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November 30, 2020

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

10 CFR 50.4

**SUSQUEHANNA STEAM ELECTRIC STATION  
SUBMITTAL OF UNIT 2 CYCLE 20 CORE  
OPERATING LIMITS REPORT, REVISION 3  
PLA-7909**

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**Docket No. 50-388**

Susquehanna Steam Electric Station (SSES) 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. Pursuant to this requirement, the SSES Unit 2 Cycle 20 COLR, Revision 3, is provided in the attachment. This revision is a result of updated licensing analysis which is documented in the Susquehanna Nuclear, LLC, Corrective Action Program. All changes are denoted by revision bars in the margin of the report.

There are no new or revised commitments contained in this submittal.

Should you have any questions regarding this submittal, please contact Ms. Melisa Krick, Manager – Nuclear Regulatory Affairs, at (570) 542-1818.

A handwritten signature in black ink, appearing to read "K. Cimorelli", with a stylized, cursive script.

K. Cimorelli

Attachment: SSES Unit 2 Cycle 20 COLR, Revision 3

Copy: NRC Region I  
Mr. C. Highley, NRC Sr. Resident Inspector  
Ms. S. Goetz, NRC Project Manager  
Mr. M. Shields, PA DEP/BRP

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**Attachment to PLA-7909**

**SSES Unit 2 Cycle 20 COLR, Revision 3**

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# **Susquehanna SES Unit 2 Cycle 20**

## **CORE OPERATING LIMITS REPORT**

**Nuclear Fuels  
Engineering**

**December 2020**

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## CORE OPERATING LIMITS REPORT REVISION DESCRIPTION INDEX

REV NO.	AFFECTED SECTIONS	DESCRIPTION / PURPOSE OF REVISION
0	ALL	<p>Issuance of this COLR is in support of Unit 2 Cycle 20 operation.</p> <p>CR-2019-03732 is evaluating a condition that should it result in a revision to the COLR, will be submitted in accordance with Technical Specification 5.6.5.</p>
1	ALL	<p>The U2C20 COLR is revised to include licensing analyses results for the revised U2C20 core design (CR-2019-03732).</p> <p>Changes are made to the following figures: 5.2-1 through 5.2-10, 6.2-5, and 8.2-2 through 8.2-11. Changes to the thermal limits are limited to the following figures: 5.2-1 through 5.2-5, 5.2-7, 5.2-9, 5.2-10, 6.2-5, 8.2-2, 8.2-4, 8.2-6, 8.2-8, and 8.2-10. Only the captions were changed for the remaining figures (5.2-6, 5.2-8, 8.2-3, 8.2-5, 8.2-7, 8.2-9, 8.2-11).</p> <p>Revision 1 of the Unit 2 Cycle 20 COLR is valid only for operation from BOC to MOC. MOC (Middle Of Cycle) is defined as a cycle exposure of 4,975 MWd/MTU.</p>
2	ALL	<p>The U2C20 COLR is revised to include licensing analyses results for the full cycle of U2C20 operation.</p> <p>Changes are made to the following figures: 5.2-1 to 5.2-10, 6.2-3, 6.2-5, 6.2-7, 6.2-9, and 8.2-2 to 8.2-11. Changes to the thermal limits are limited to the following figures: 5.2-4, 5.2-8, 6.2-3, 6.2-5, 6.2-7, 6.2-9, 8.2-5, and 8.2-9. Only the captions were changed for the remaining figures (5.2-1 to 5.2-3, 5.2-5 to 5.2-7, 5.2-9, 5.2-10, 8.2-2 to 8.2-4, 8.2-6 to 8.2-8, 8.2-10, and 8.2-11).</p> <p>Revision 2 of the Unit 2 Cycle 20 COLR is valid for operation from BOC to EOC.</p>
3	ALL	<p>The U2C20 COLR is revised to include the updated licensing analyses from Framatome with revised operating limits (CR-2020-15813) and new limits using a new set of Optimal Scram Insertion Times from MOC to EOC (AR-2020-15255).</p> <p>New figures are added: 5.2-11, 5.2-12, 6.2-10, and 6.2-11. Changes are made to the following figures: 5.2-4, and 6.2-1. Table 5.3-1 has been changed for new scram times.</p> <p>Revision 3 of the Unit 2 Cycle 20 COLR includes fuel thermal operating limits valid from BOC to EOC and adds exposure-dependent limits valid from MOC to EOC, where MOC is a cycle exposure of 16,876.9 MWd/MTU.</p>

**SUSQUEHANNA STEAM ELECTRIC STATION**  
**Unit 2 Cycle 20**  
**CORE OPERATING LIMITS REPORT**

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## **1.0 INTRODUCTION**

This CORE OPERATING LIMITS REPORT for Susquehanna Unit 2 Cycle 20 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<sub>f</sub> is a multiplier applied to the LHGR limit when operating at less than 108 Mlbm/hr core flow. The LHGRFAC<sub>f</sub> 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<sub>p</sub> is a multiplier applied to the LHGR limit when operating at less than RATED THERMAL POWER. The LHGRFAC<sub>p</sub> 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<sub>P</sub> 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<sub>P</sub> is the OPRM trip setpoint for the peak to average OPRM signal.
- 2.11 F<sub>P</sub> 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**

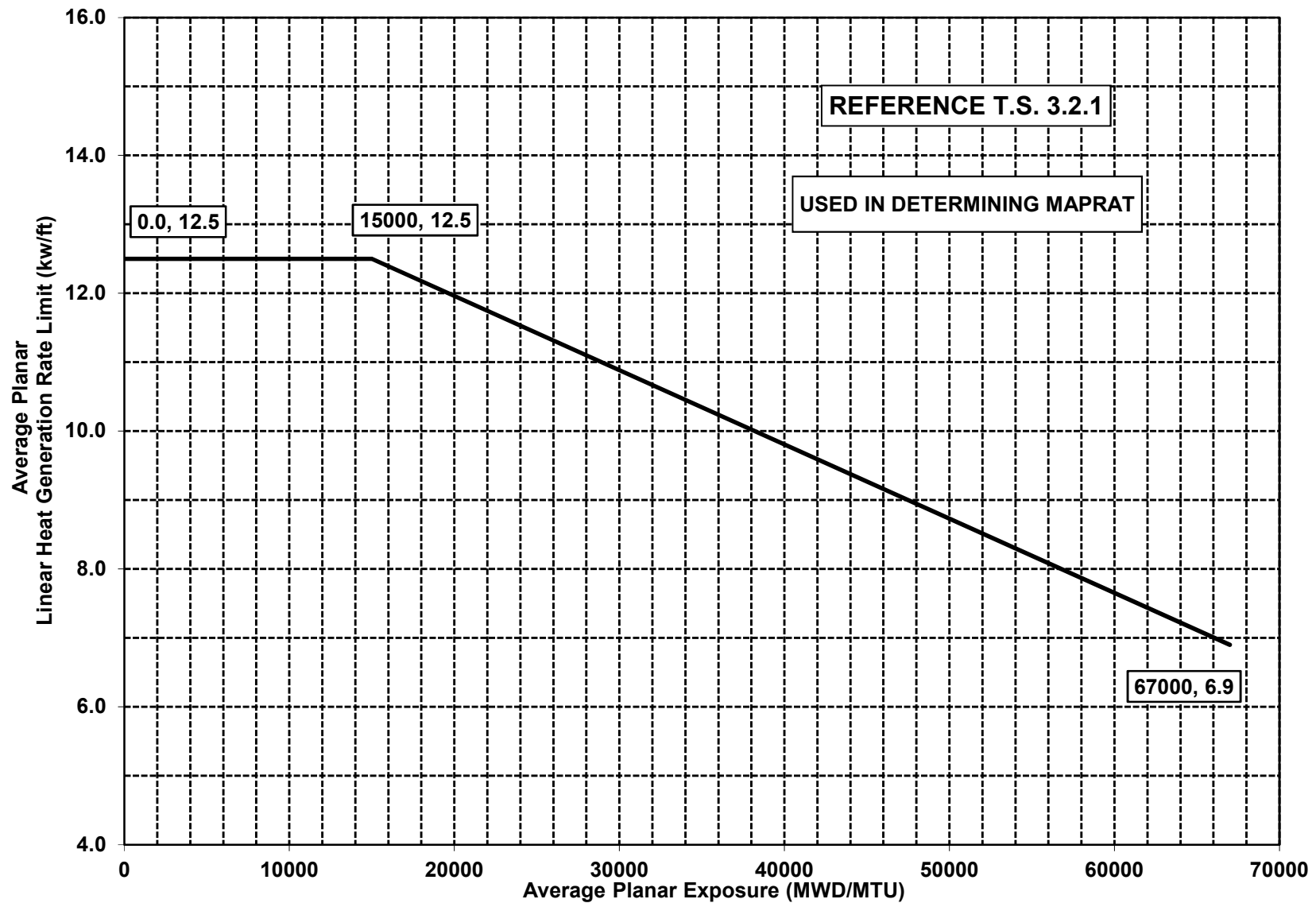
Technical Specification 3.2.1

##### **4.2 Description**

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

The APLHGR limits in Figure 4.2-1 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.

## SSSES UNIT 2 CYCLE 20



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 **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) 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

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

Figure 5.2-9: Flow-Dependent MCPR value determined from BOC to EOC

Figure 5.2-10: Power-Dependent MCPR value determined from BOC to EOC

f) Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable – Optimal Scram Insertion Time

Figure 5.2-11: Flow-Dependent MCPR value determined from MOC to EOC

Figure 5.2-12: Power-Dependent MCPR value determined from MOC to EOC

The MCPR limits in Figures 5.2-1 through 5.2-12 are valid for Two Loop operation.

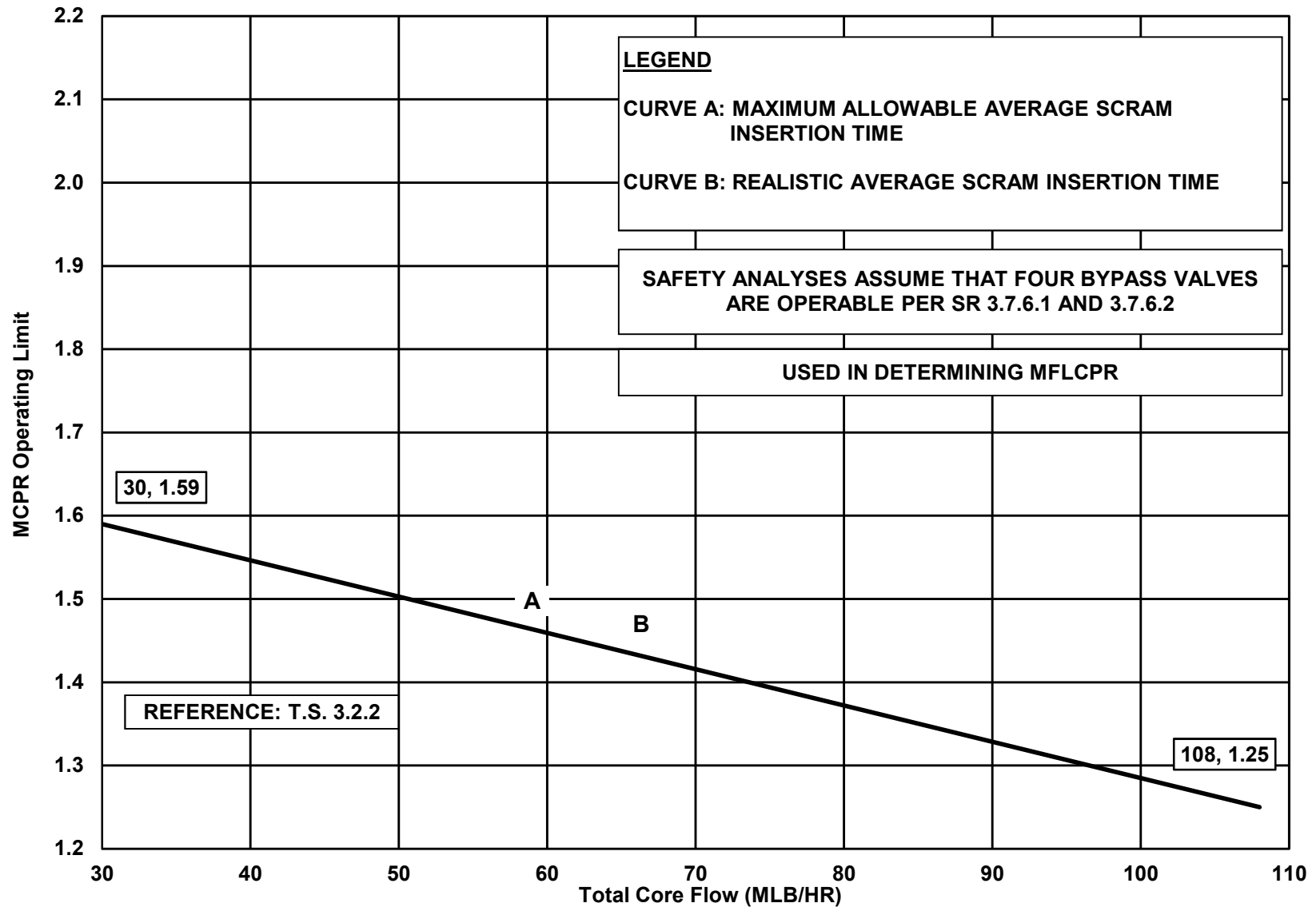
The MCPR limits for Single Loop operation are provided in Section 8.0.

### 5.3 Average Scram Time Fraction

If the average measured scram times are greater than the Optimal Scram times listed in Table 5.3-1 then the MCPR operating limits corresponding to the Realistic Average Scram Insertion Time must be implemented. 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.

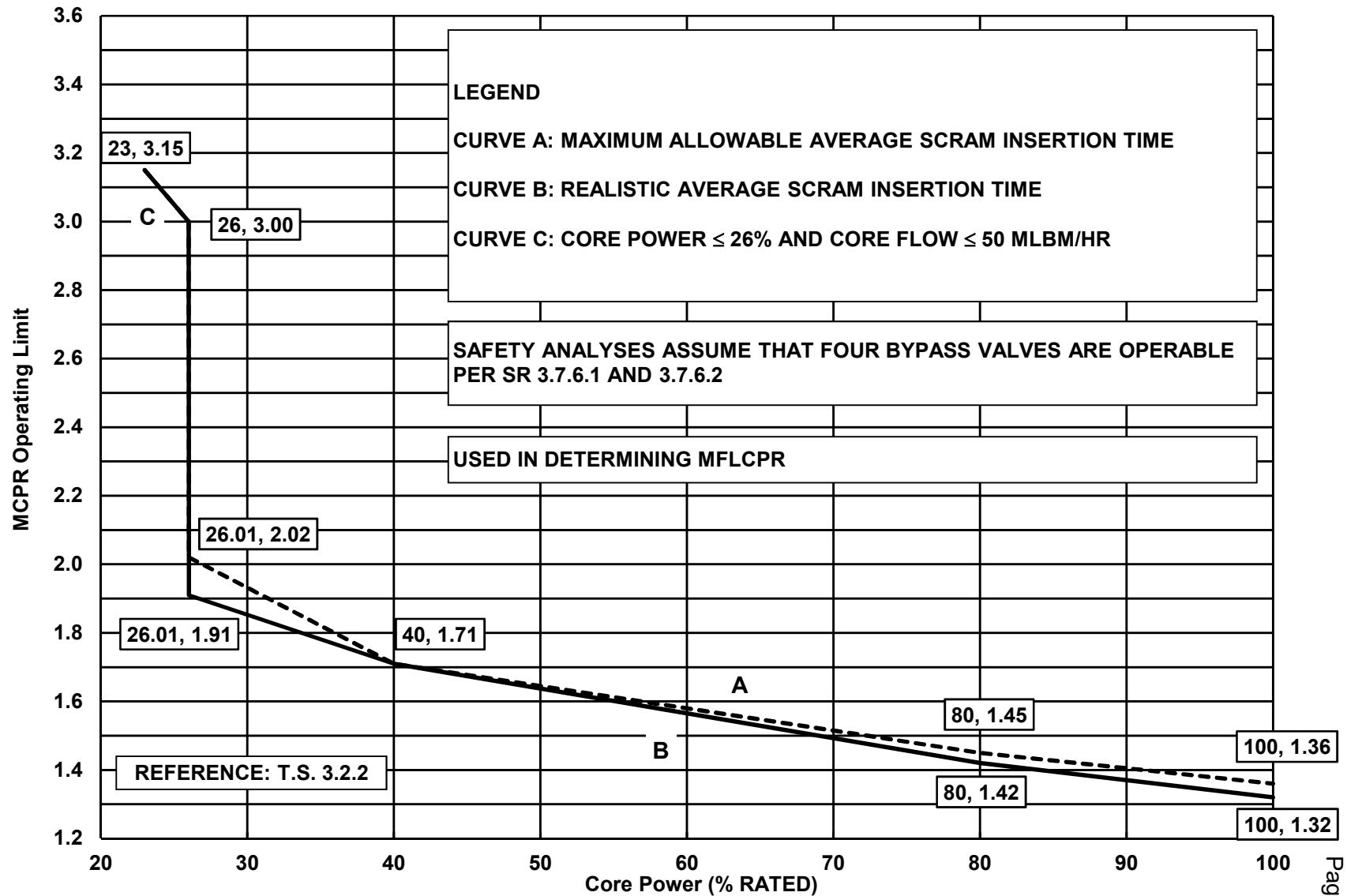
# **Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable**

