

Florida Power Corporation
Crystal River Unit 3

Cycle 11
Core Operating Limits Report
F96-0001
Revision 0

Referencing Revised
Standard Technical Specifications

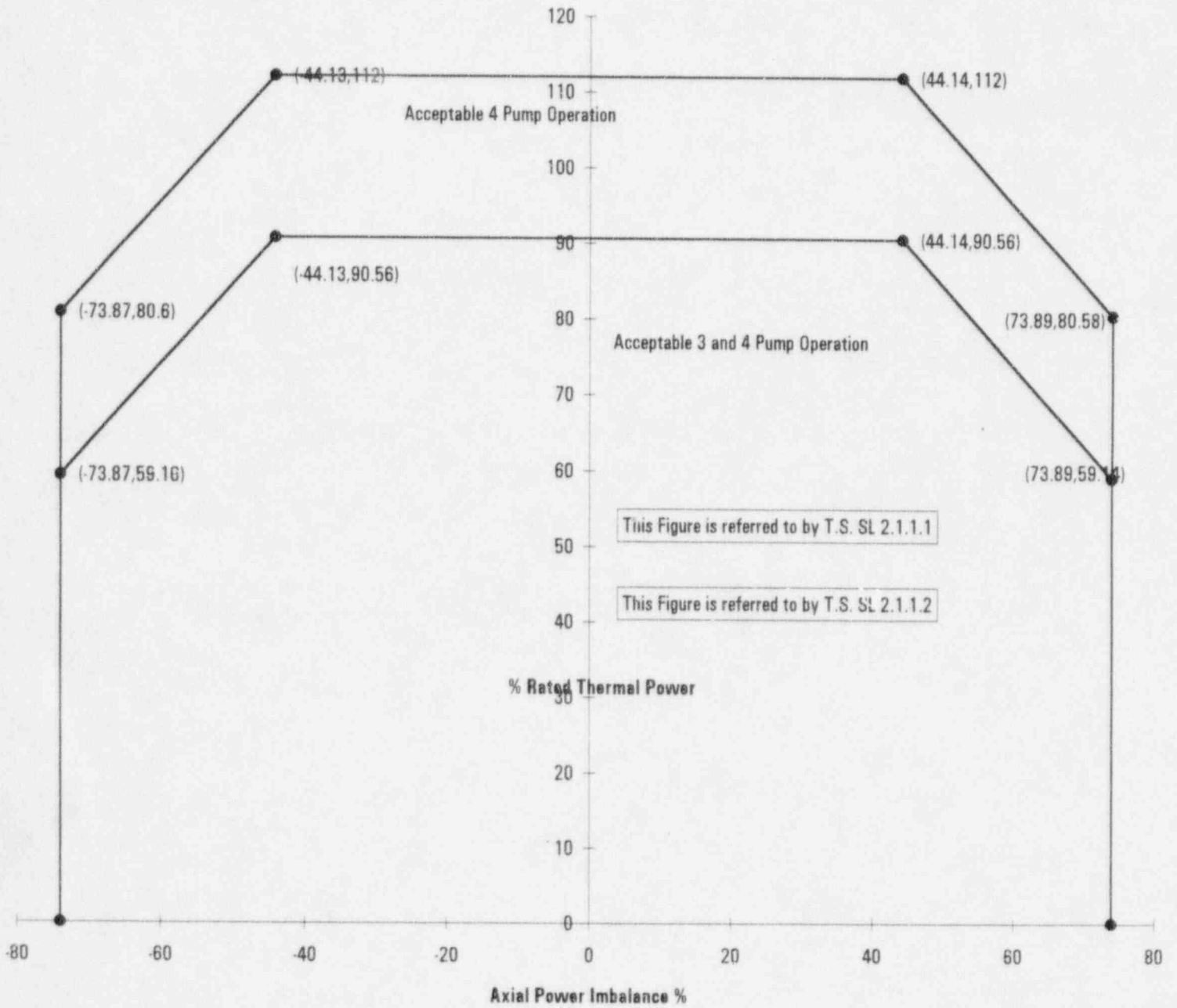
1.0 Core Operating Limits

This Core Operating Limits Report for CR3 Cycle 11 has been prepared in accordance with the requirements of Technical Specification Section 1.1 and 5.6.2.18. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC. These methods are documented in BAW-10179PA, Rev. 1 "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses", NRC Letter R. Jones to J.H. Willoughby dated January 22, 1996. The Cycle 11 limits generated using this methodology above are documented in BAW-2262, "Crystal River Unit 3 Cycle 11 Reload Report", dated January 1996

The following limits are included in this report.

- SL 2.1.1.1 AXIAL POWER IMBALANCE PROTECTIVE LIMITS
- SL 2.1.1.2 AXIAL POWER IMBALANCE PROTECTIVE LIMITS
- LCO 3.1.1 SHUTDOWN MARGIN
- LCO 3.1.3 MODERATOR TEMPERATURE COEFFICIENT
- SR 3.1.7.1 API/RPI POSITION INDICATION AGREEMENT
- LCO 3.2.1 REGULATING ROD INSERTION LIMITS
- LCO 3.2.2 AXIAL POWER SHAPING ROD INSERTION LIMITS
- LCO 3.2.3 AXIAL POWER IMBALANCE OPERATING LIMITS
- LCO 3.2.4 QUADRANT POWER TILT
- LCO 3.2.5 POWER PEAKING FACTORS
- LCO 3.3.1 REACTOR PROTECTION SYSTEM INSTRUMENTATION
- LCO 3.9.1 REFUELING BORON CONCENTRATION

Axial Power Imbalance Protective Limits



Shutdown Margin (SDM)

No special evolutions are expected during Cycle 11 therefore

Mode 1,2,3,4,5 $SDM \geq 1.0\% \Delta k/k$

These limits are
referred to by
Technical
Specification
LCO 3.1.1

Moderator Temperature Coefficient Limit

Lower Limit

MTC at HFP $> -3.29 \times 10^{-4} \Delta k/k/^{\circ}F$

Upper Limit

MTC $\leq 0.9 \times 10^{-4} \Delta k/k/^{\circ}F$ when Thermal Power $< 95\%$ RTP

MTC ≤ 0.0 when Thermal Power $\geq 95\%$ RTP

These limits are
referred to by
Technical
Specification
LCO 3.1.3

Absolute Position Indicator / Relative Position Indicator Agreement Limits

2.7% when the comparison is performed using the plant computer, or

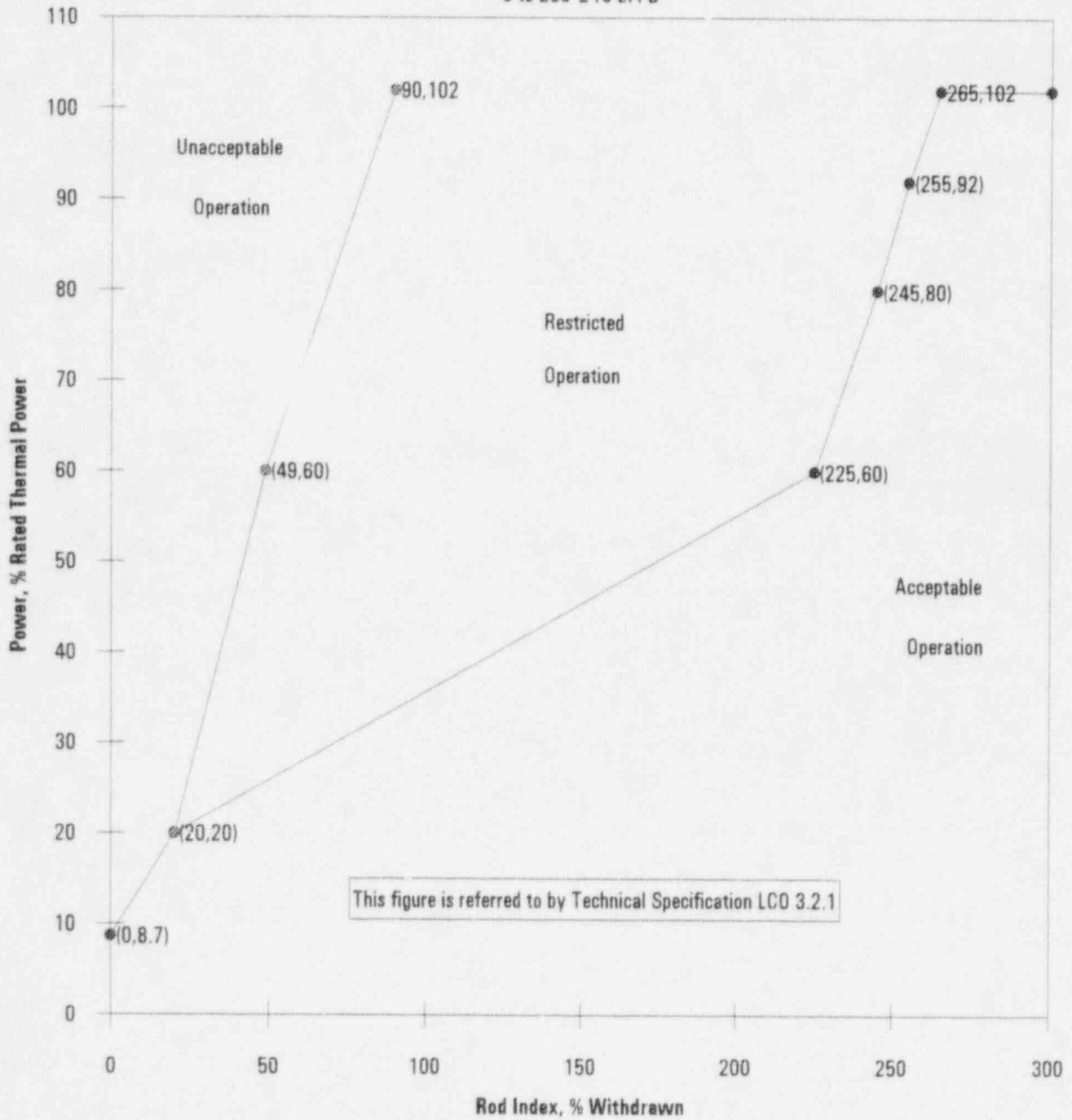
3.5% when the comparison is performed using the panel meters on the main control board.

