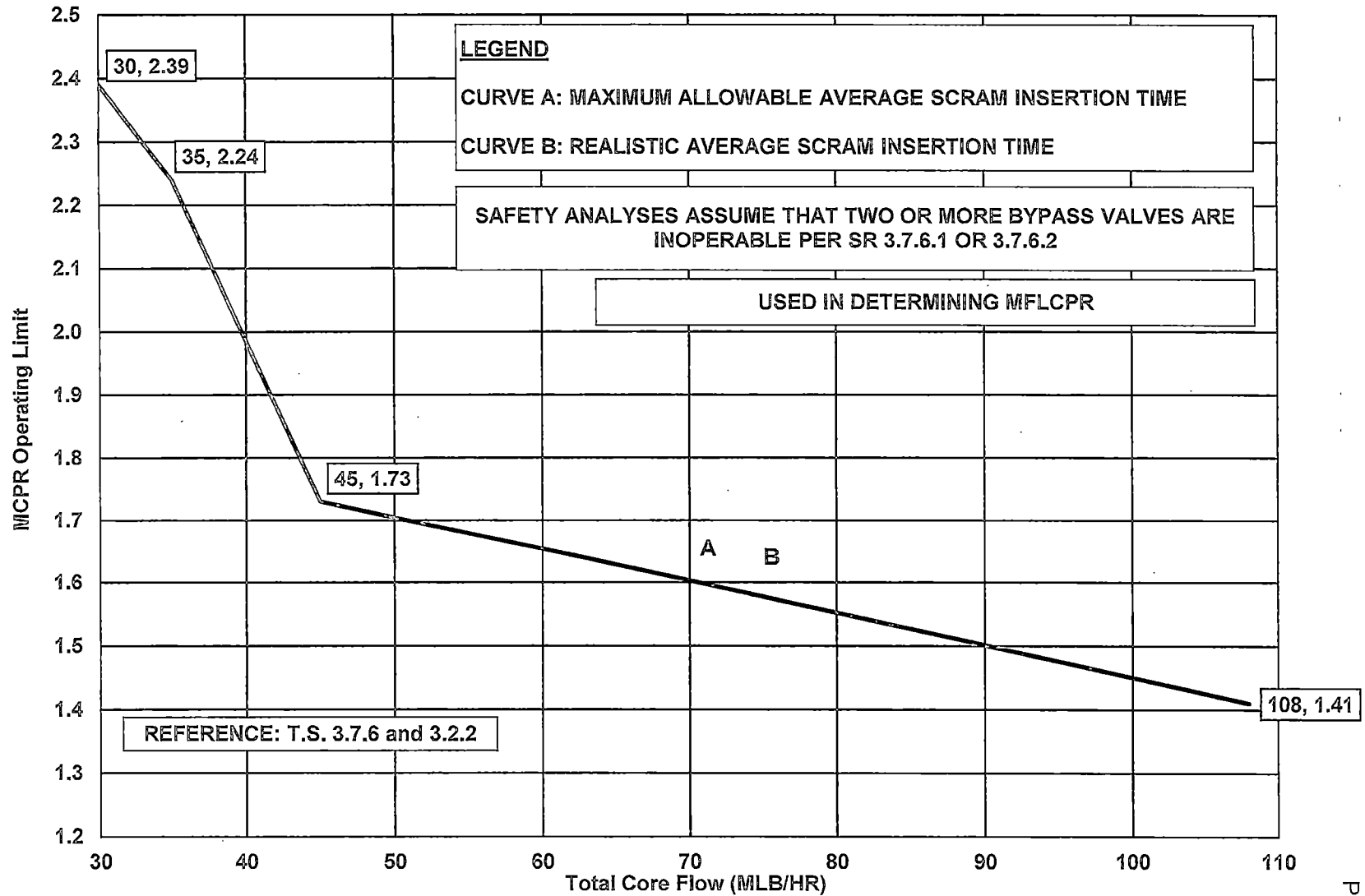
SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 5.2-2B

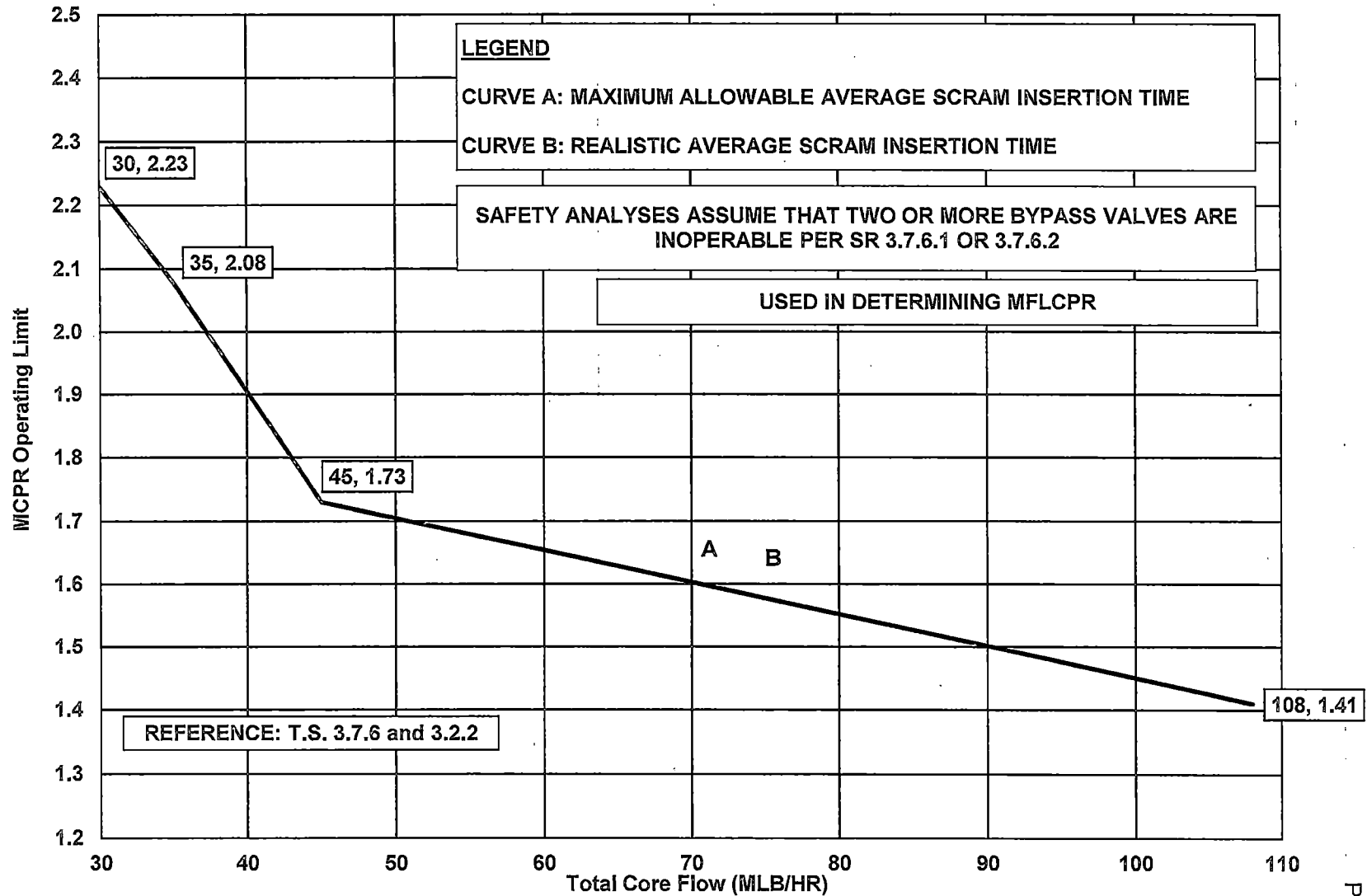
Main Turbine Bypass Inoperable

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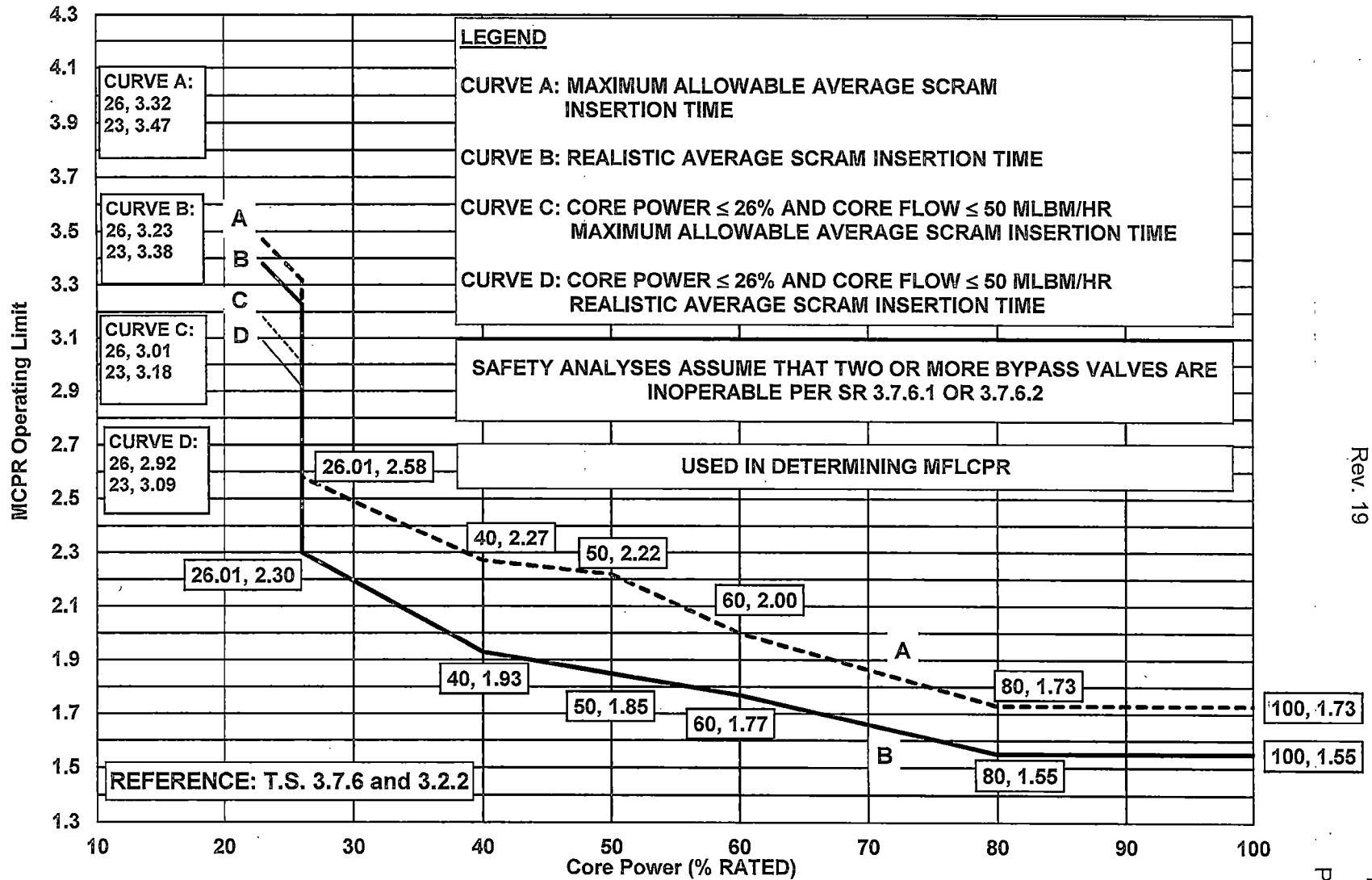
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 MAIN TURBINE BYPASS INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-3A

SSSES UNIT 2 CYCLE 21



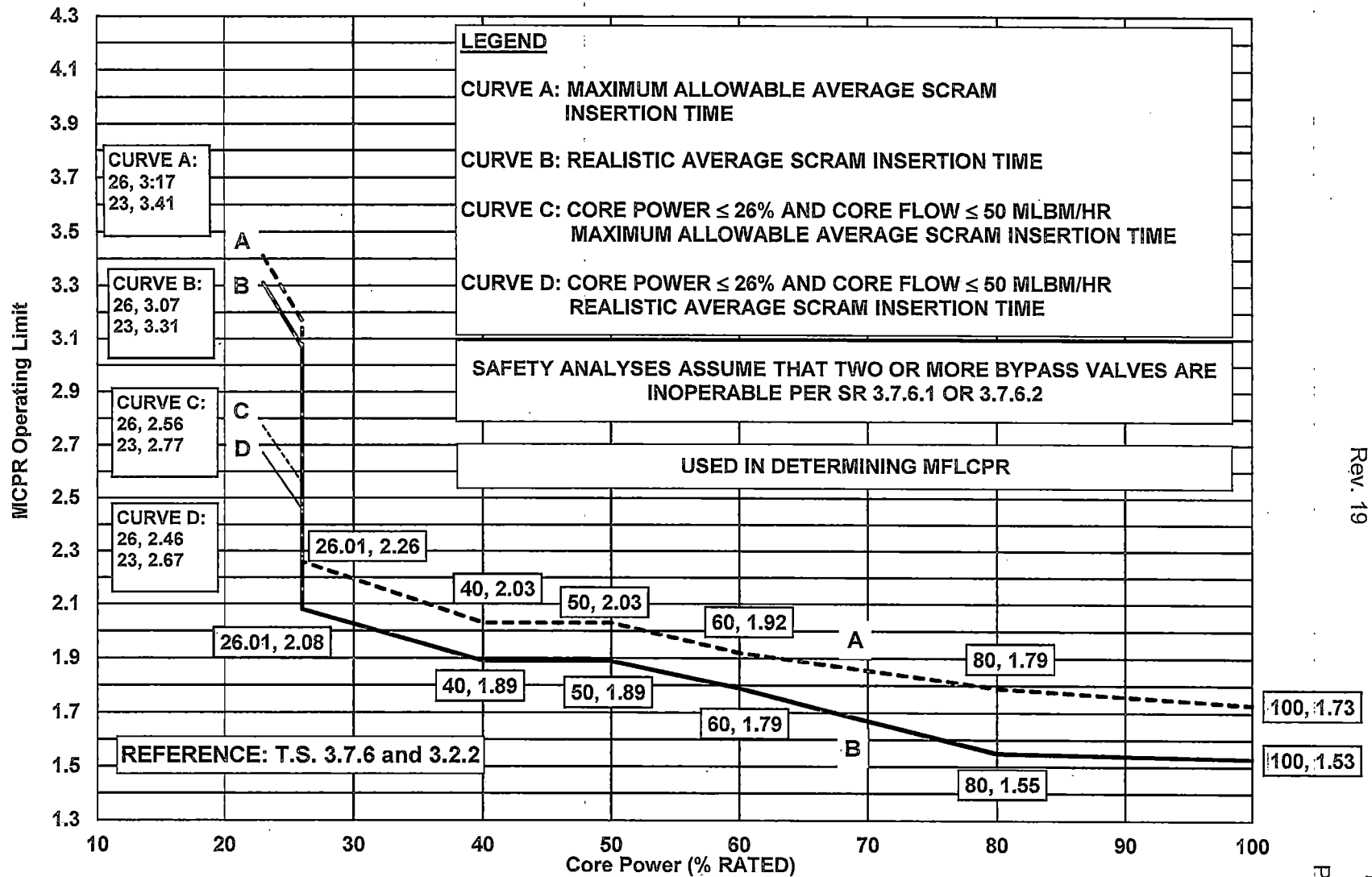
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 MAIN TURBINE BYPASS INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 5.2-3B

SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-4A

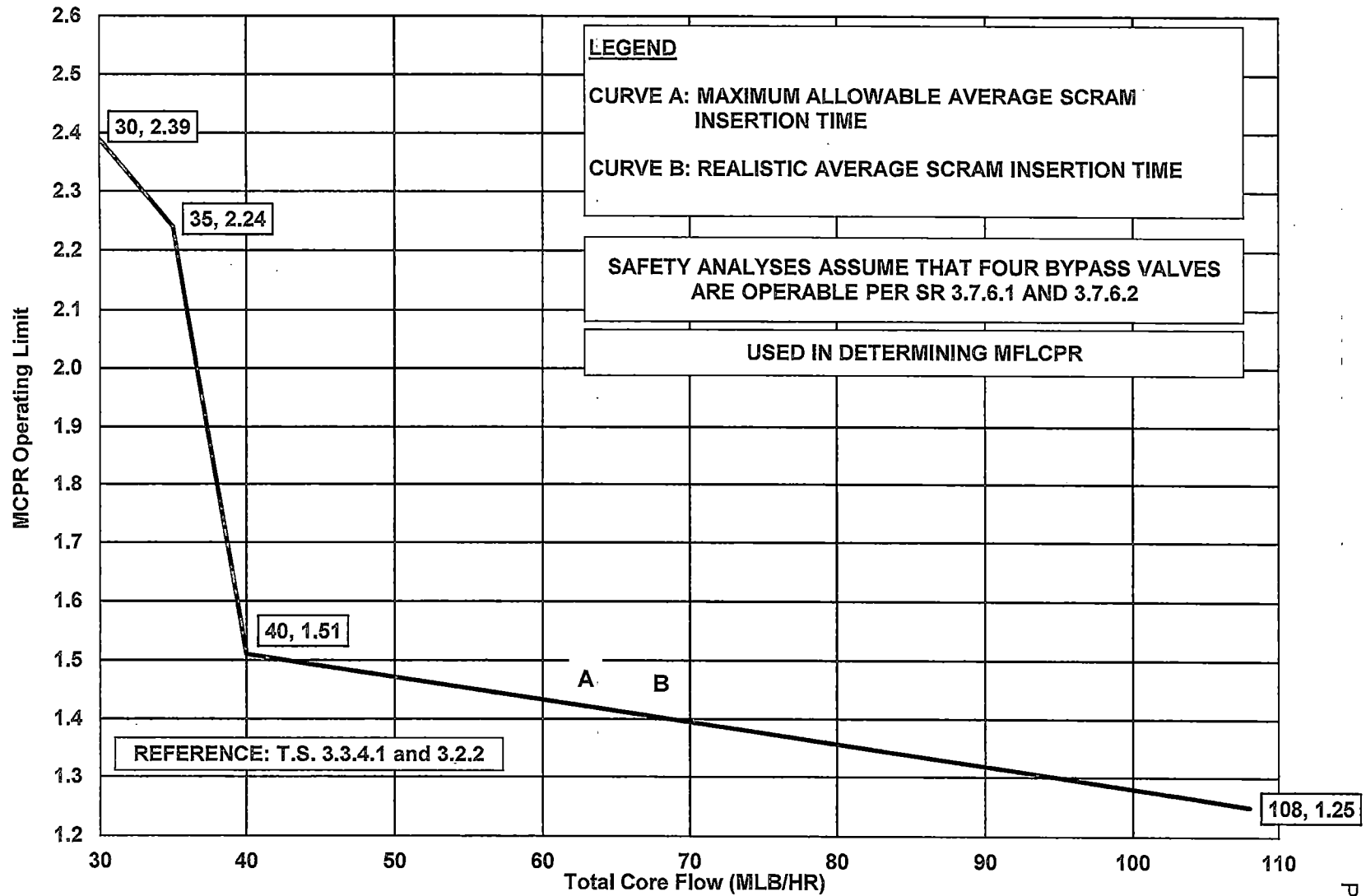
SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
MAIN TURBINE BYPASS INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 5.2-4B

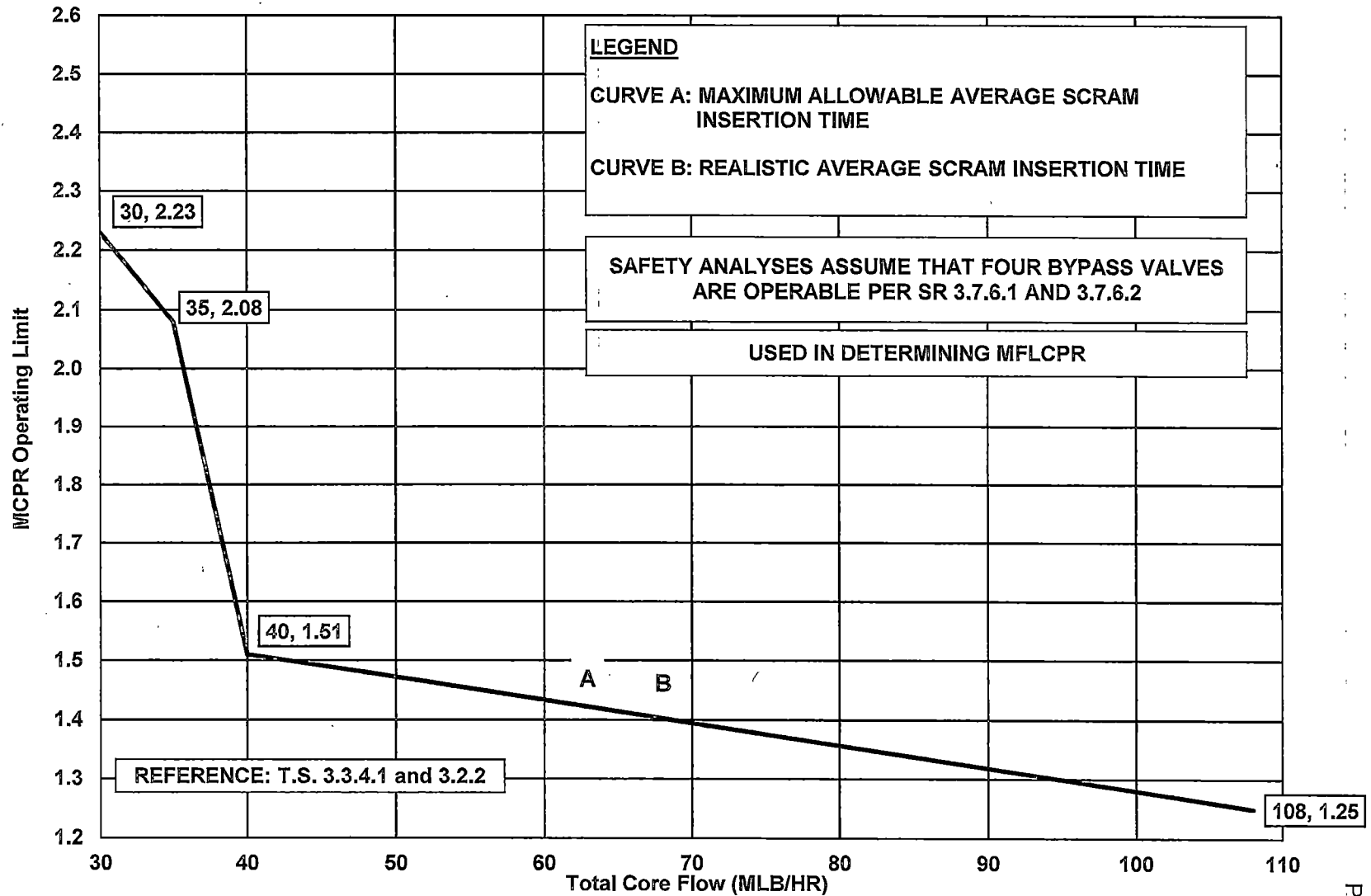
EOC-RPT Inoperable

SSSES UNIT 2 CYCLE 21



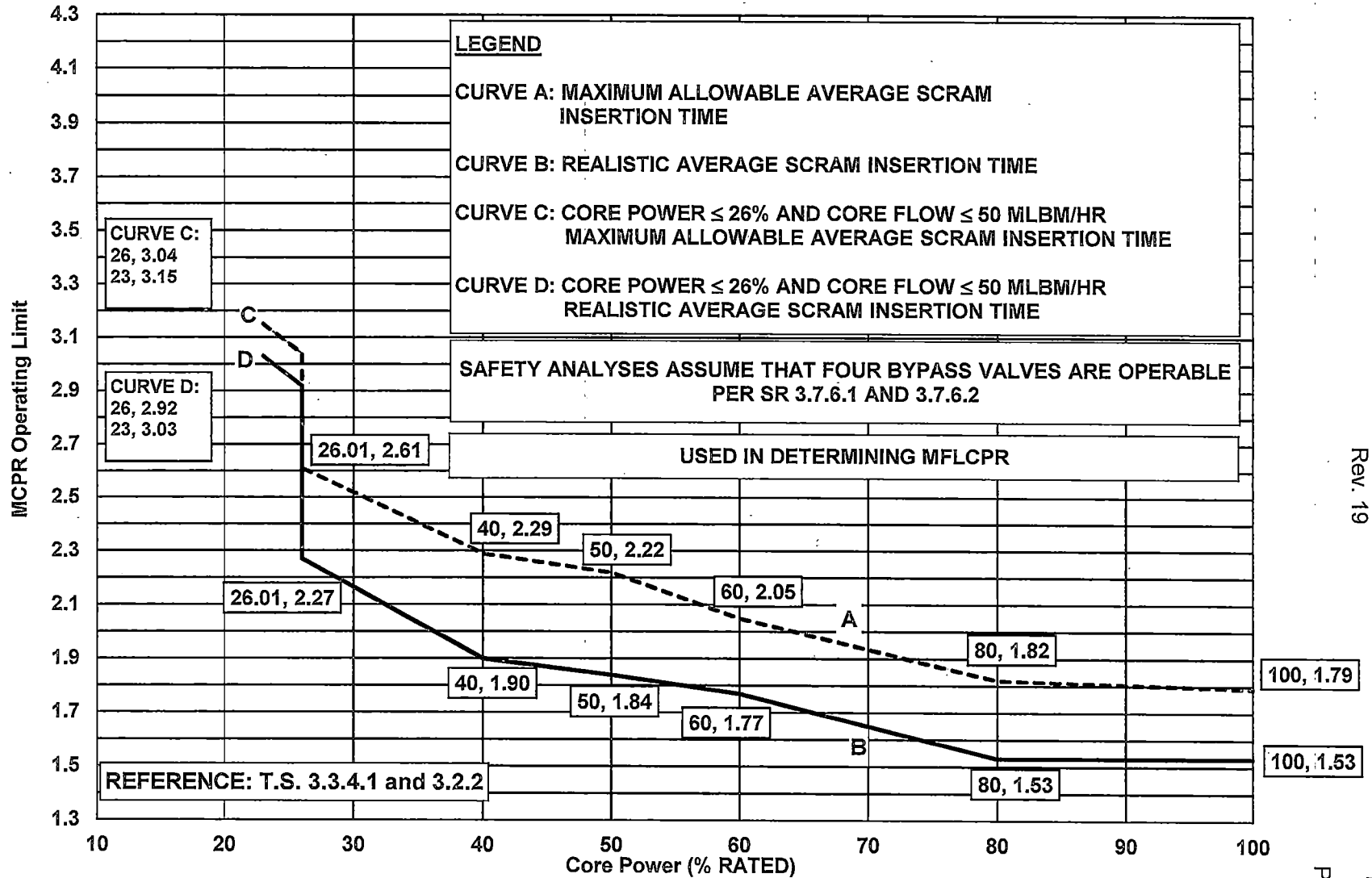
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 EOC-RPT INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-5A

SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 EOC-RPT INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 5.2-5B

SSSES UNIT 2 CYCLE 21



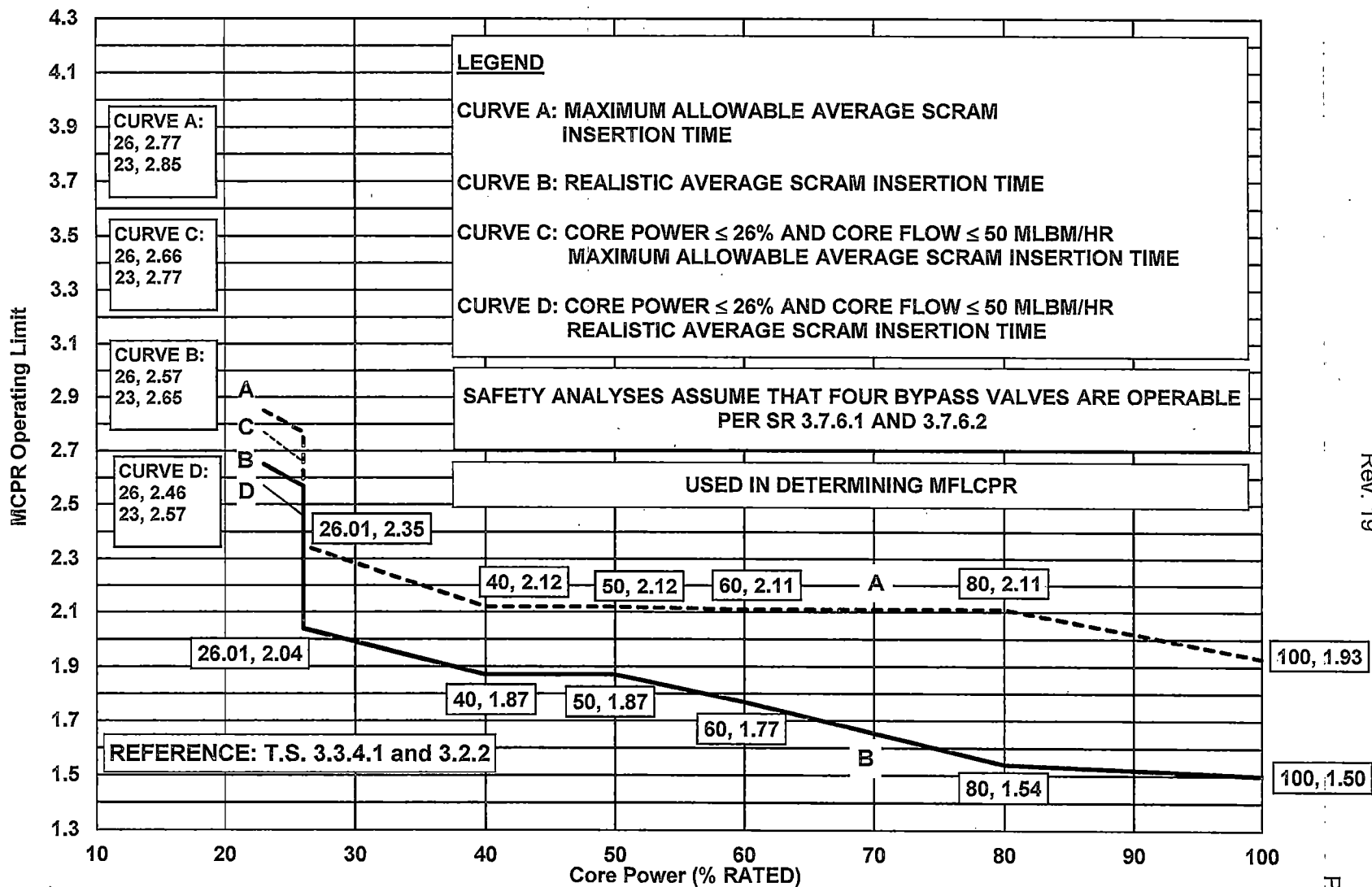
MCPR OPERATING LIMIT VERSUS CORE POWER
EOC-RPT INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™-10 FUEL
FIGURE 5.2-6A