## SSS UNIT 2 CYCLE 20



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

## SSS UNIT 2 CYCLE 20

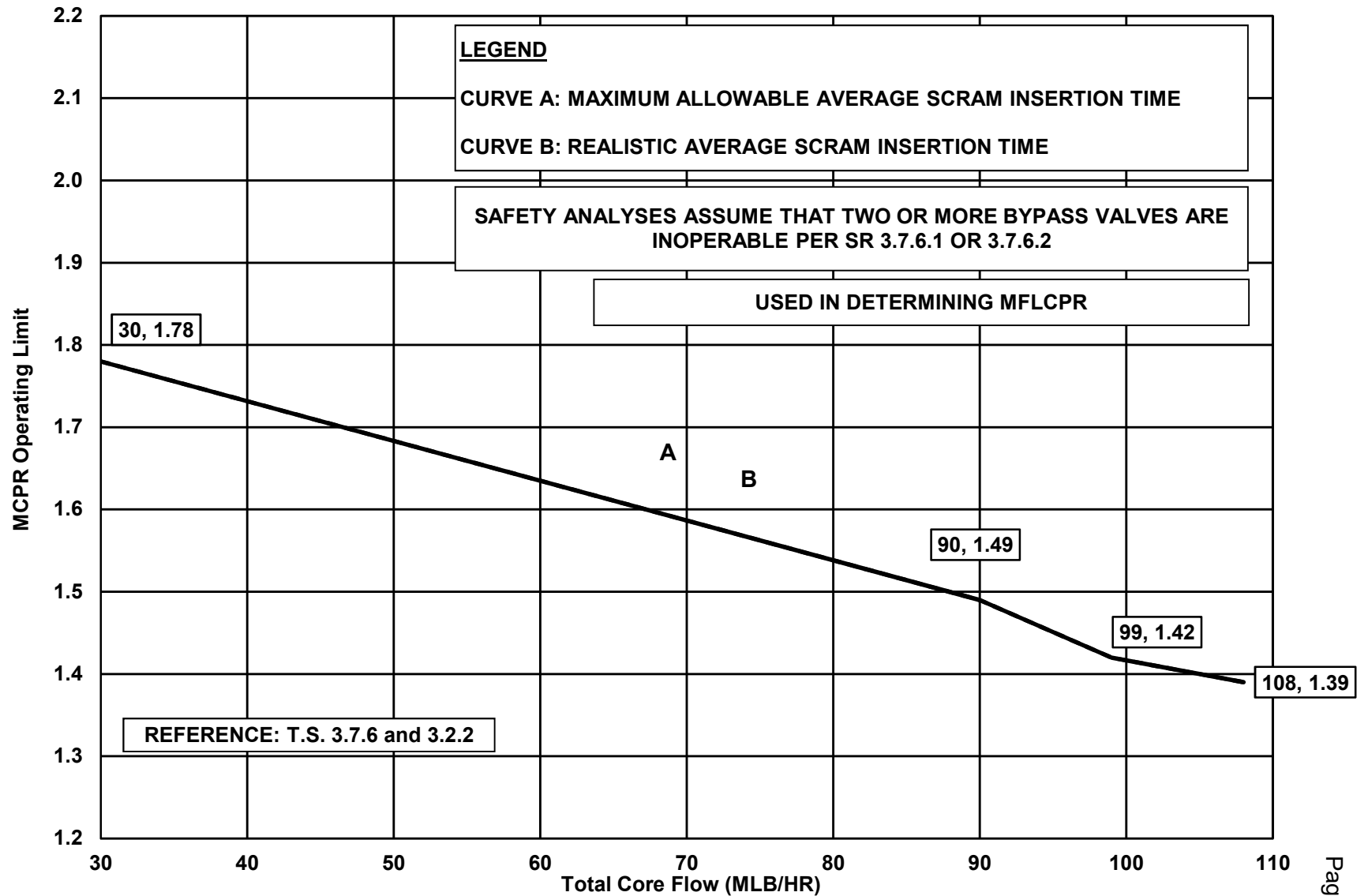


MCPR OPERATING LIMIT VERSUS CORE POWER  
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE  
 TWO LOOP OPERATION (BOC TO EOC)  
 FIGURE 5.2-2