These limits are
referred to by
Technical
Specification
SR 3.1.7.1

Regulating Rod Group Insertion Limits

Four Pump Operation

0 to 250 ± 10 EFPD

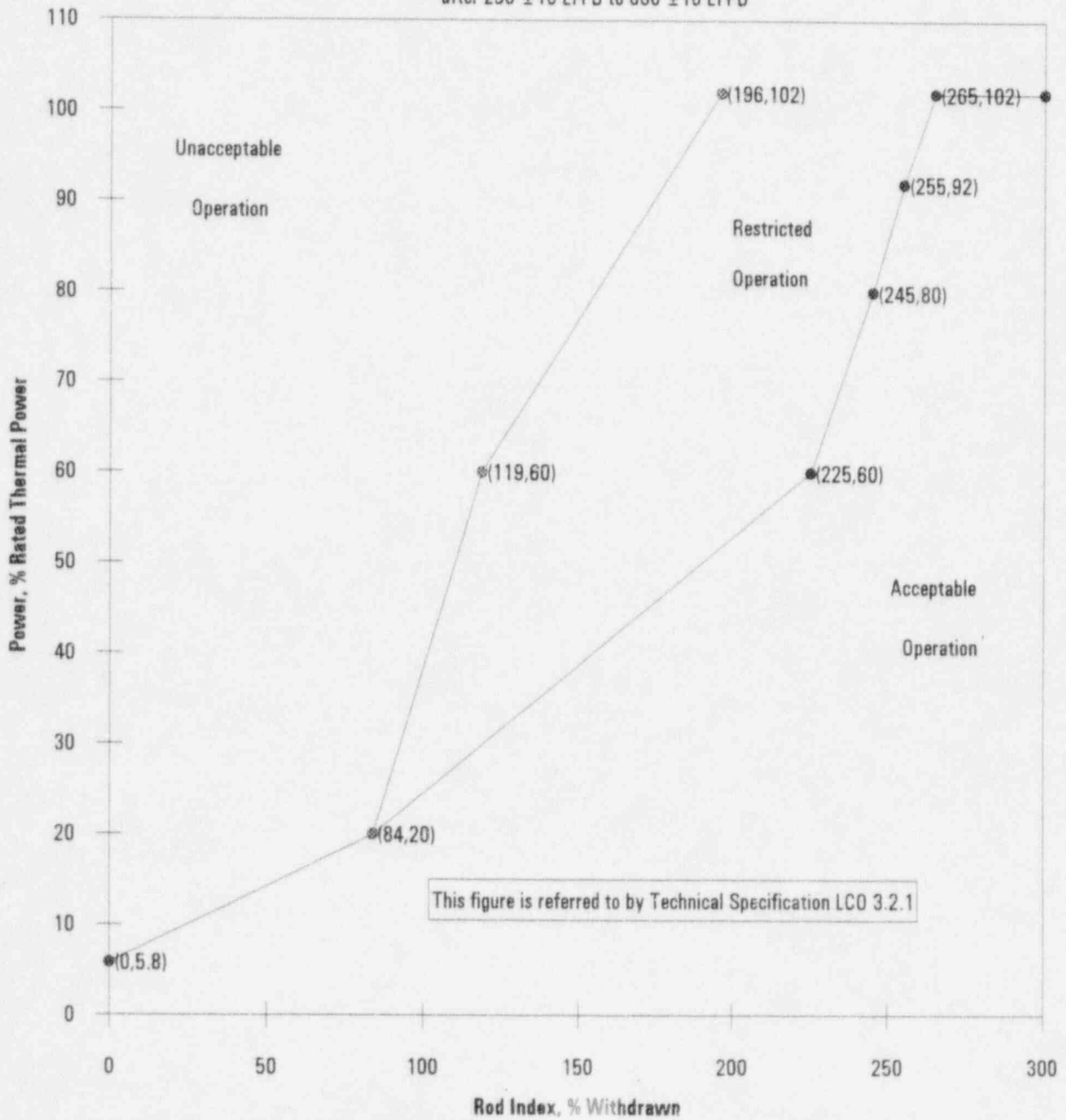


Note 1: A rod group overlap of $25 \pm 5\%$ between sequential withdrawn groups 5 and 6, and 6 and 7 shall be maintained

Regulating Rod Group Insertion Limits

Four Pump Operation

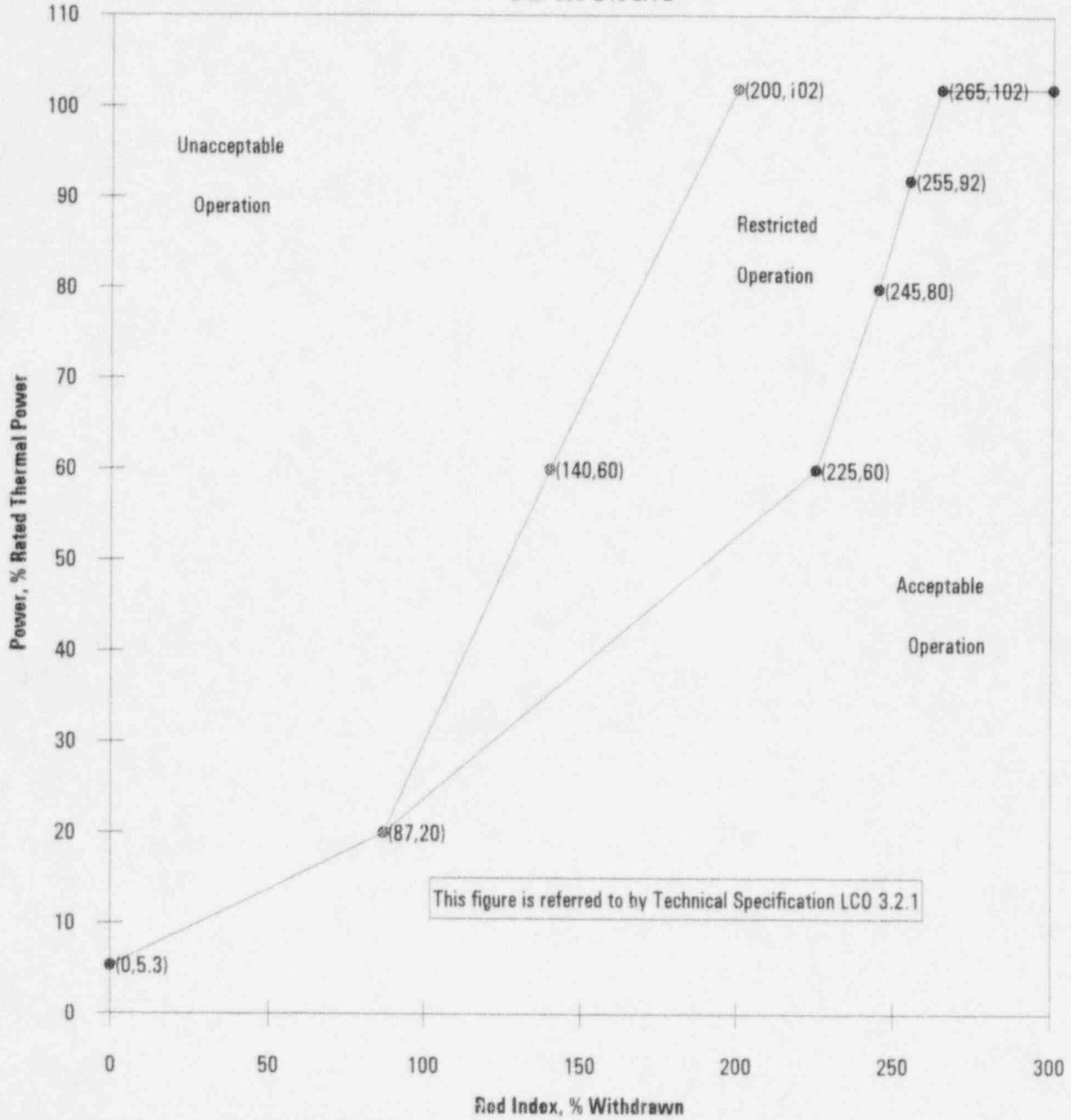
after 250 ± 10 EFPD to 600 ± 10 EFPD



Note 1: A rod group overlap of $25 \pm 5\%$ between sequential withdrawn groups 5 and 6, and 6 and 7 shall be maintained