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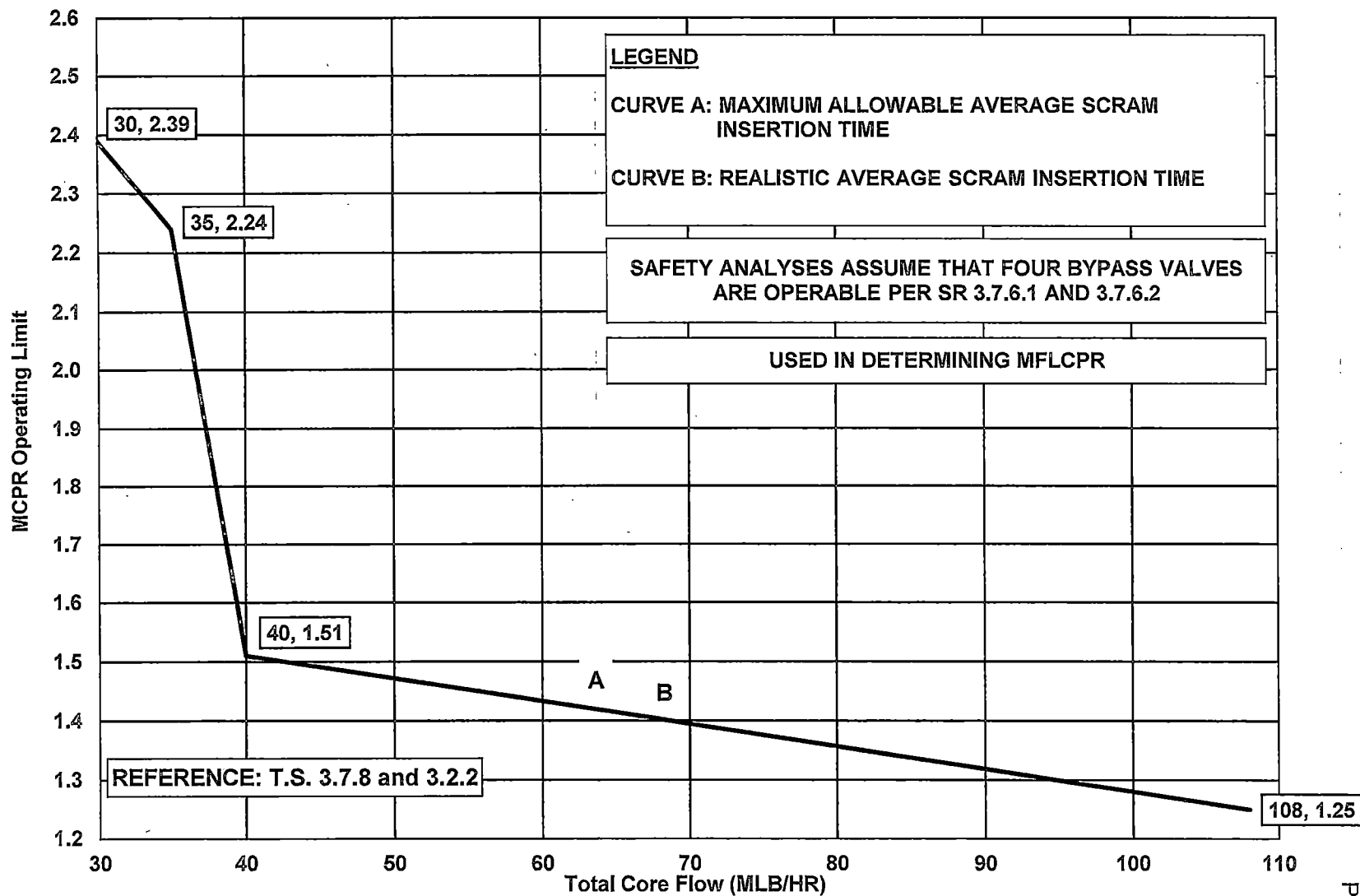
SSES UNIT 2 CYCLE 21



M CPR OPERATING LIMIT VERSUS CORE POWER
EOC-RPT INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 5.2-6B

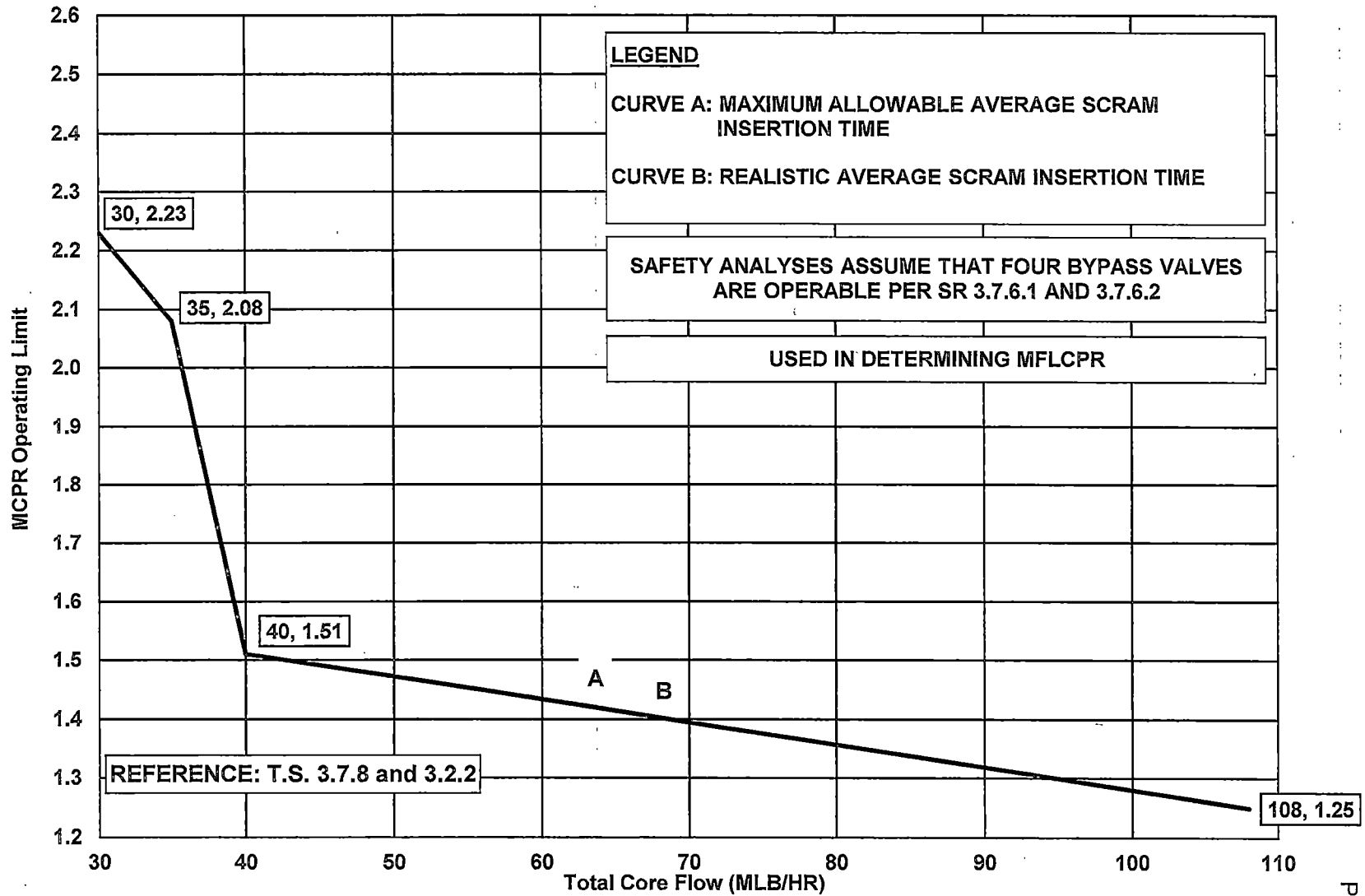
Backup Pressure Regulator Inoperable

SSES UNIT 2 CYCLE 21



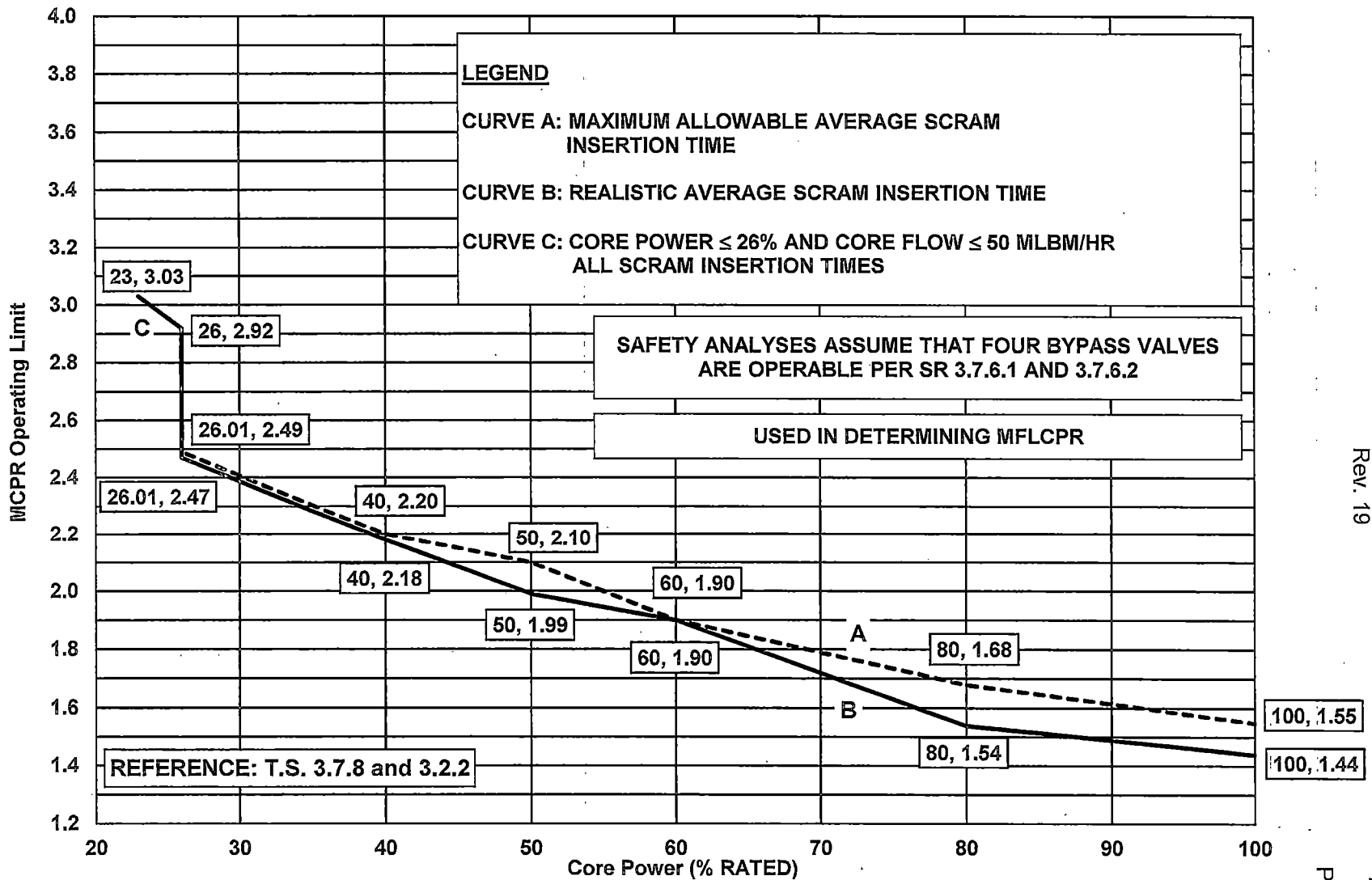
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 BACKUP PRESSURE REGULATOR INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-7A

SSSES UNIT 2 CYCLE 21



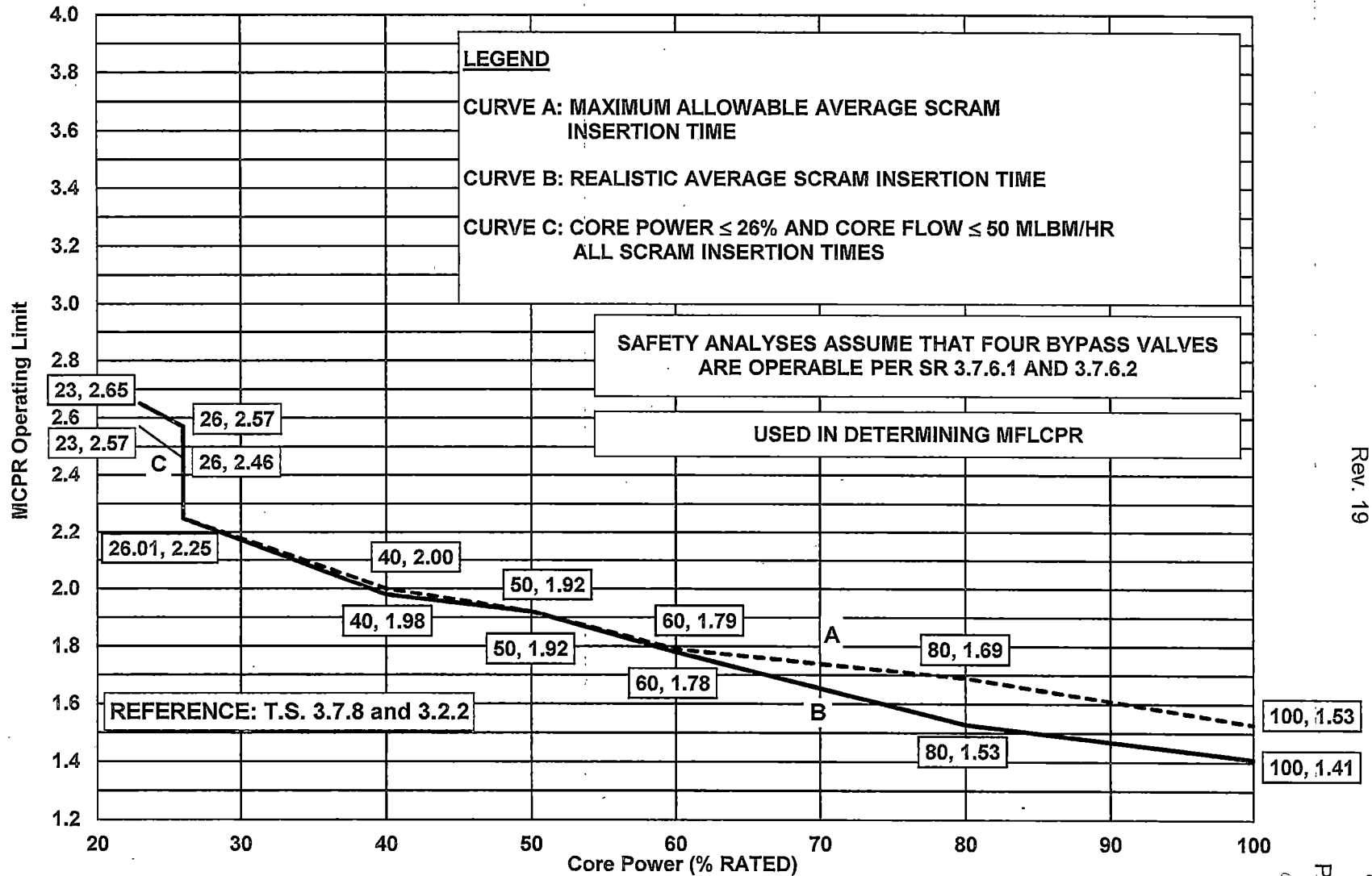
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 BACKUP PRESSURE REGULATOR INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 5.2-7B

SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 BACKUP PRESSURE REGULATOR INOPERABLE
 TWO LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 5.2-8A

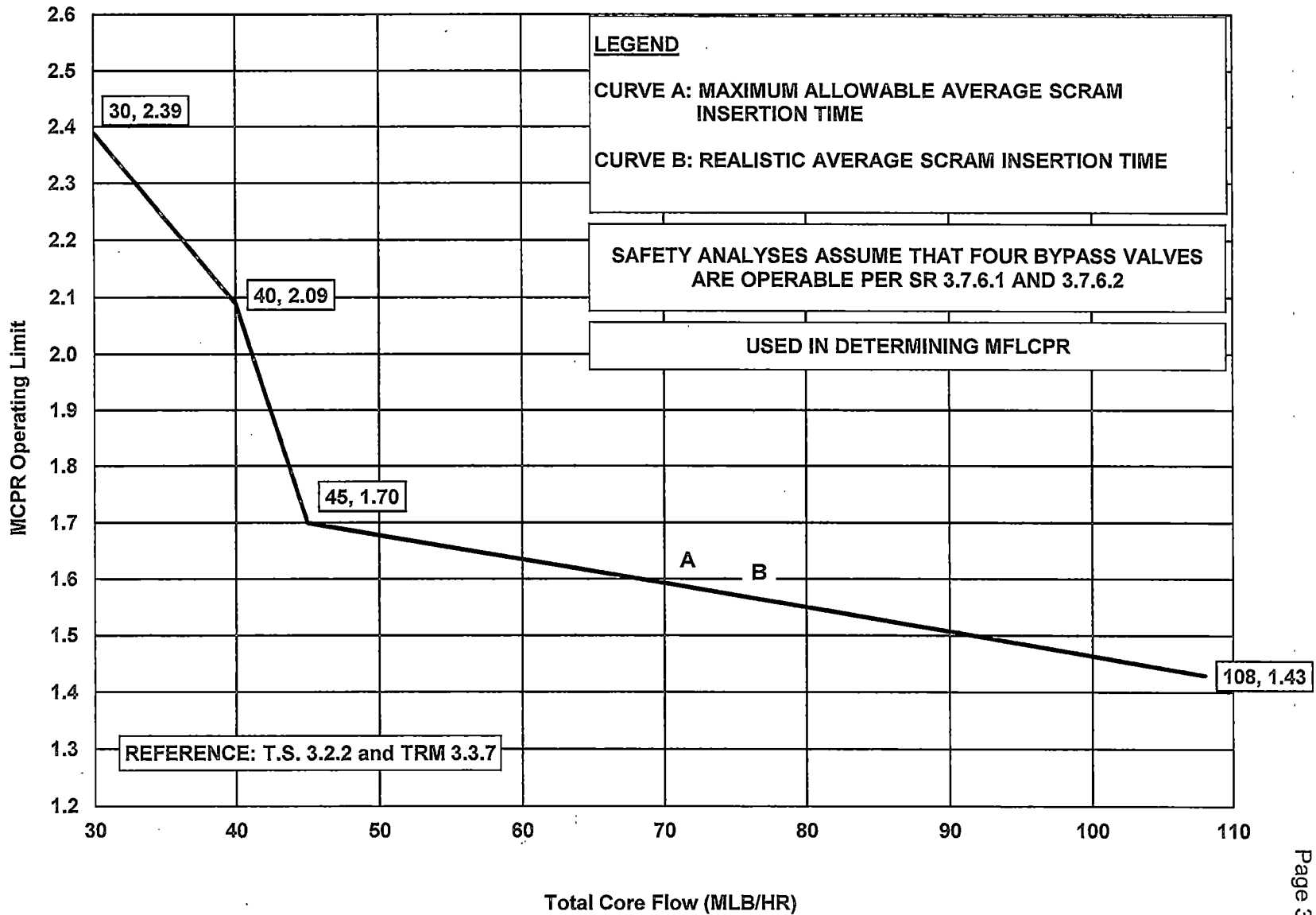
SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
BACKUP PRESSURE REGULATOR INOPERABLE
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 5.2-8B

One TSV or TCV Closed

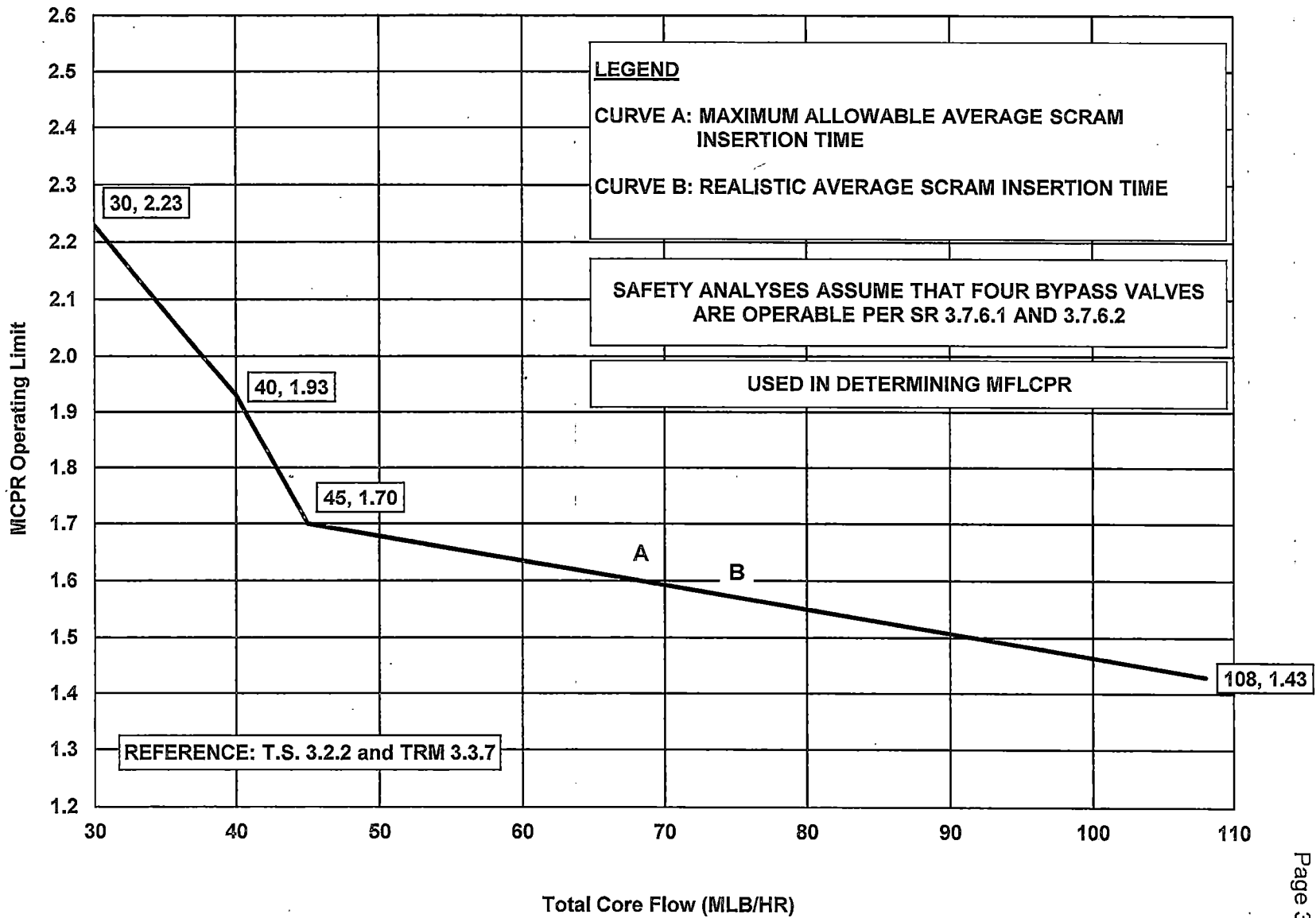
SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
ONE TSV OR TCV CLOSED*
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™-10 FUEL
FIGURE 5.2-9A

*Operation with one TSV or TCV closed is only supported at power levels $\leq 75\%$ rated power

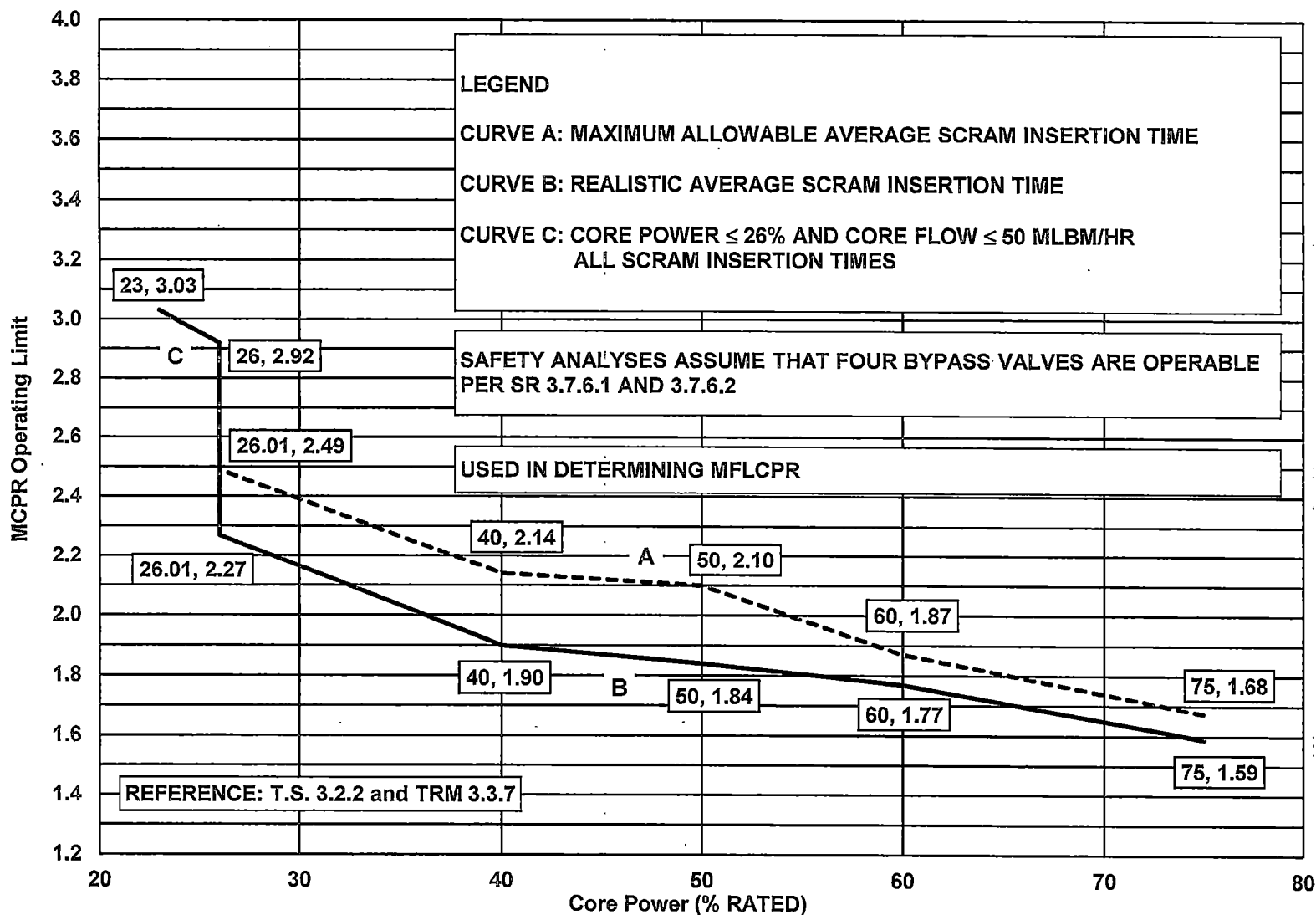
SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
ONE TSV OR TCV CLOSED*
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 5.2-9B

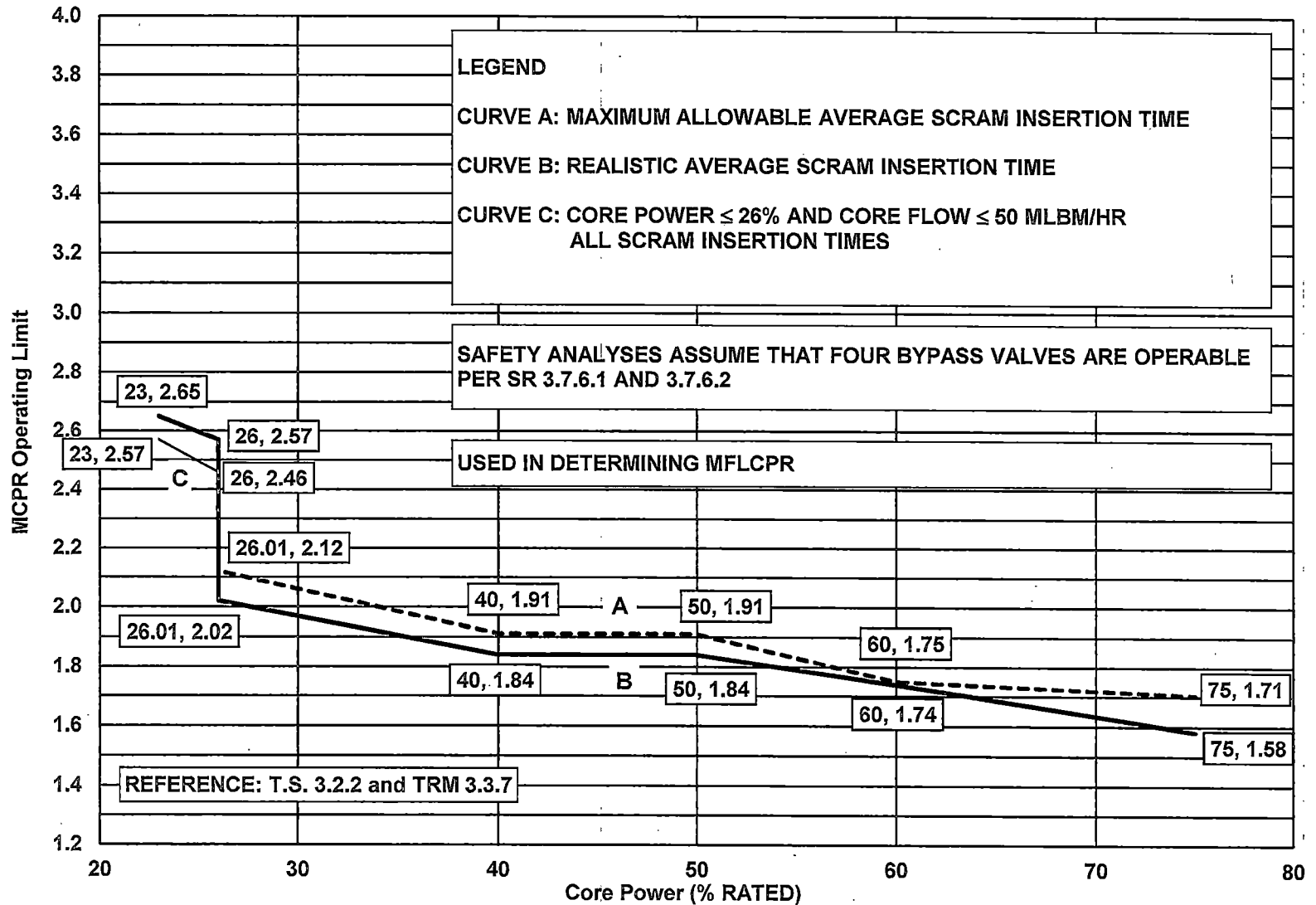
*Operation with one TSV or TCV closed is only supported at power levels $\leq 75\%$ rated power

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MCPR OPERATING LIMIT VERSUS CORE POWER
ONE TSV OR TCV CLOSED
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™-10 FUEL
FIGURE 5.2-10A

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MCPR OPERATING LIMIT VERSUS CORE POWER
ONE TSV OR TCV CLOSED
TWO LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 5.2-10B

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 References

Technical Specification 3.2.3, 3.3.4.1, 3.7.6, and 3.7.8

Technical Requirements Manual 3.3.7

6.2 Description

The maximum LHGR for ATRIUM™-10 and ATRIUM™ 11 fuel shall not exceed the LHGR limits determined from Figure 6.2-1A and Figure 6.2-1B, respectively. The LHGR limits in Figures 6.2-1A and 6.2-1B are valid for Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, Backup Pressure Regulator Operable and Inoperable, and with one Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) closed.