## **Main Turbine Bypass Inoperable**

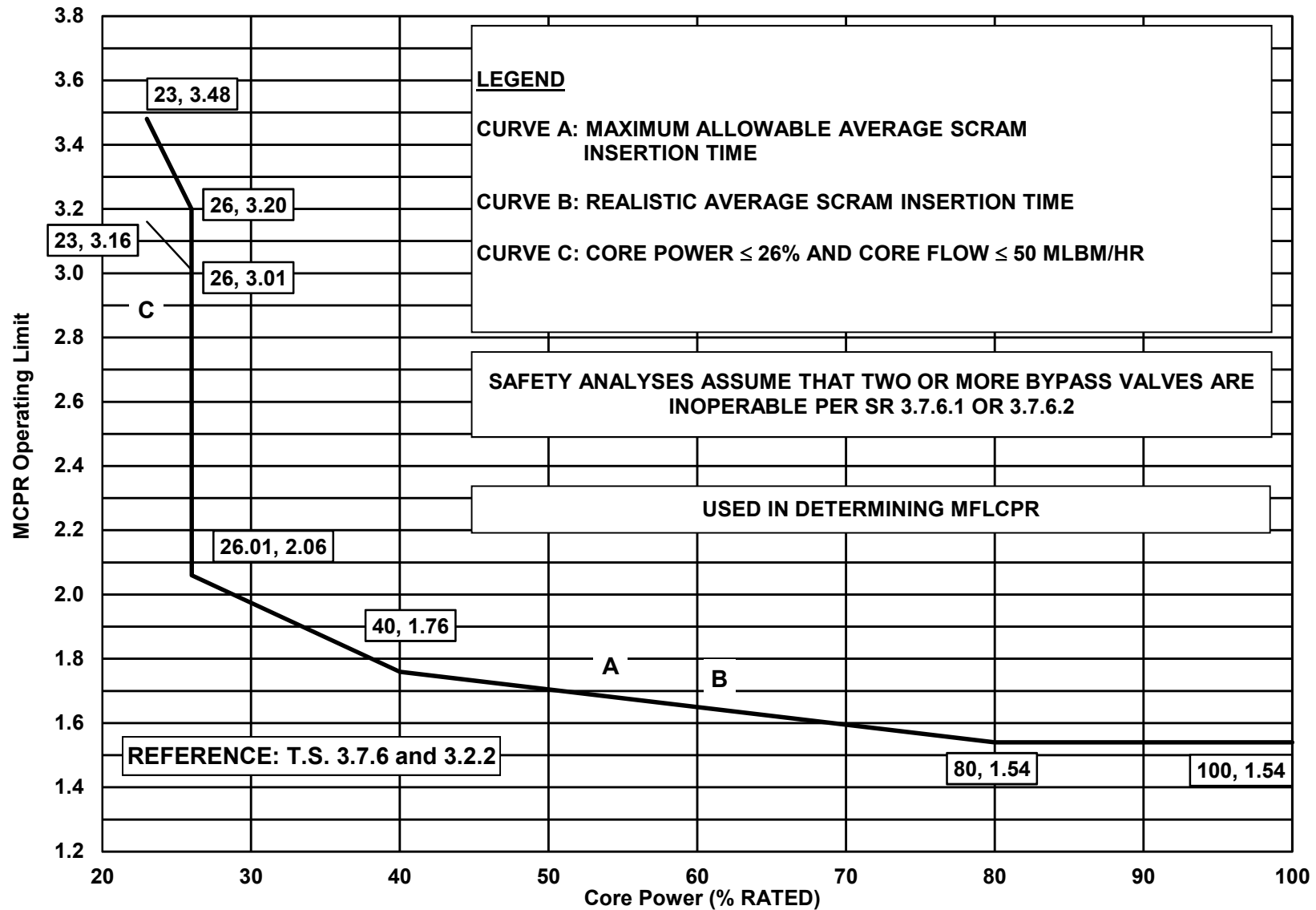


## SSS UNIT 2 CYCLE 20



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

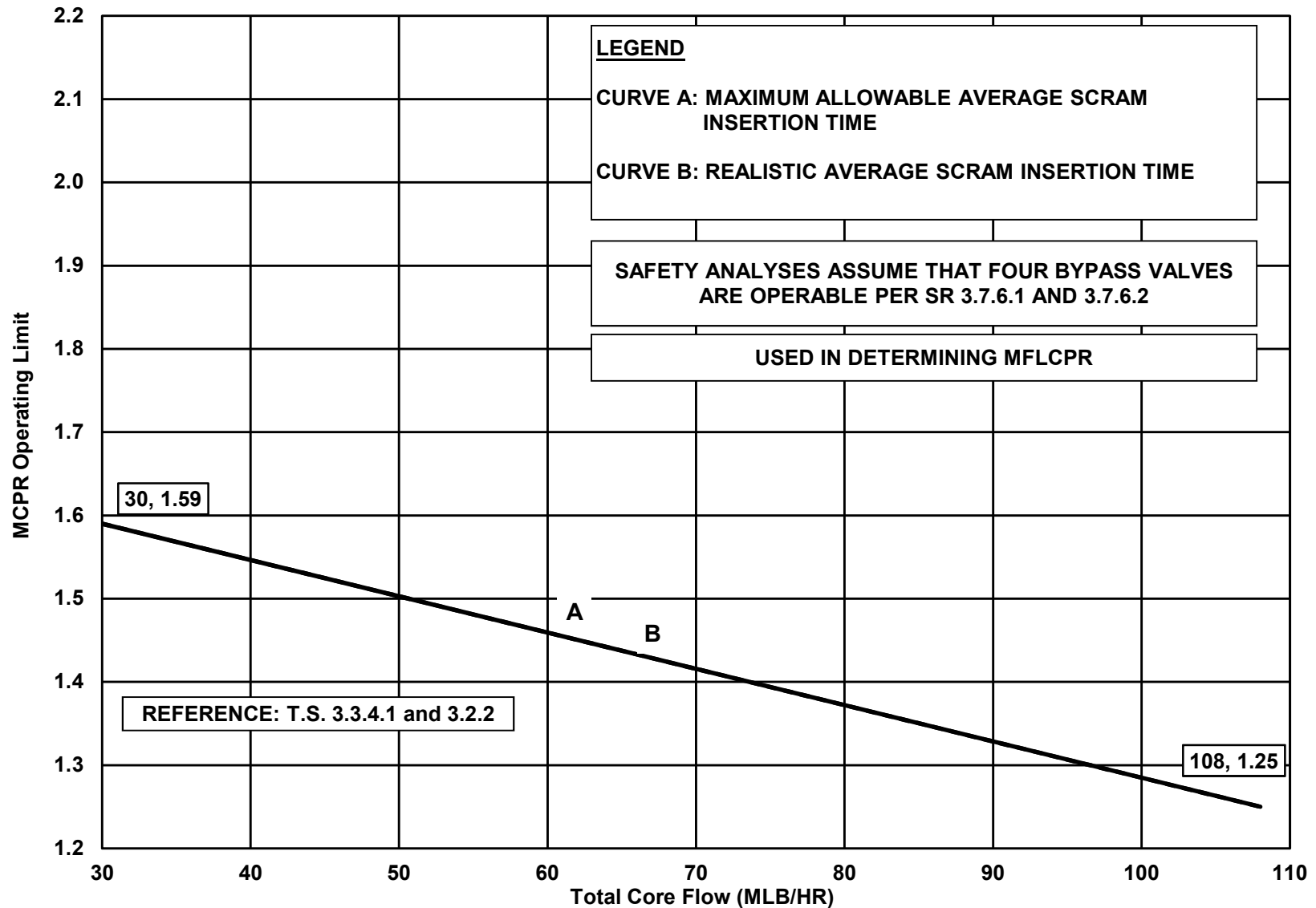
## SSS UNIT 2 CYCLE 20



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

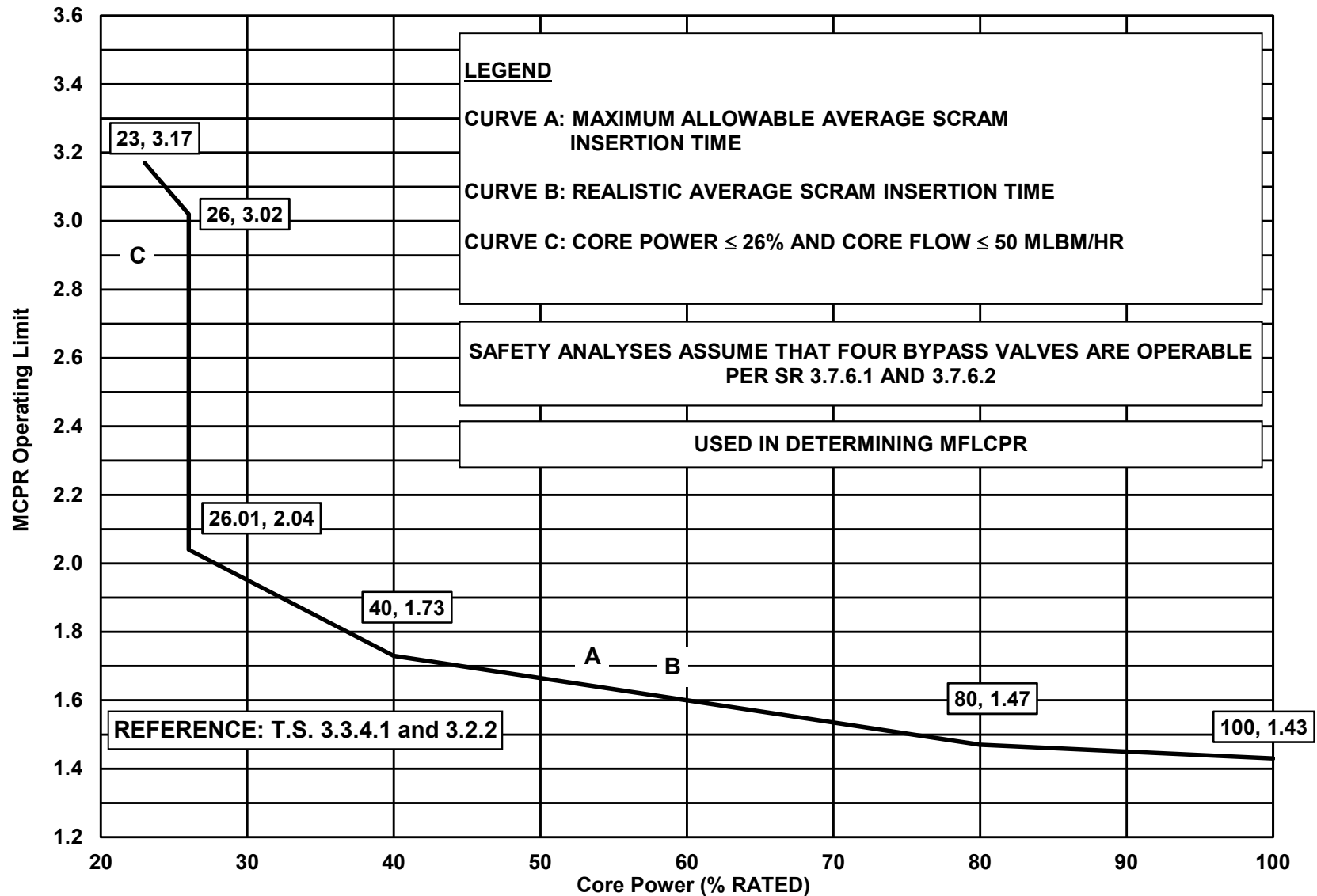
# **EOC-RPT Inoperable**

## SSS UNIT 2 CYCLE 20



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

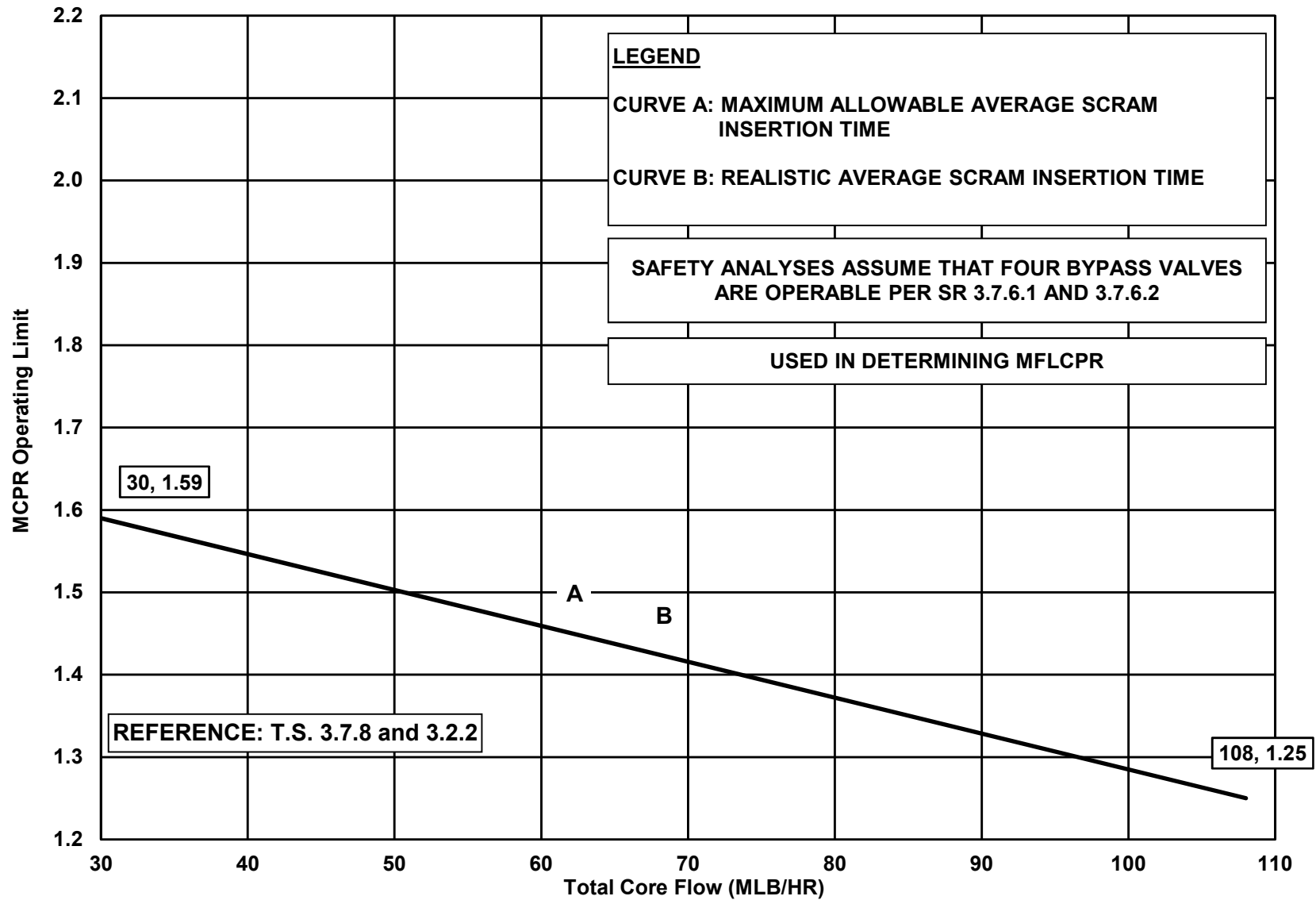
## SSS UNIT 2 CYCLE 20



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

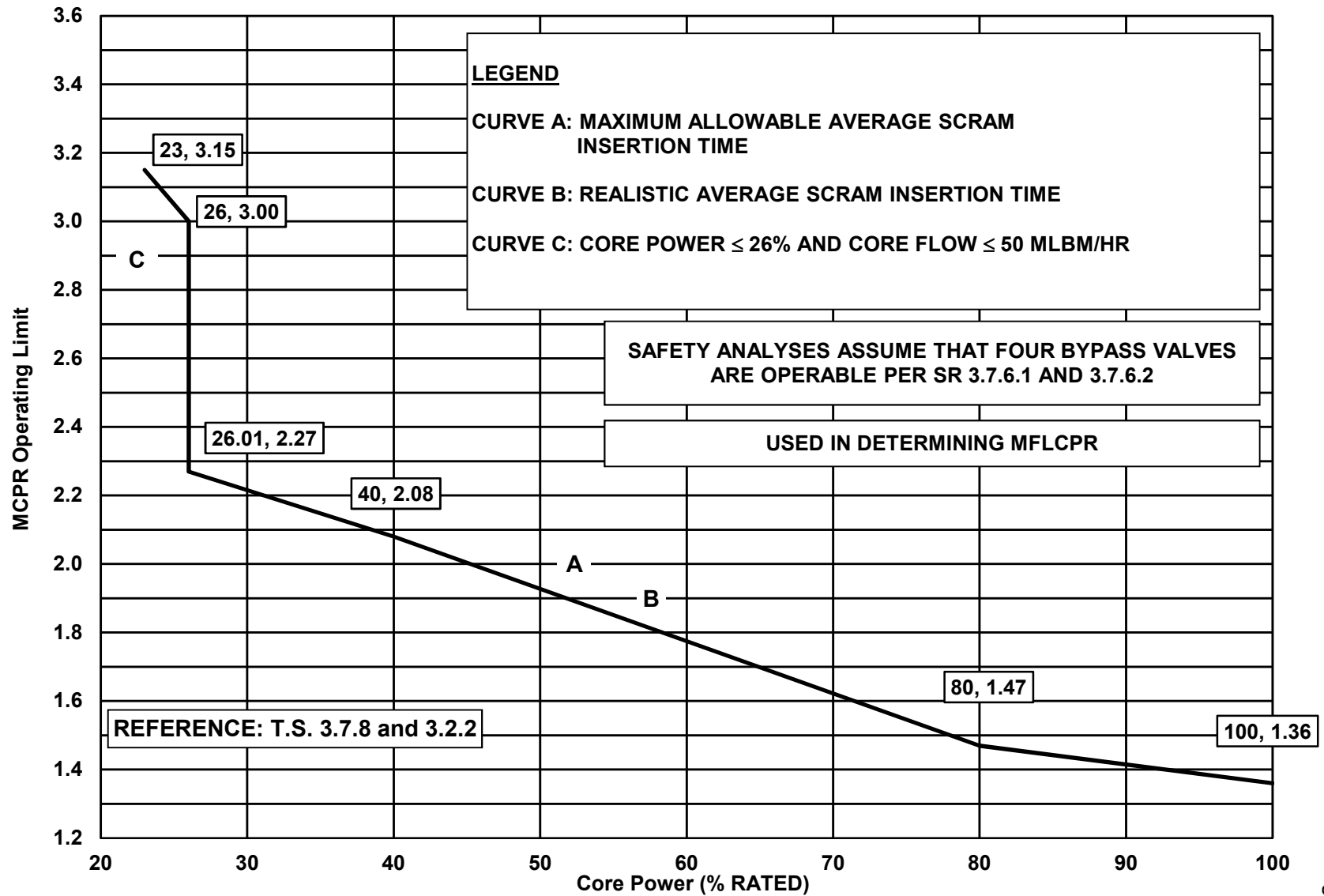
## **Backup Pressure Regulator Inoperable**

## SSS UNIT 2 CYCLE 20



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

## SSS UNIT 2 CYCLE 20

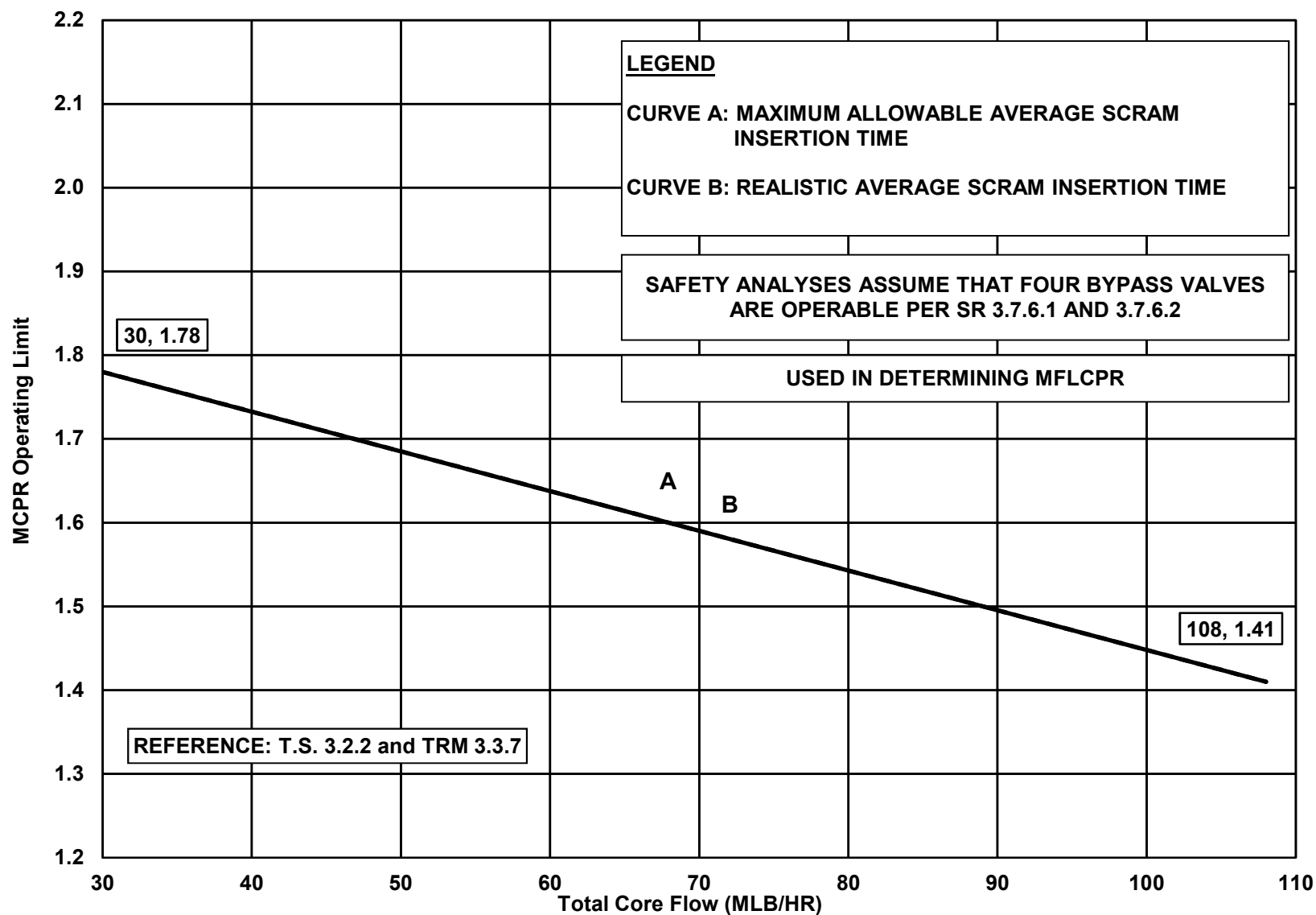


MCPR OPERATING LIMIT VERSUS CORE POWER  
 BACKUP PRESSURE REGULATOR INOPERABLE  
 TWO LOOP OPERATION (BOC TO EOC)  
 FIGURE 5.2-8



## **One TSV or TCV Closed**

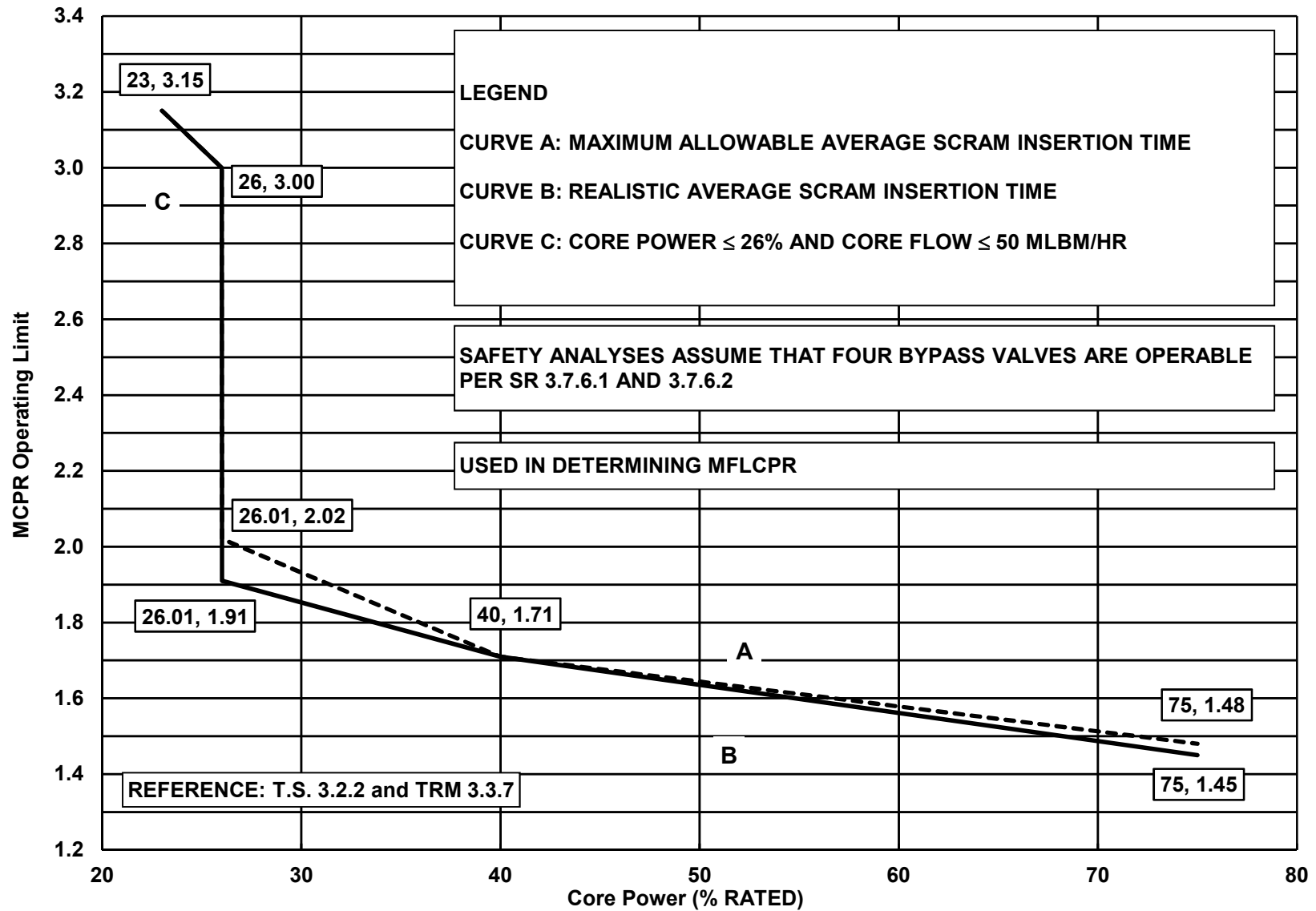
## SSS UNIT 2 CYCLE 20



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

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

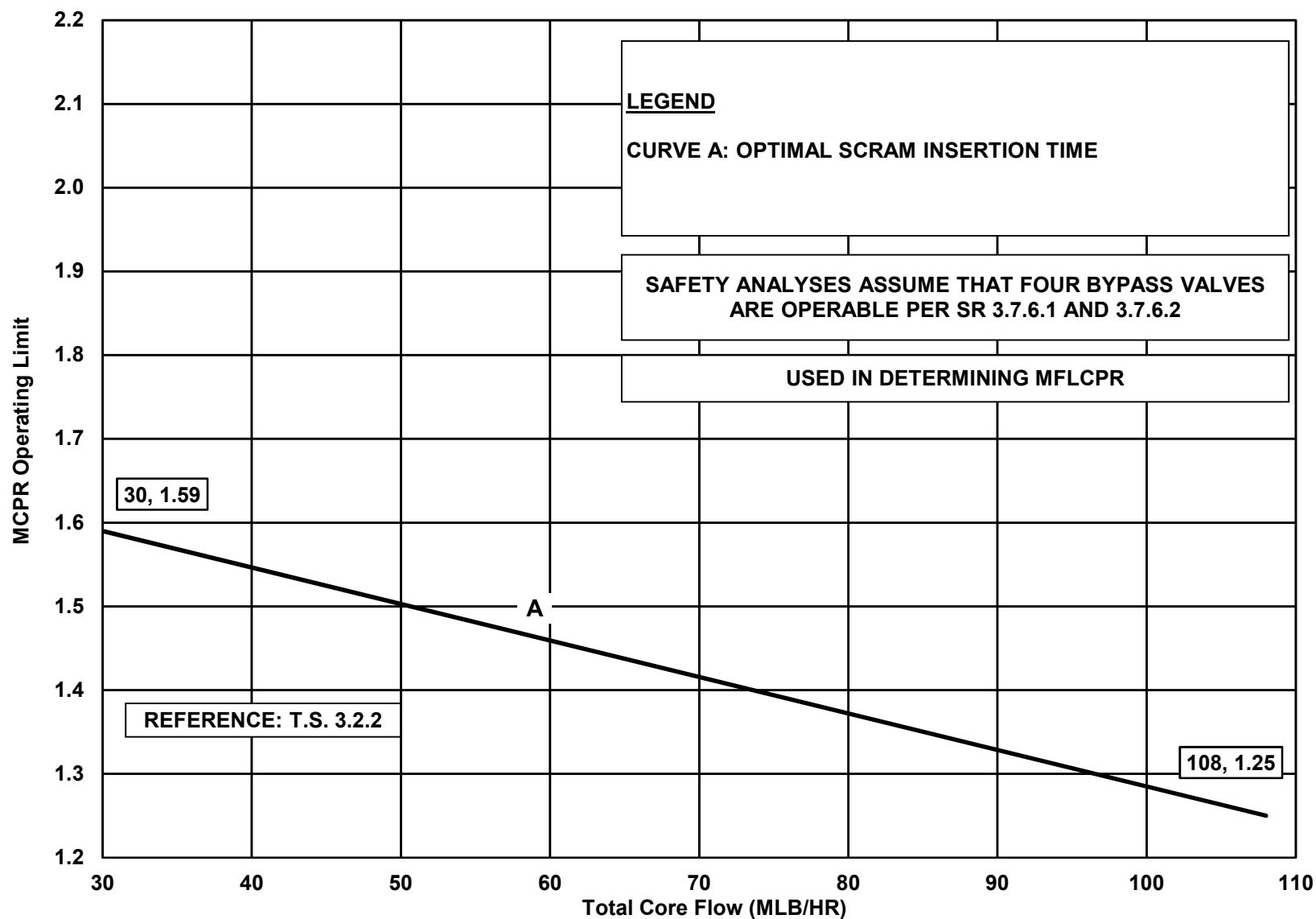
## SSS UNIT 2 CYCLE 20



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

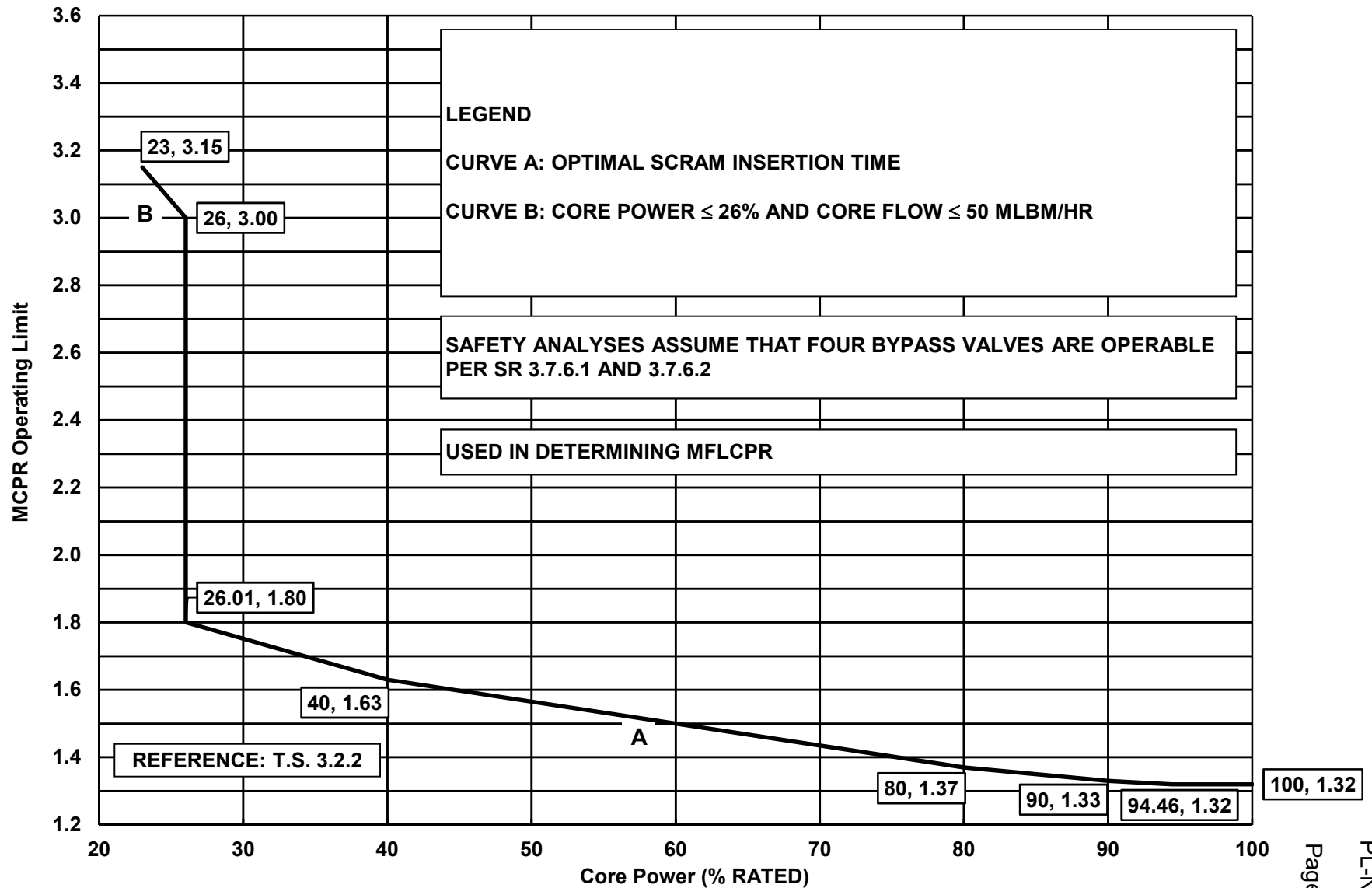
**Main Turbine Bypass / EOC-RPT /  
Backup Pressure Regulator  
Operable – Optimal Scram Insertion  
Time**