Regulating Rod Group Insertion Limits

Four Pump Operation:
after 600 ± 10 EFPD

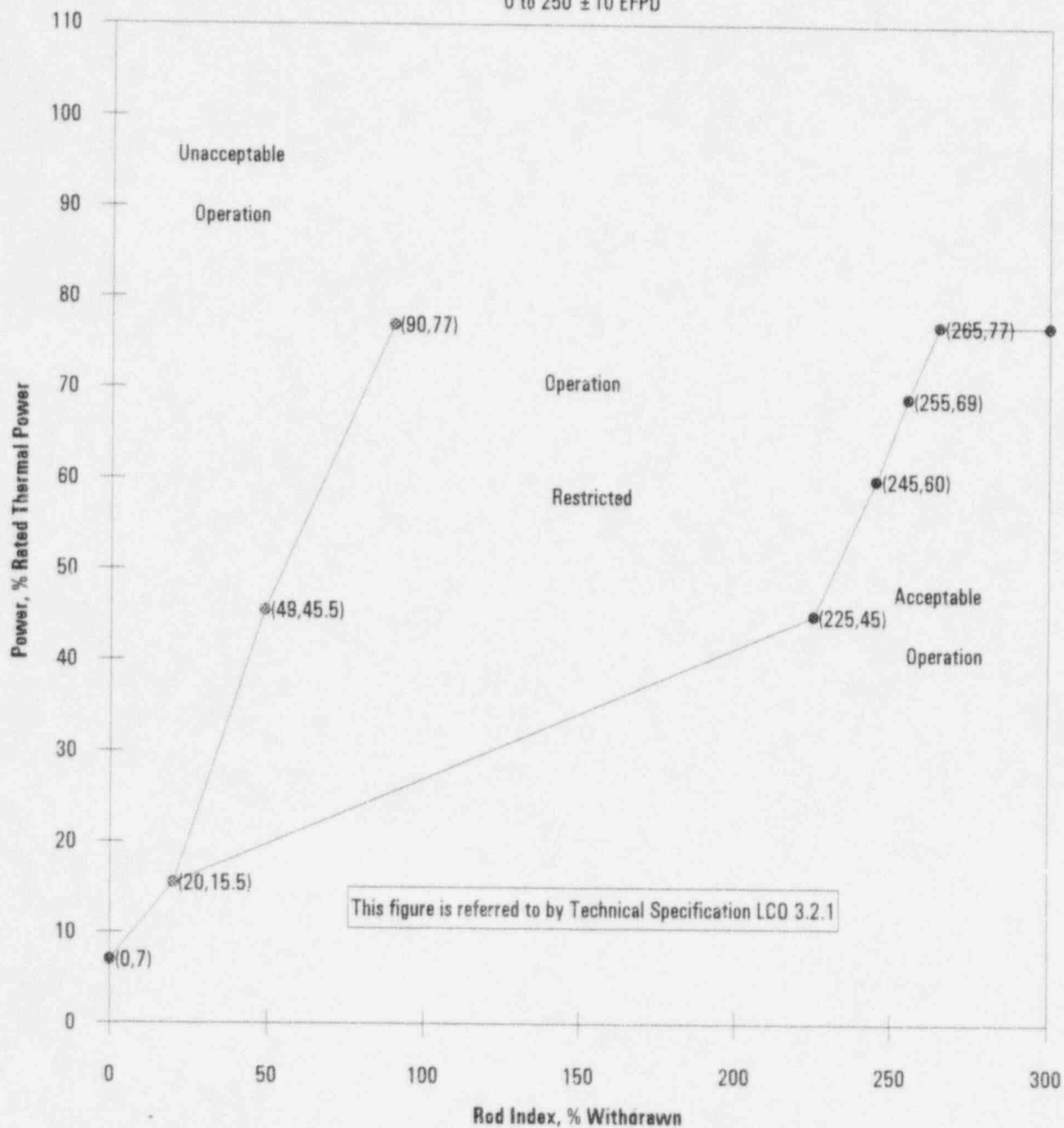


Note 1: A rod group overlap of $25 \pm 5\%$ between sequential withdrawn groups 5 and 6, and 6 and 7 shall be maintained

Note 2: This figure shall be used up to, during, after APSR withdrawal per LCO 3.2.2

Regulating Rod Group Insertion Limits

Three Pump Operation
0 to 250 ± 10 EFPD

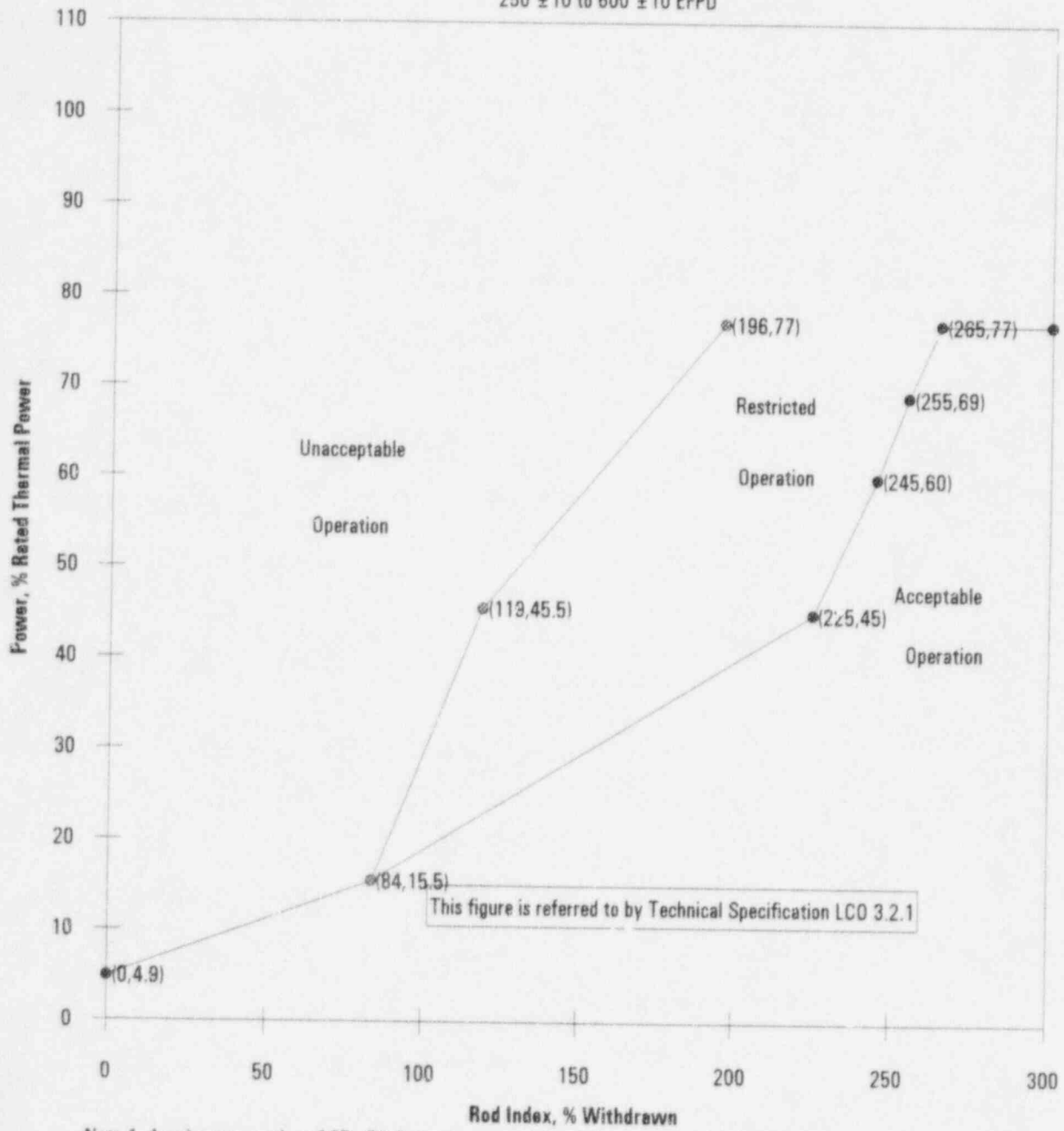


Note 1: A rod group overlap of 25 ± 5% between sequential withdrawn groups 5 and 6, and 6 and 7 shall be maintained