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 in the following figures:

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

Figure 6.2-2A: Flow-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-2B: Flow-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

Figure 6.2-3A: Power-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-3B: Power-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

b) Main Turbine Bypass Inoperable

Figure 6.2-4A: Flow-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-4B: Flow-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

Figure 6.2-5A: Power-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-5B: Power-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

c) EOC-RPT Inoperable

Figure 6.2-6A: Flow-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-6B: Flow-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

Figure 6.2-7A: Power-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-7B: Power-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

d) Backup Pressure Regulator Inoperable

Figure 6.2-8A: Flow-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-8B: Flow-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

Figure 6.2-9A: Power-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-9B: Power-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

e) One Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) Closed

Figure 6.2-10A: Flow-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

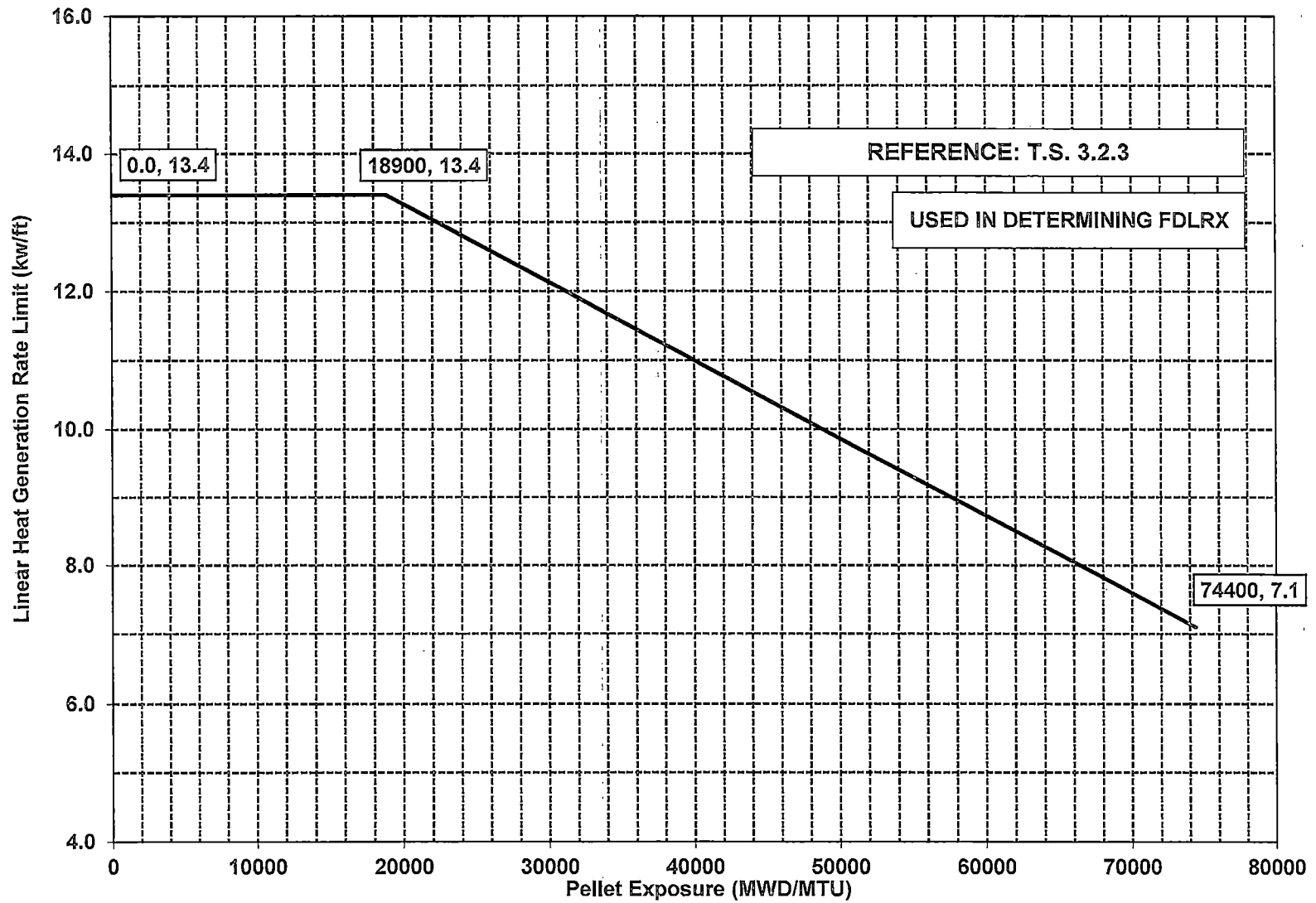
Figure 6.2-10B: Flow-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

Figure 6.2-11A: Power-Dependent LHGR Limit Multiplier for ATRIUM™-10 Fuel

Figure 6.2-11B: Power-Dependent LHGR Limit Multiplier for ATRIUM™ 11 Fuel

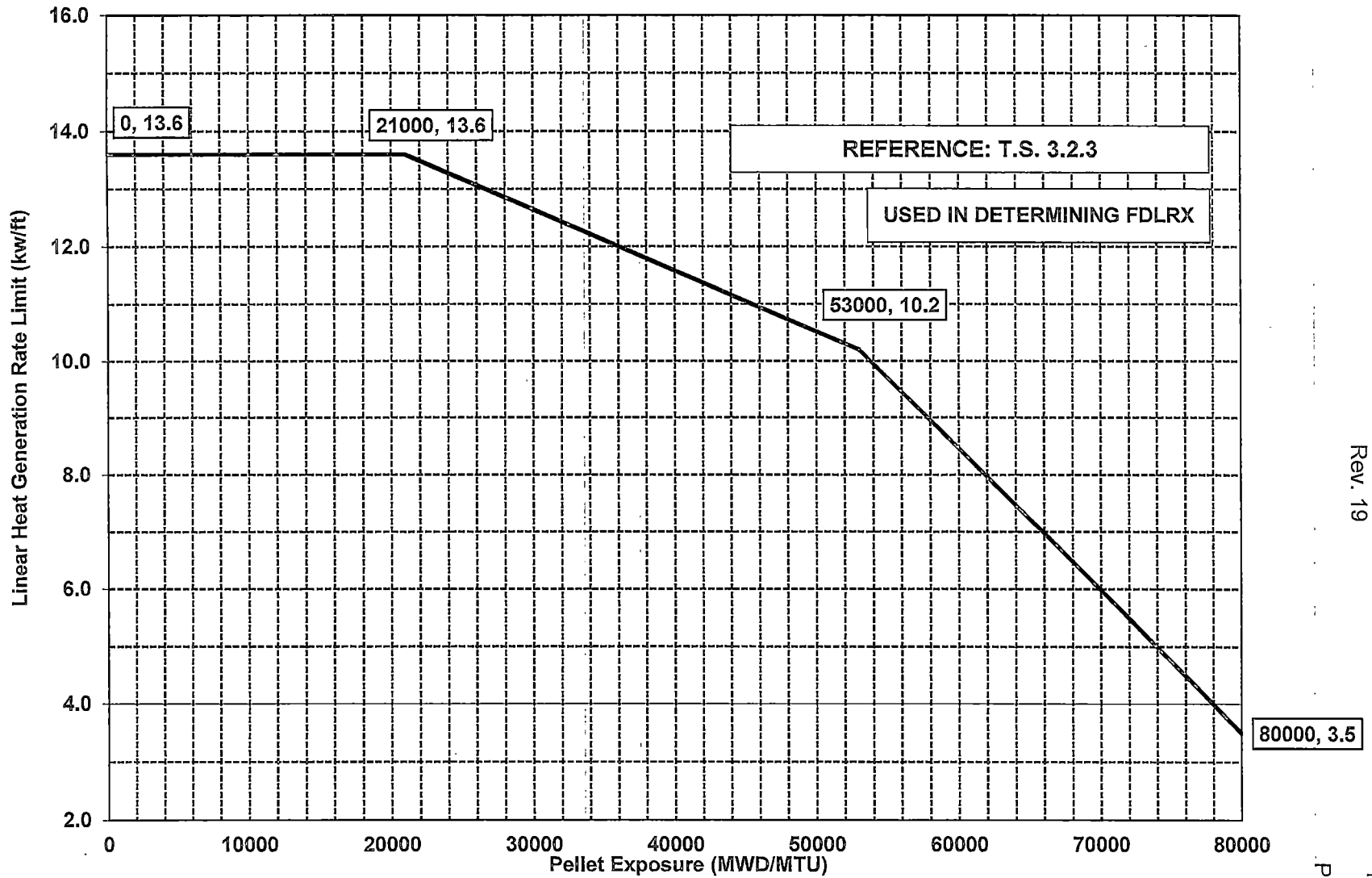
The LHGR limits and LHGR limit multipliers in Figures 6.2-1A/6.2-1B through 6.2-11A/6.2-11B are valid for both Two Loop and Single Loop operation.

SSSES UNIT 2 CYCLE 21



LINEAR HEAT GENERATION RATE LIMIT VERSUS PELLETS EXPOSURE
 ATRIUM™-10 FUEL
 FIGURE 6.2-1A

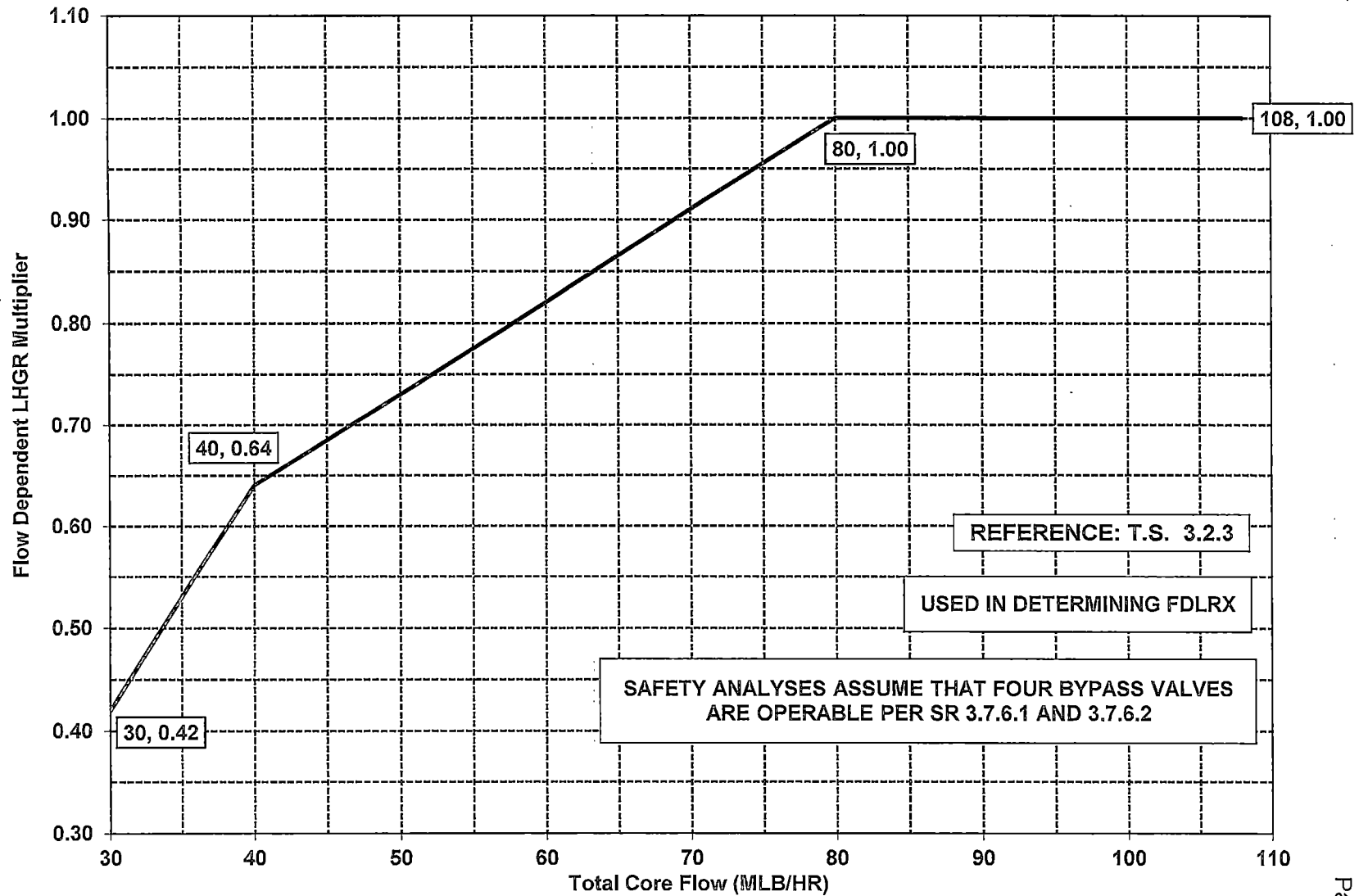
SSSES UNIT 2 CYCLE 21



LINEAR HEAT GENERATION RATE LIMIT VERSUS PELLETT EXPOSURE
 ATRIUM™ 11 FUEL
 FIGURE 6.2-1B

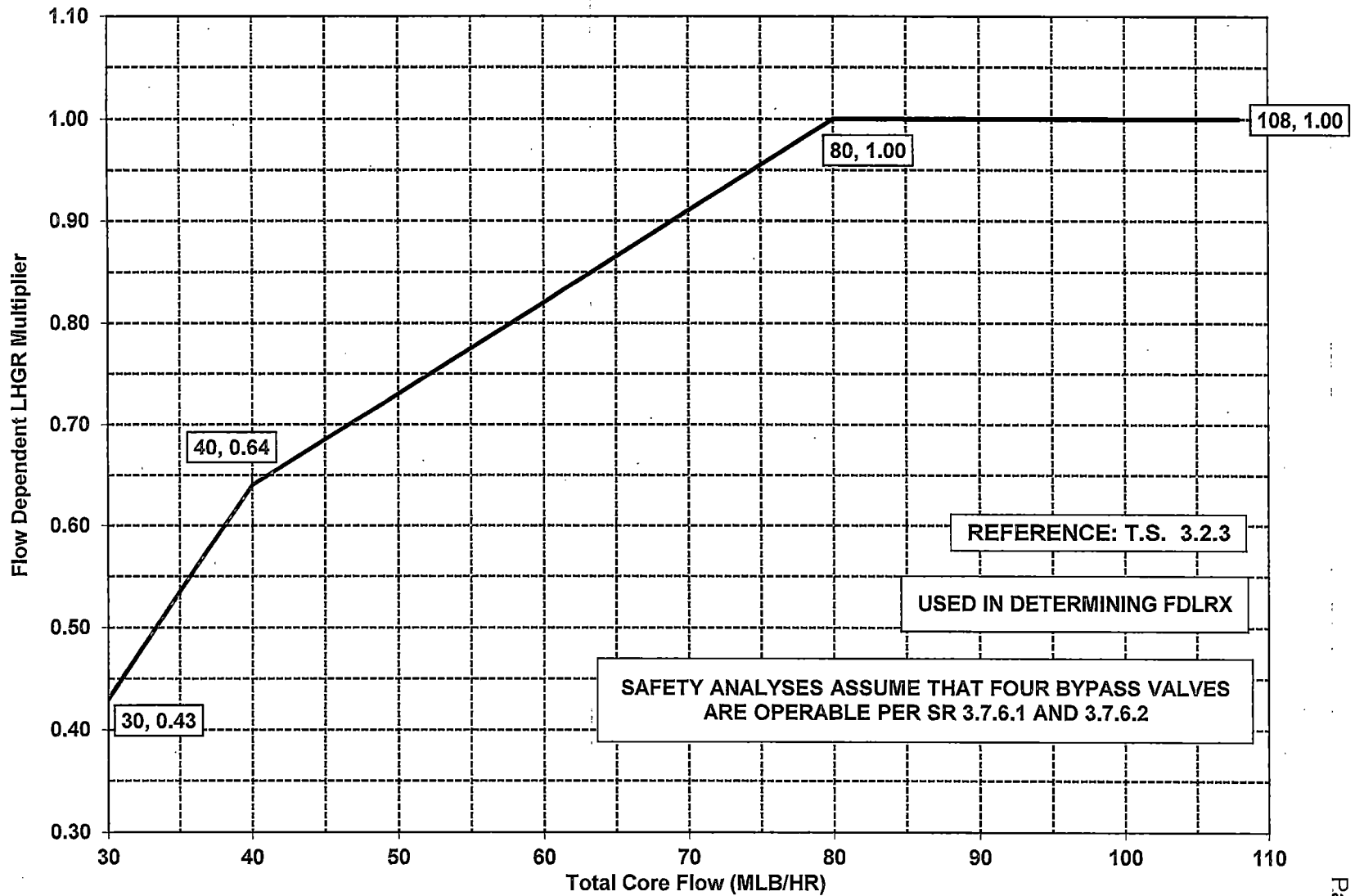
Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

SSSES UNIT 2 CYCLE 21



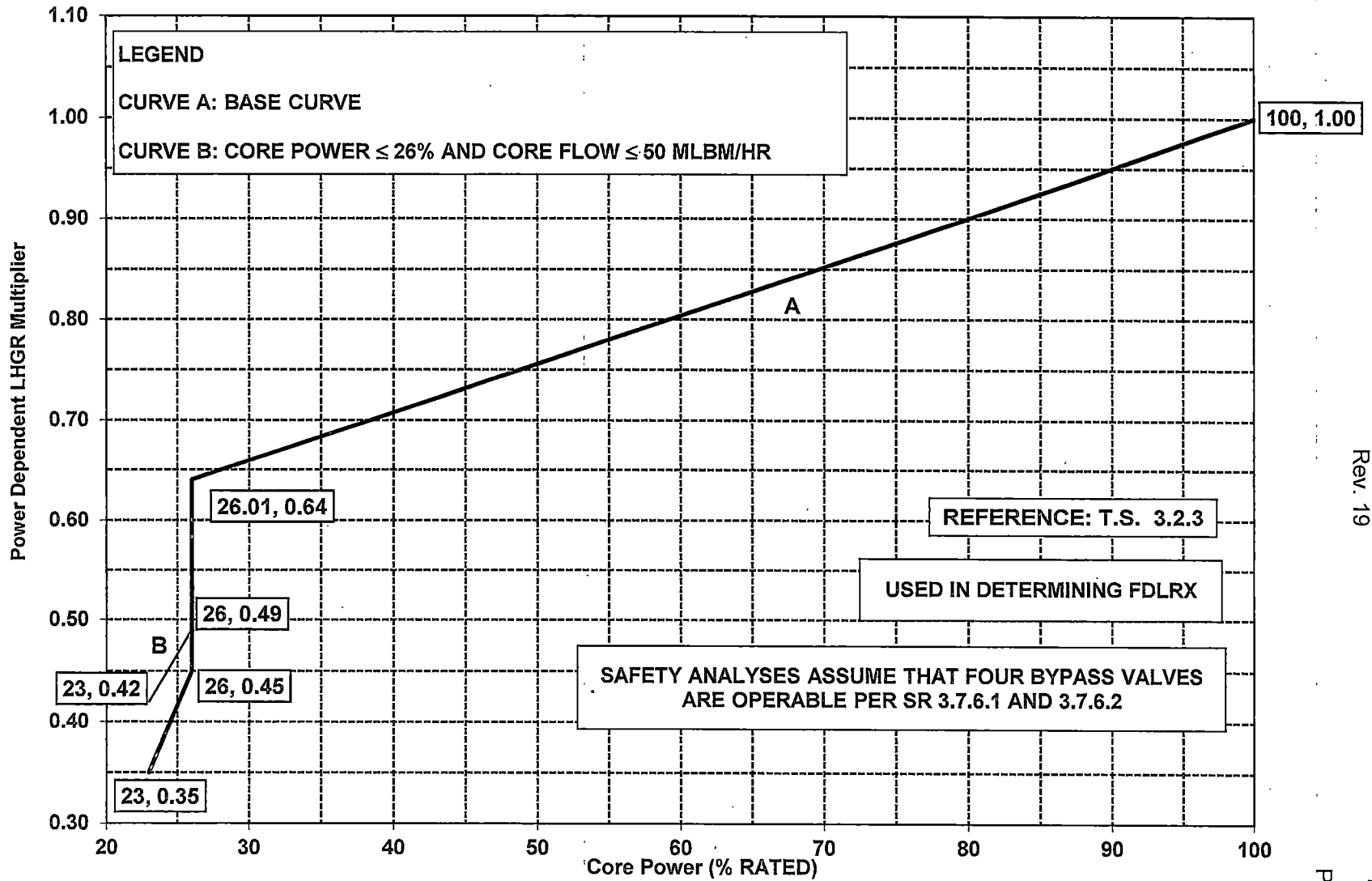
FLOW DEPENDENT LHGR LIMIT MULTIPLIER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 ATRIUM™-10 FUEL
 FIGURE 6.2-2A

SSSES UNIT 2 CYCLE 21



FLOW DEPENDENT LHGR LIMIT MULTIPLIER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 ATRIUM™ 11 FUEL
 FIGURE 6.2-2B

SSS UNIT 2 CYCLE 21

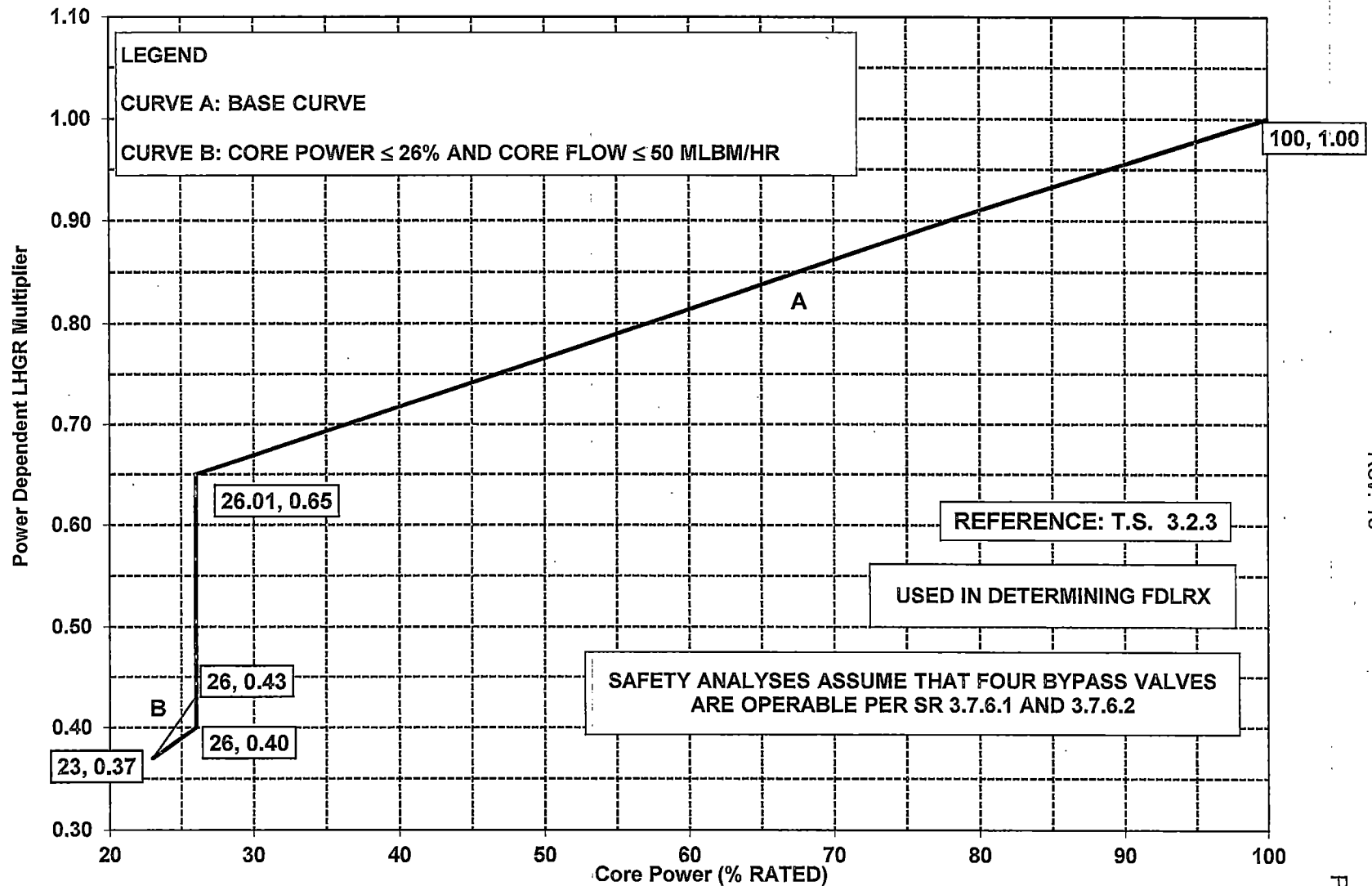


POWER DEPENDENT LHGR LIMIT MULTIPLIER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 ATRIUM™-10 FUEL
 FIGURE 6.2-3A

SSSES UNIT 2 CYCLE 21

SUSQUEHANNA UNIT 2

TRM / 3.2-47



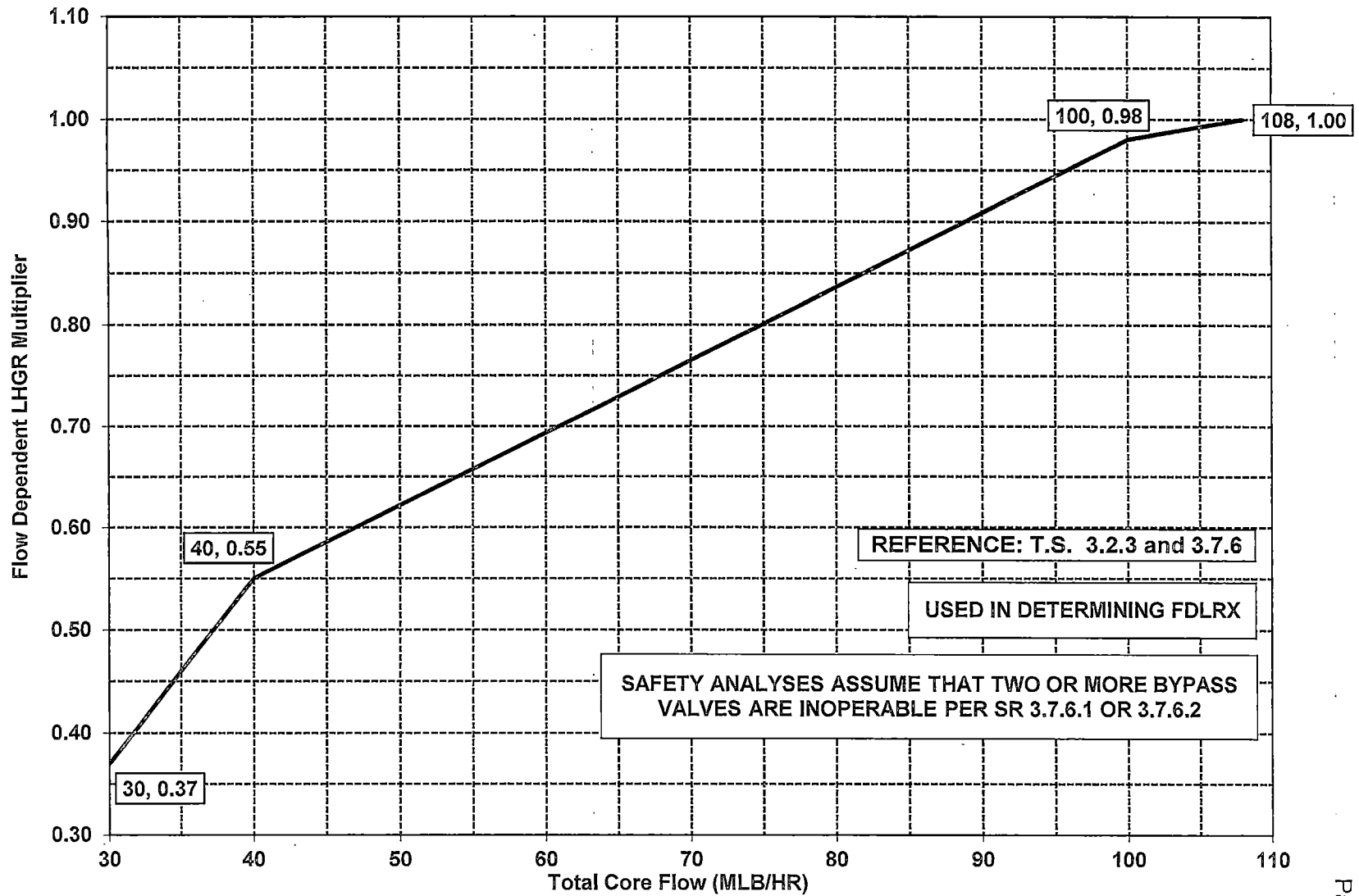
POWER DEPENDENT LHGR LIMIT MULTIPLIER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 ATRIUM™ 11 FUEL
 FIGURE 6.2-3B