## SSS UNIT 2 CYCLE 20



MCPR OPERATING LIMIT VERSUS TOTAL CORE FLOW  
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE  
TWO LOOP OPERATION (MOC TO EOC)  
OPTIMAL SCRAM INSERTION TIME  
FIGURE 5.2-11

## SSS UNIT 2 CYCLE 20



MCPR OPERATING LIMIT VERSUS CORE POWER  
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE  
 TWO LOOP OPERATION (MOC TO EOC)  
 OPTIMAL SCRAM INSERTION TIME  
 FIGURE 5.2-12

**Table 5.3-1****Average Scram Time Fraction Table For Use With Scram Time Dependent  
MCPR Operating Limits**

<b>Control Rod Position</b>	<b>Average Scram Time to Position (seconds)</b>		
<b>45</b>	<b>0.310</b>	<b>0.470</b>	<b>0.520</b>
<b>39</b>	<b>0.620</b>	<b>0.630</b>	<b>0.860</b>
<b>25</b>	<b>1.380</b>	<b>1.500</b>	<b>1.910</b>
<b>5</b>	<b>2.550</b>	<b>2.700</b>	<b>3.440</b>
<b>Average Scram Insertion Time</b>	<b>Optimal</b>	<b>Realistic</b>	<b>Maximum Allowable</b>

## 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 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, 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 6.2-2: 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

c) EOC-RPT or Backup Pressure Regulator Inoperable

Figure 6.2-6: Flow-Dependent LHGR Limit Multiplier

Figure 6.2-7: Power-Dependent LHGR Limit Multiplier

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

Figure 6.2-8: Flow-Dependent LHGR Limit Multiplier

Figure 6.2-9: Power-Dependent LHGR Limit Multiplier

e) Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable – Optimal Scram Insertion Time

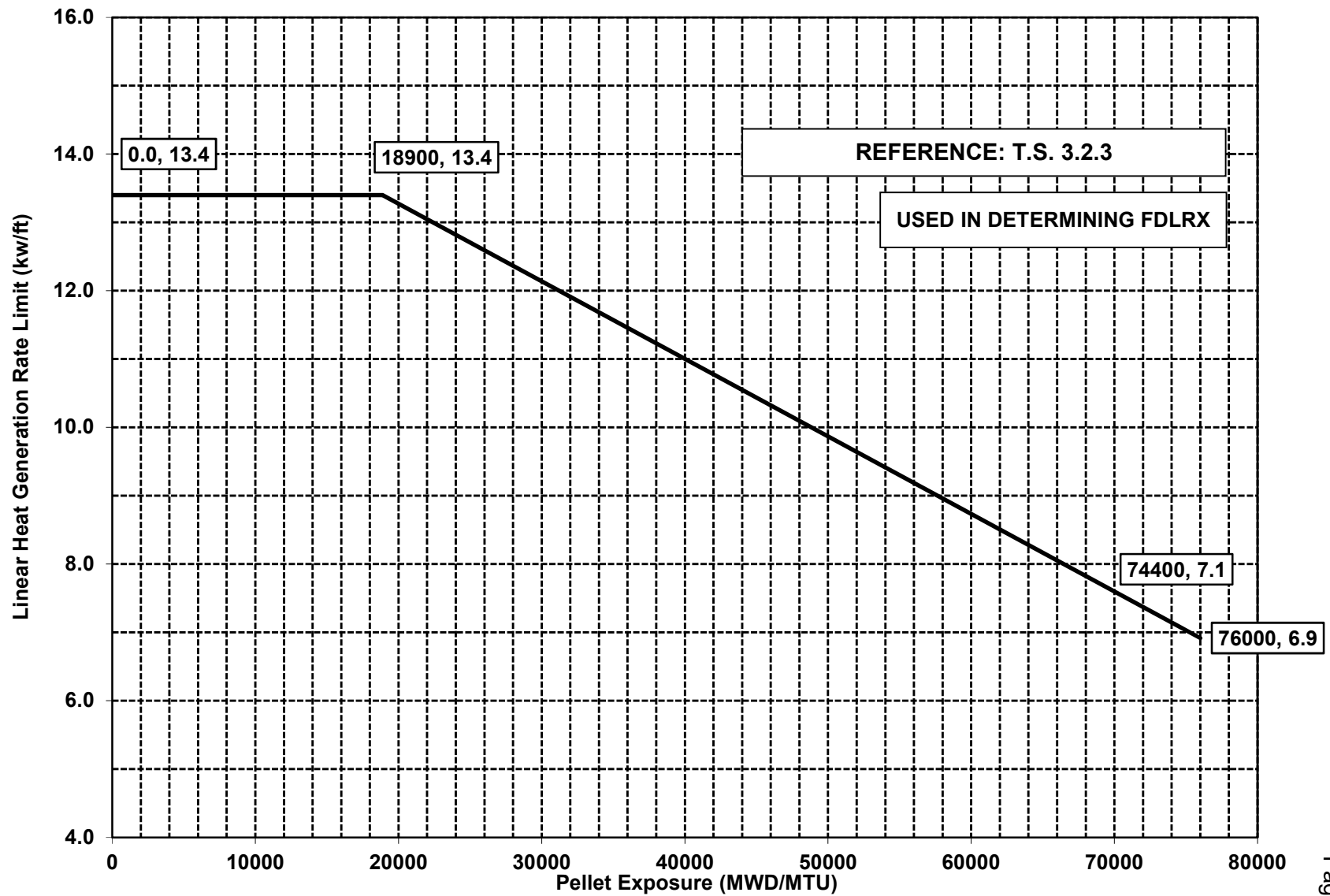
Figure 6.2-10: Flow-Dependent LHGR Limit Multiplier

Figure 6.2-11: Power-Dependent LHGR Limit Multiplier



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

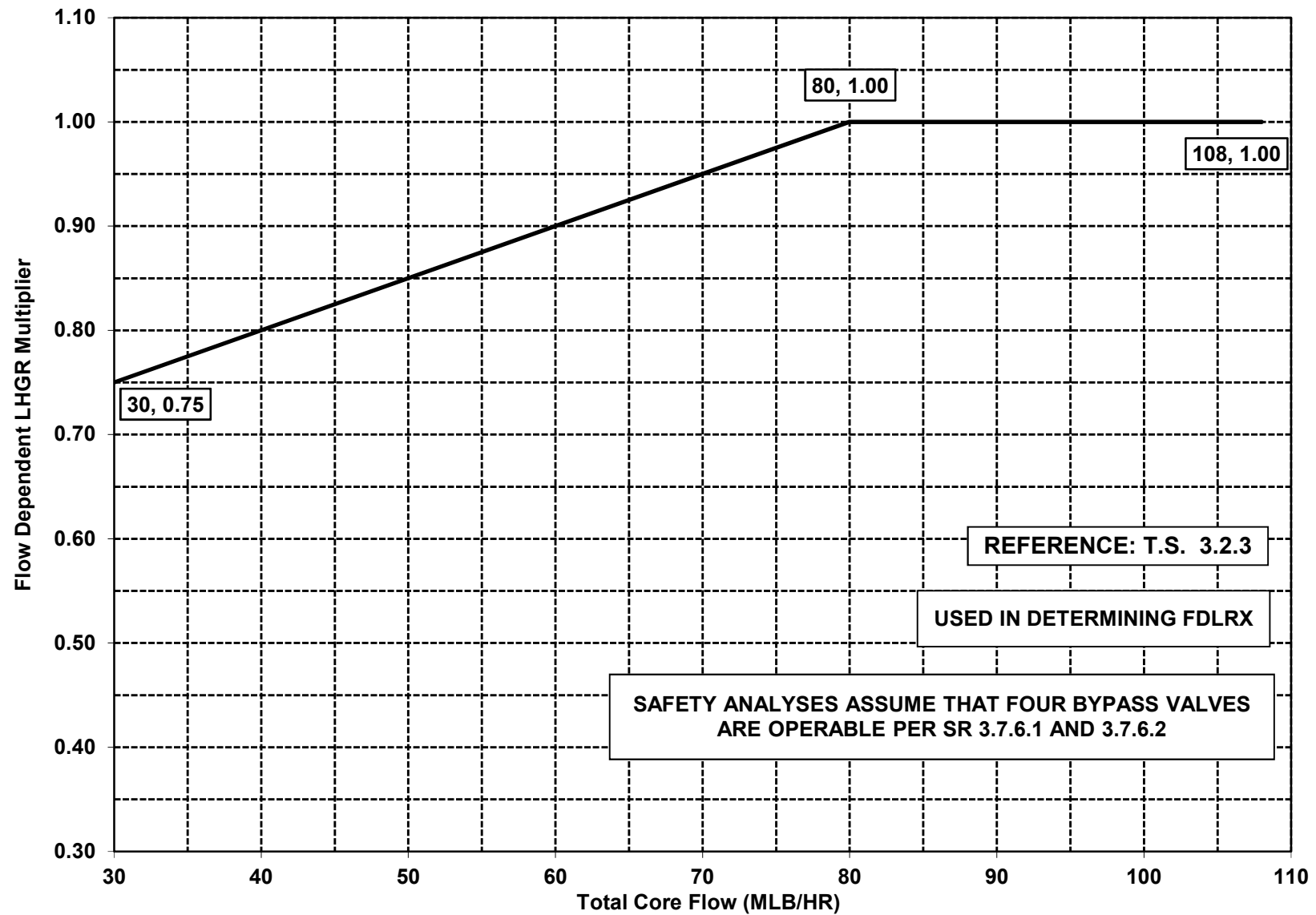
## SSSES UNIT 2 CYCLE 20



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

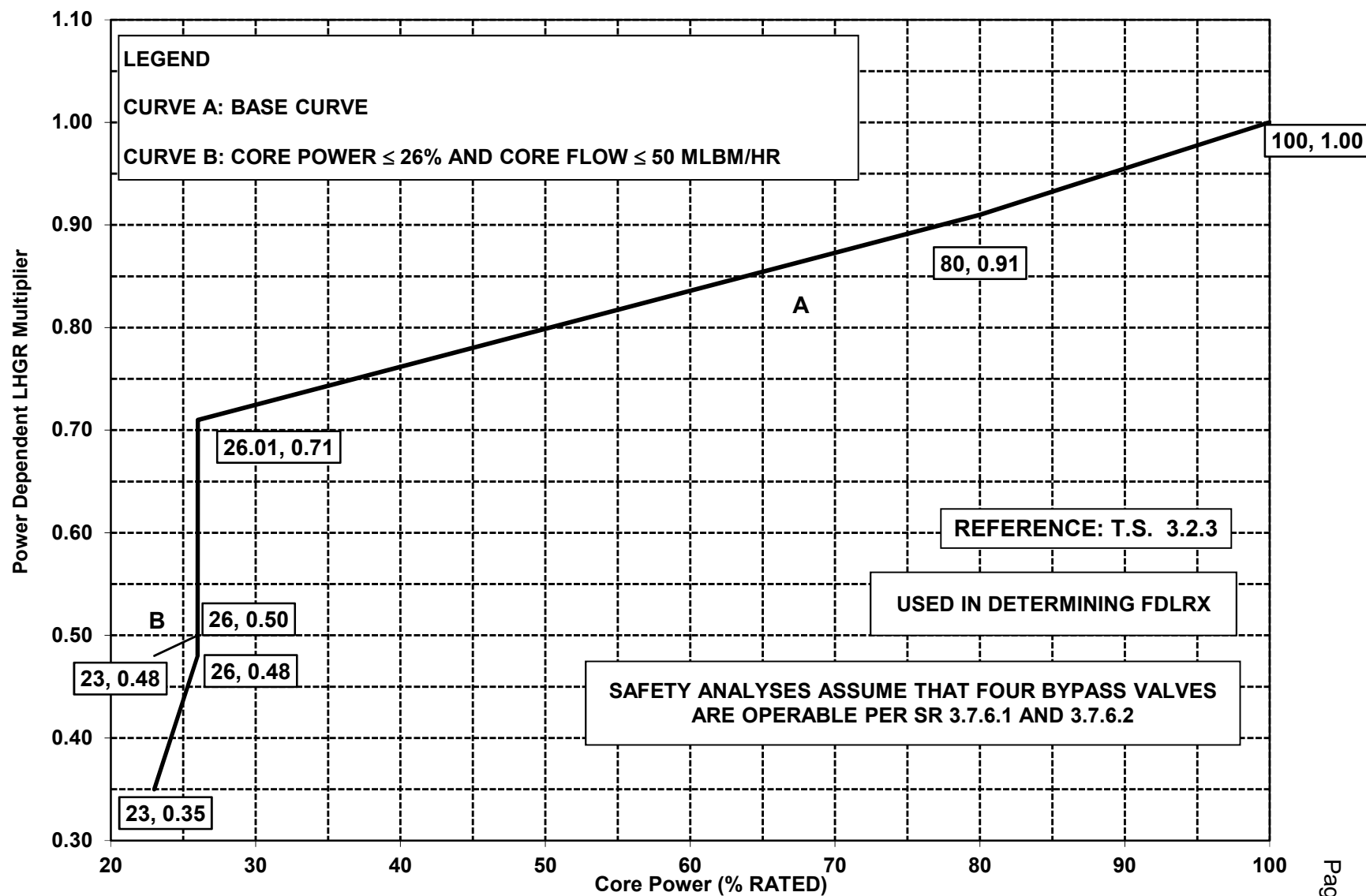
# **Main Turbine Bypass / EOC-RPT / Backup Pressure Regulator Operable**