Regulating Rod Group Insertion Limits

Three Pump Operation

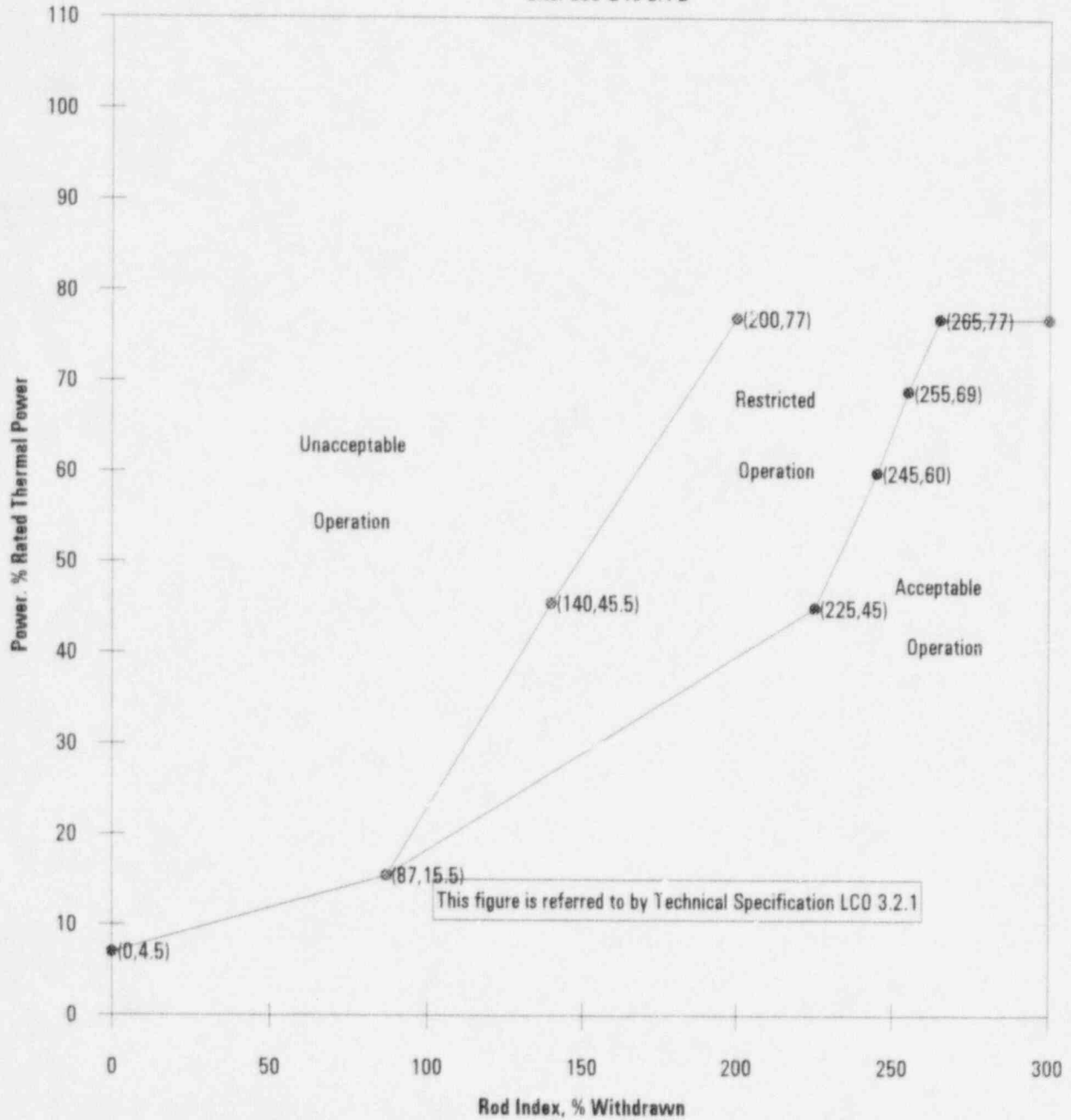
250 ± 10 to 600 ± 10 EFPD



Note 1: A rod group overlap of 25 ± 5% between sequential withdrawn groups 5 and 6, and 6 and 7 shall be maintained

Regulating Rod Group Insertion Limits

Three Pump Operation
after 600 ± 10 EFPD



Note 1: A rod group overlap of 25 ± 5% between sequential withdrawn groups 5 and 6, and 6 and 7 shall be maintained
 Note 2: This figure shall be used up to, during, and after APSR withdrawal per LCO 3.2.2

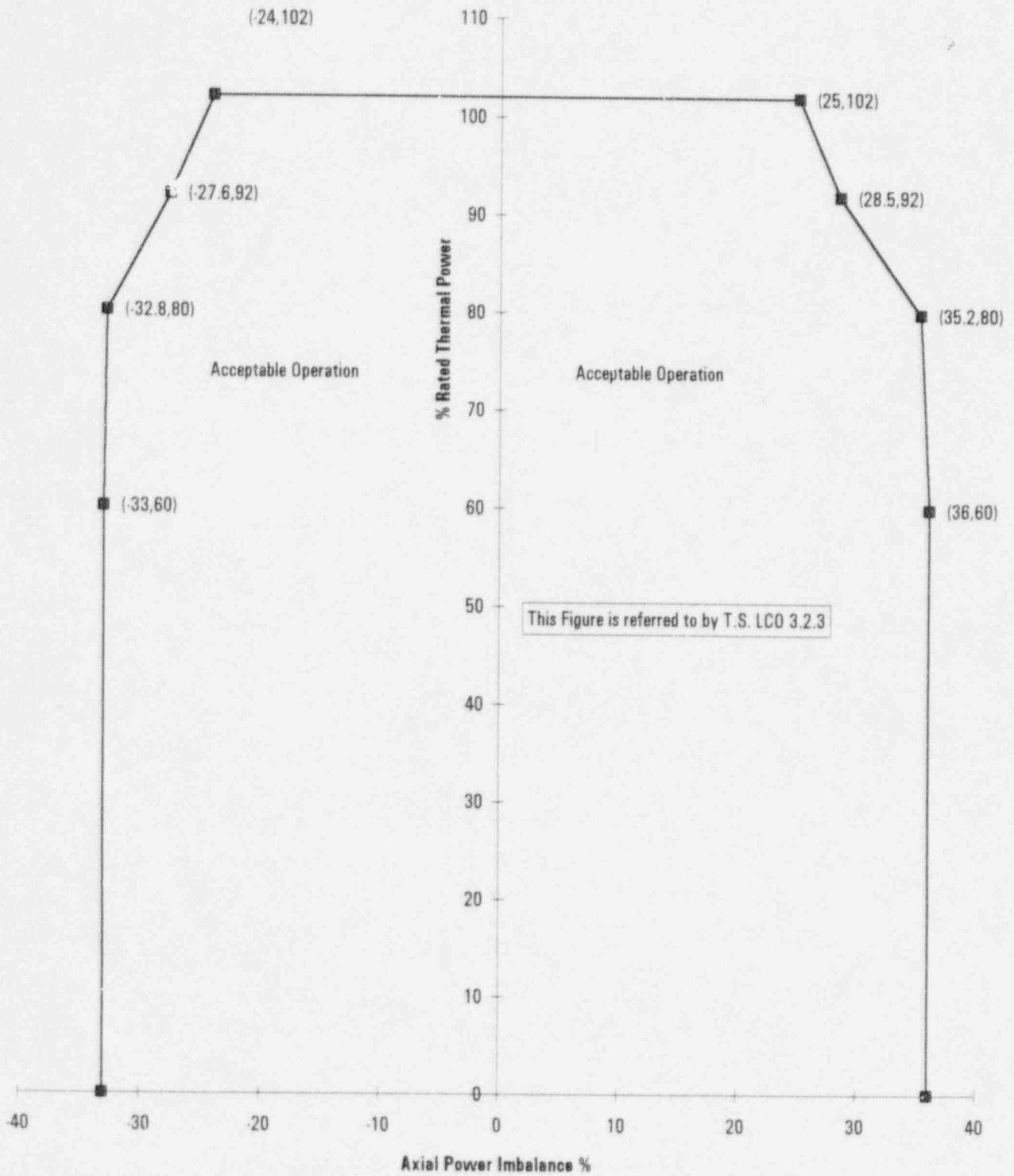
Axial Power Shaping Rod Insertion Limits

Up to 640 EFPD the APSRs may be positioned as necessary. The APSRs shall be completely withdrawn (100%) by 560 EFPD. Once withdrawn during this period, 640EFPD to 660EFPD the APSRs shall not be reinserted for the remainder of the cycle.