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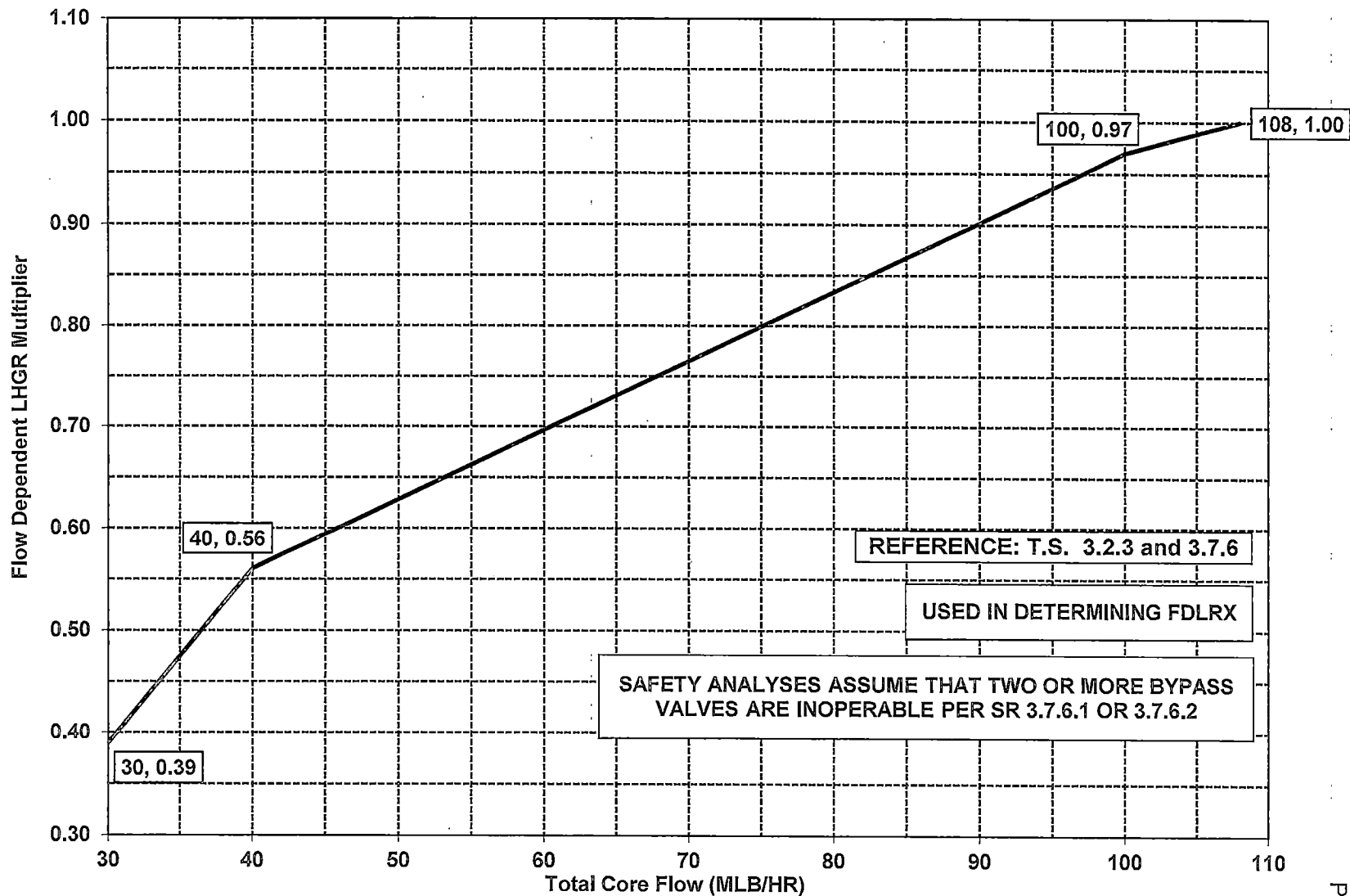
Main Turbine Bypass Inoperable

SSSES UNIT 2 CYCLE 21



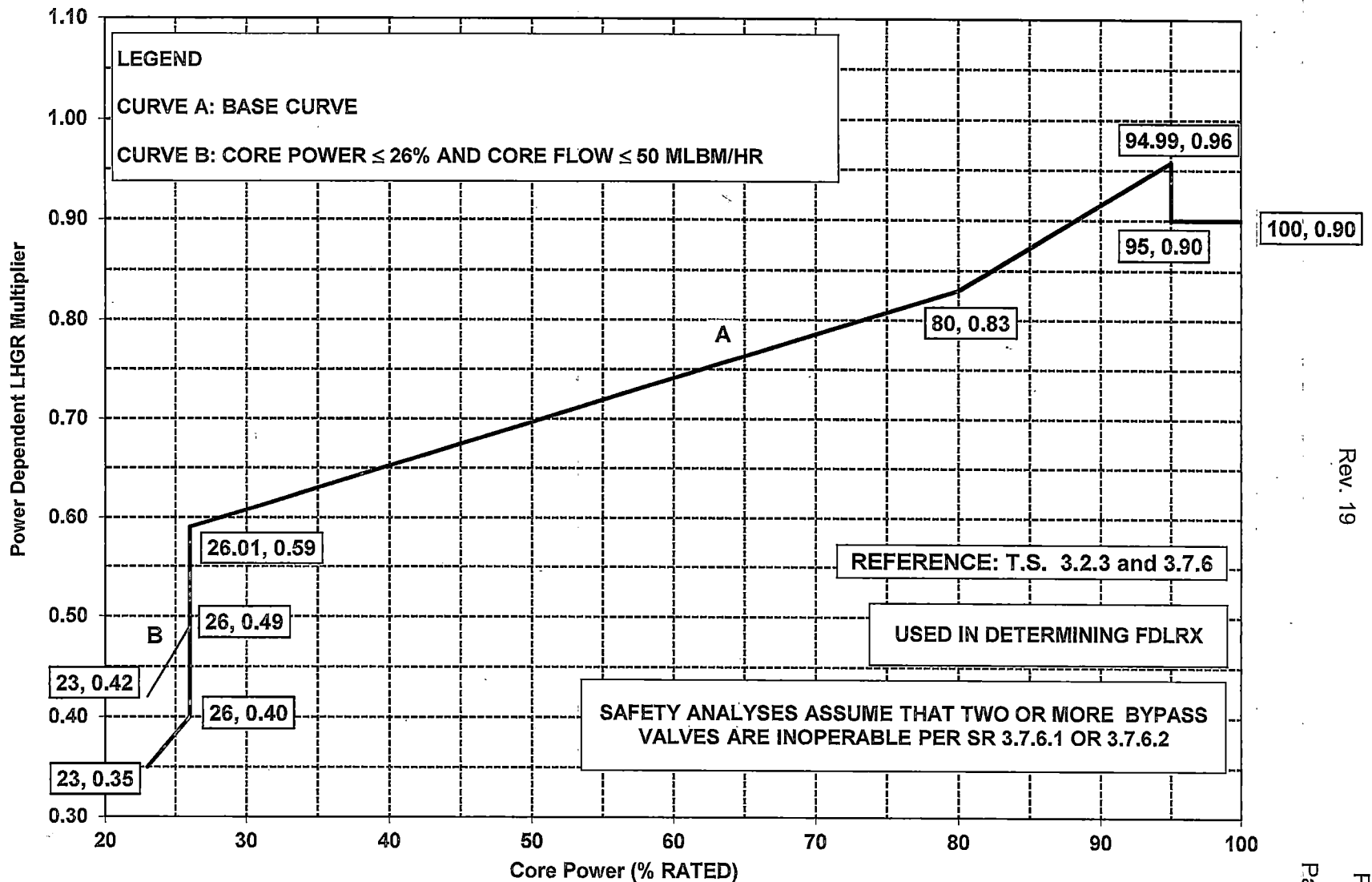
FLOW DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS INOPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-4A

SSS UNIT 2 CYCLE 21



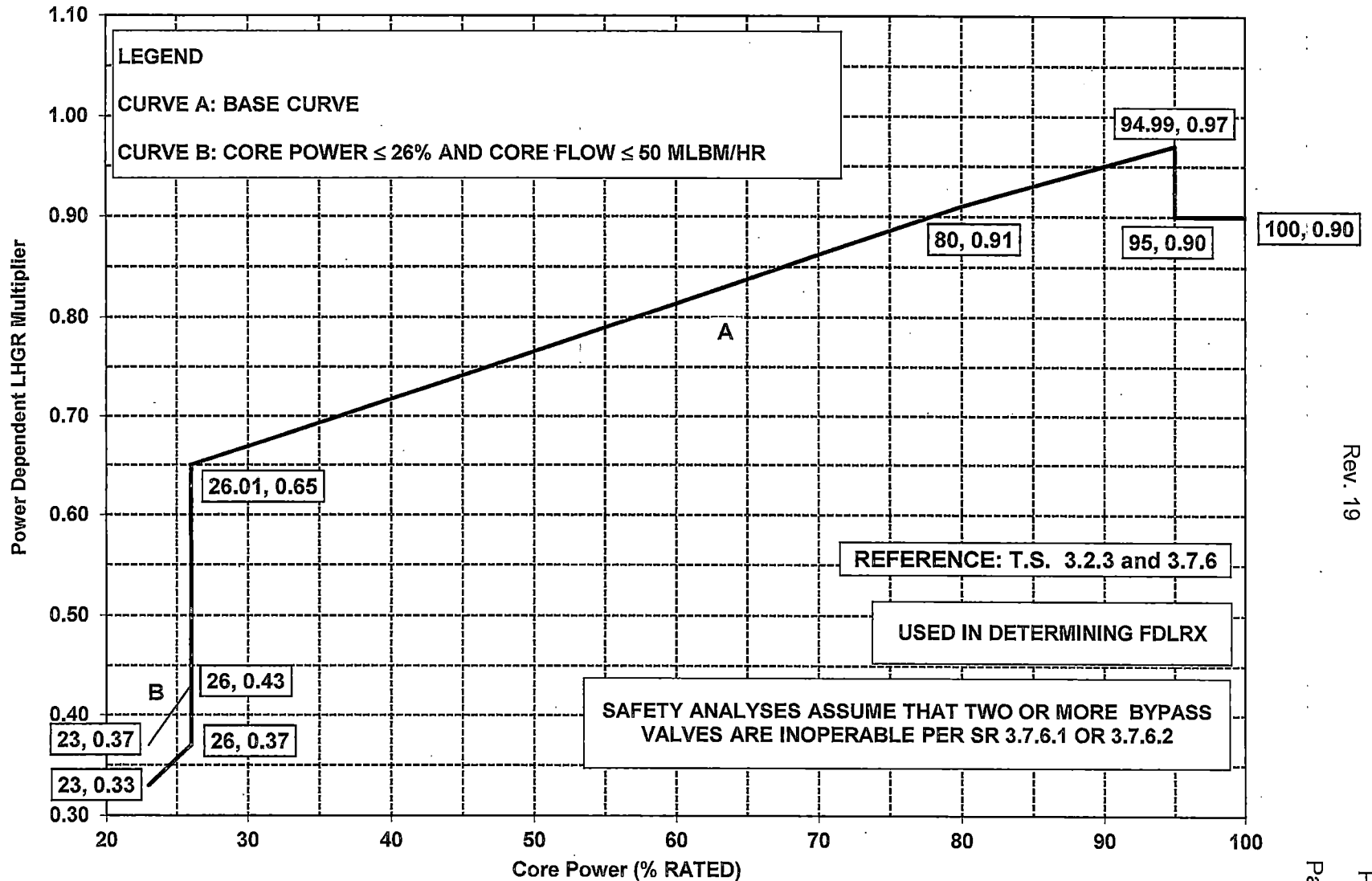
FLOW DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS INOPERABLE
ATRIUM™ 11 FUEL
FIGURE 6.2-4B

SSES UNIT 2 CYCLE 21



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

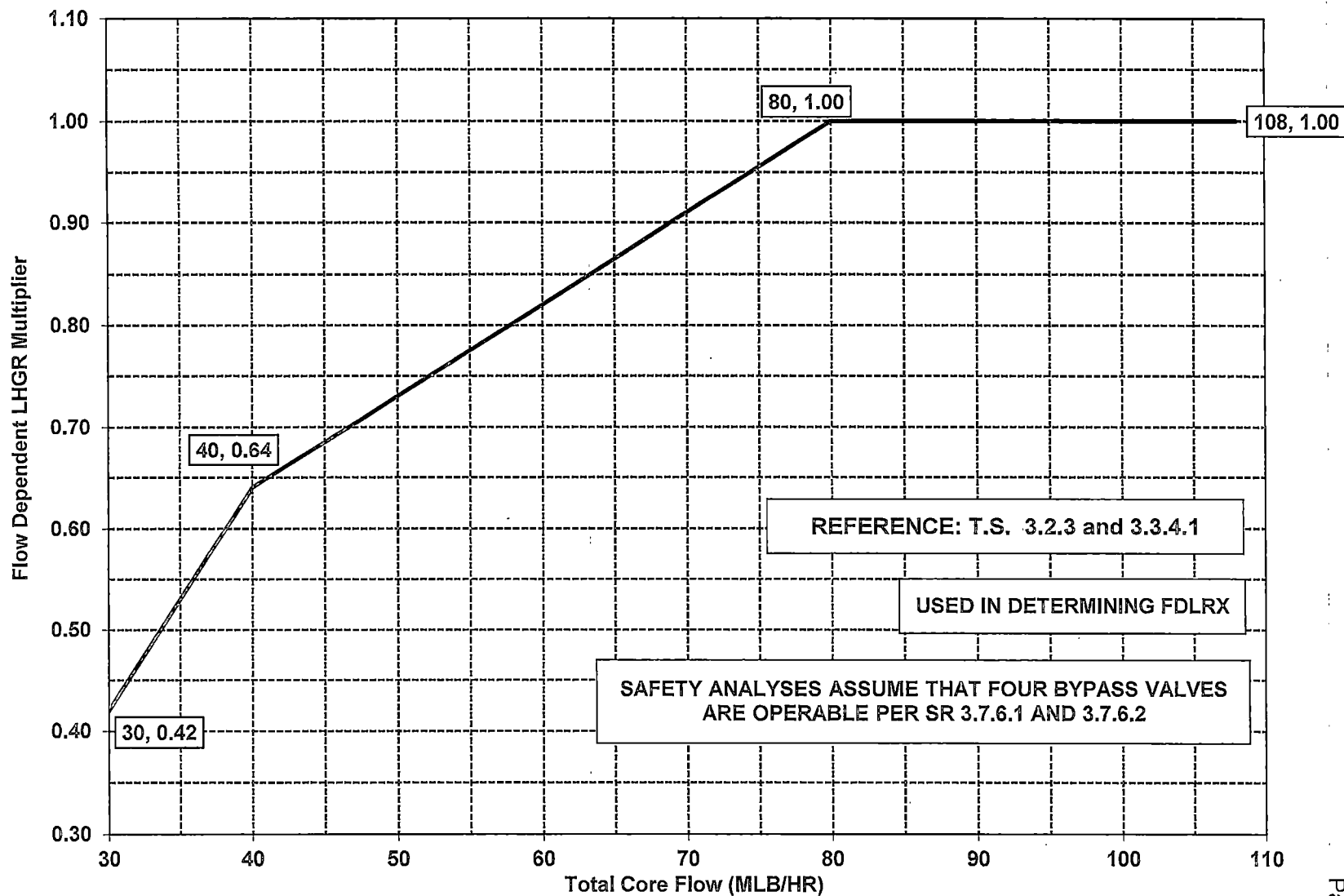
SSES UNIT 2 CYCLE 21



POWER DEPENDENT LHGR LIMIT MULTIPLIER
MAIN TURBINE BYPASS INOPERABLE
ATRIUM™ 11 FUEL
FIGURE 6.2-5B

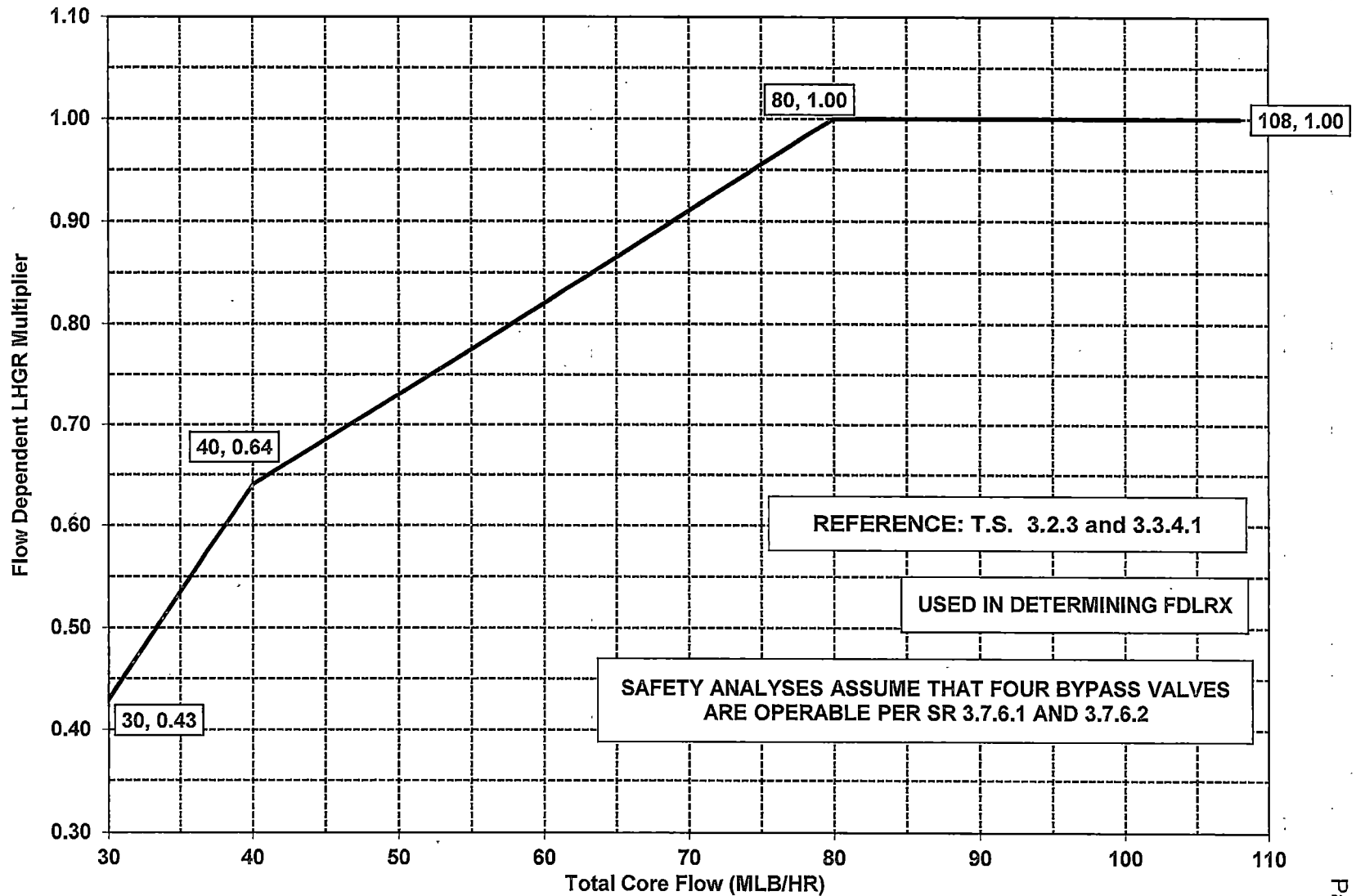
EOC-RPT Inoperable

SSES UNIT 2 CYCLE 21



FLOW DEPENDENT LHGR LIMIT MULTIPLIER
EOC-RPT INOPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-6A

SSSES UNIT 2 CYCLE 21

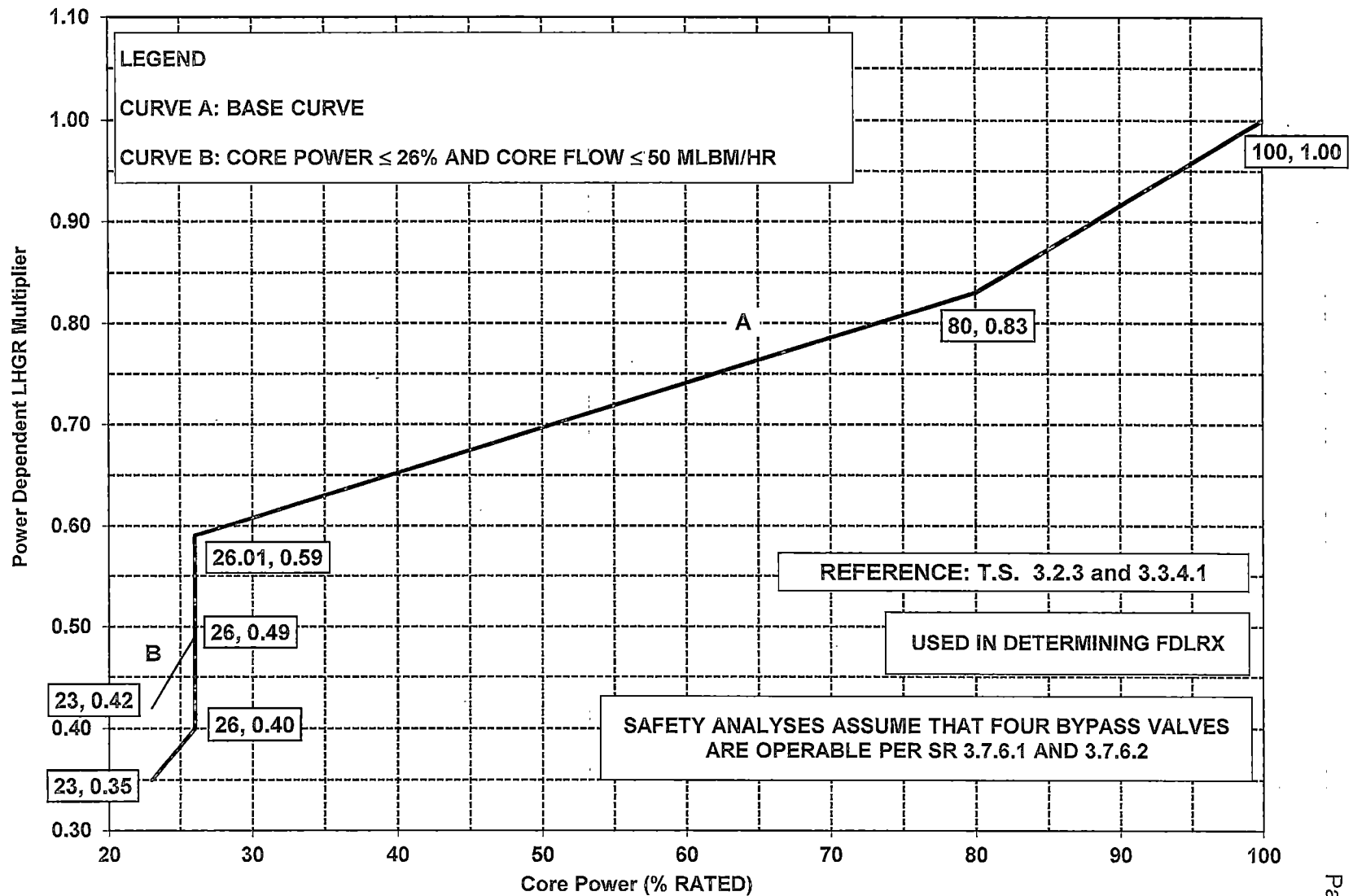


FLOW DEPENDENT LHGR LIMIT MULTIPLIER
EOC-RPT INOPERABLE
ATRIUM™ 11 FUEL
FIGURE 6.2-6B

SSES UNIT 2 CYCLE 21

SUSQUEHANNA UNIT 2

TRM / 3.2-56

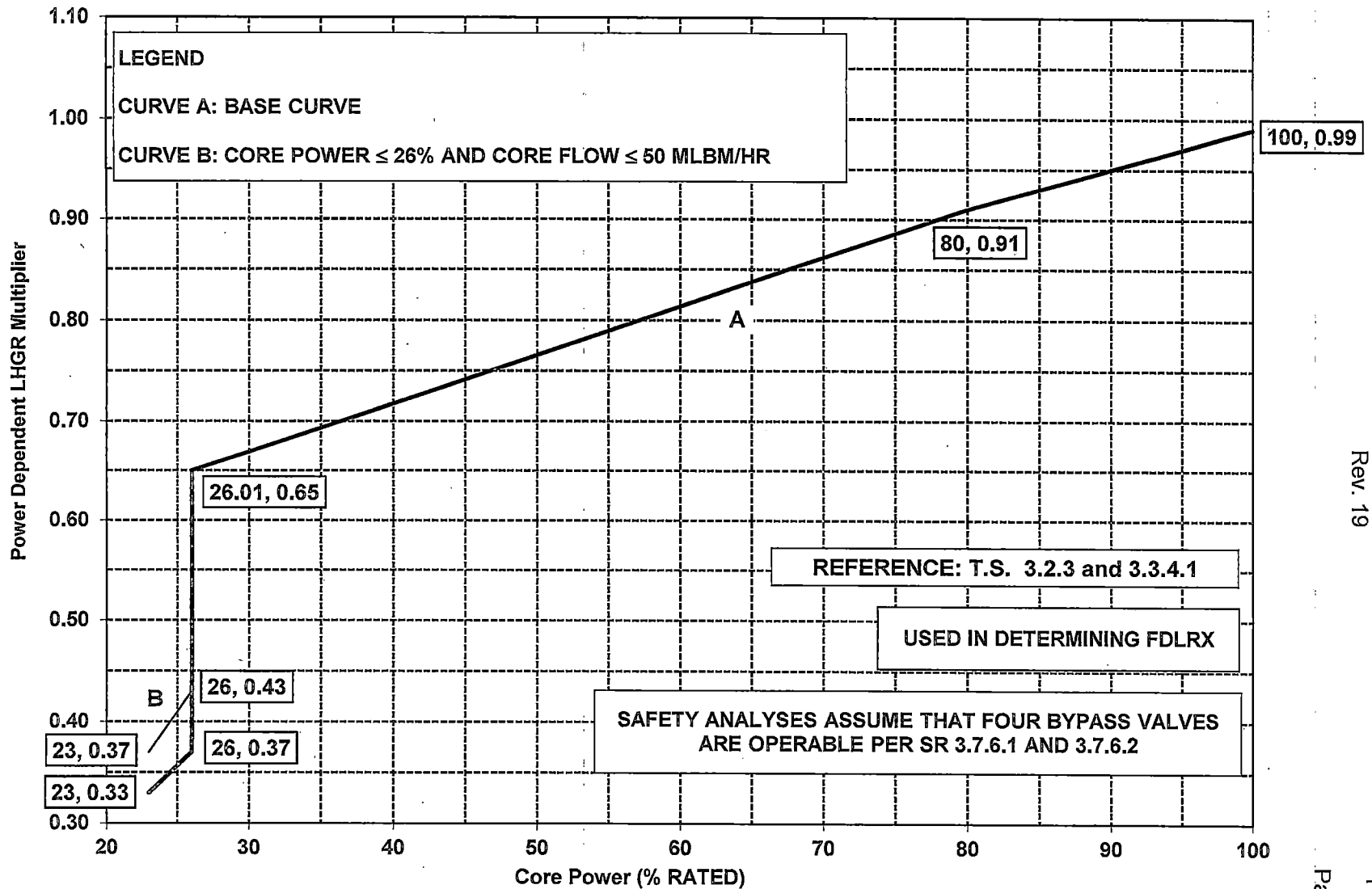


POWER DEPENDENT LHGR LIMIT MULTIPLIER
EOC-RPT INOPERABLE
ATRIUM™-10 FUEL
FIGURE 6.2-7A

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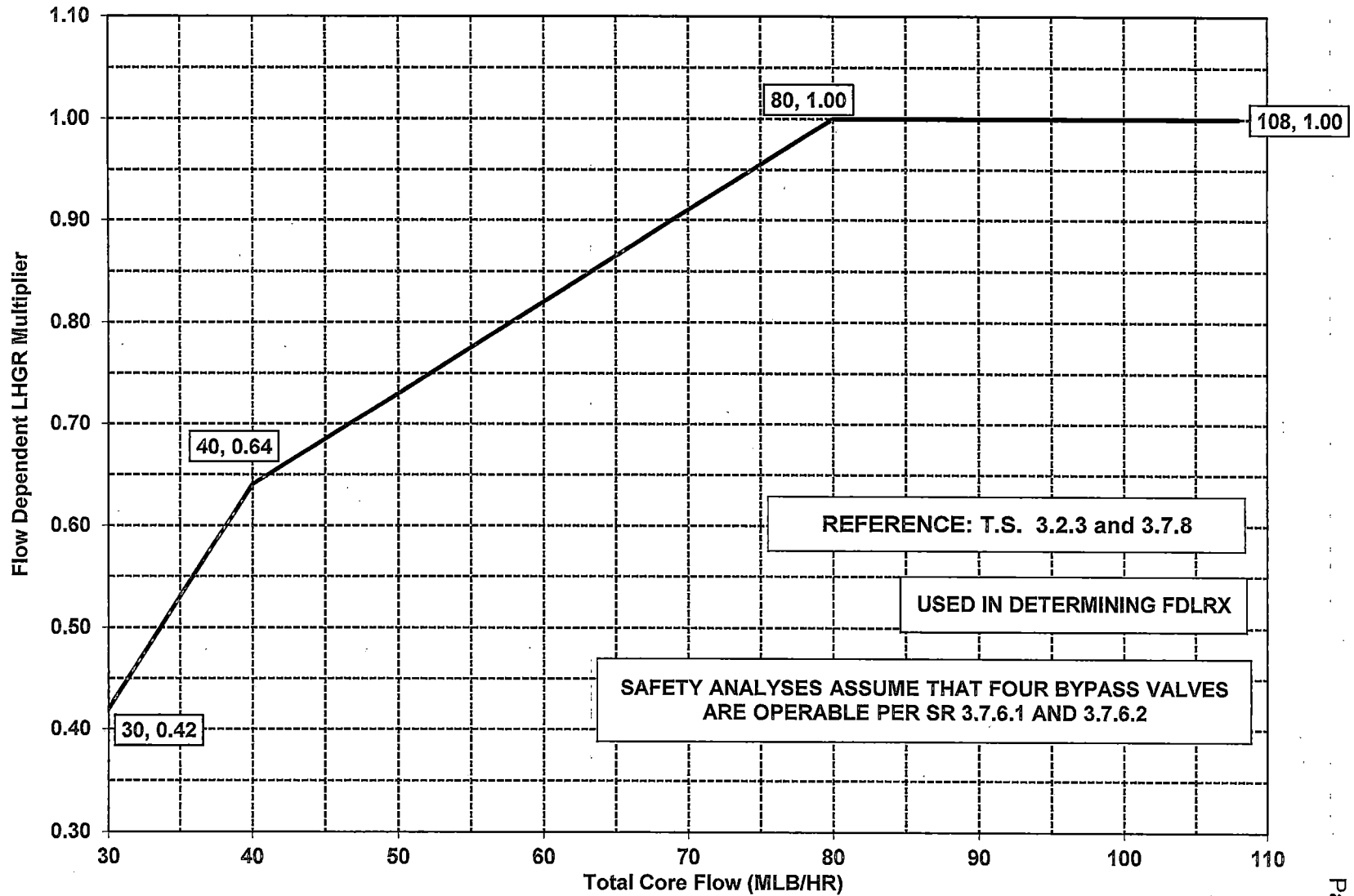
SSES UNIT 2 CYCLE 21