## SSS UNIT 2 CYCLE 20



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

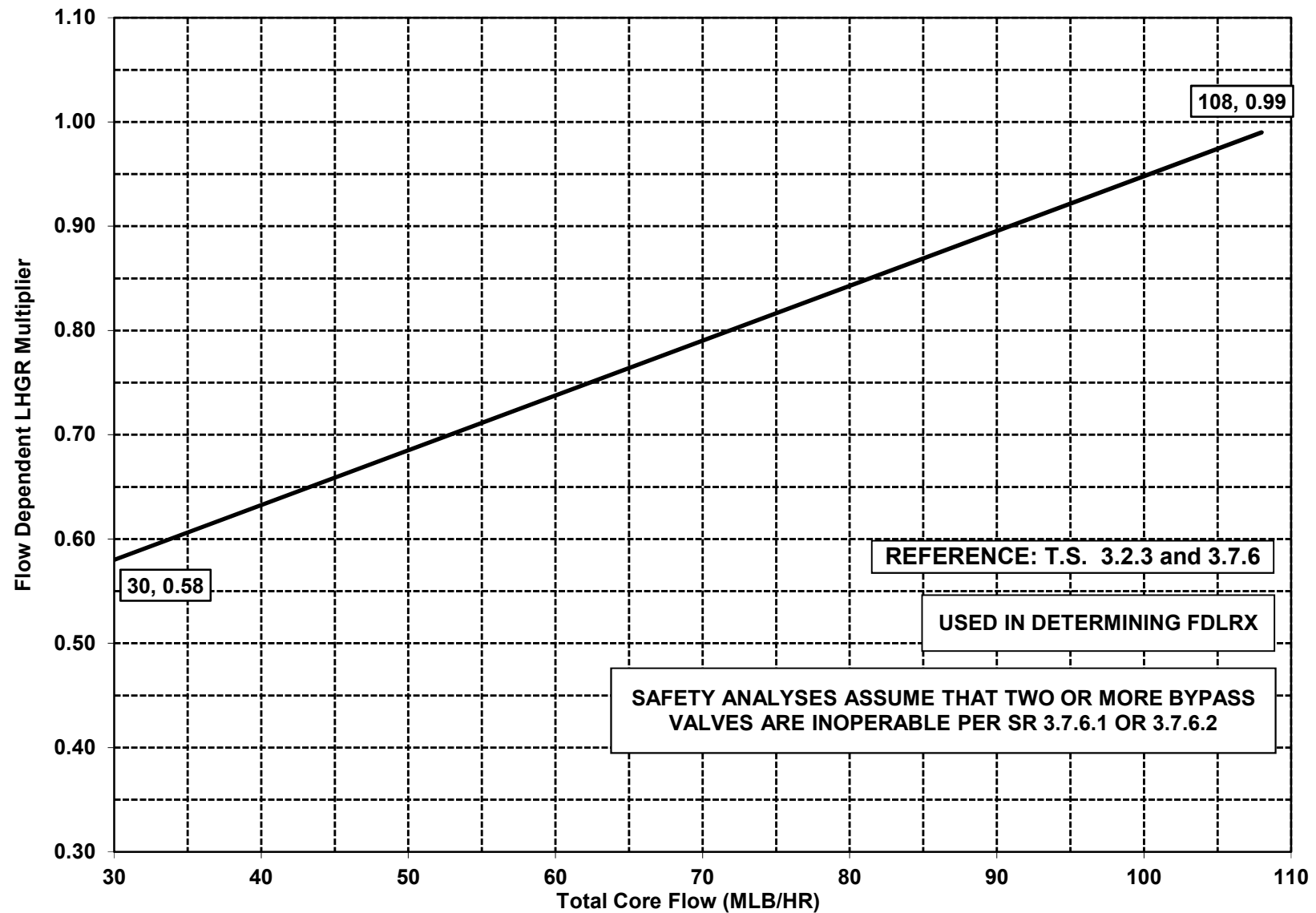
## SSS UNIT 2 CYCLE 20



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

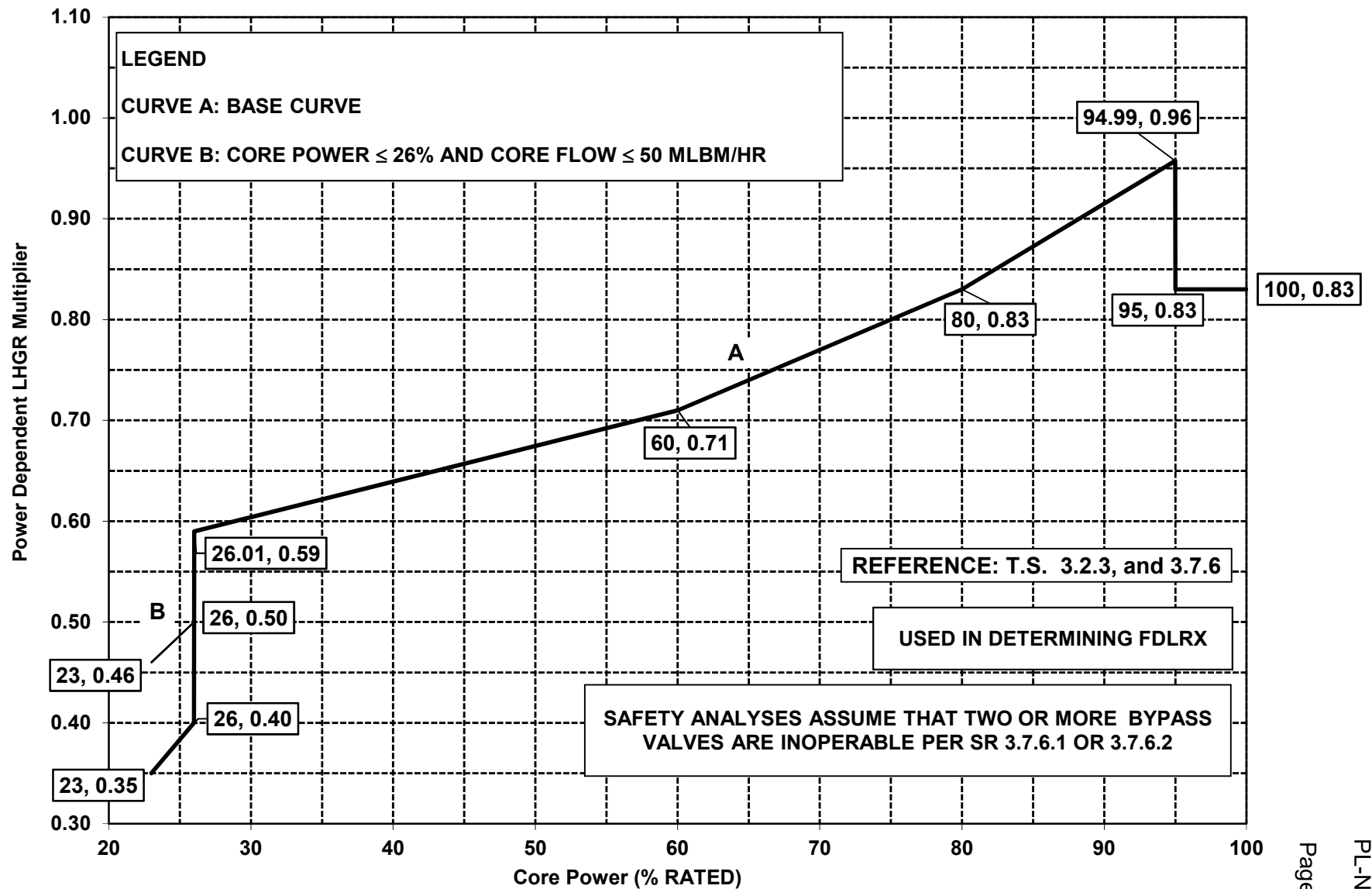
## **Main Turbine Bypass Inoperable**

## SSS UNIT 2 CYCLE 20



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

## SSS UNIT 2 CYCLE 20

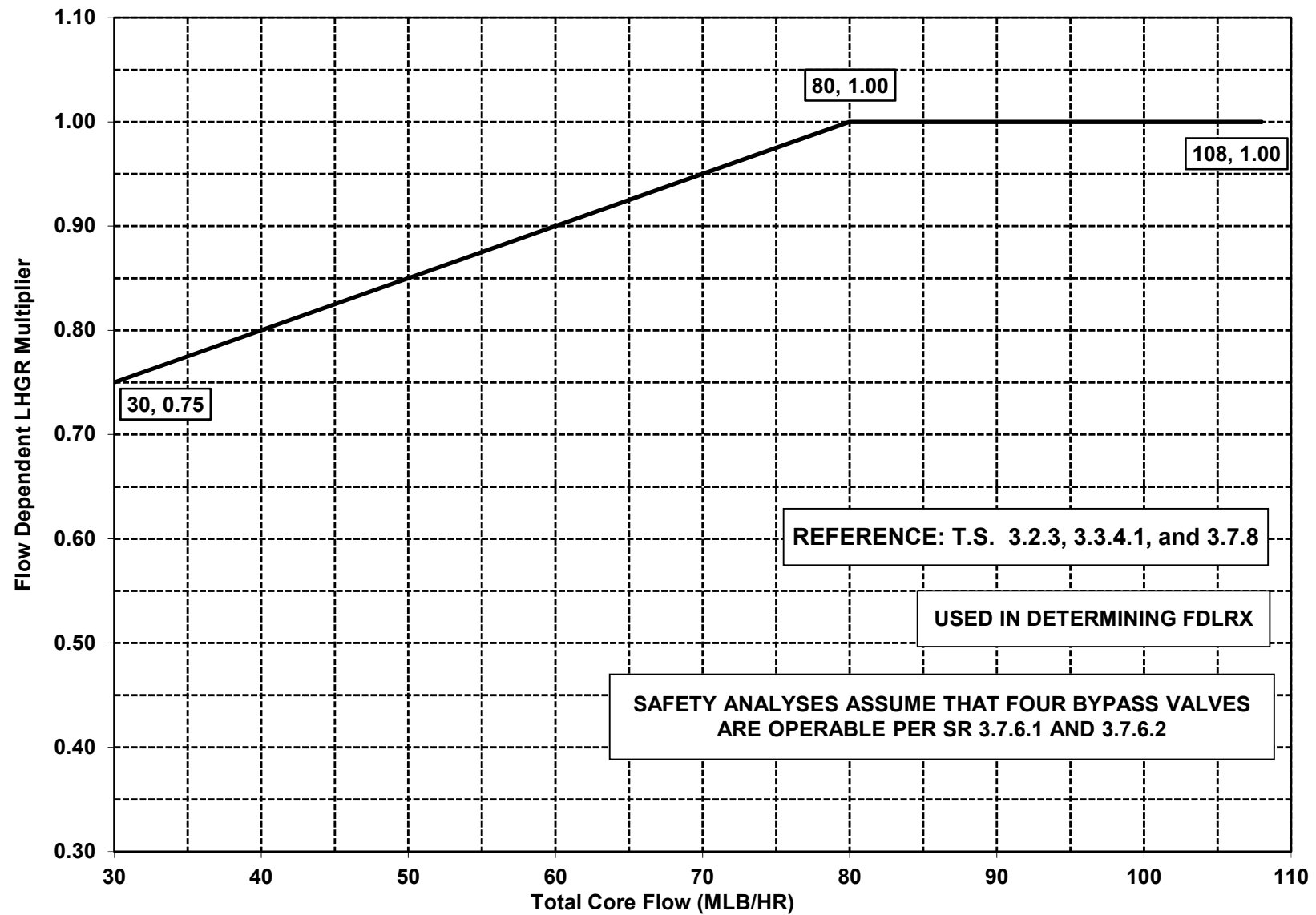


POWER DEPENDENT LHGR LIMIT MULTIPLIER  
MAIN TURBINE BYPASS INOPERABLE  
ATRIUM™-10 FUEL  
FIGURE 6.2-5



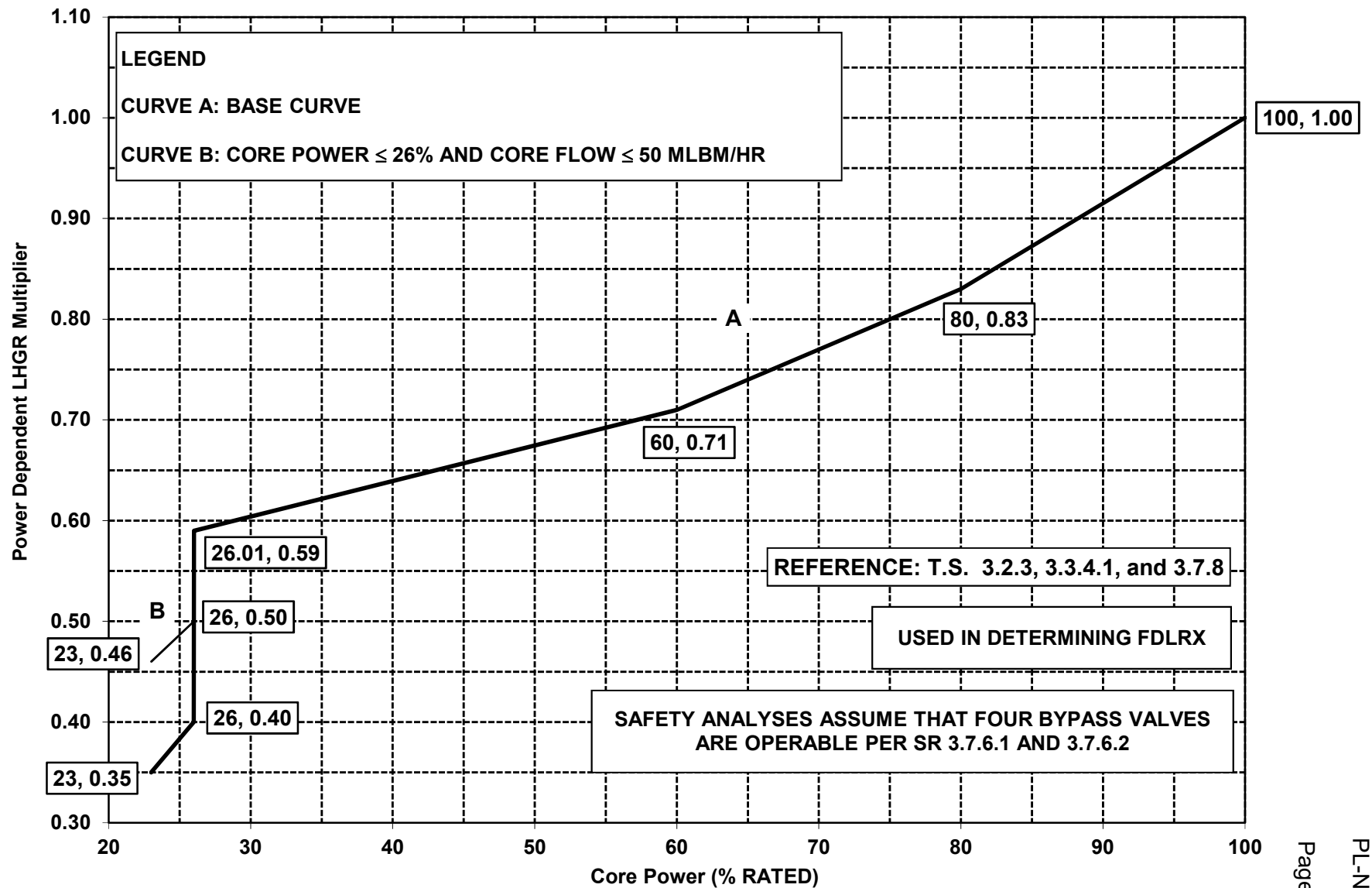
## **EOC-RPT or Backup Pressure Regulator Inoperable**