These limits are
referred to by
Technical
Specification
LCO 3.2.2

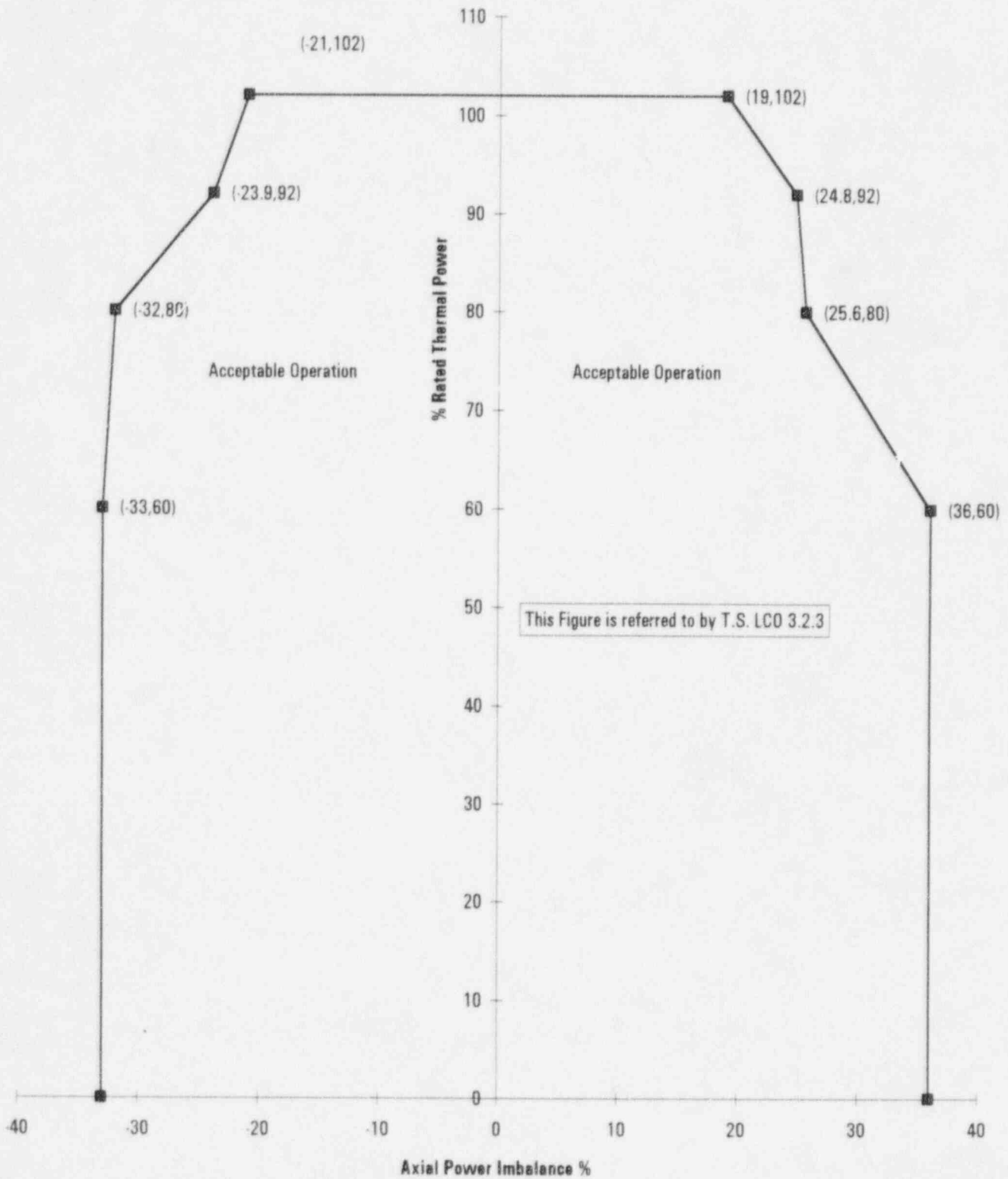
Axial Power Imbalance Operating Limits

Four Pump Operation
0 to 250 ± 10 EFPD



Axial Power Imbalance Operating Limits

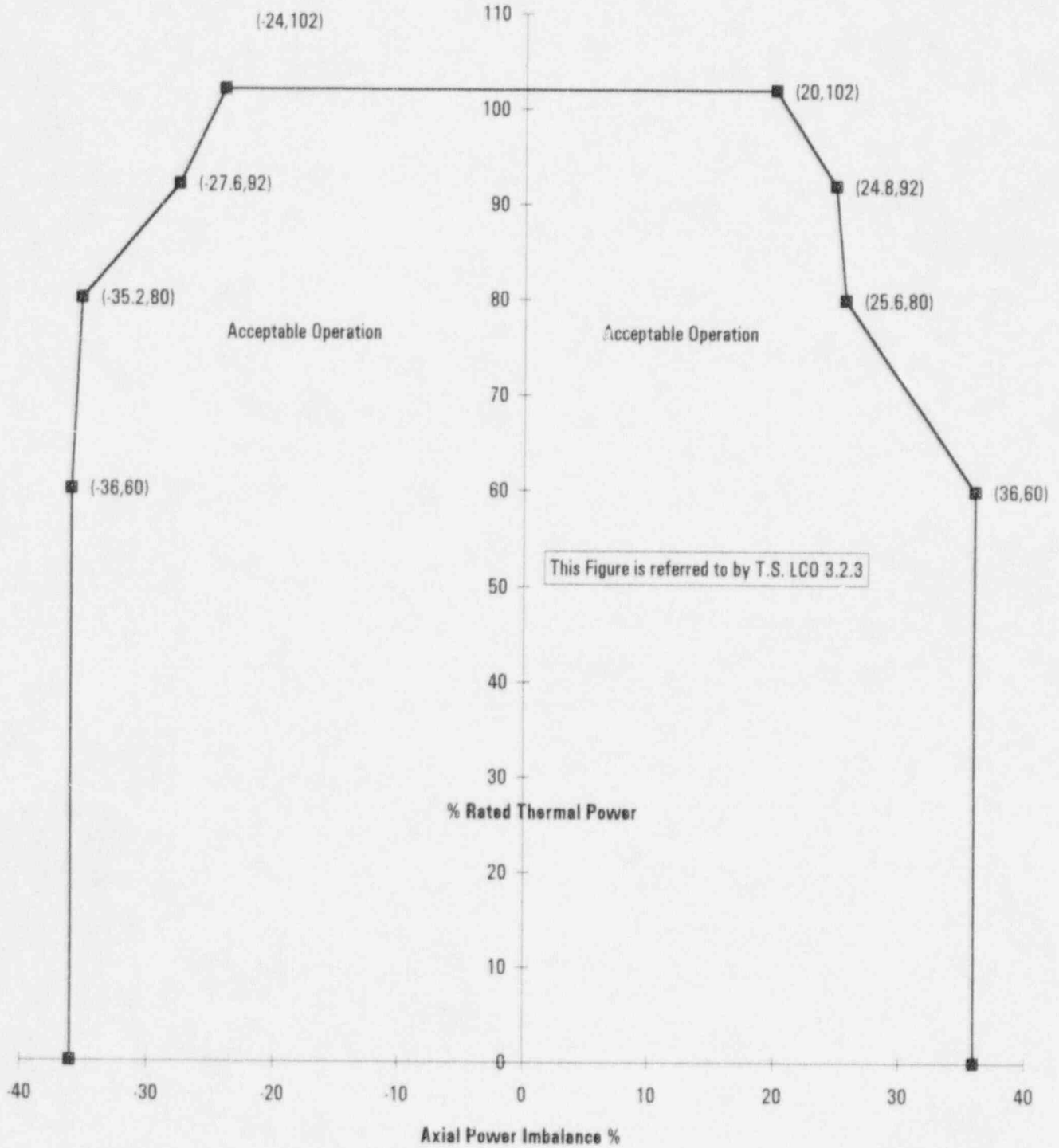
Four Pump Operation
250 ± 10 to 500 ± 10 EFPD