POWER DEPENDENT LHGR LIMIT MULTIPLIER
EOC-RPT INOPERABLE
ATRIUM™ 11 FUEL
FIGURE 6.2-7B

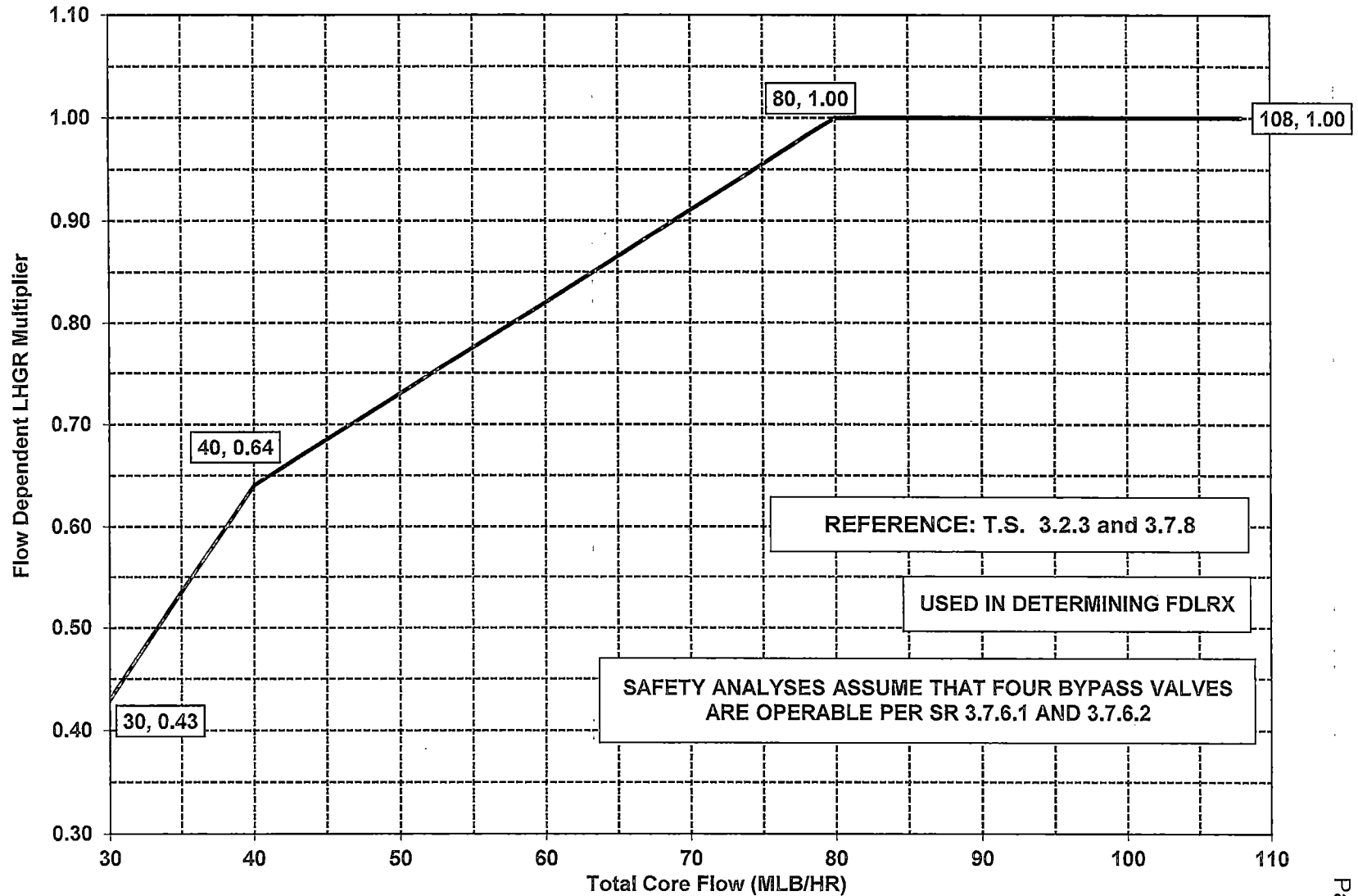
Backup Pressure Regulator Inoperable

SSS UNIT 2 CYCLE 21



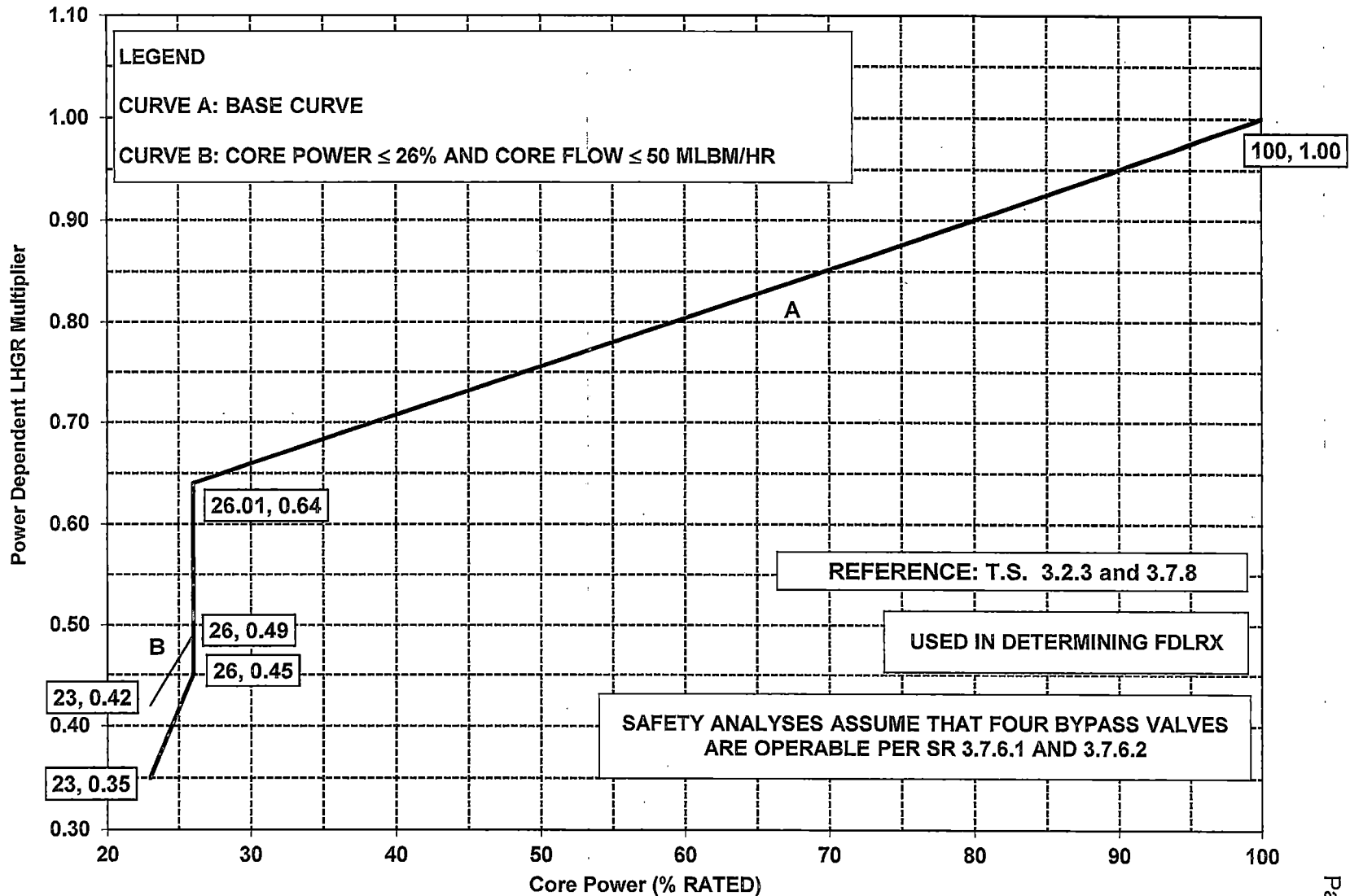
FLOW DEPENDENT LHGR LIMIT MULTIPLIER
 BACKUP PRESSURE REGULATOR INOPERABLE
 ATRIUM™-10 FUEL
 FIGURE 6.2-8A

SSSES UNIT 2 CYCLE 21



FLOW DEPENDENT LHGR LIMIT MULTIPLIER
 BACKUP PRESSURE REGULATOR INOPERABLE
 ATRIUM™ 11 FUEL
 FIGURE 6.2-8B

SSES UNIT 2 CYCLE 21

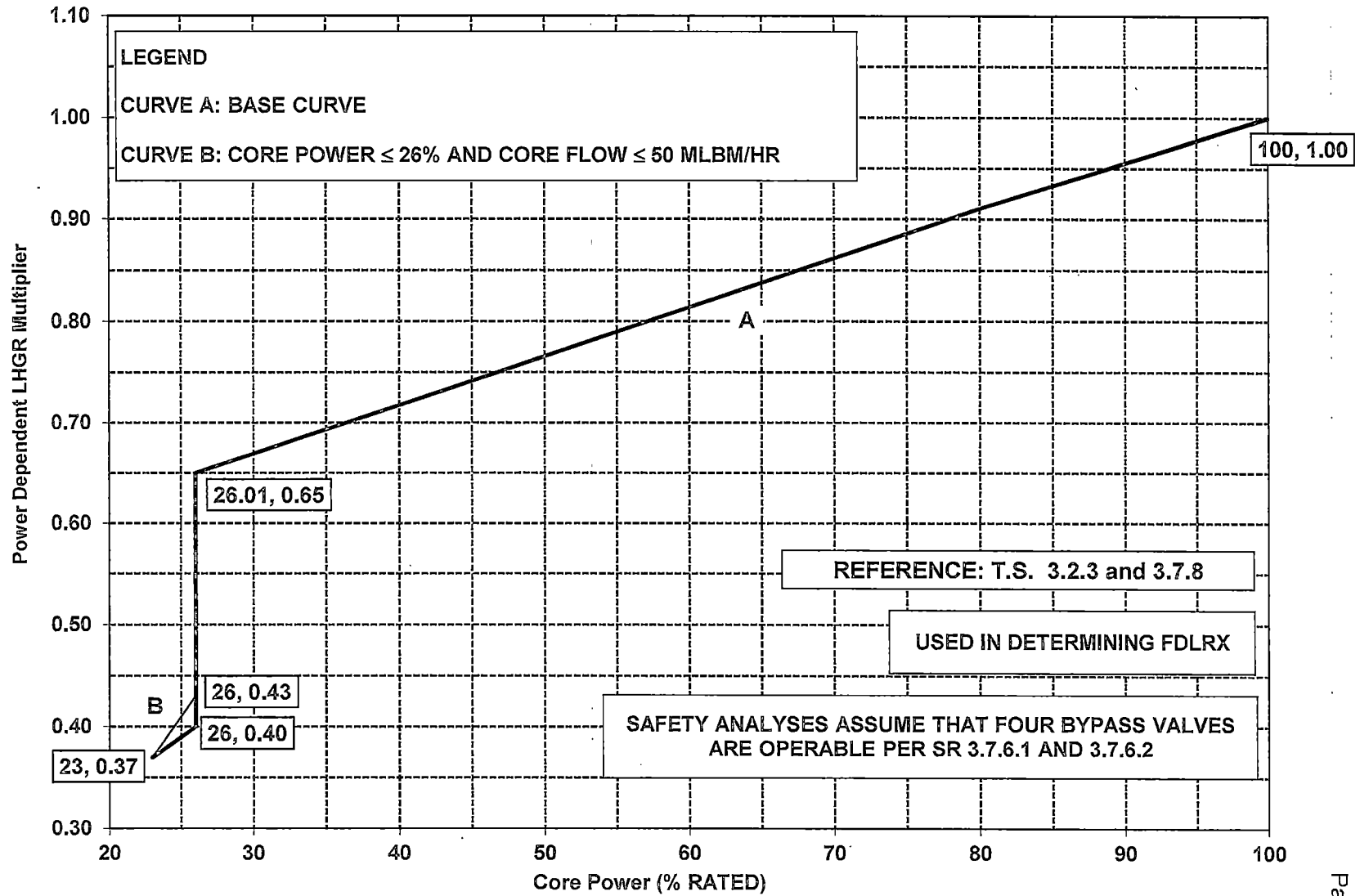


POWER DEPENDENT LHGR LIMIT MULTIPLIER
 BACKUP PRESSURE REGULATOR INOPERABLE
 ATRIUM™-10 FUEL
 FIGURE 6.2-9A

SSS UNIT 2 CYCLE 21

SUSQUEHANNA UNIT 2

TRM / 3.2-62



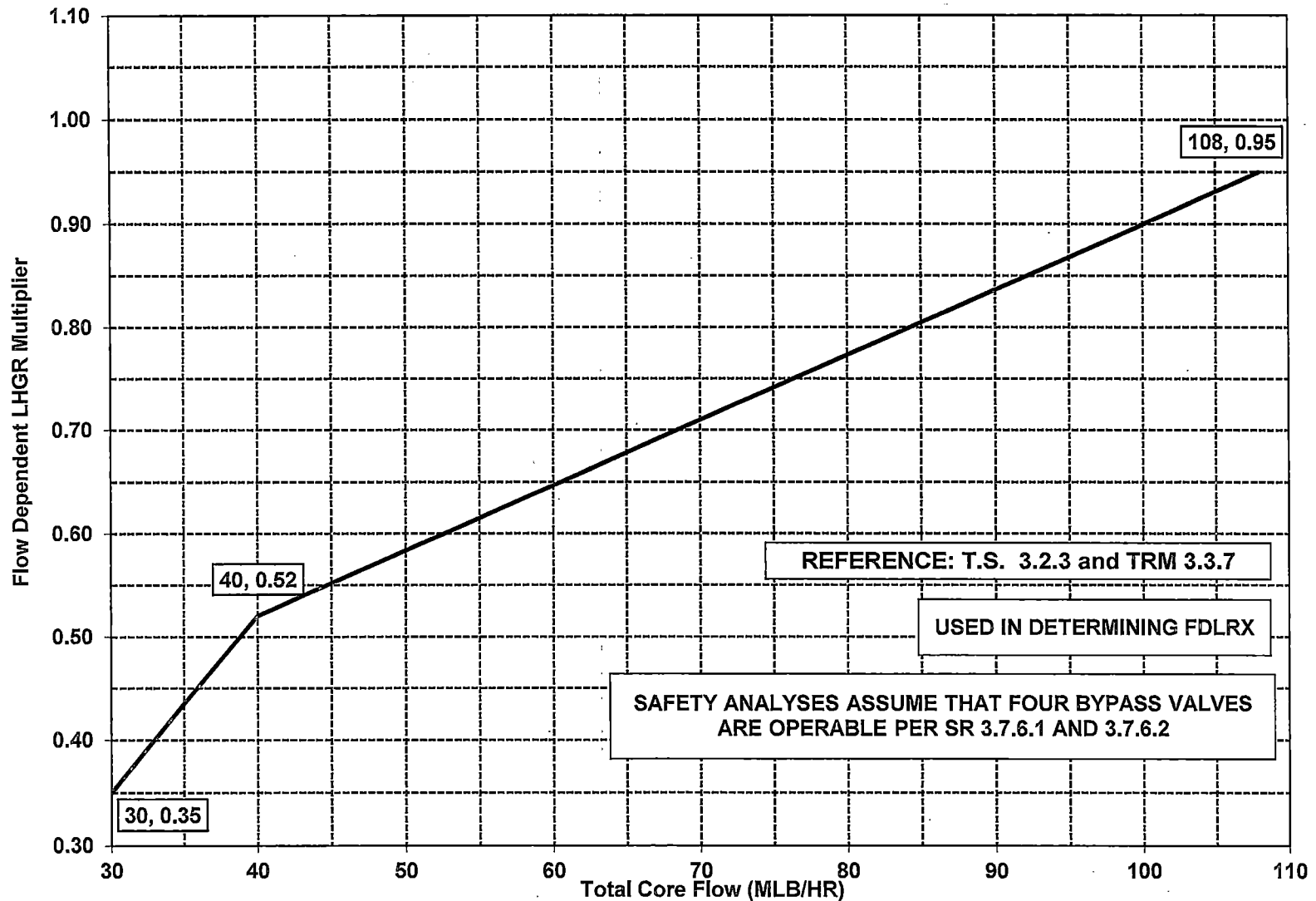
POWER DEPENDENT LHGR LIMIT MULTIPLIER
BACKUP PRESSURE REGULATOR INOPERABLE
ATRIUM™ 11 FUEL
FIGURE 6.2-9B

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One TSV or TCV Closed

SSSES UNIT 2 CYCLE 21



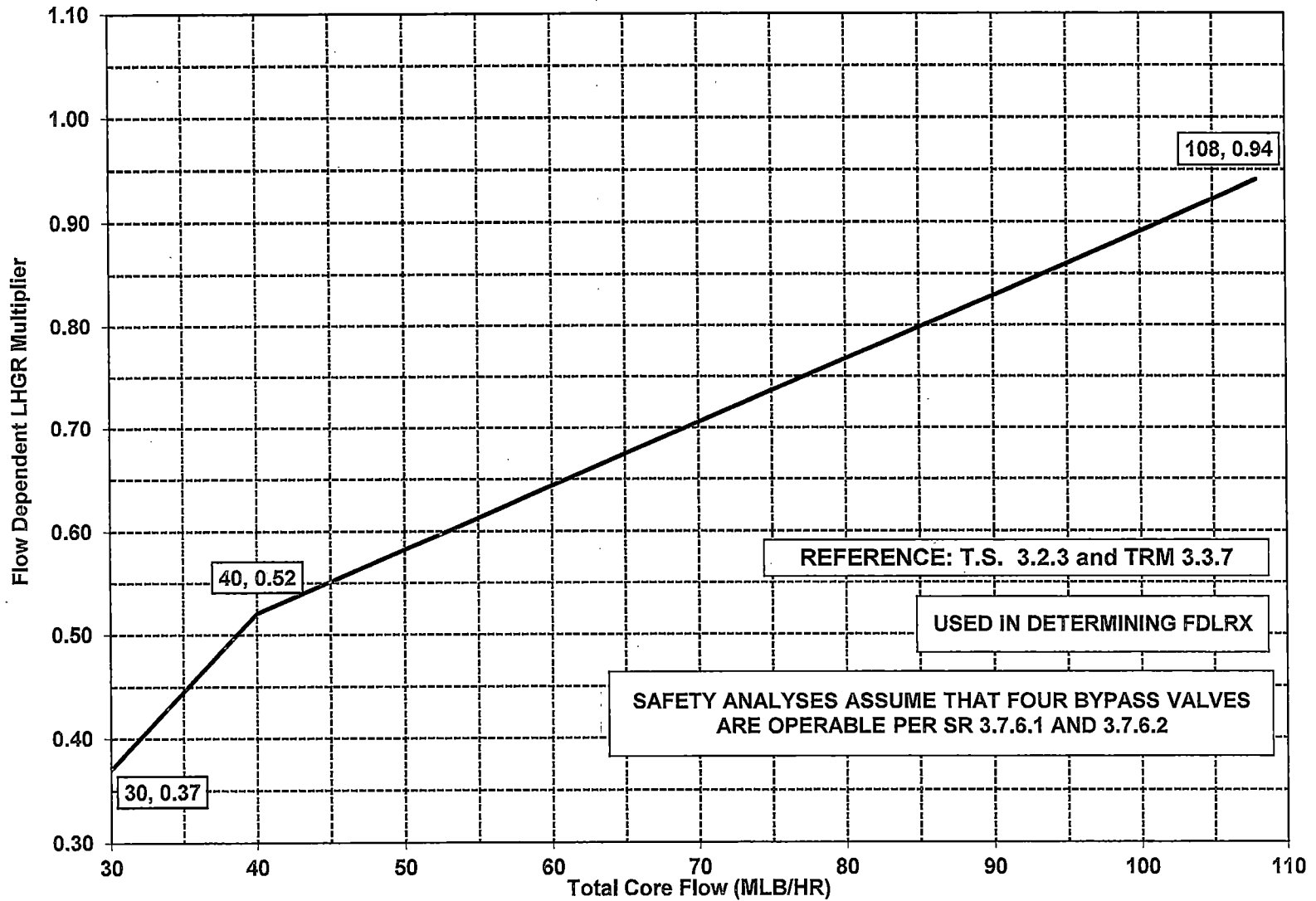
FLOW DEPENDENT LHGR LIMIT MULTIPLIER
ONE TSV OR TCV CLOSED*
ATRIUM™-10 FUEL
FIGURE 6.2-10A

*Operation with one TSV or TCV closed is only supported at power levels ≤ 75% rated power

SSSES UNIT 2 CYCLE 21

SUSQUEHANNA UNIT 2

TRM / 3.2-65



FLOW DEPENDENT LHGR LIMIT MULTIPLIER

ONE TSV OR TCV CLOSED*

ATRIUM™ 11 FUEL

FIGURE 6.2-10B

*Operation with one TSV or TCV closed is only supported at power levels $\leq 75\%$ rated power

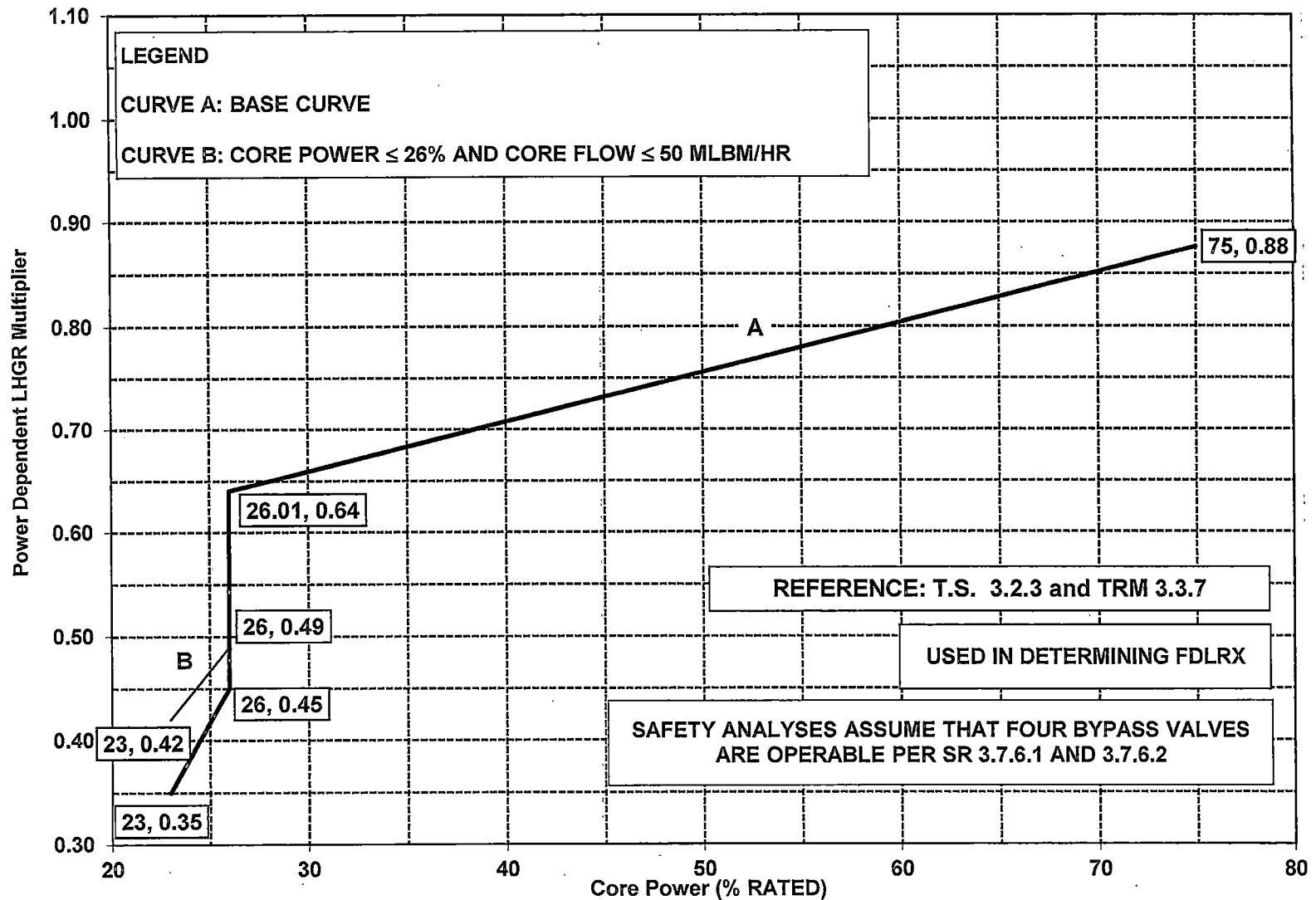
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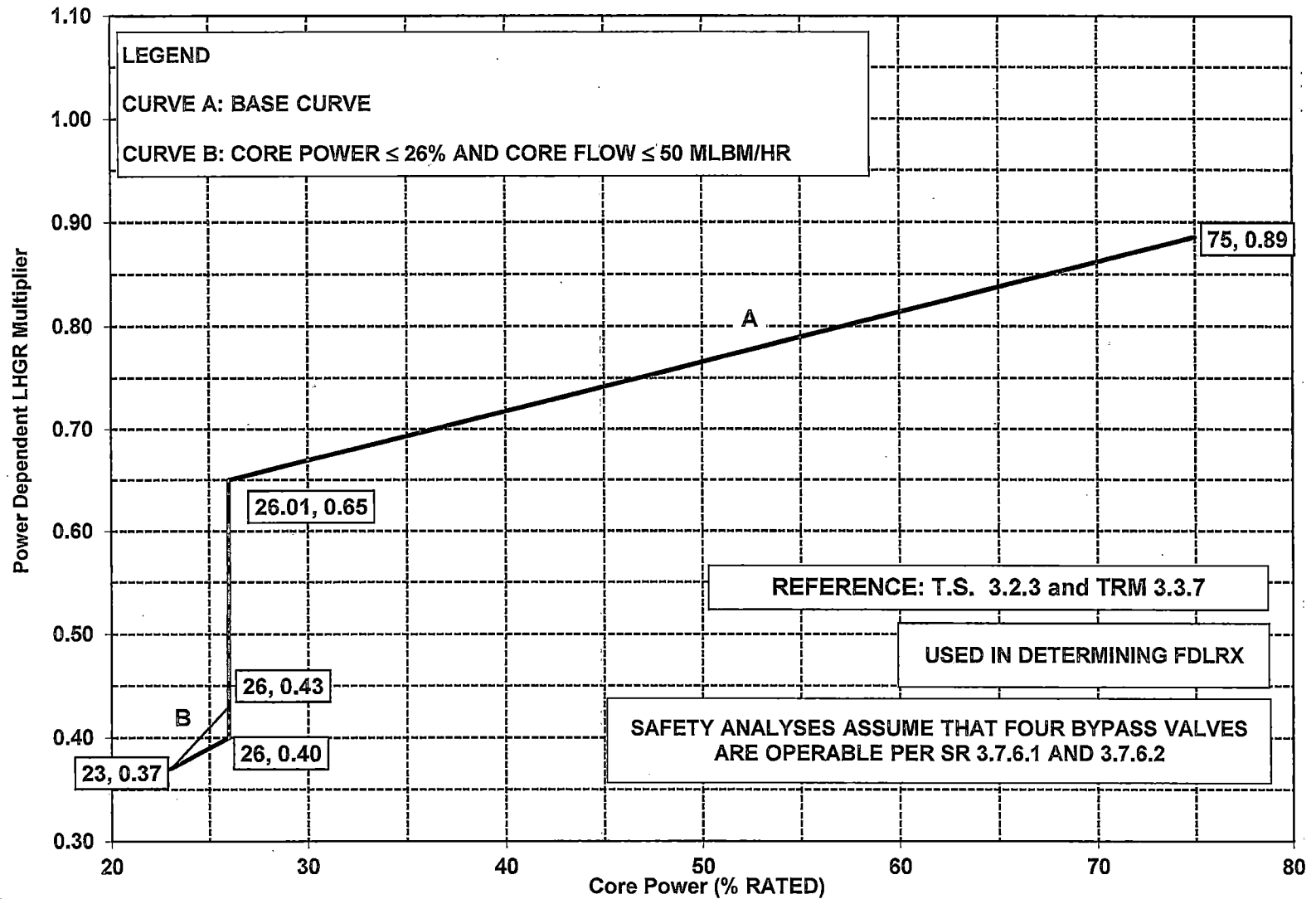
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SSSES UNIT 2 CYCLE 21



POWER DEPENDENT LHGR LIMIT MULTIPLIER
ONE TSV OR TCV CLOSED
ATRIUM™-10 FUEL
FIGURE 6.2-11A

SSSES UNIT 2 CYCLE 21



POWER DEPENDENT LHGR LIMIT MULTIPLIER
 ONE TSV OR TCV CLOSED
 ATRIUM™ 11 FUEL
 FIGURE 6.2-11B

7.0 ROD BLOCK MONITOR (RBM) SETPOINTS AND OPERABILITY REQUIREMENTS

7.1 References

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, Backup Pressure Regulator Operable and Inoperable, and with one Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) closed.

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 ^(2,3,4)
≥ 28 and < 90	< 1.76
≥ 90 and < 95	< 1.47
≥ 95	< 1.68

- (2) Applicable to Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, Backup Pressure Regulator Operable and Inoperable, and one TCV/TSV closed.
- (3) Applicable to both Two Loop and Single Loop Operation.
- (4) Applicable to both ATRIUM-10 and ATRIUM 11 Fuel.

8.0 RECIRCULATION LOOPS - SINGLE LOOP OPERATION

8.1 References

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

Technical Requirements Manual 3.3.7

8.2 Description

APLHGR

The APLHGR limit for ATRIUM™-10 fuel shall be equal to the APLHGR Limit from Figure 8.2-1A. The APLHGR limit for ATRIUM™ 11 fuel shall be equal to the APLHGR Limit from Figure 8.2-1B.

The APLHGR limits in Figures 8.2-1A and 8.2-1B are valid in Single Loop operation for Main Turbine Bypass Operable and Inoperable, EOC-RPT Operable and Inoperable, Backup Pressure Regulator Operable and Inoperable, and with one Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) closed.