## SSS UNIT 2 CYCLE 20



FLOW DEPENDENT LHGR LIMIT MULTIPLIER  
EOC-RPT OR BACKUP PRESSURE REGULATOR INOPERABLE  
ATRIUM™-10 FUEL  
FIGURE 6.2-6

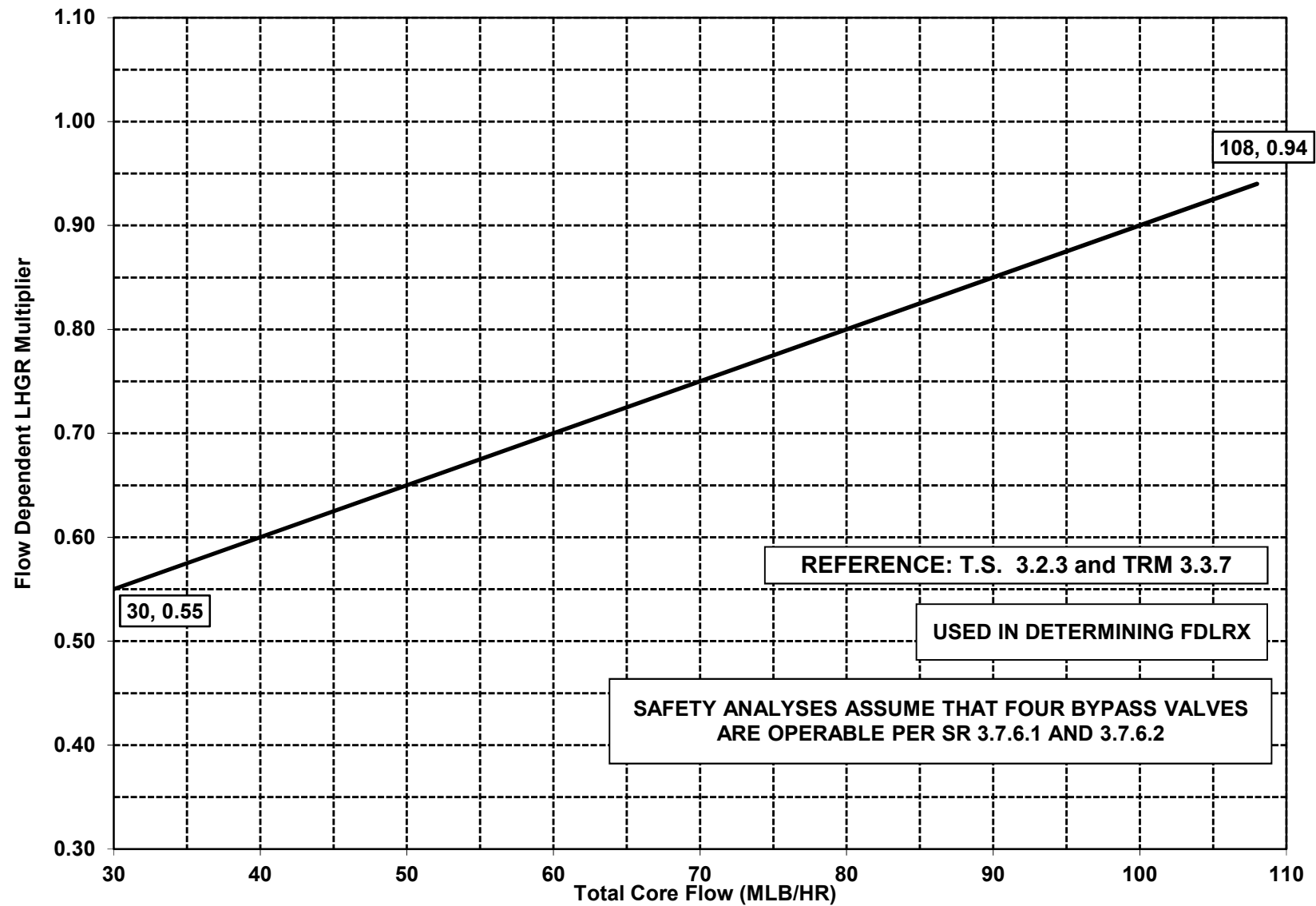
## SSSES UNIT 2 CYCLE 20



POWER DEPENDENT LHGR LIMIT MULTIPLIER  
EOC-RPT OR BACKUP PRESSURE REGULATOR INOPERABLE  
ATRIUM™-10 FUEL  
FIGURE 6.2-7

## **One TSV or TCV Closed**

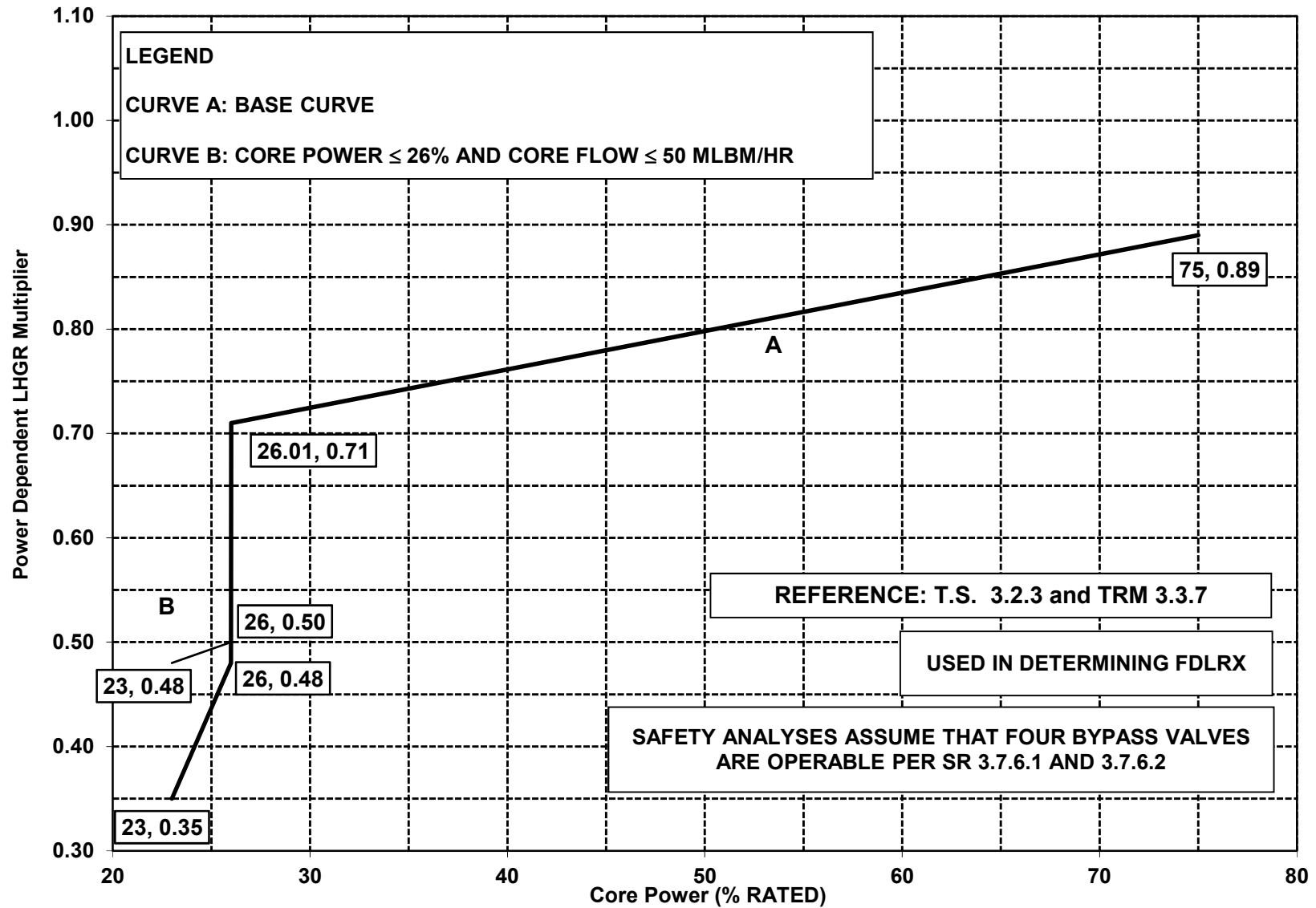
## SSS UNIT 2 CYCLE 20



FLOW DEPENDENT LHGR LIMIT MULTIPLIER  
ONE TSV OR TCV CLOSED\*  
ATRIUM™-10 FUEL  
FIGURE 6.2-8

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

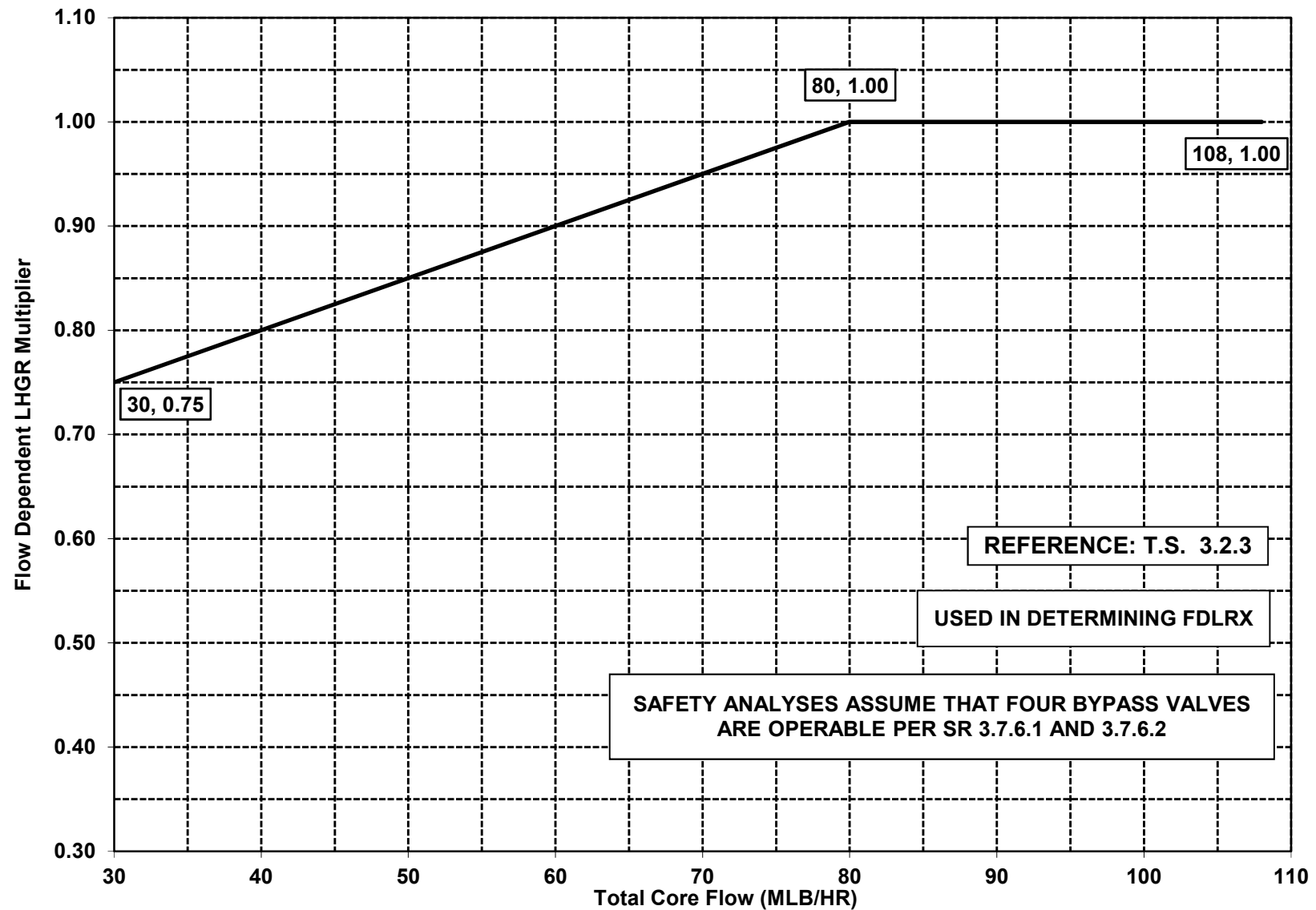
# SSS UNIT 2 CYCLE 20



POWER DEPENDENT LHGR LIMIT MULTIPLIER  
ONE TSV OR TCV CLOSED  
ATRIUM™-10 FUEL  
FIGURE 6.2-9

**Main Turbine Bypass / EOC-RPT /  
Backup Pressure Regulator  
Operable – Optimal Scram Insertion  
Time**

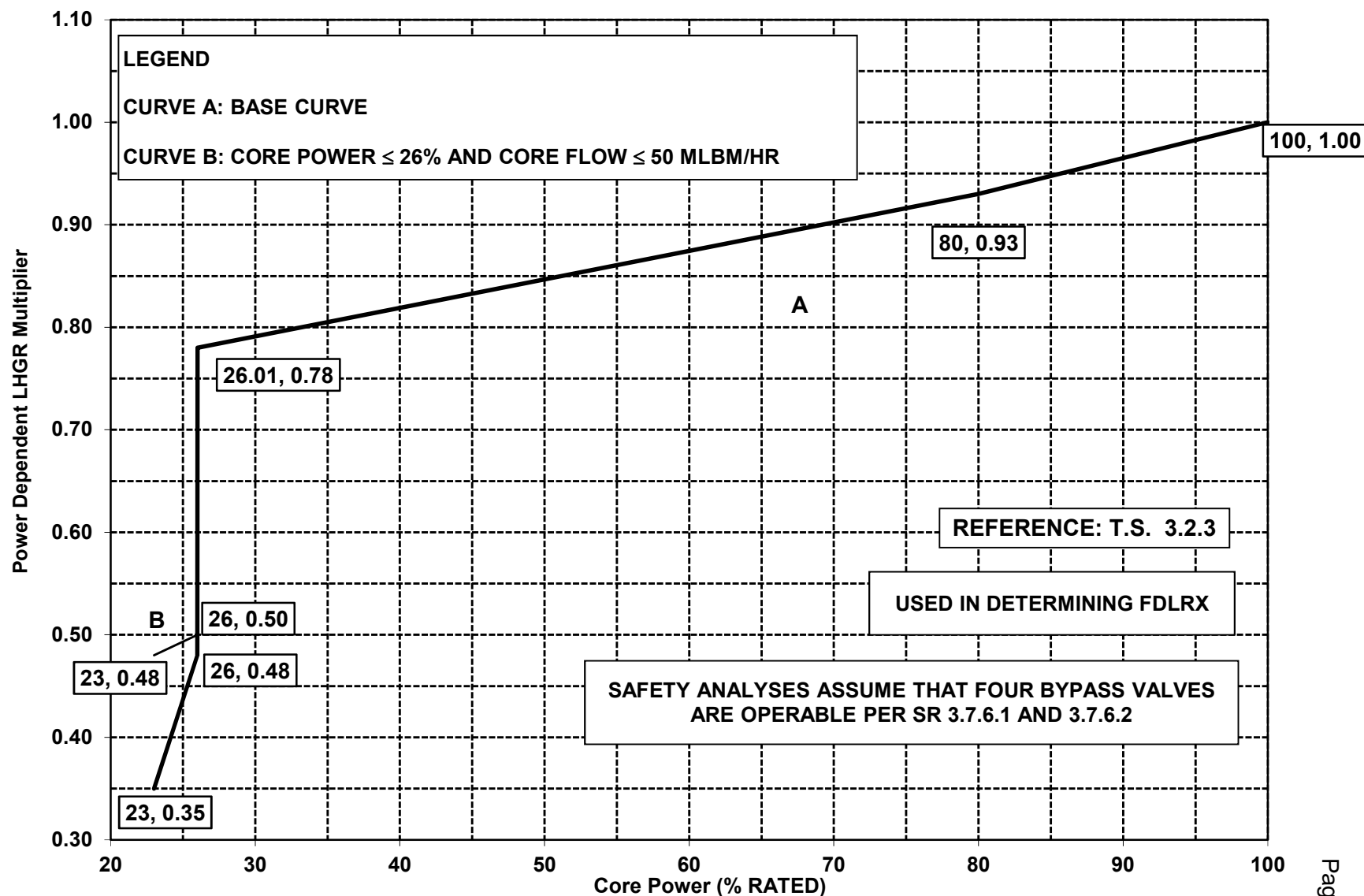
## SSS UNIT 2 CYCLE 20



FLOW DEPENDENT LHGR LIMIT MULTIPLIER  
MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE  
ATRIUM™<sub>10</sub> FUEL  
OPTIMAL SCRAM INSERTION TIME (MOC TO EOC)  
FIGURE 6.2-10



## SSS UNIT 2 CYCLE 20



POWER DEPENDENT LHGR LIMIT MULTIPLIER  
 MAIN TURBINE BYPASS / EOC-RPT / BACKUP PRESSURE REGULATOR OPERABLE  
 ATRIUM™-10 FUEL  
 OPTIMAL SCRAM INSERTION TIME (MOC TO EOC)  
 FIGURE 6.2-11

## 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 <sup>(1)</sup>	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 <sup>(2,3)</sup>
$\geq 28$ and $< 90$	$< 1.76$
$\geq 90$ and $< 95$	$< 1.47$
$\geq 95$	$< 1.68$

- (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.

## 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 8.2-1.

The APLHGR limits in Figure 8.2-1 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) 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

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

Figure 8.2-10: Flow-Dependent MCPR value determined from BOC to EOC

Figure 8.2-11: Power-Dependent MCPR value determined from BOC to EOC

The MCPR limits in Figures 8.2-2 through 8.2-11 are valid only for Single Loop operation.

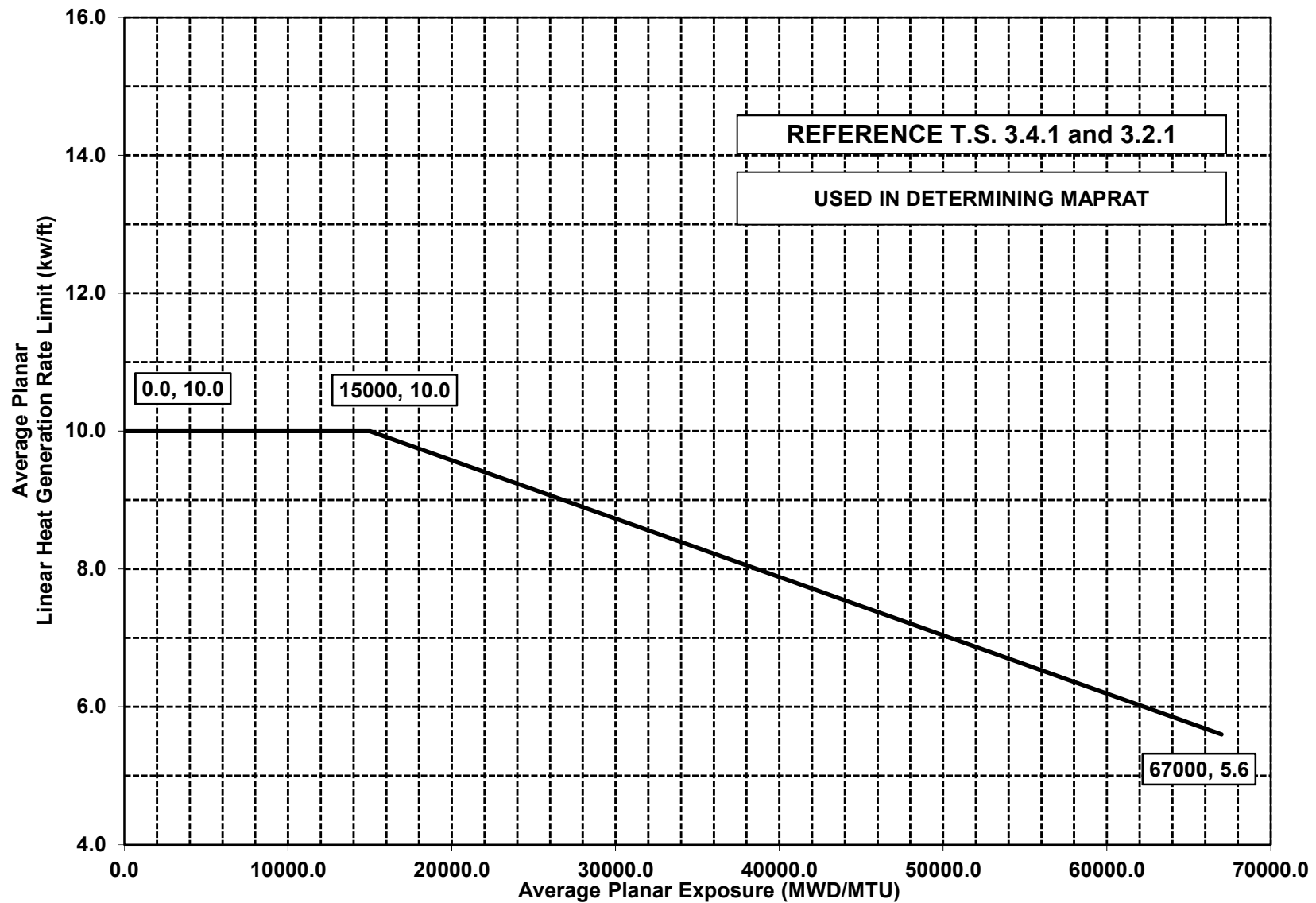
#### Linear Heat Generation Rate Limit

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.