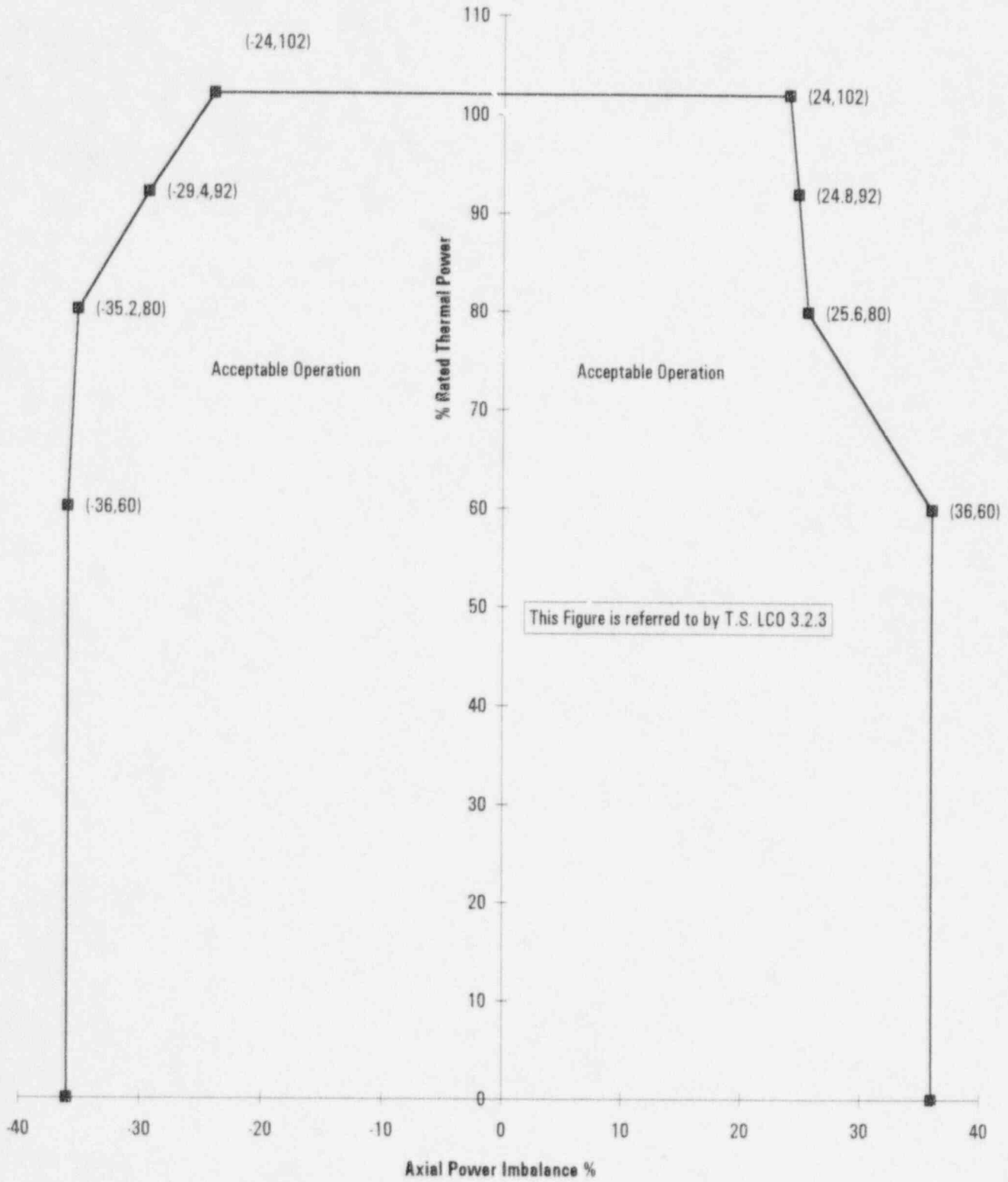
Axial Power Imbalance Operating Limits

Four Pump Operation

500 ± 10 to 600 ± 10 EFPD

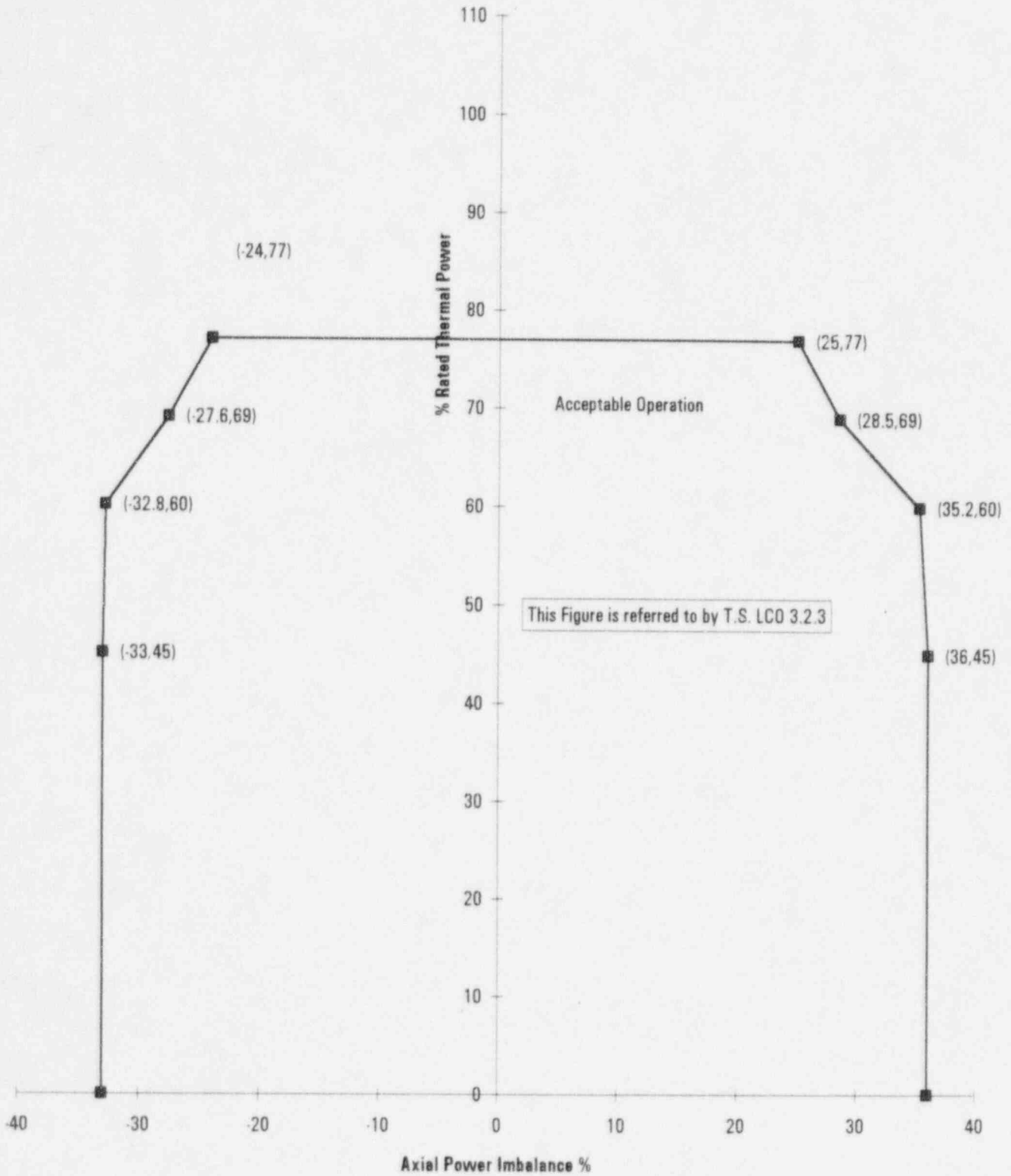


Axial Power Imbalance Operating Limits
Four Pump Operation
after 600 ± 10 EFPD

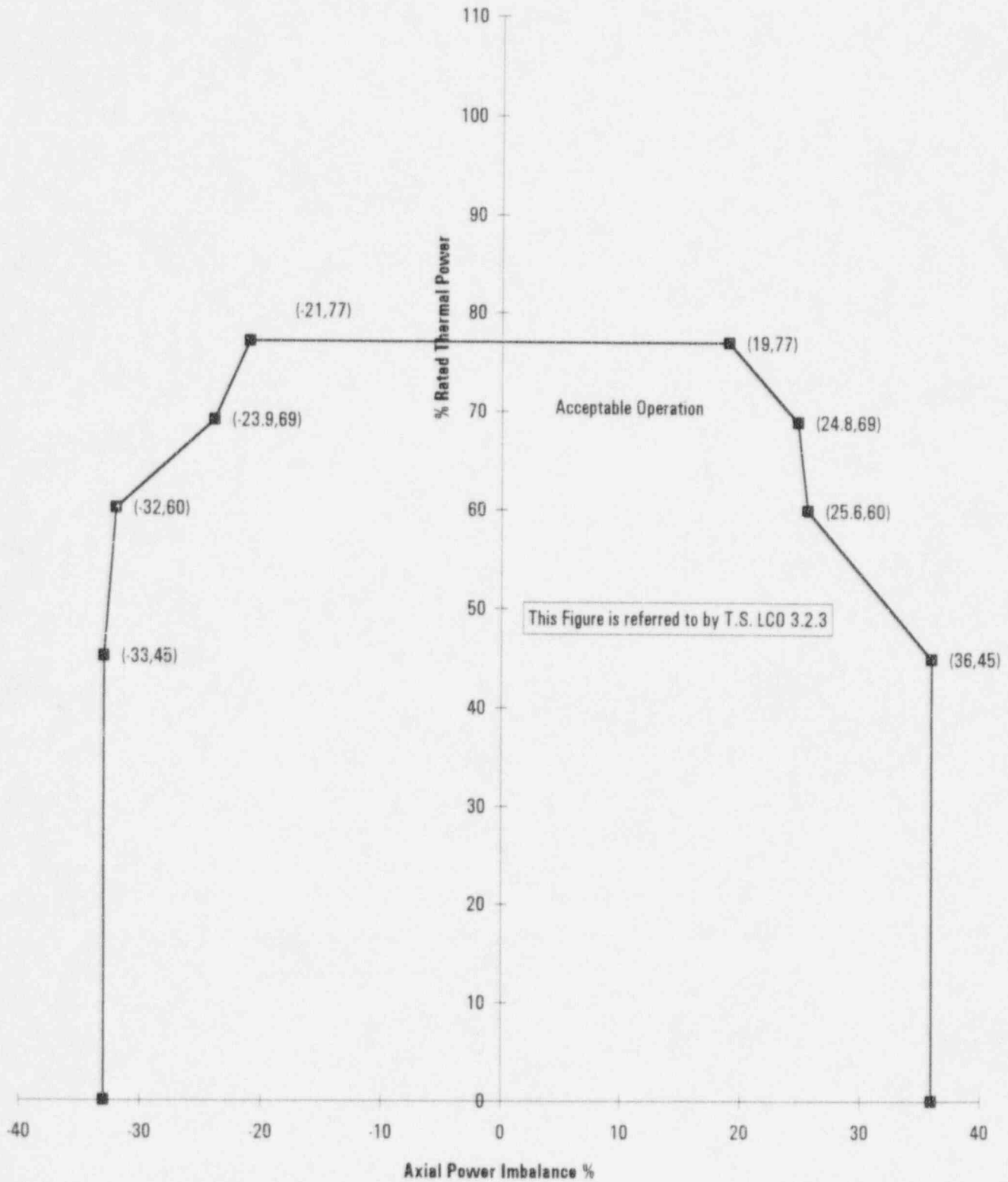