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 and ATRIUM™ 11) 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 8.2-2A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-2B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 8.2-3A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-3B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

b) Main Turbine Bypass Inoperable

Figure 8.2-4A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-4B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 8.2-5A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-5B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

c) EOC-RPT Inoperable

Figure 8.2-6A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-6B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 8.2-7A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-7B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

d) Backup Pressure Regulator Inoperable

Figure 8.2-8A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-8B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 8.2-9A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-9B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

e) One Turbine Stop Valve (TSV) or Turbine Control Valve (TCV) Closed

Figure 8.2-10A: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-10B: Flow-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

Figure 8.2-11A: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™-10 Fuel

Figure 8.2-11B: Power-Dependent MCPR value determined from BOC to EOC for ATRIUM™ 11 Fuel

The MCPR limits in Figures 8.2-2A/8.2-2B through 8.2-11A/8.2-11B are valid only for Single Loop operation and support power levels up to 67.2% RATED THERMAL POWER and core flows up to 52 Mlbm/hr. These conditions

conservatively bound Single Loop Operation in accordance with Technical Specification 3.4.1.

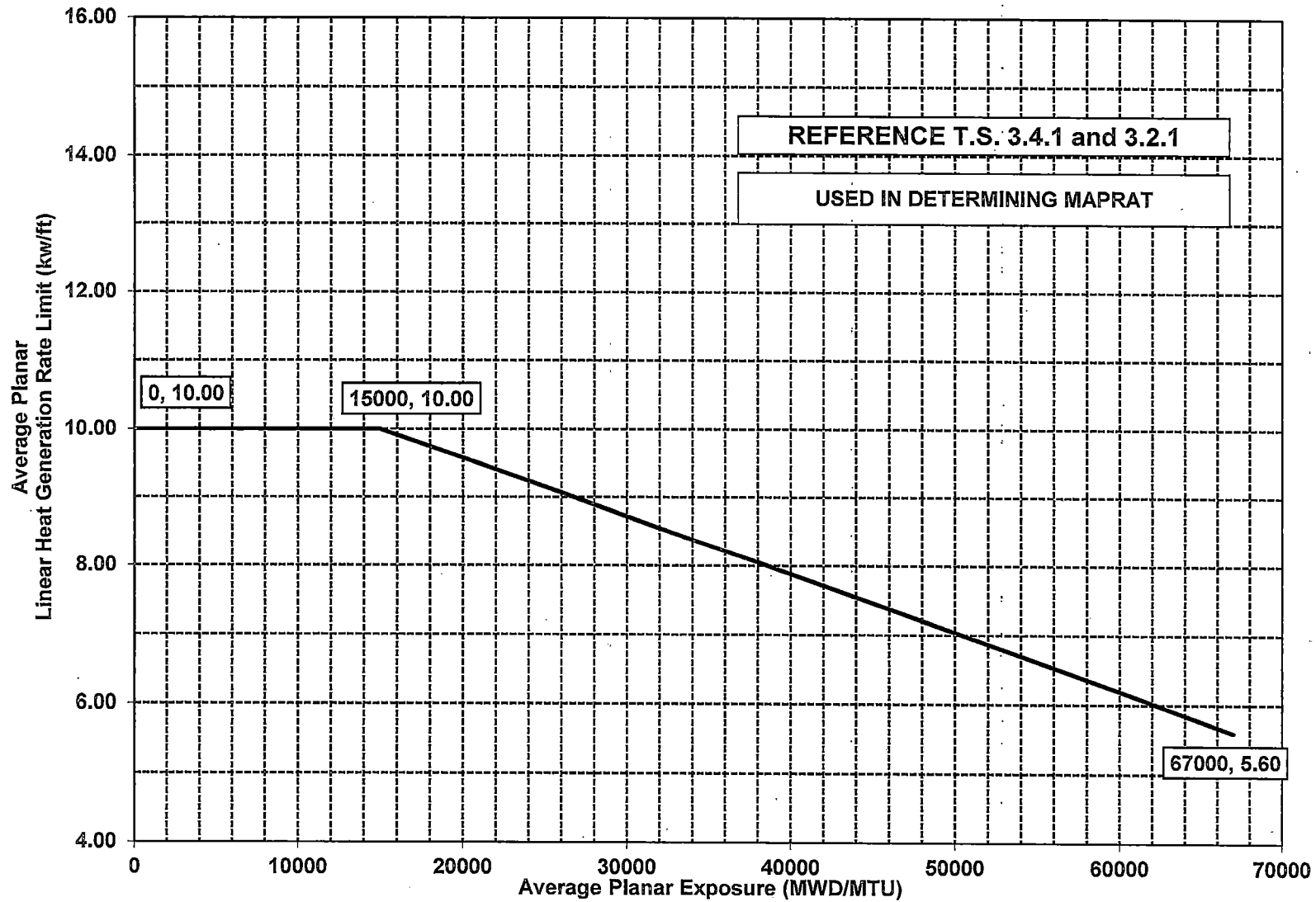
Linear Heat Generation Rate Limit

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

RBM Setpoints and Operability Requirements

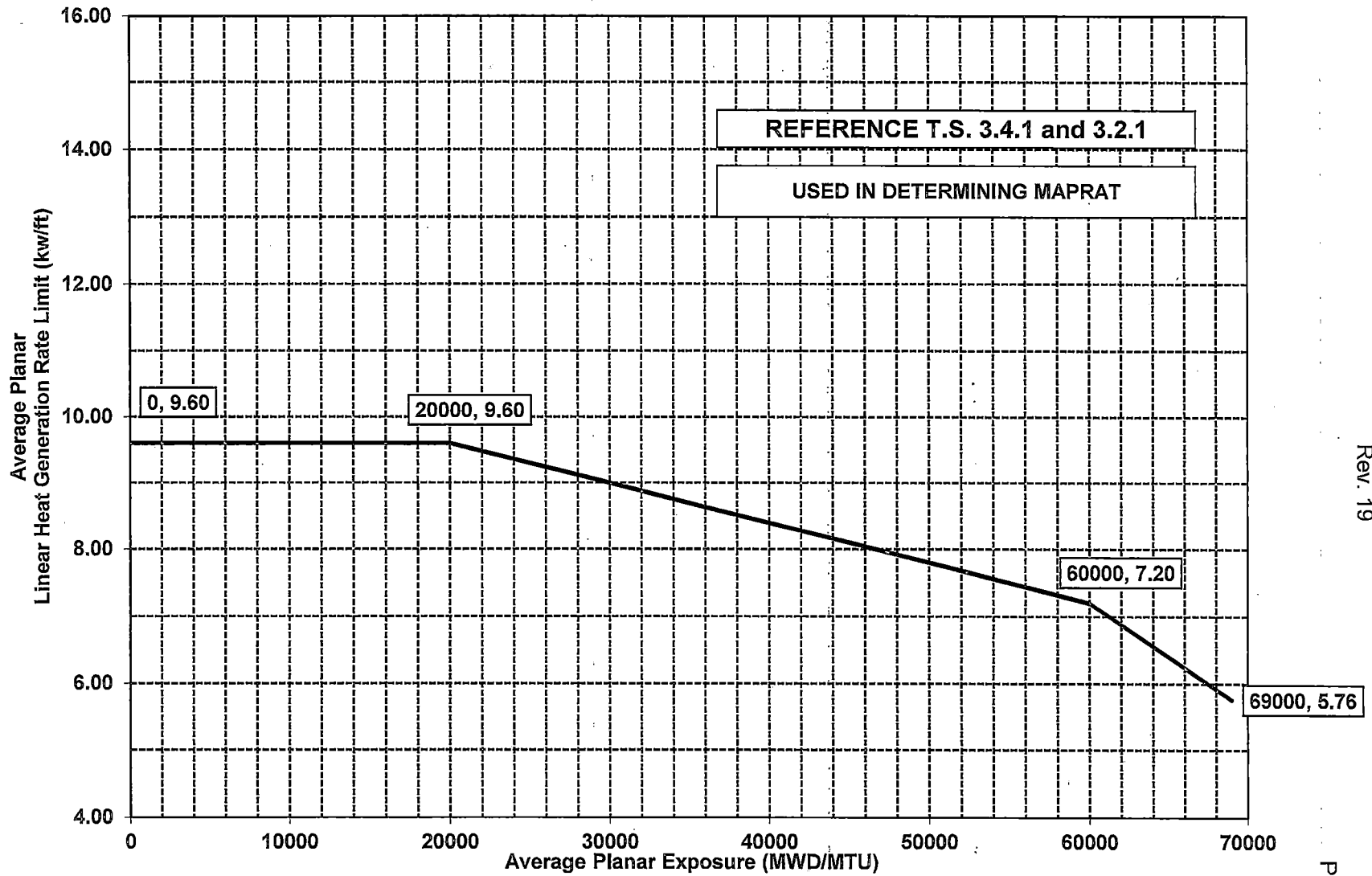
The RBM setpoints and operability requirements for Single Loop Operation are defined in Section 7.0.

SSES UNIT 2 CYCLE 21



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

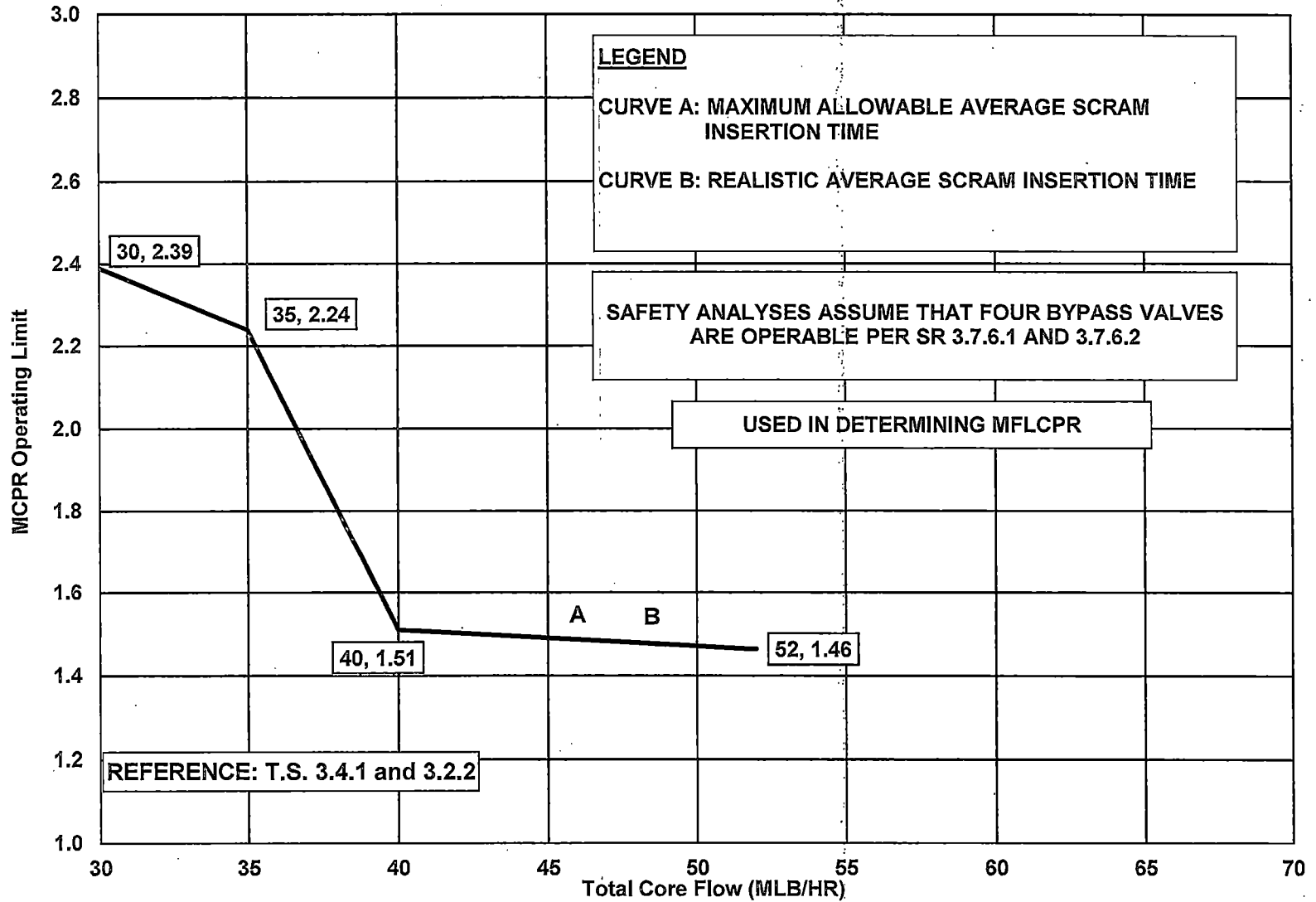
SSSES UNIT 2 CYCLE 21



AVERAGE PLANAR LINEAR HEAT GENERATION RATE LIMIT VERSUS
AVERAGE PLANAR EXPOSURE - SINGLE LOOP OPERATION
ATRIUM™ 11 FUEL
FIGURE 8.2-1B

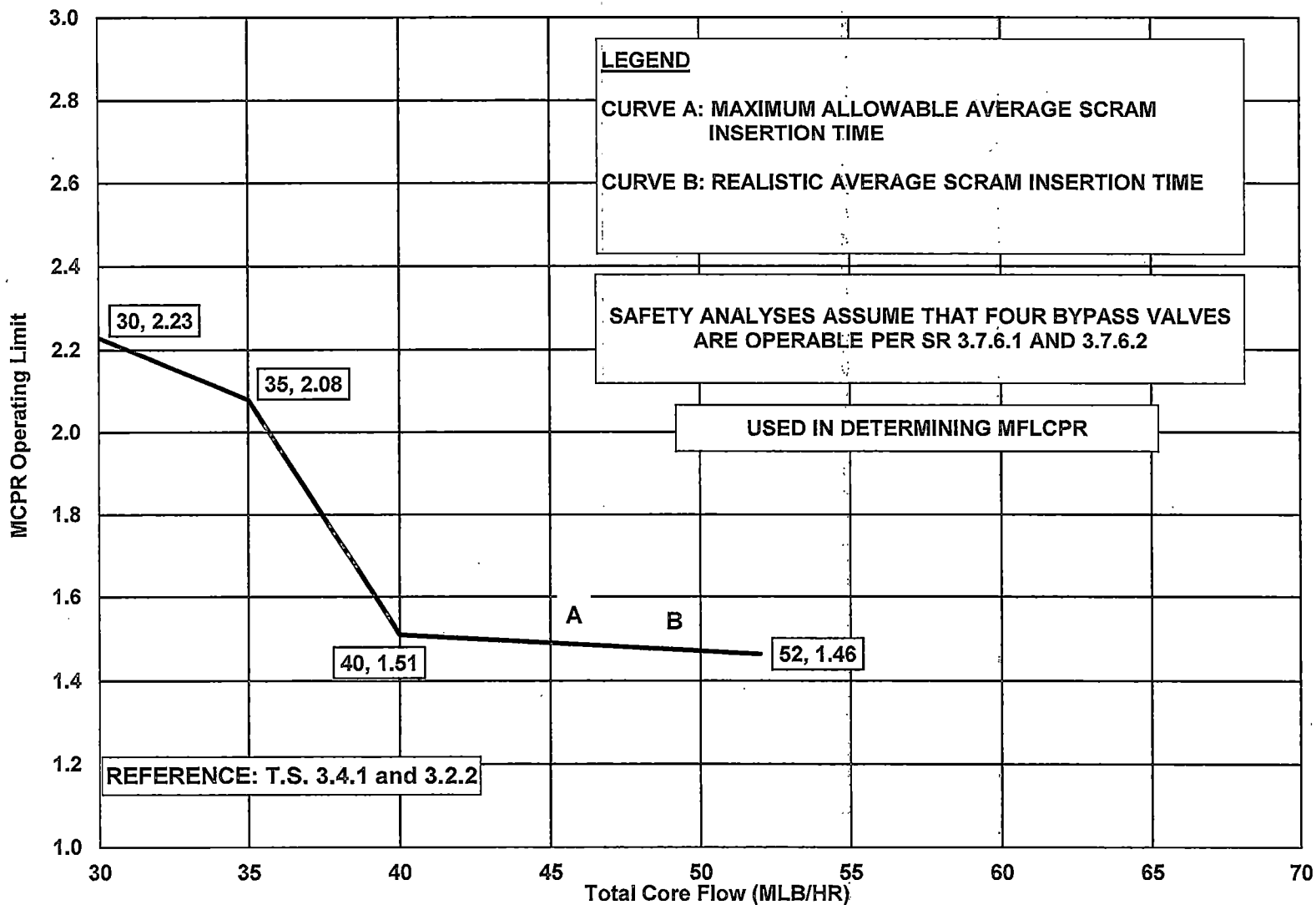
Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable

SSSES UNIT 2 CYCLE 21



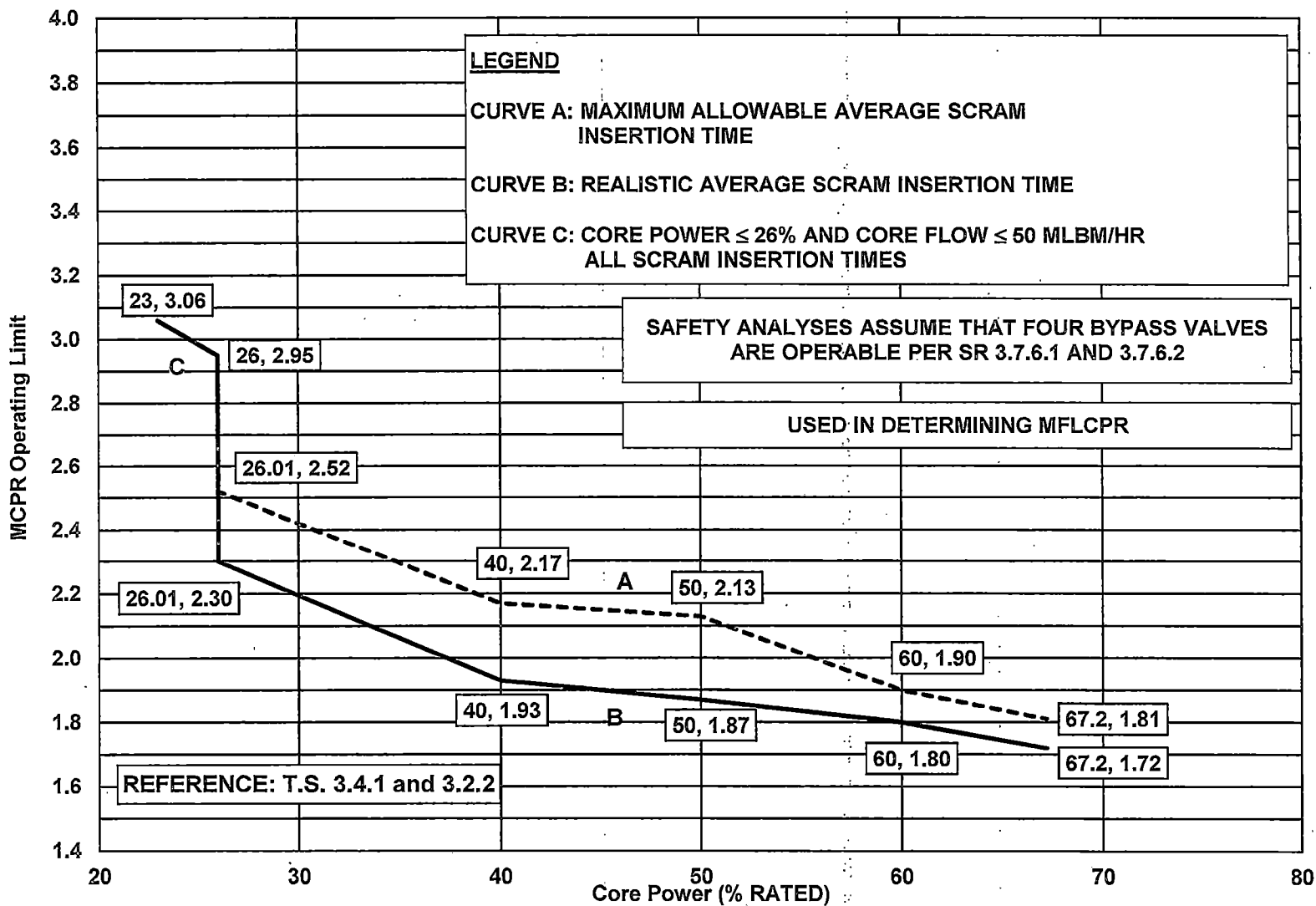
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™-10 FUEL
FIGURE 8.2-2A

SSES UNIT 2 CYCLE 21



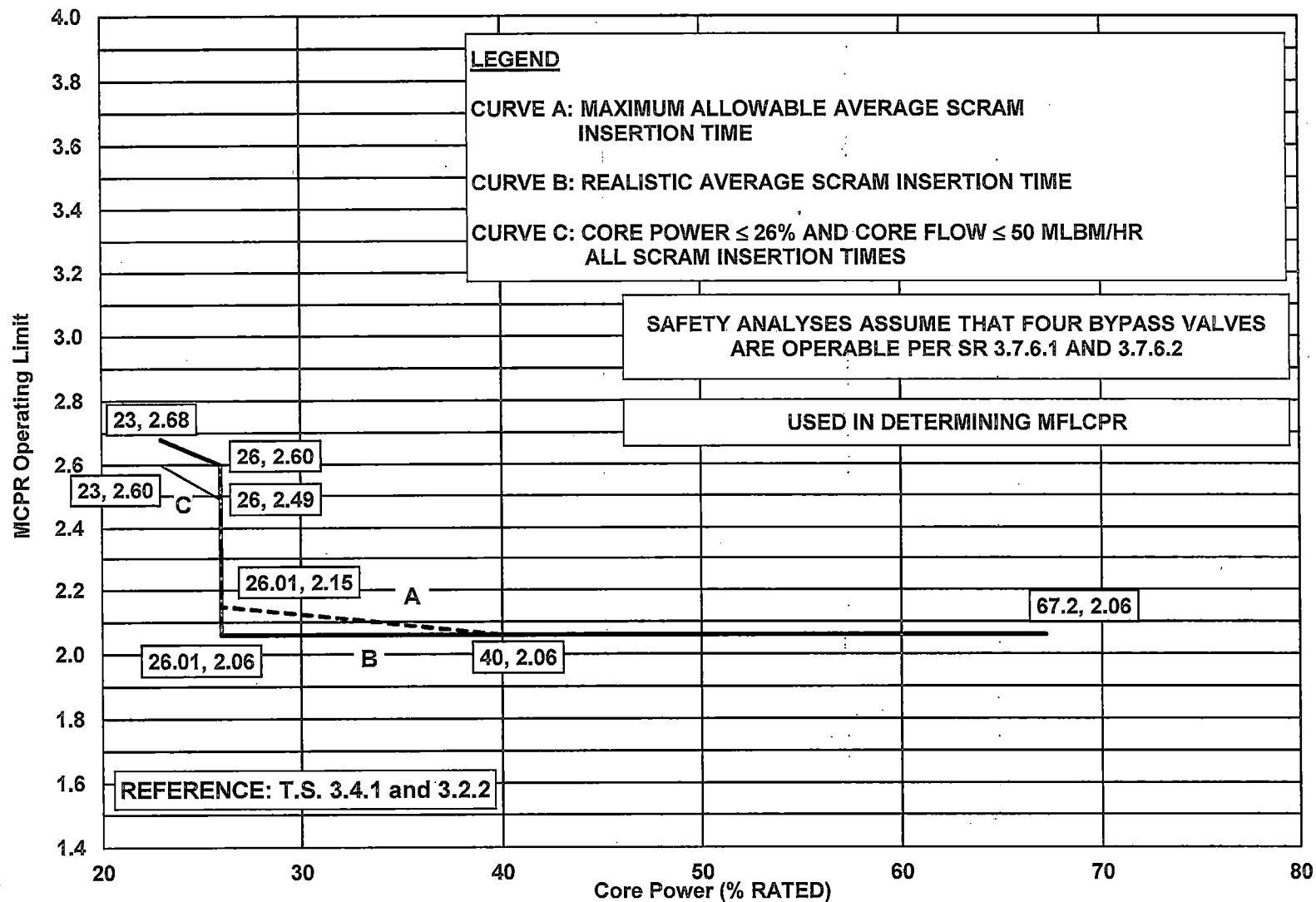
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-2B

SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 8.2-3A

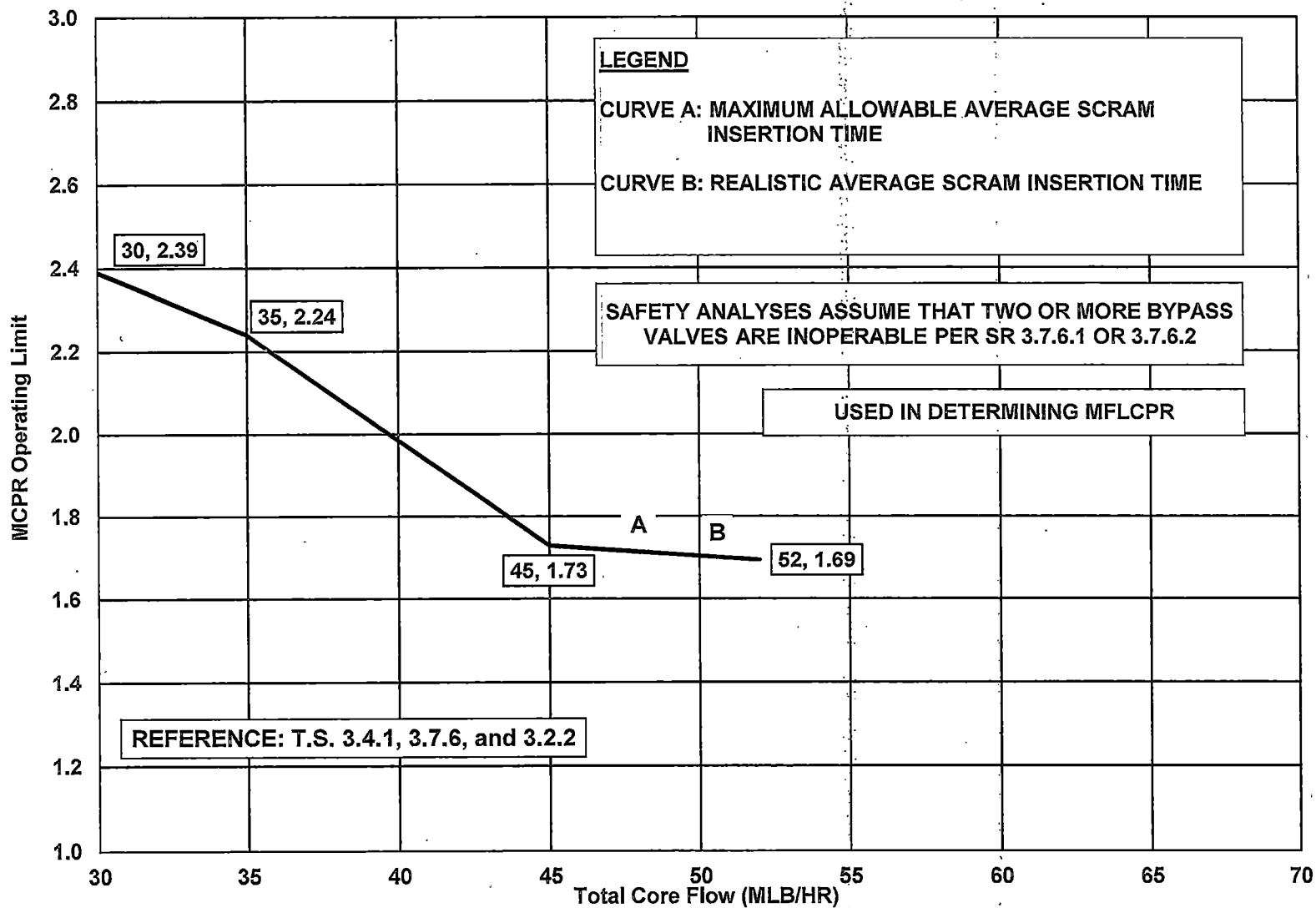
SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-3B