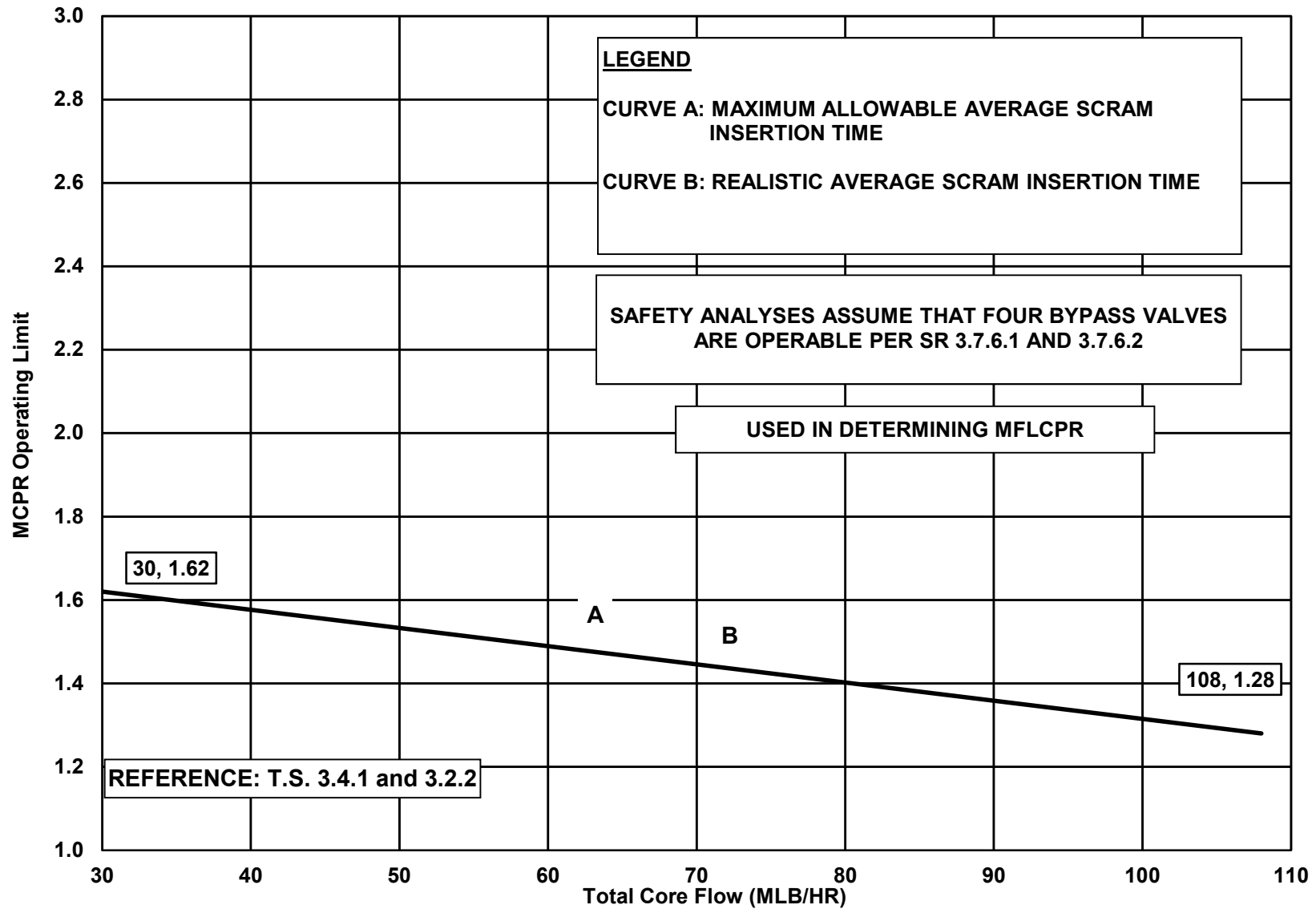
# **SSES UNIT 2 CYCLE 20**



**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**

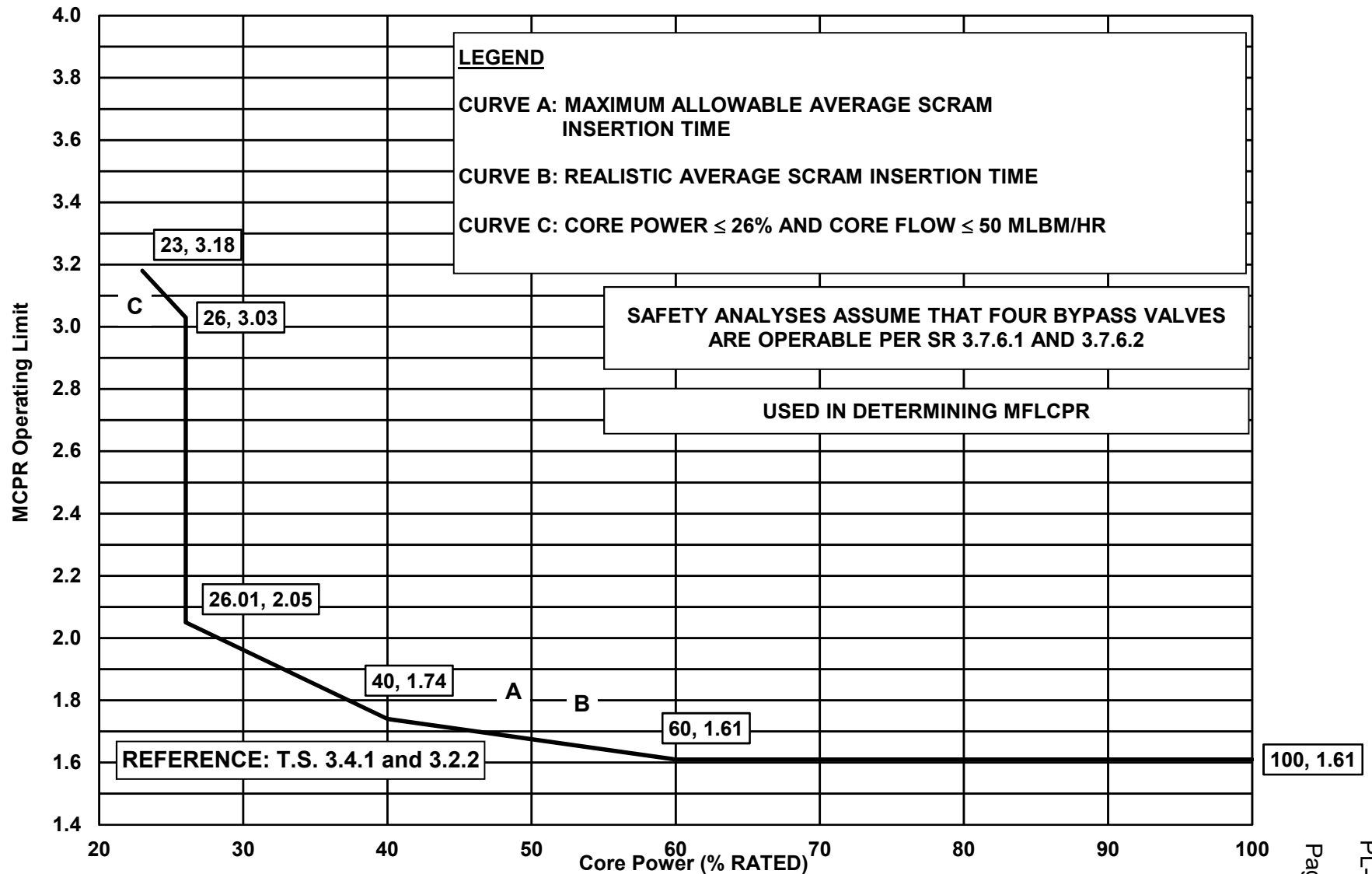
## SSS UNIT 2 CYCLE 20



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



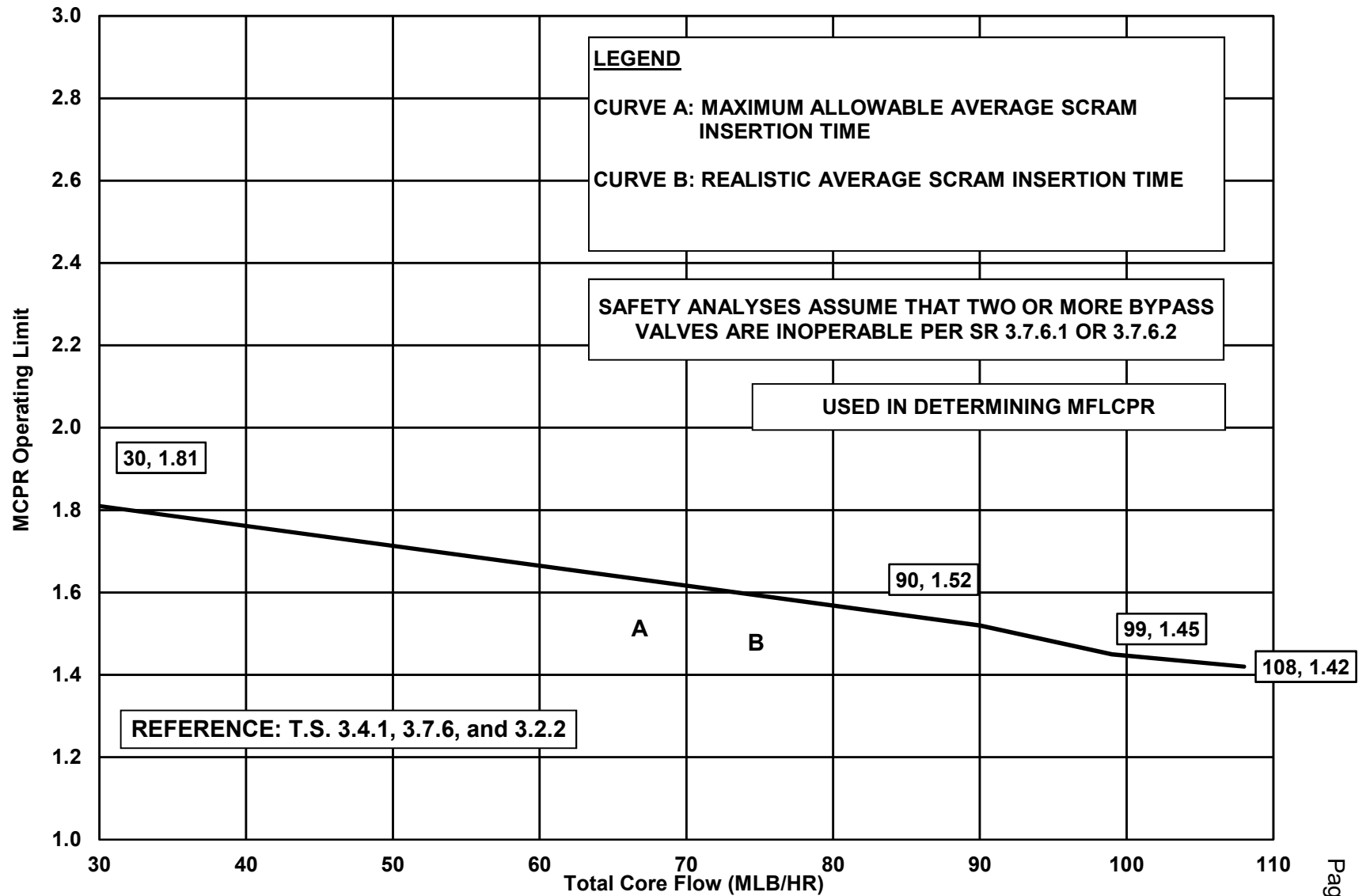
## SSS UNIT 2 CYCLE 20



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

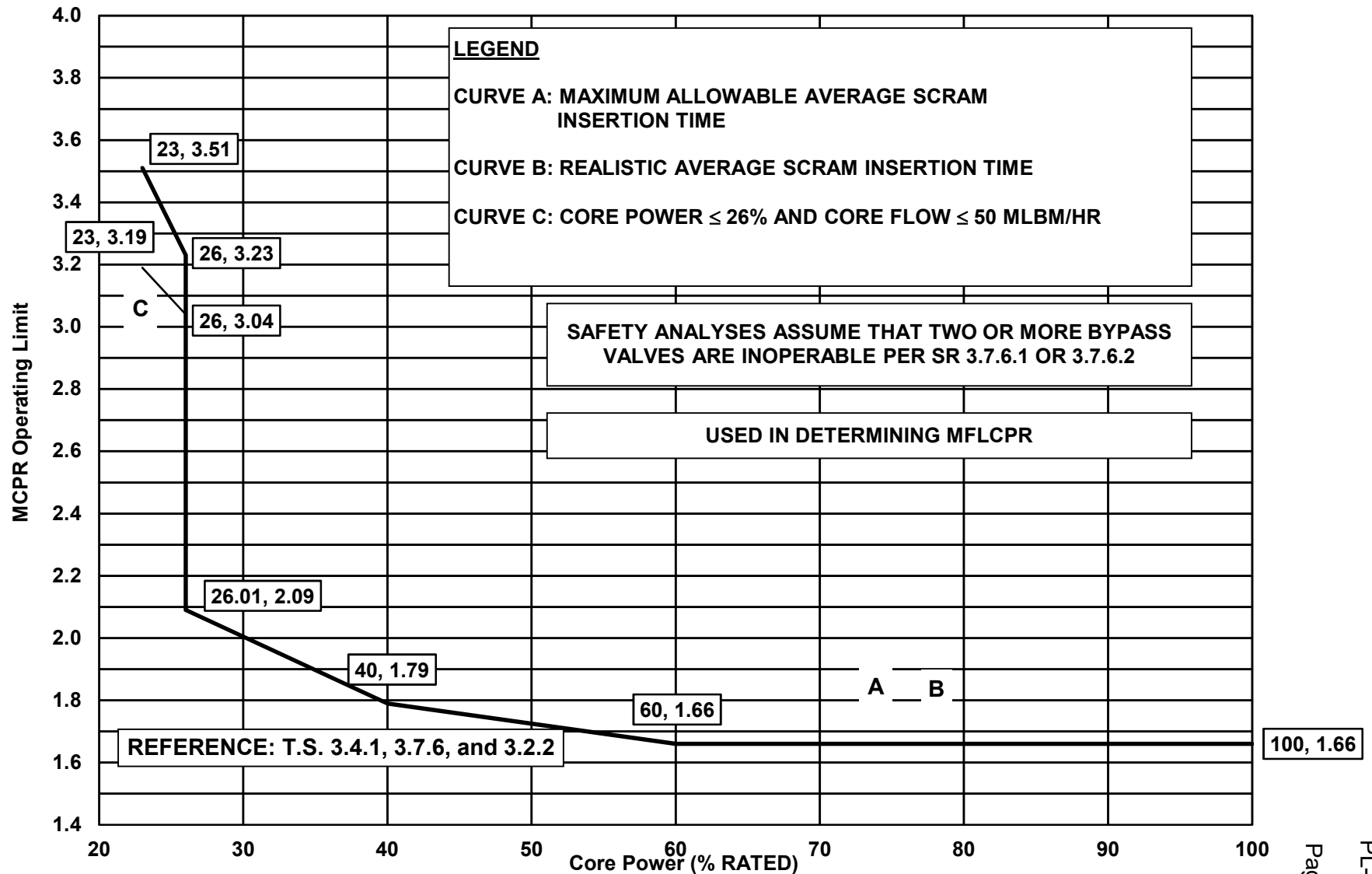
## **Main Turbine Bypass Inoperable**

# SSSES UNIT 2 CYCLE 20



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

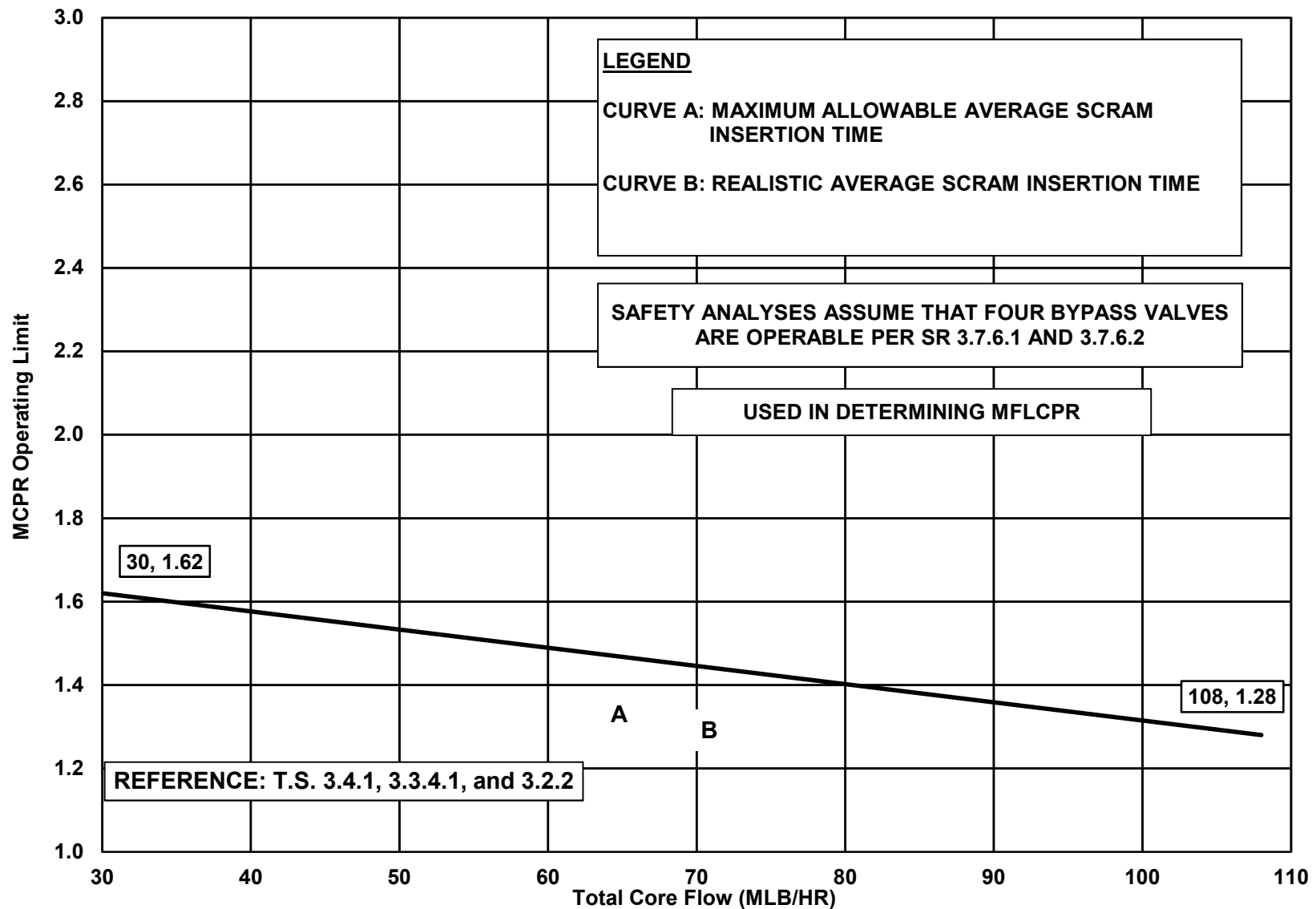
## SSS UNIT 2 CYCLE 20



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

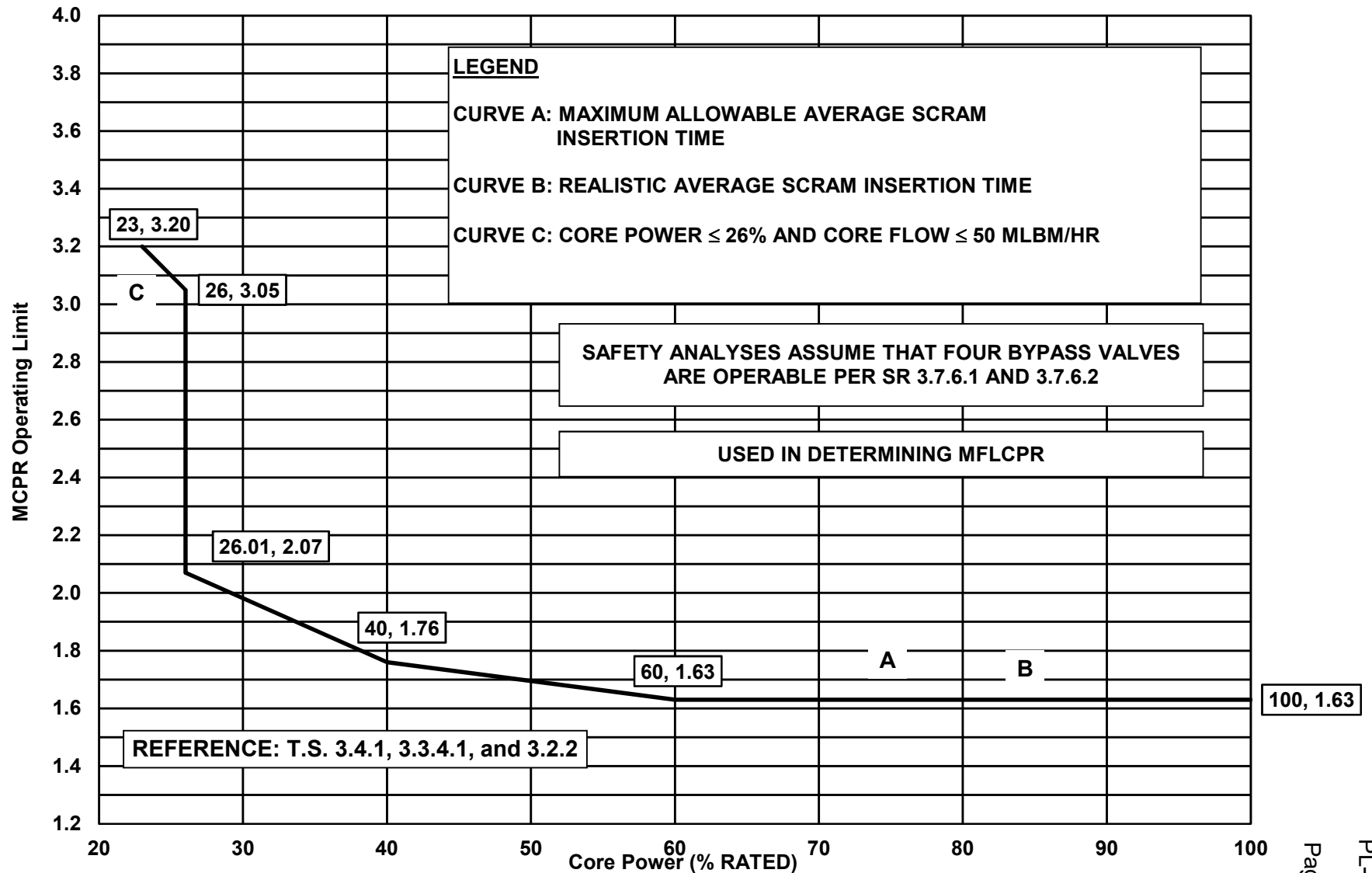
# **EOC-RPT Inoperable**

## SSS UNIT 2 CYCLE 20



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

# SSS UNIT 2 CYCLE 20

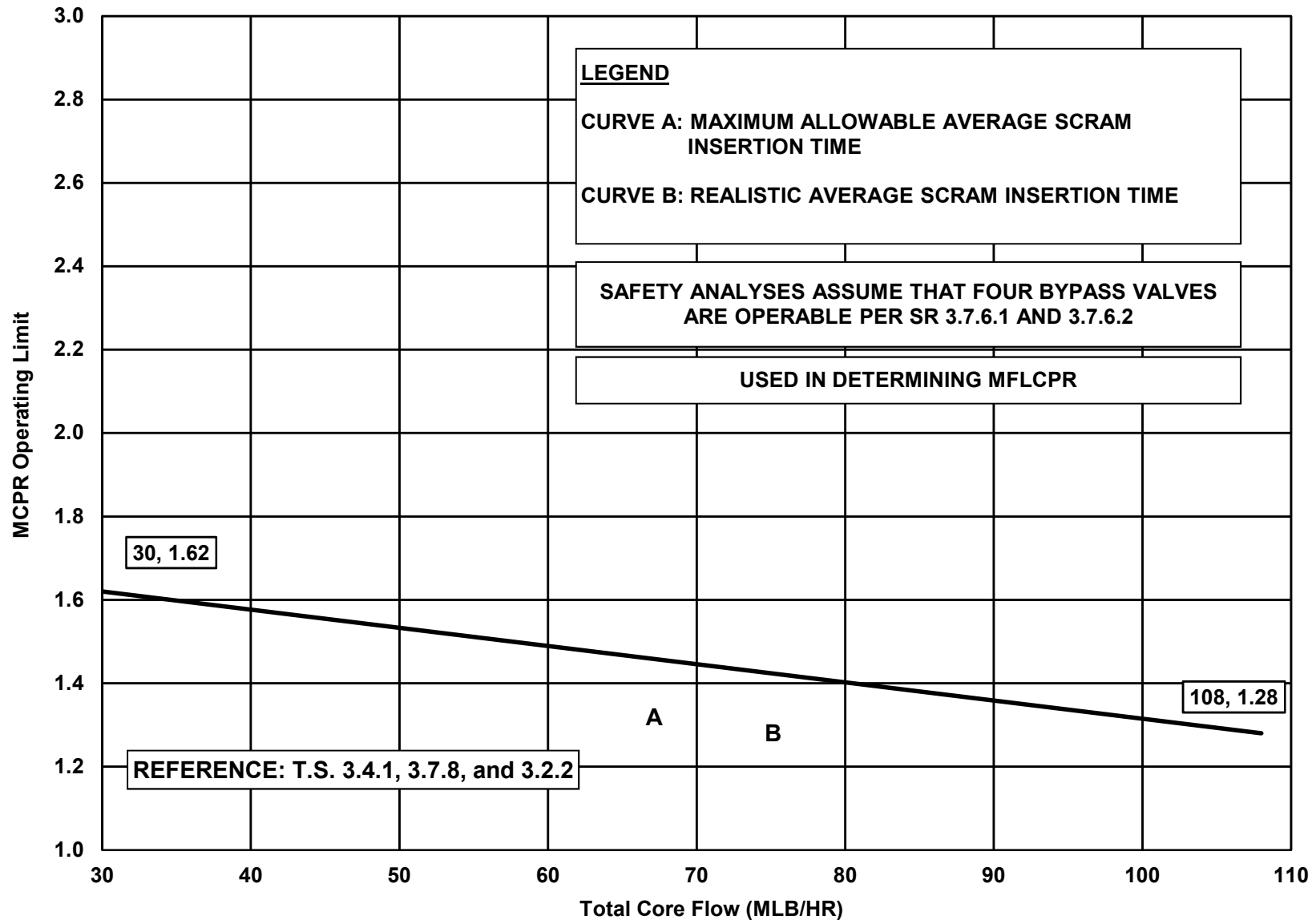


MCPR OPERATING LIMIT VERSUS CORE POWER  
EOC-RPT INOPERABLE  
SINGLE LOOP OPERATION (BOC TO EOC)  
FIGURE 8.2-7

## **Backup Pressure Regulator Inoperable**

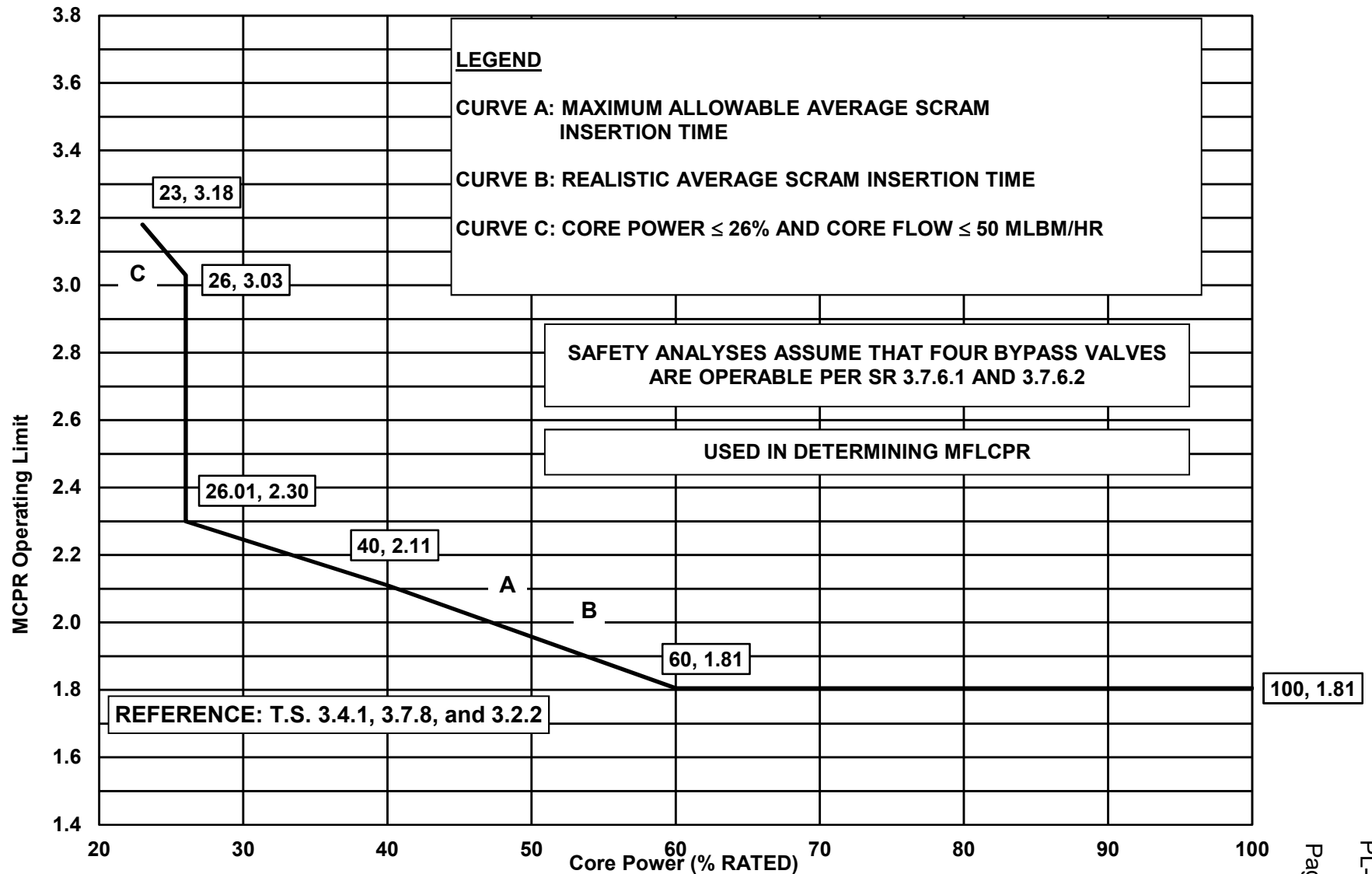