Axial Power Imbalance Operating Limits

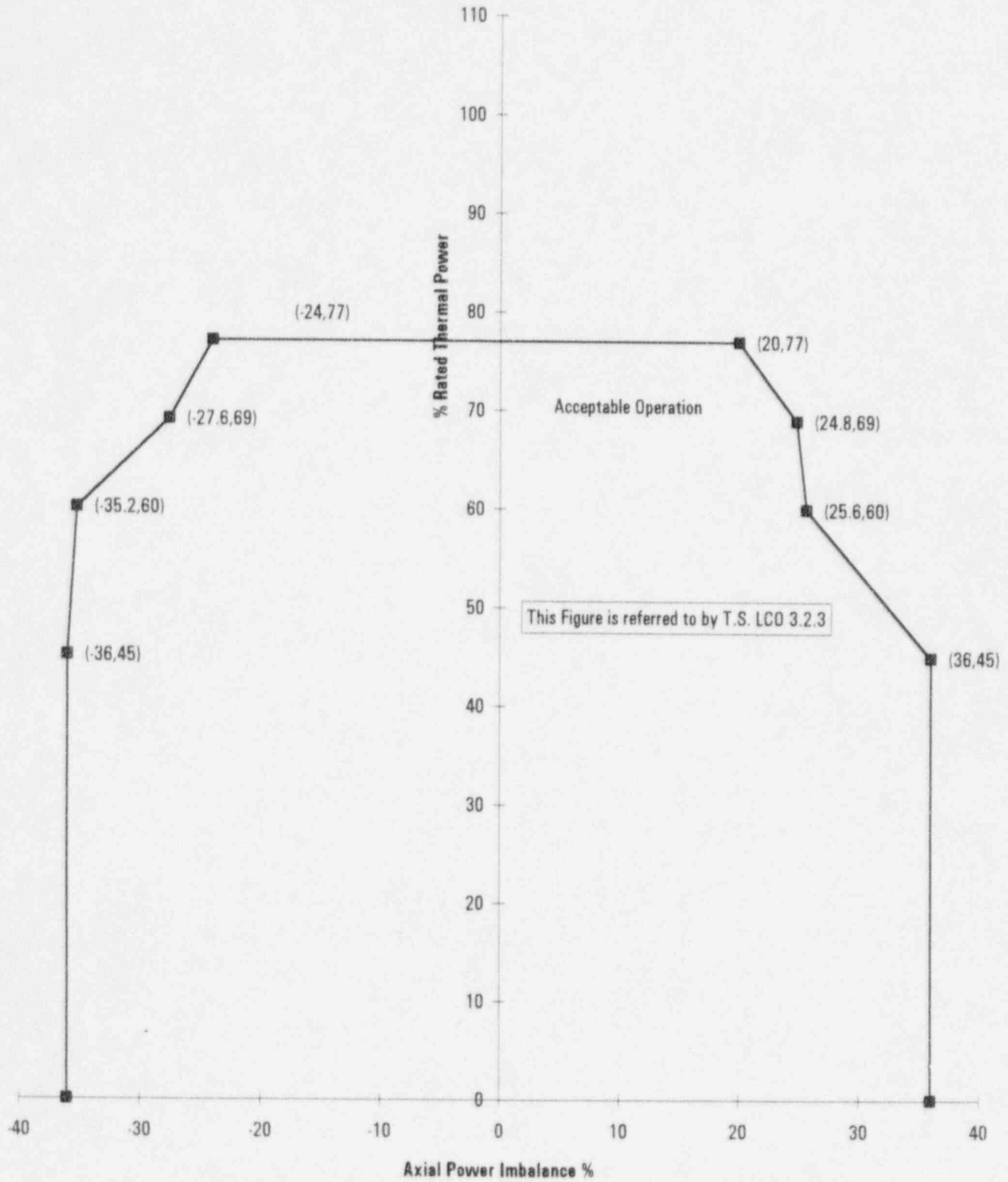
Three Pump Operation
0 - 250 ± 10 EFPD



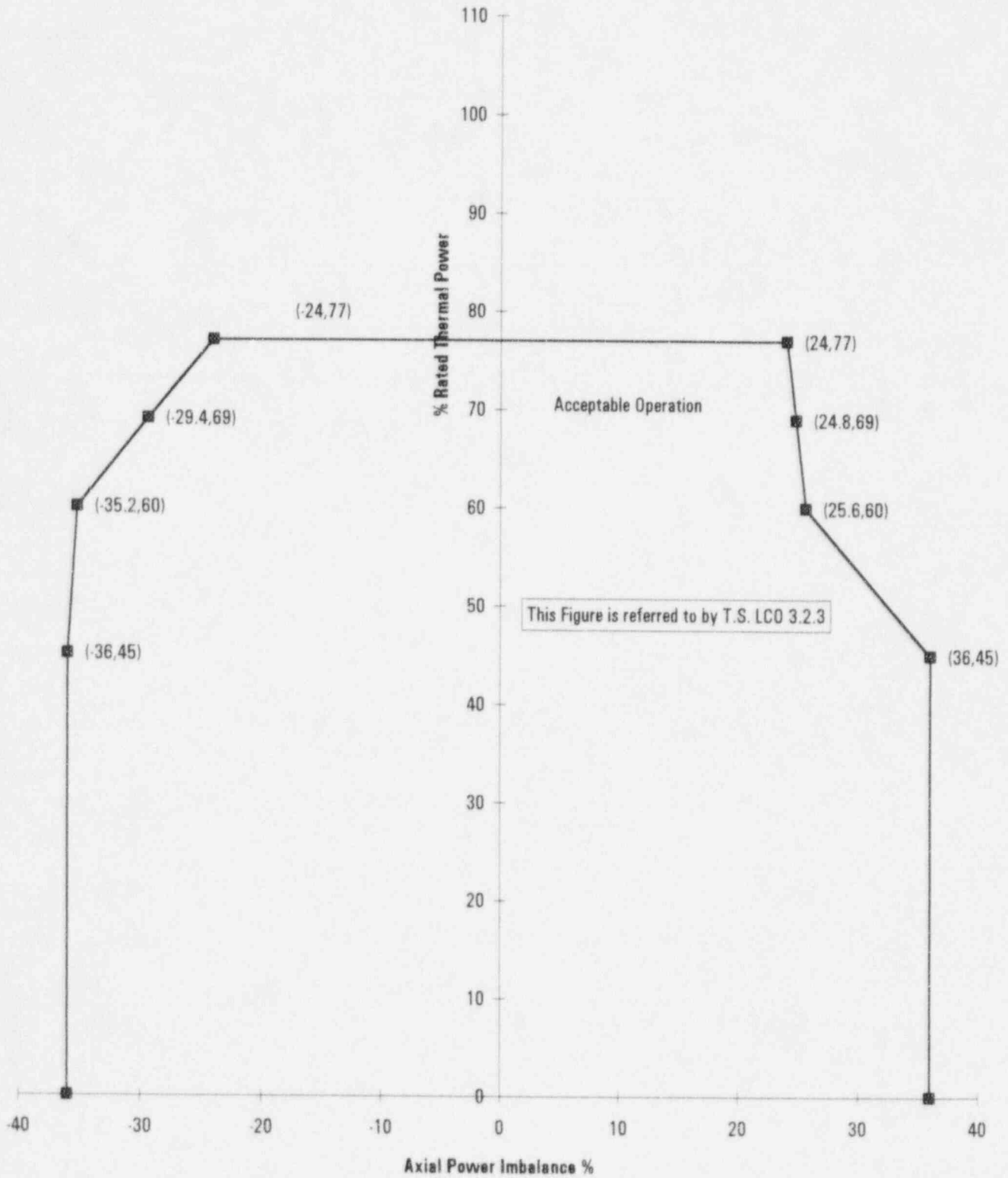
Axial Power Imbalance Operating Limits
Three Pump Operation
250 ± 10 to 500 ± 10 EFPD