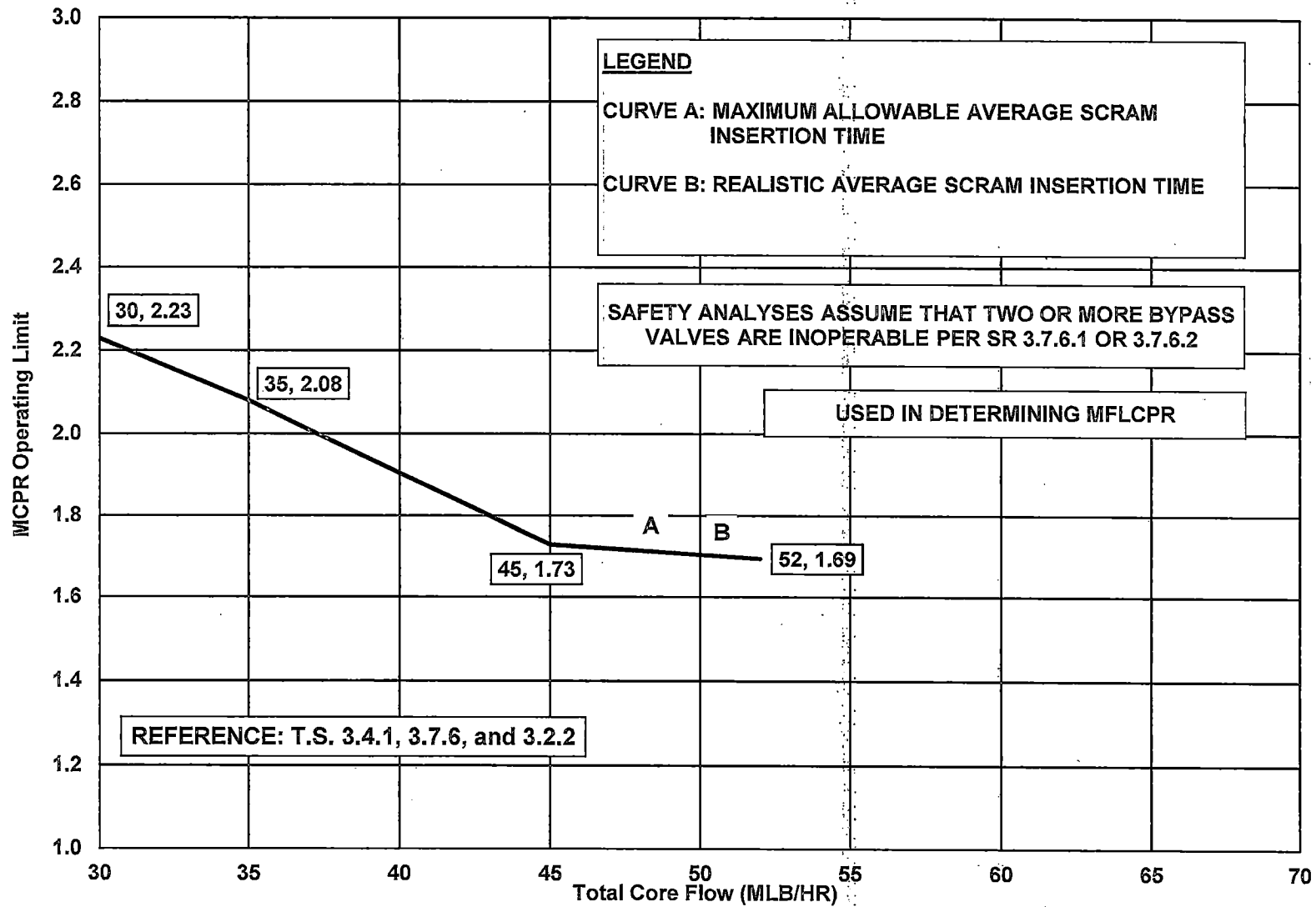
Main Turbine Bypass Inoperable

SSES UNIT 2 CYCLE 21



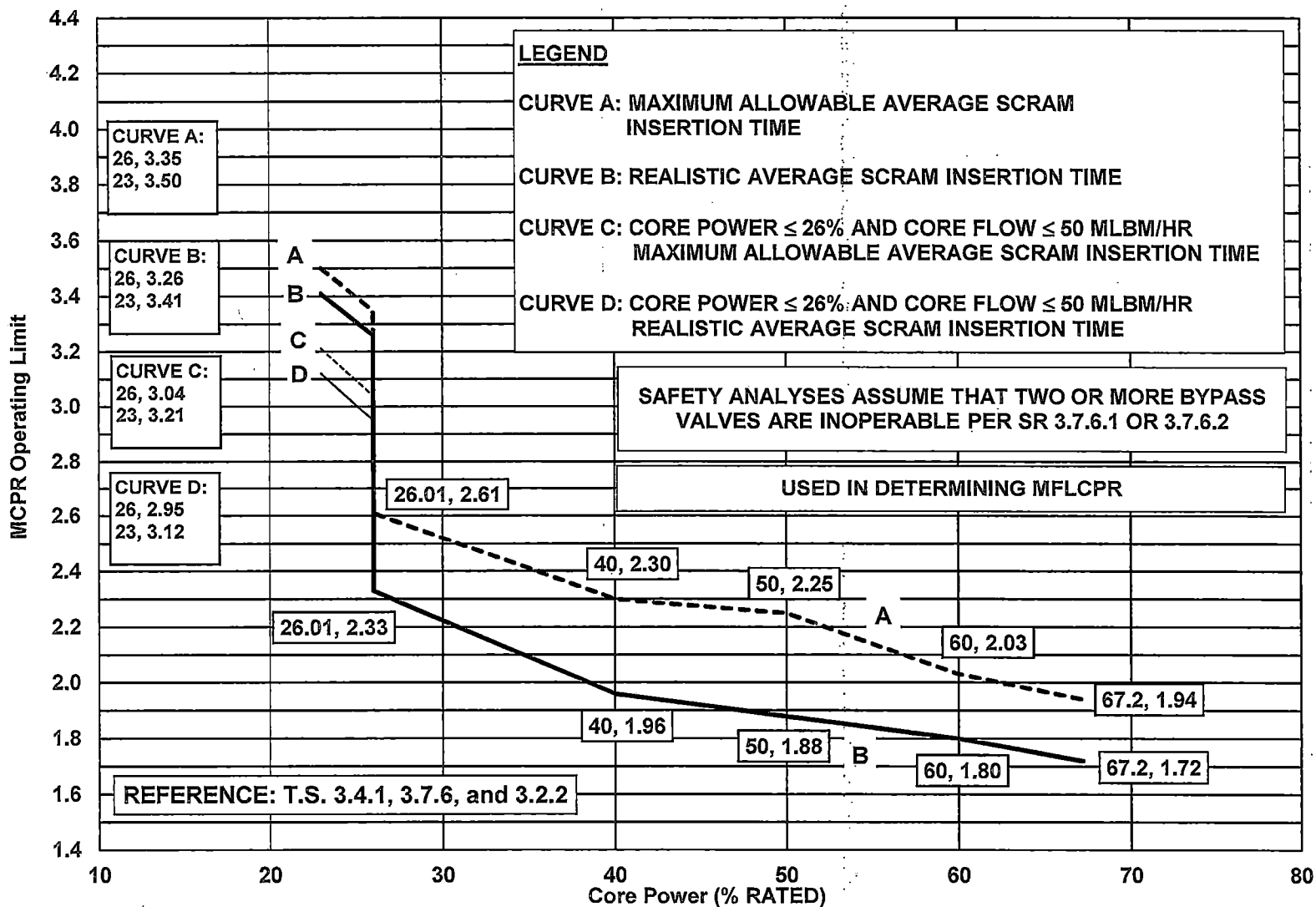
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS INOPERABLE
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™10 FUEL
FIGURE 8.2-4A

SSSES UNIT 2 CYCLE 21



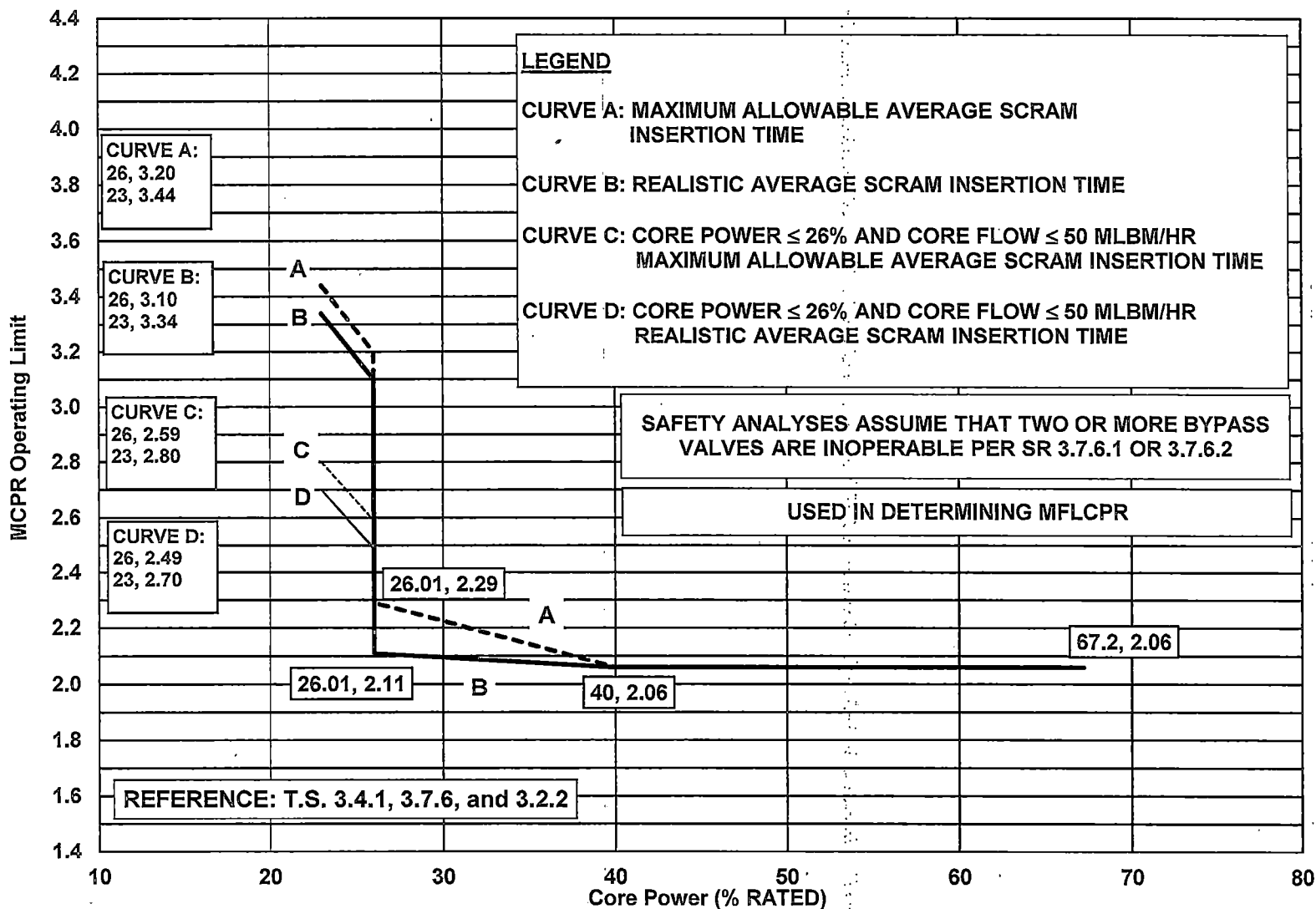
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
MAIN TURBINE BYPASS INOPERABLE
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 8.2-4B

SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™10 FUEL
 FIGURE 8.2-5A

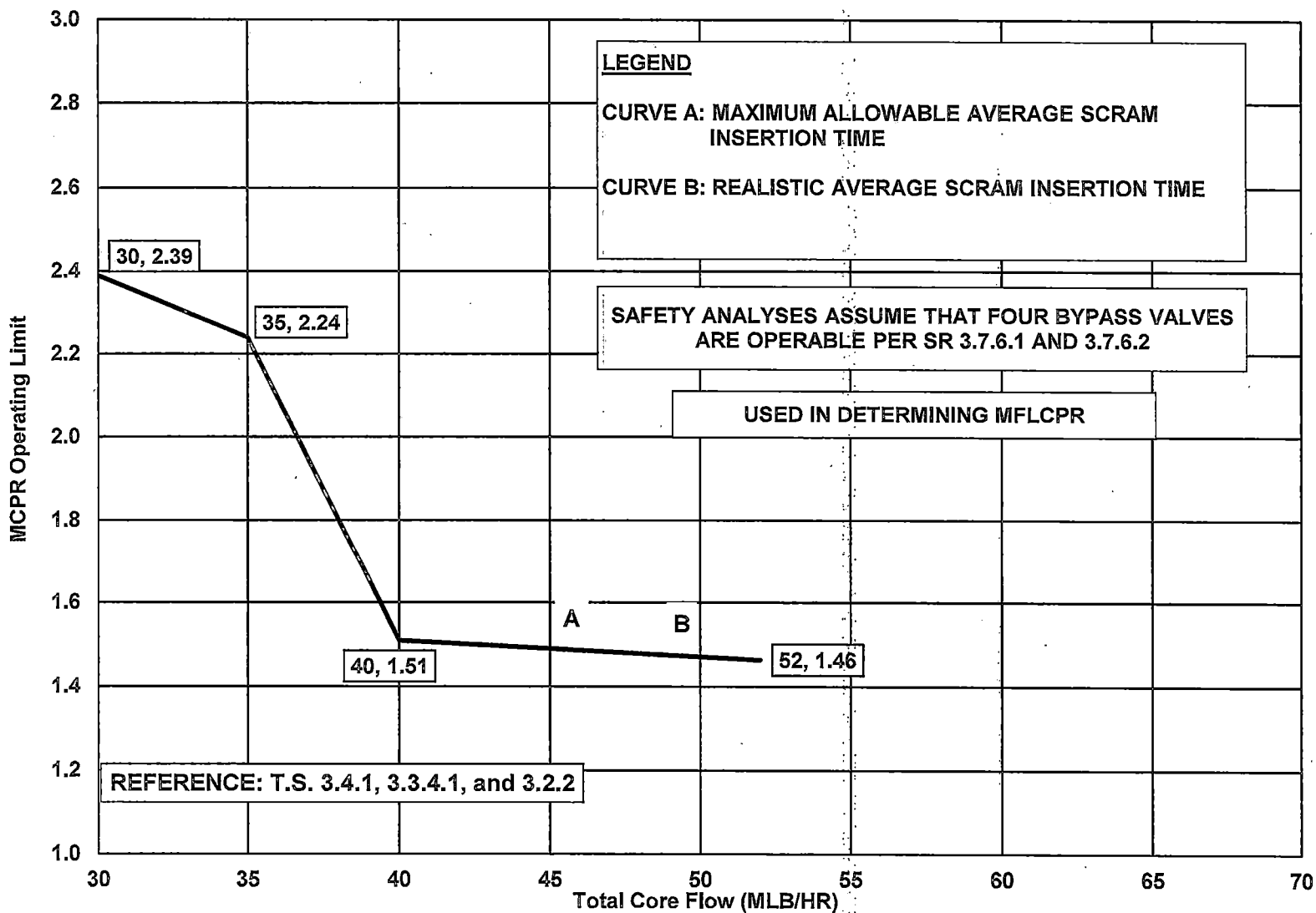
SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 MAIN TURBINE BYPASS INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-5B

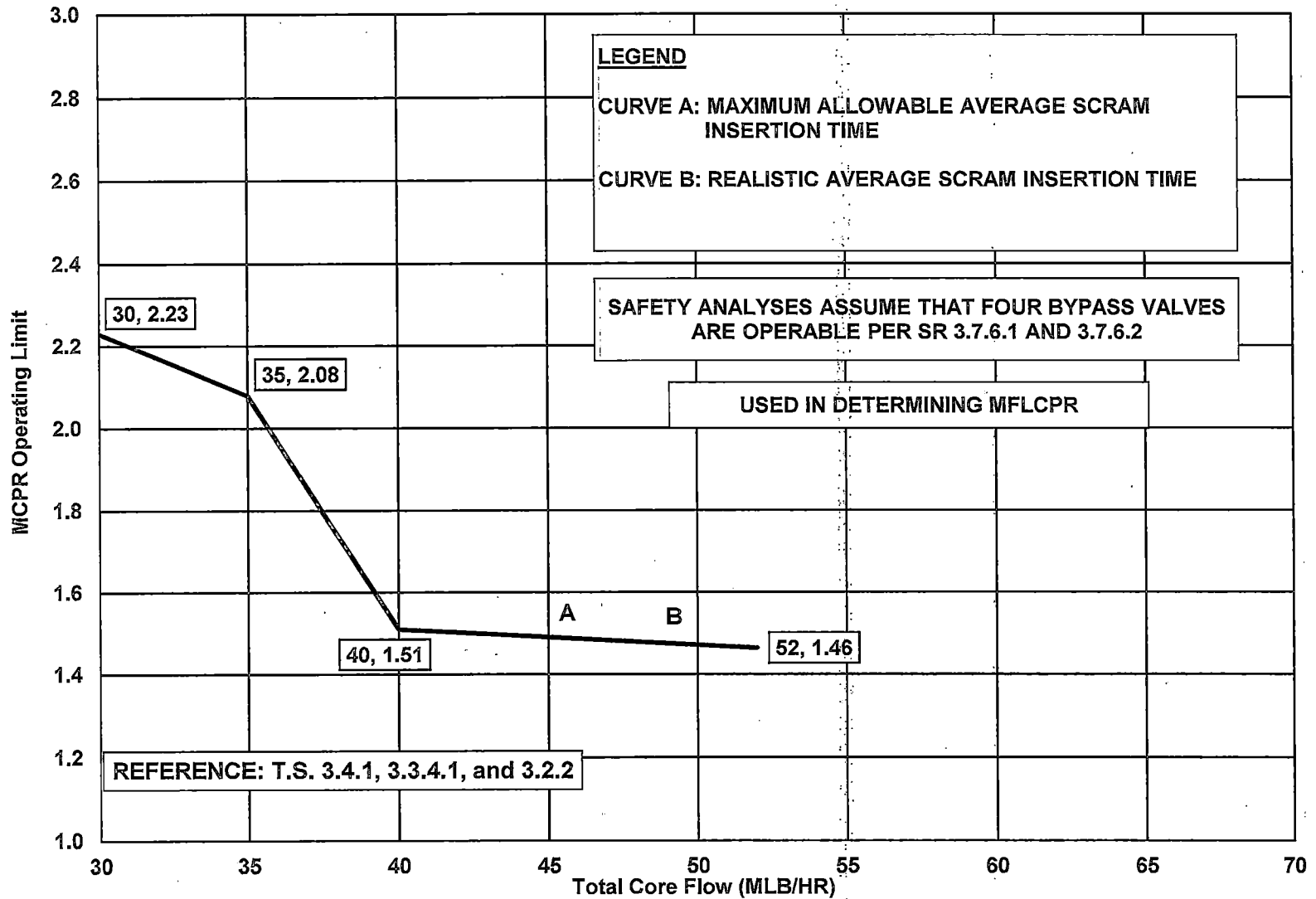
EOC-RPT Inoperable

SSES UNIT 2 CYCLE 21



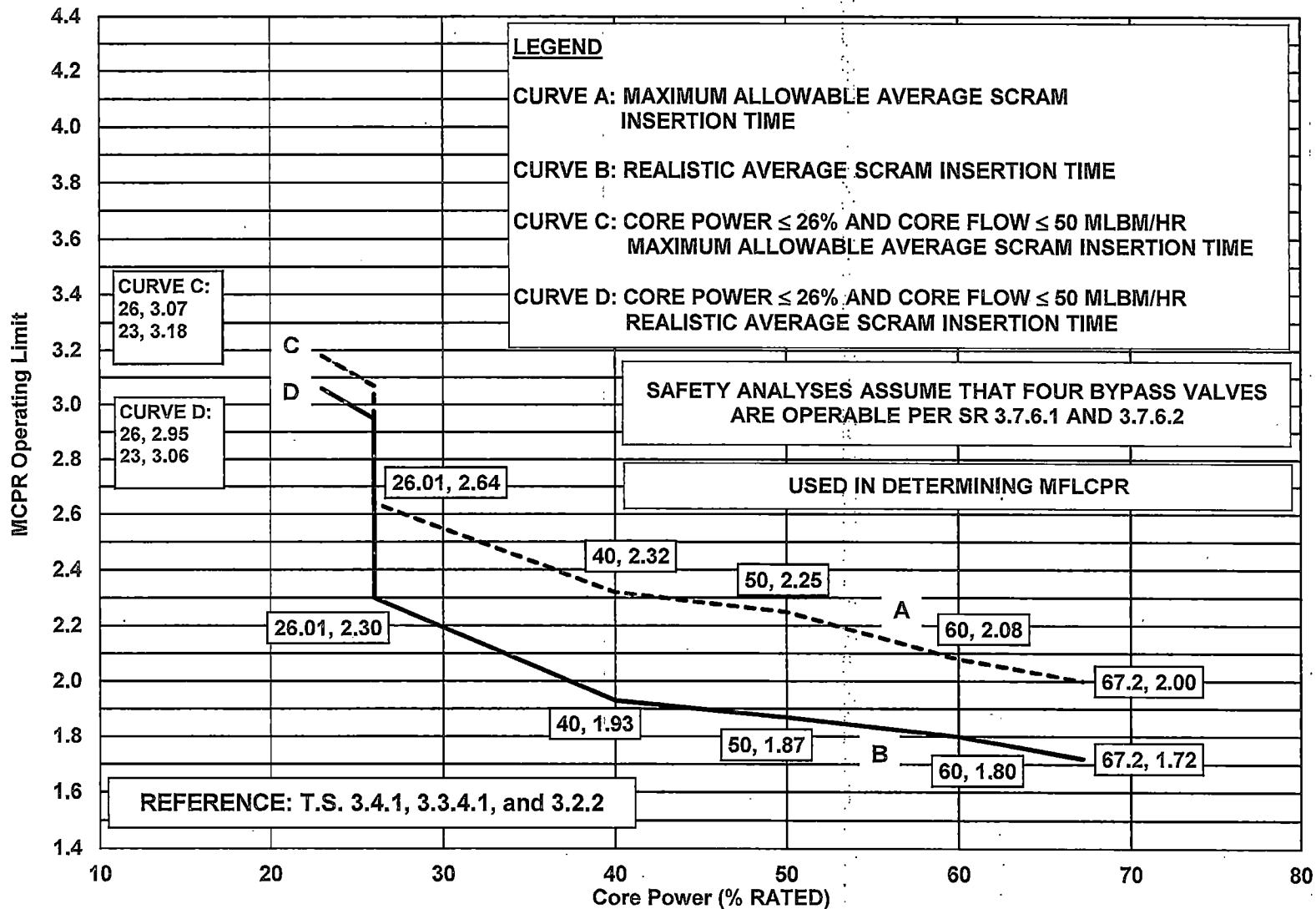
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 EOC-RPT INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 8.2-6A

SSES UNIT 2 CYCLE 21



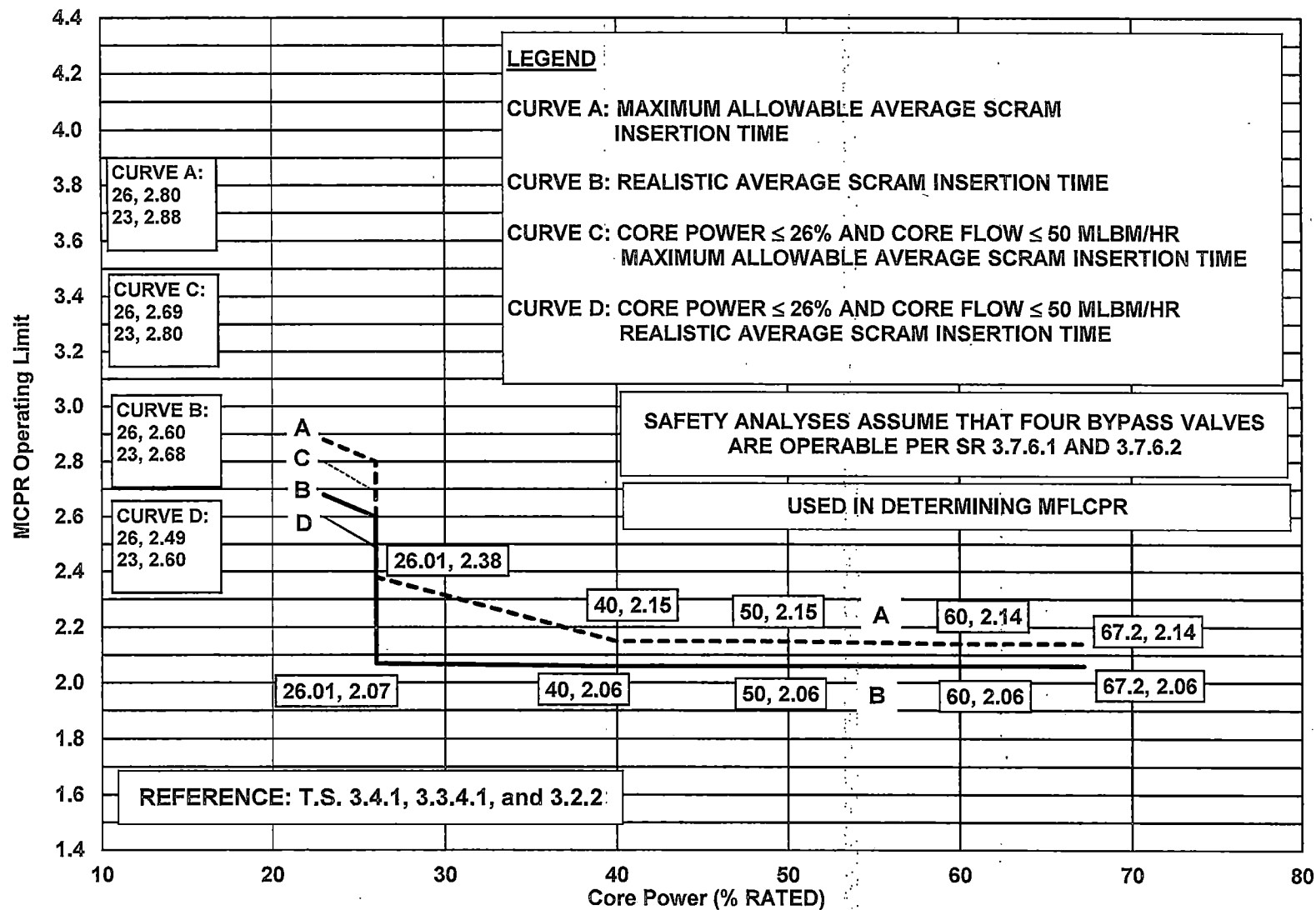
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
EOC-RPT INOPERABLE
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 8.2-6B

SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
EOC-RPT INOPERABLE
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™-10 FUEL
FIGURE 8.2-7A

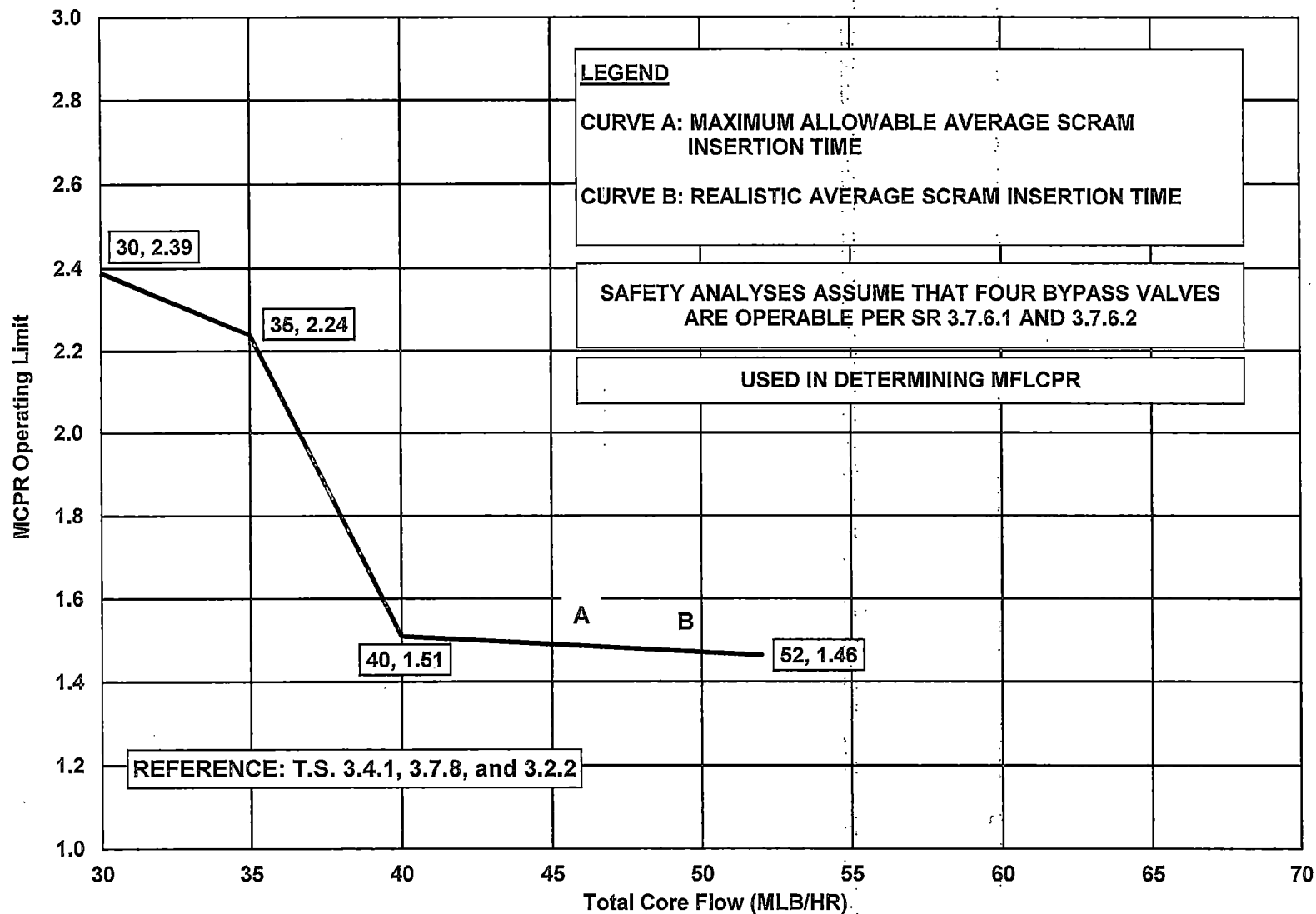
SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
EOC-RPT INOPERABLE
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™ 11 FUEL
FIGURE 8.2-7B