## SSS UNIT 2 CYCLE 20



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

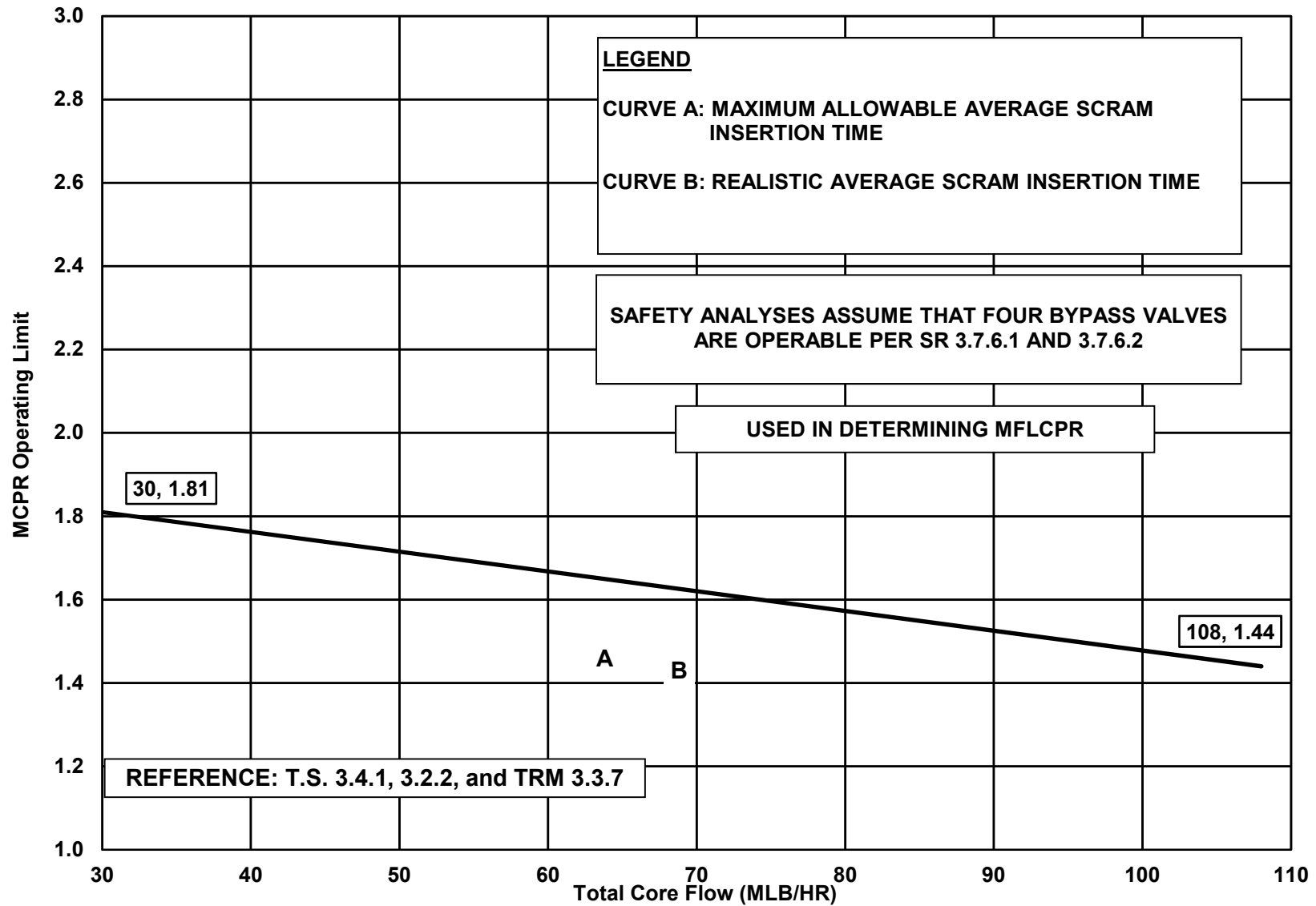
## SSS UNIT 2 CYCLE 20



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

## **One TSV or TCV Closed**

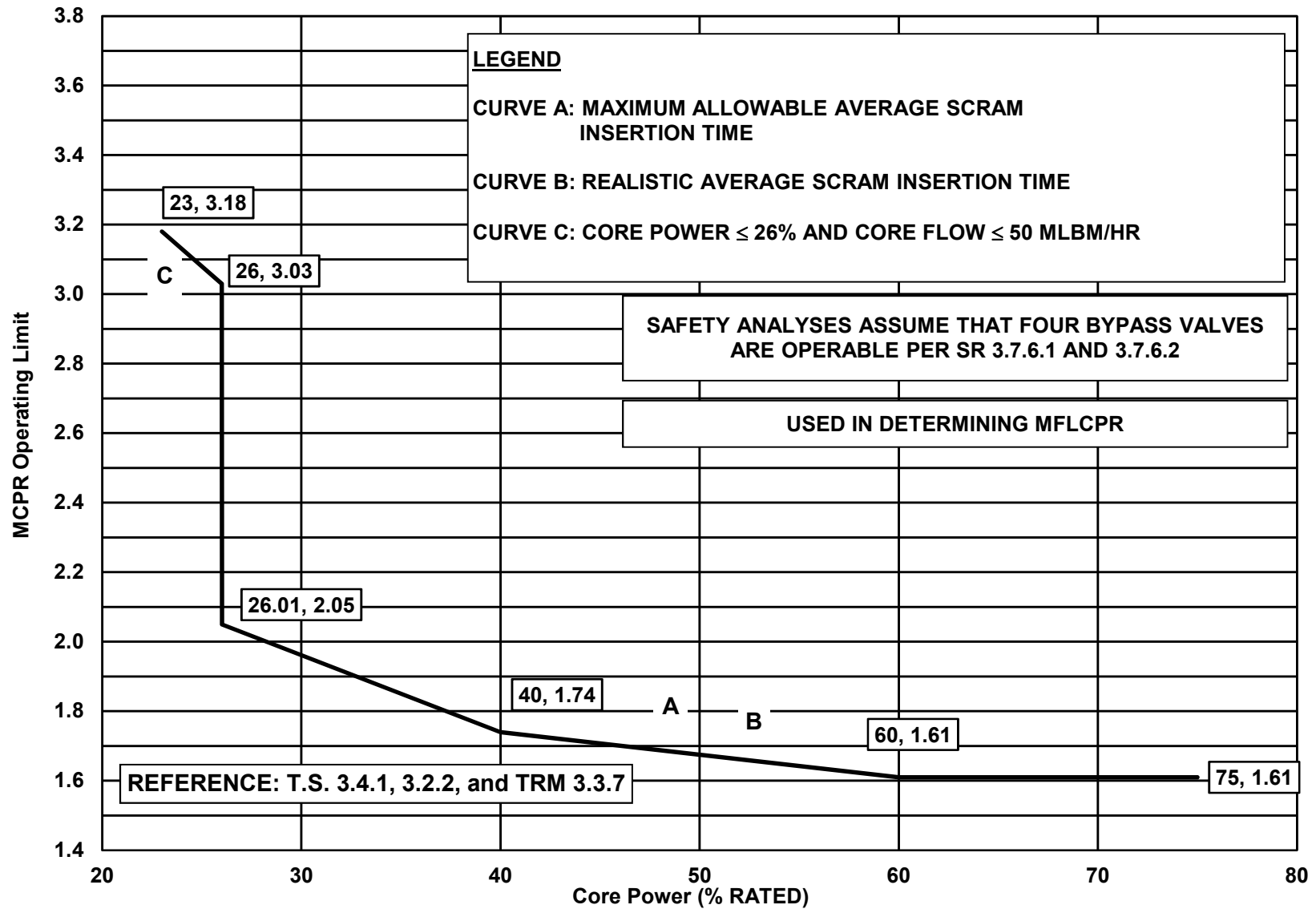
## SSS UNIT 2 CYCLE 20



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

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

## SSS UNIT 2 CYCLE 20



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

## 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.

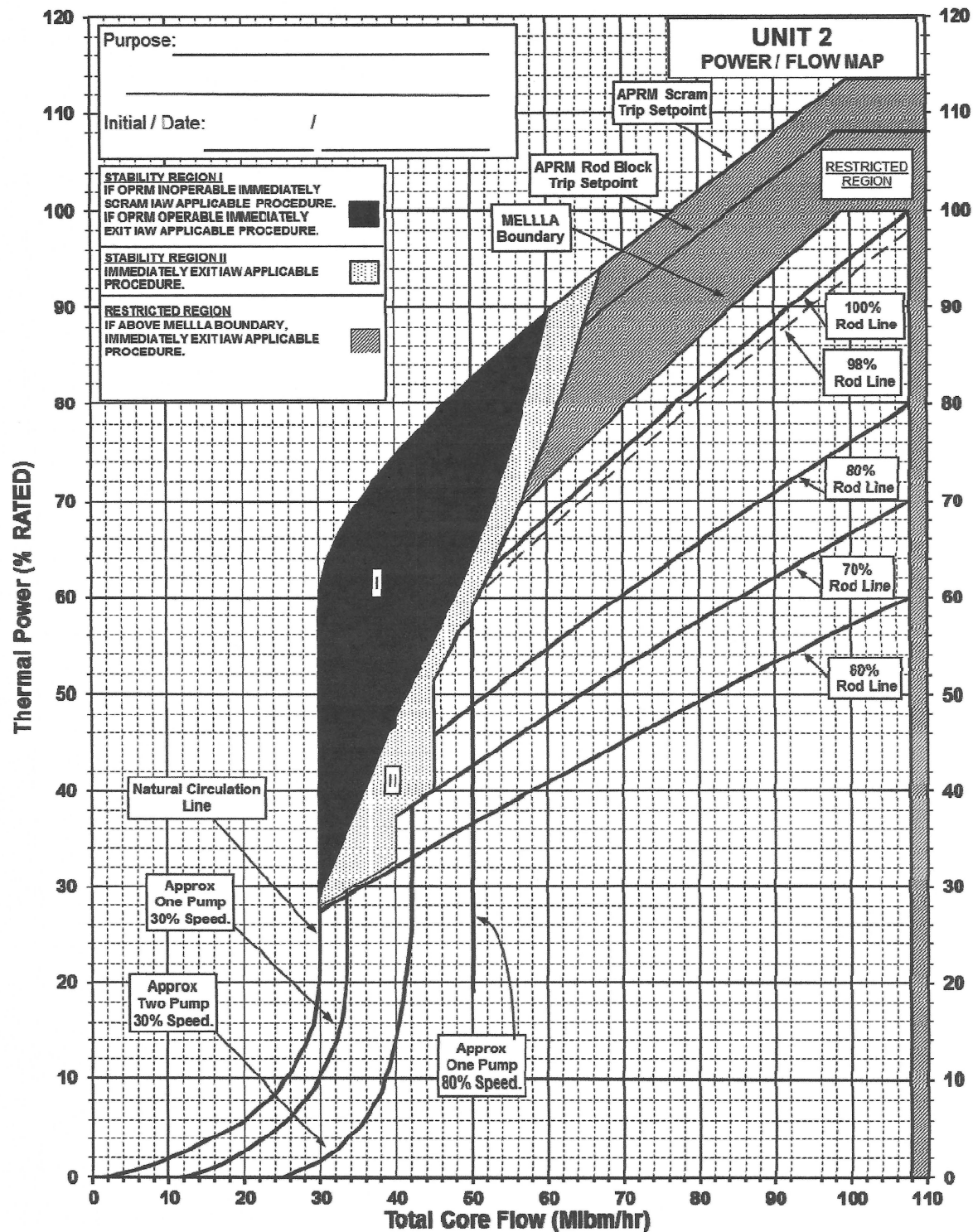


Figure 9.1  
SSES Unit 2 Cycle 20 Power / Flow Map

## 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:

$$S_P = 1.12$$

$$N_P = 16$$

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



## 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).
  12. ANF-89-98(P)(A) Revision 1 and Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation, May 1995.

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.