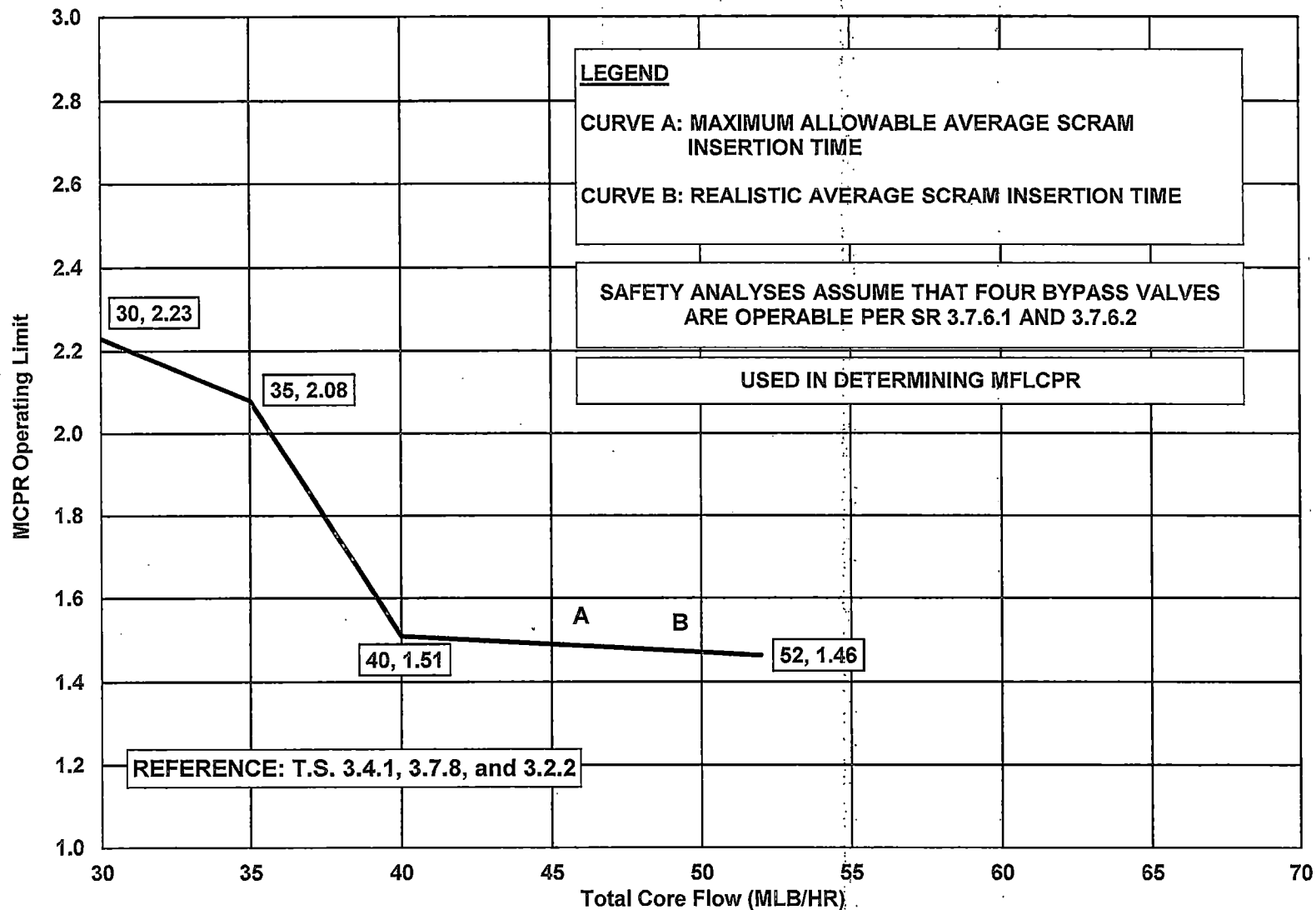
Backup Pressure Regulator Inoperable

SSES UNIT 2 CYCLE 21



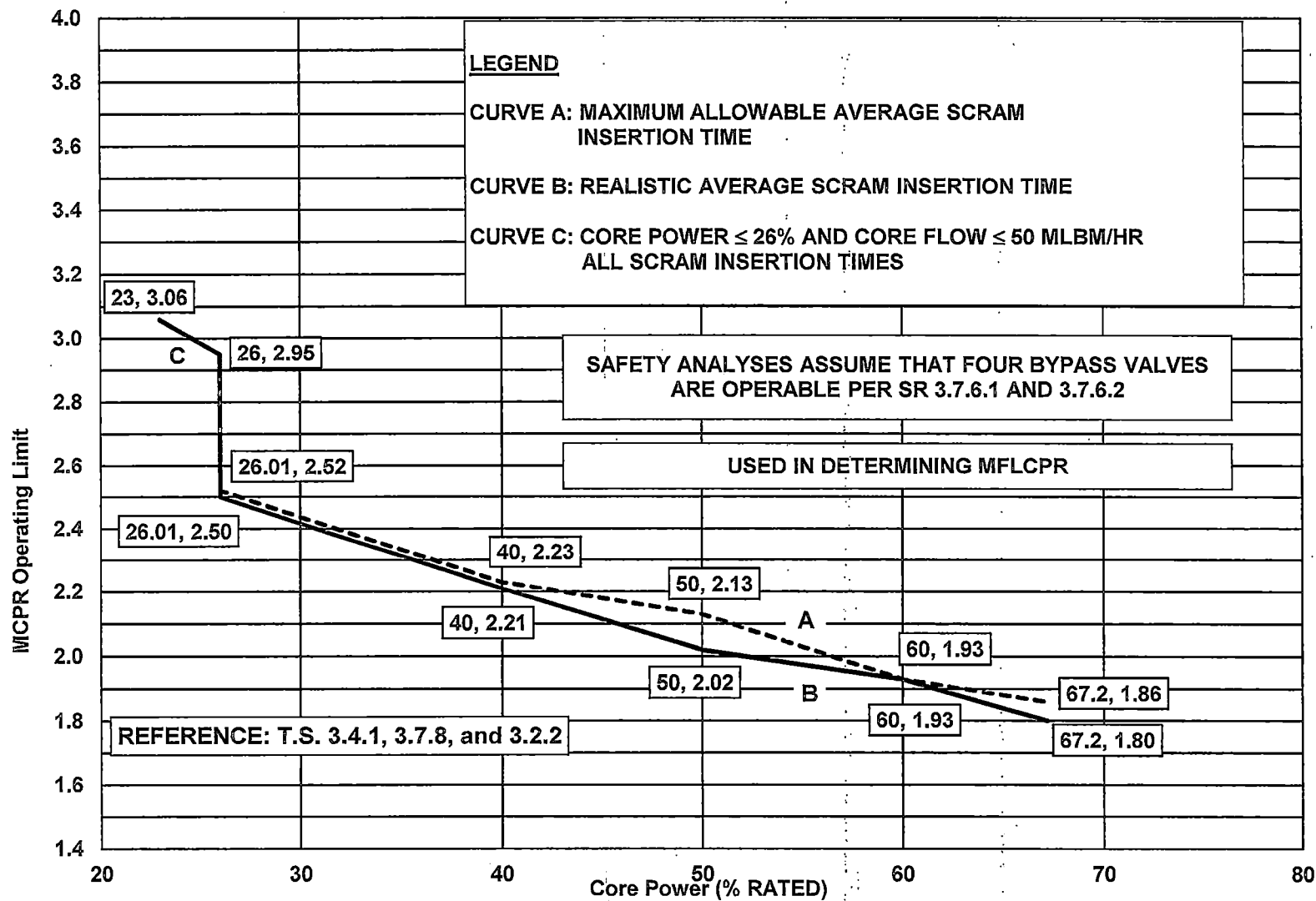
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 BACKUP PRESSURE REGULATOR INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 8.2-8A

SSES UNIT 2 CYCLE 21



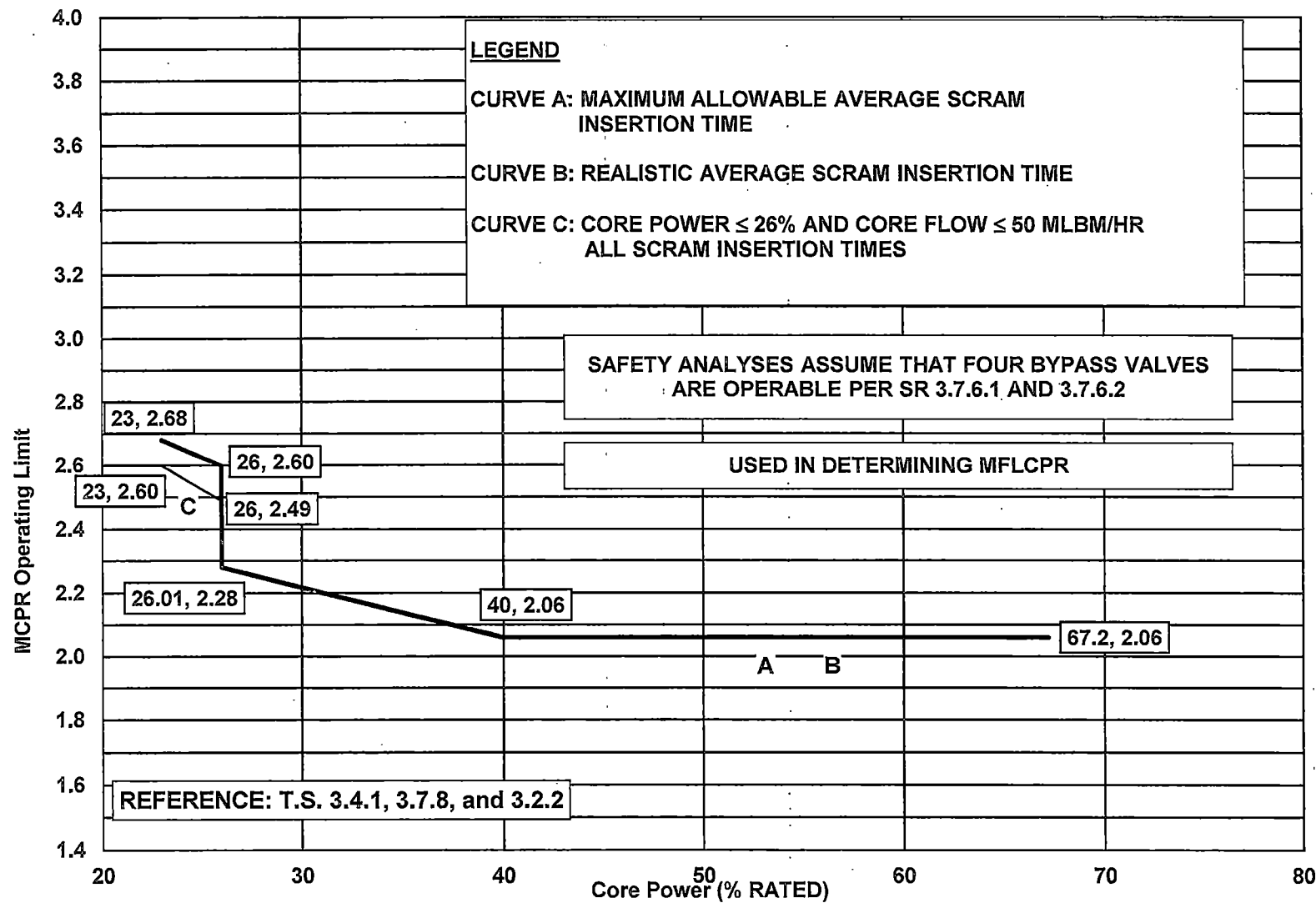
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 BACKUP PRESSURE REGULATOR INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-8B

SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 BACKUP PRESSURE REGULATOR INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 8.2-9A

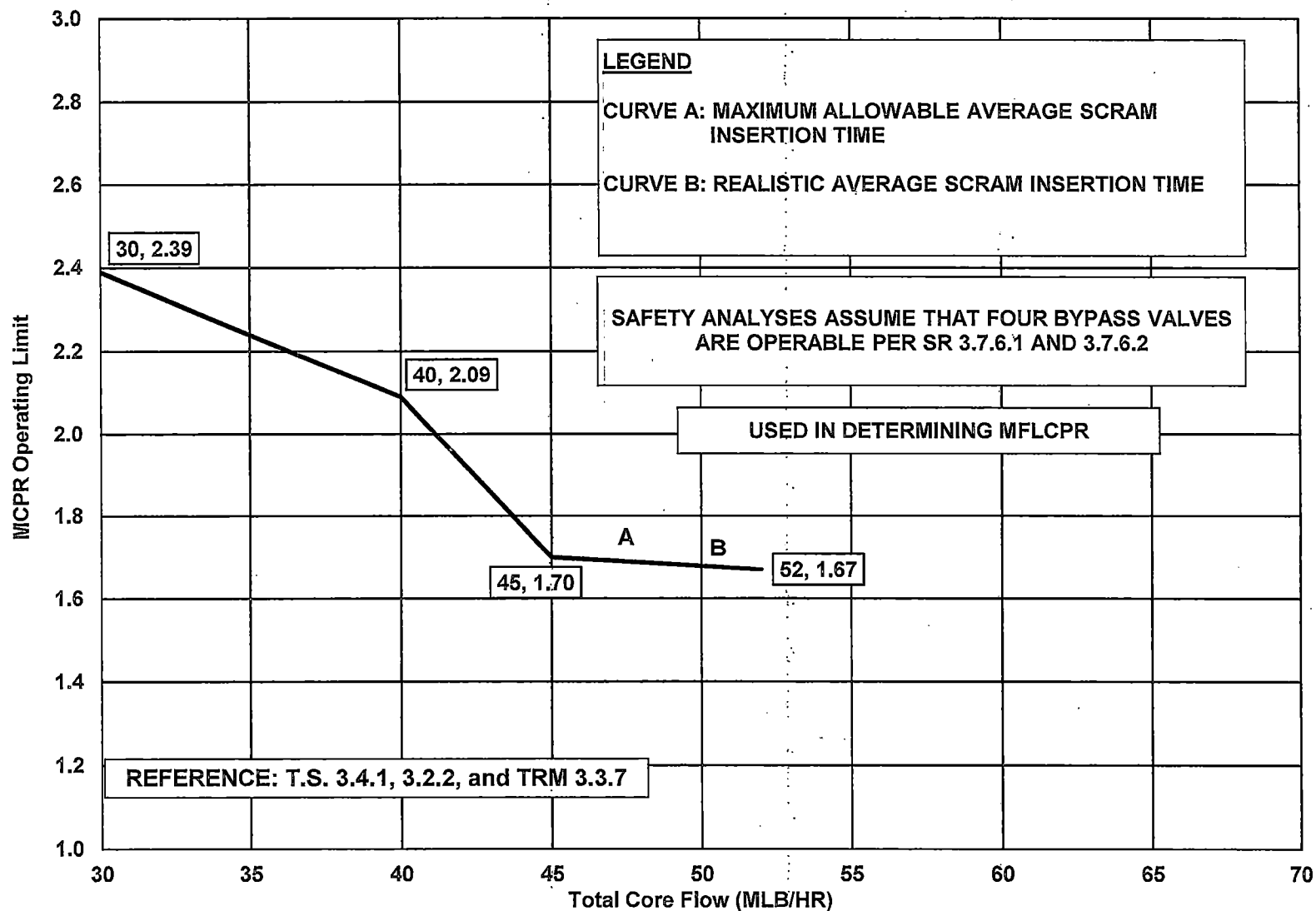
SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 BACKUP PRESSURE REGULATOR INOPERABLE
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-9B

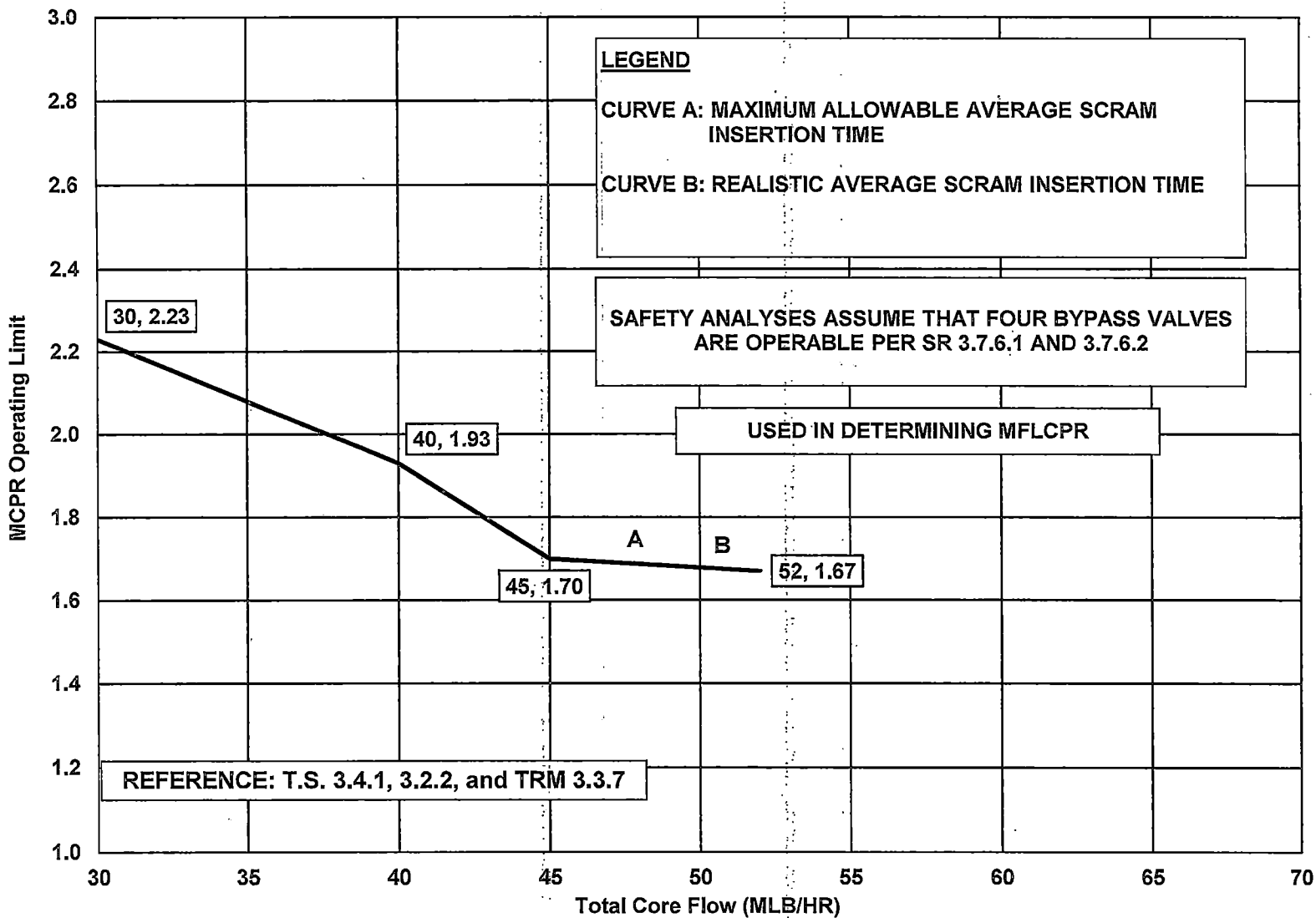
One TSV or TCV Closed

SSES UNIT 2 CYCLE 21



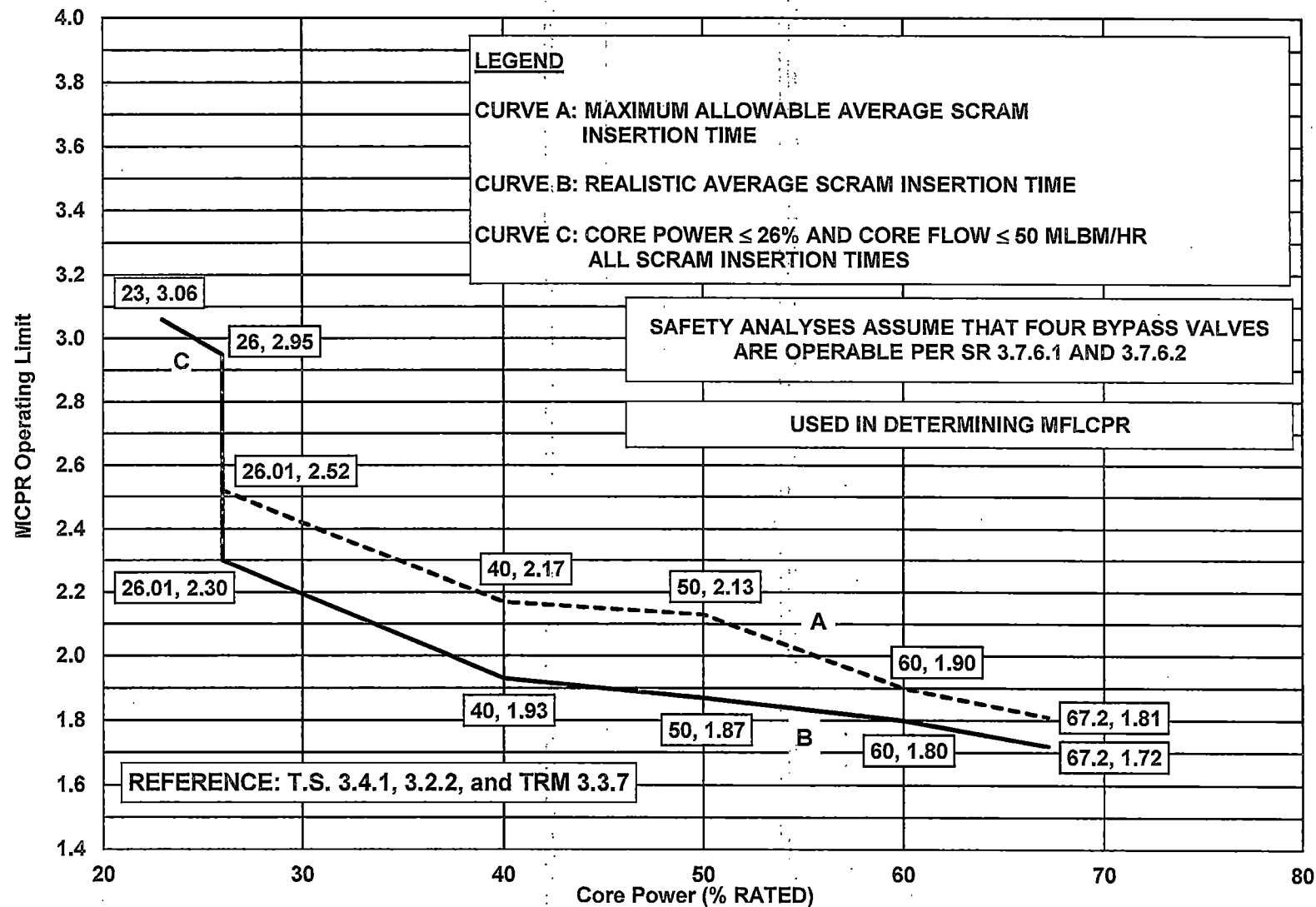
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
ONE TSV OR TCV CLOSED
SINGLE LOOP OPERATION (BOC TO EOC)
ATRIUM™-10 FUEL
FIGURE 8.2-10A

SSES UNIT 2 CYCLE 21



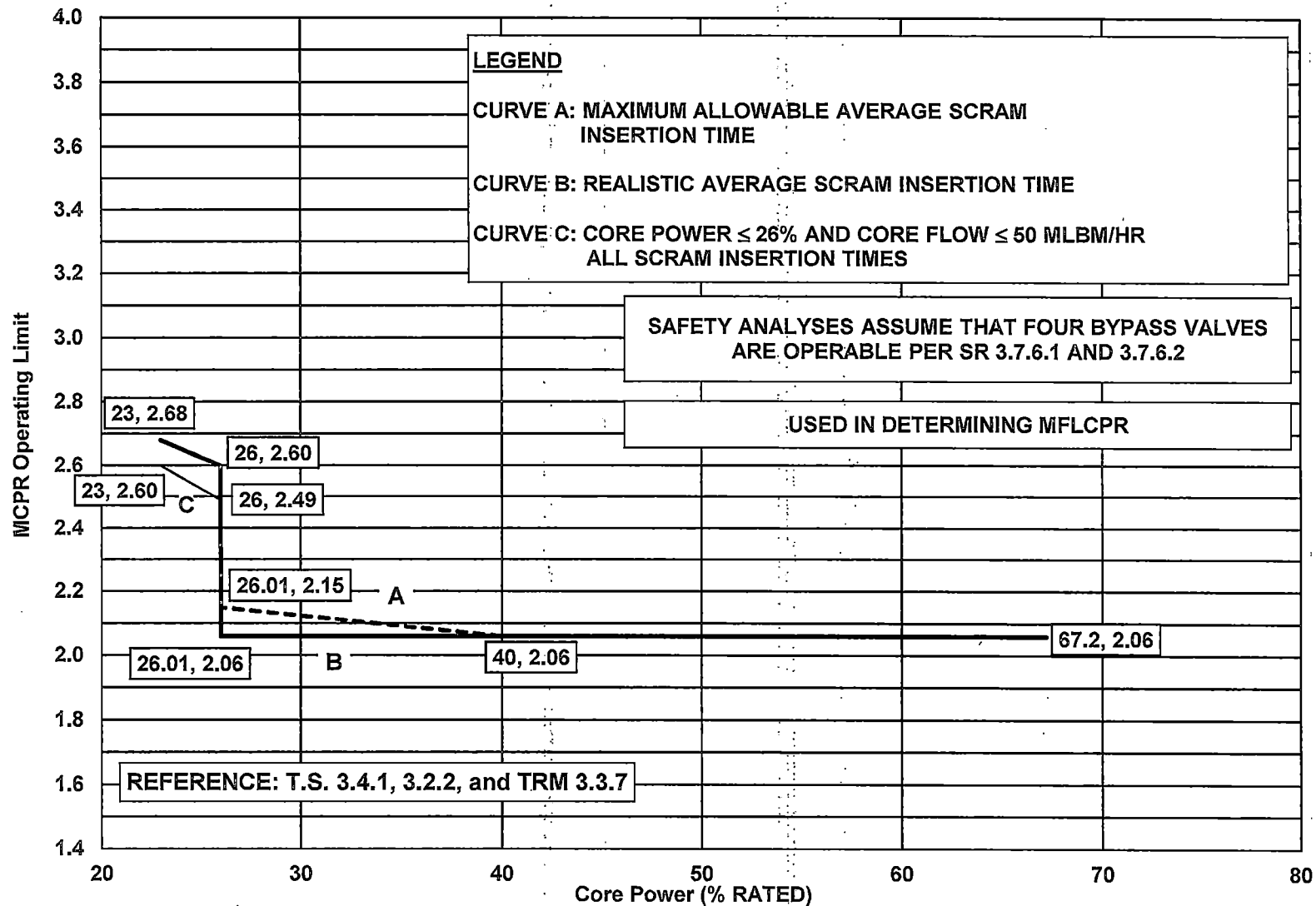
MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW
 ONE TSV OR TCV CLOSED
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-10B

SSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 ONE TSV OR TCV CLOSED
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™-10 FUEL
 FIGURE 8.2-11A

SSSES UNIT 2 CYCLE 21



MCPR OPERATING LIMIT VERSUS CORE POWER
 ONE TSV OR TCV CLOSED
 SINGLE LOOP OPERATION (BOC TO EOC)
 ATRIUM™ 11 FUEL
 FIGURE 8.2-11B

9.0 POWER / FLOW MAP

9.1 References

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.

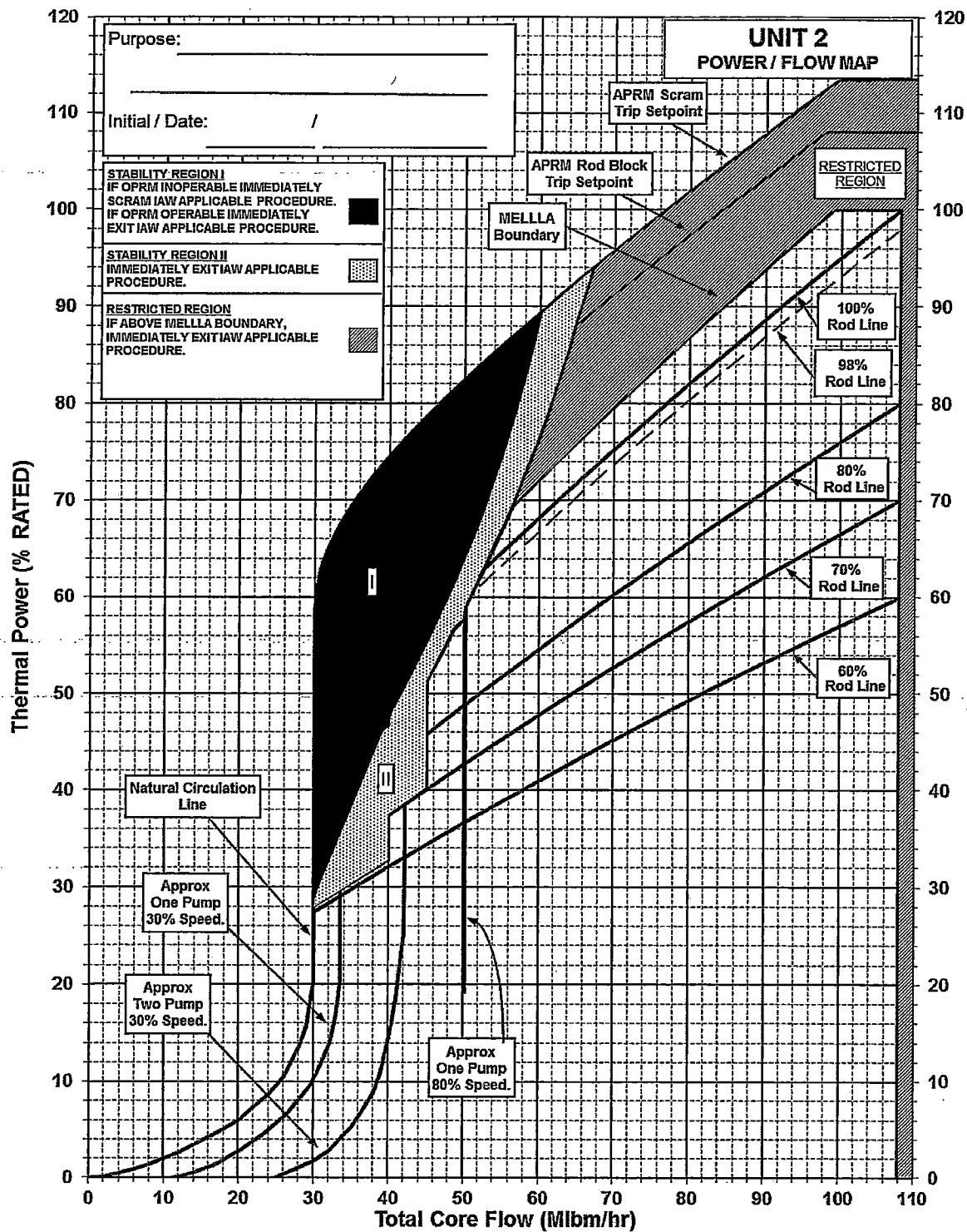


Figure 9.1
SSES Unit 2 Cycle 21 Power / Flow Map

10.0 OPRM SETPOINTS

10.1 References

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:

$$S_P = 1.12$$

$$N_P = 16$$

$$F_P = 60 \text{ Milbm / hr}$$

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-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.
5. 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.
6. 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.
7. 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.
8. ANF-89-98(P)(A) Revision 1 and Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation, May 1995.
9. EMF-2209(P)(A), Revision 3, "SPCB Critical Power Correlation," AREVA NP, September 2009.
10. 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.
11. 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.
12. 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.

13. NEDO-32465-A, "BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," August 1996.
14. ANF-1358(P)(A), Revision 3, "The Loss of Feedwater Heating Transient in Boiling Water Reactors," Framatome ANP, September 2005.
15. BAW-10247PA, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," AREVA, Inc., April 2008.
16. ANP-10340P-A, Revision 0, "Incorporation of Chromia-Doped Fuel Properties in AREVA Approved Methods," Framatome Inc., May 2018.
17. ANP-10335P-A, Revision 0, "ACE/ATRIUM-11 Critical Power Correlation," Framatome Inc., May 2018.
18. ANP-10300P-A, Revision 1, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios," Framatome Inc., January 2018.
19. ANP-10332P-A, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios," Framatome Inc., March 2019.
20. ANP-10333P-A, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Control Rod Drop Accident (CRDA)," Framatome Inc., March 2018.
21. ANP-10307PA, Revision 0, "AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," AREVA, Inc., June 2011.
22. BAW-10247P-A Supplement 1P-A, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors, Supplement 1: Qualification of RODEX4 for Recrystallized Zircaloy-2 Cladding," AREVA Inc., April 2017.
23. BAW-10247P-A Supplement 2P-A, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors, Supplement 2: Mechanical Methods," Framatome Inc., August 2018.