Axial Power Imbalance Operating Limits
Three Pump Operation
500 ± 10 to 600 ± 10 EFPD



Axial Power Imbalance Operating Limits
Three Pump Operation
after 600 ± 10 EFPD



Quadrant Power Tilt Limits**For Operation from 0 EFPD to EOC**Thermal Power \leq 60% RTP

	Steady State	Transient	Maximum
Symmetrical Incore Detector System	7.50	10.03	20.00
Power Range Channels	4.94	6.96	20.00
Minimum Incore Detector System	3.07	4.40	20.00
Measurement System Independent	8.58	11.07	20.00

Thermal Power $>$ 60% RTP

	Steady State	Transient	Maximum
Symmetrical Incore Detector System	4.49	10.03	20.00
Power Range Channels	1.96	6.96	20.00
Minimum Incore Detector System	1.90	4.40	20.00
Measurement System Independent	4.92	11.07	20.00

<p>These limits are referred to by Technical Specification LCO 3.2.4</p>
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Power Peaking Factors

This Limit is referred to by Technical Specification LCO 3.2.5

Heat Flux Hot Channel Factor FQ

FQ shall be limited by the following relationships:

$$FQ \leq LHR_{allow} (Bu) / [LHR_{avg} * P] \text{ (for } P \leq 1.0)$$

$LHR_{allow}(Bu)$ = See the following Table

LHR_{avg} = 5.79 kW/ft for Mk-B9, B10ZL, B10I, B10E fuel

LHR_{avg} = 5.74 kW/ft for Mk-B4Z fuel

P = ratio of THERMAL POWER/ RATED THERMAL POWER

Bu = Fuel Burnup (MWd/mtU)

Mk-B10I/Mk-B10E LHR_{allow} kW/ft*

Core	0	10650	33000
Elevation, ft	MWd/mtU	MWd/mtU	MWd/mtU
2	15.5	16.0	16.0
4	17.5	16.5	16.5
6	17.0	16.3	16.3
8	17.0	16.5	16.5
10	17.0	16.5	16.5

Mk-B9/Mk-B10ZL LHR_{allow} kW/ft*

Core	0	10650	40000	44000	44667	45667	57000
Elevation, ft	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU
2	15.5	16.0	16.0	15.7	15.6	15.5	11.3
4	17.5	16.5	16.5	16.2	15.9	15.5	11.3
6	17.0	16.3	16.3	16.0	15.9	15.5	11.3
8	17.0	16.5	16.5	16.2	15.9	15.5	11.3
10	17.0	16.5	16.5	16.2	15.9	15.5	11.3

Mk-B4Z LHR_{allow} kW/ft*

Core	0	1000	6000	38125	40000	40312	40750	42937	60000
Elevation, ft	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU
2	14.8	14.8	15.5	15.5	15.5	15.4	15.4	15.2	10.1
4	16.1	16.6	16.6	16.6	16.1	16.0	15.9	15.2	10.1
6	16.1	16.1	16.1	16.1	16.1	16.0	15.9	15.2	10.1
8	17.0	17.0	17.0	16.6	16.1	16.0	15.9	15.2	10.1
10	16.0	16.0	16.0	16.0	16.0	15.9	15.9	15.2	10.1

*Linear interpolation is used to calculate the LHR limit to maintain the internal pin pressure less than or equal to the limit based on NRC approved fuel rod gas pressure criterion.

Power Peaking Factors

This Limit is referred to by Technical Specification LCO 3.2.5

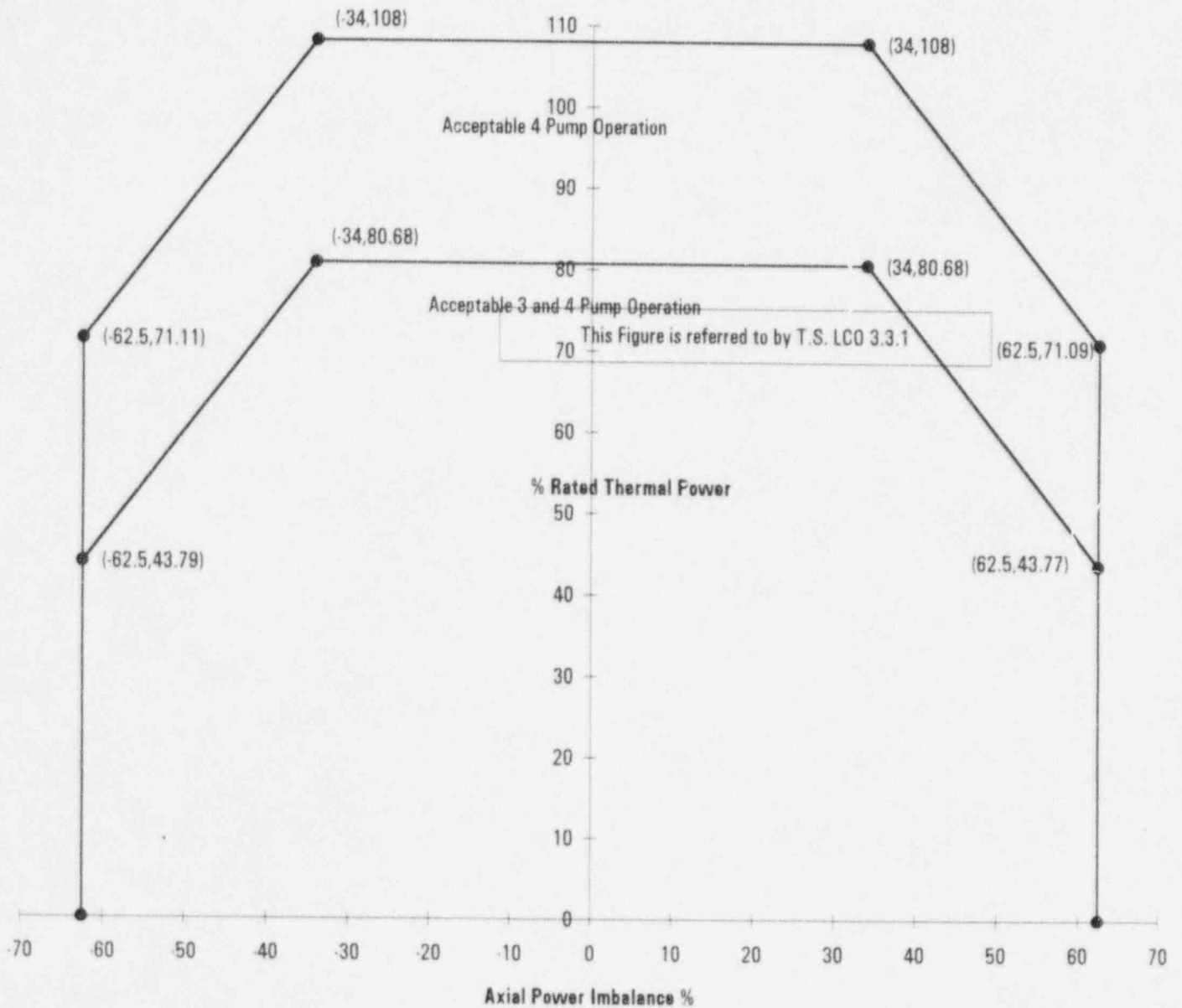
Enthalpy Rise Hot Channel Factor $F_{\Delta H}^N$

$$F_{\Delta H}^N \leq 1.80 [1 + (1-P)/RH]$$

P = Thermal Power/RTP and $P \leq 1.0$

$$RH = 3.34$$

Nuclear Overpower and Axial Power Imbalance Maximum Allowable Trip Setpoint



Refueling Boron Concentration

The boron concentration must be greater than 3013 ppmb

Note: The refueling boron concentration must be increased by 2 ppmb for every EFPD the final Cycle 10 burnup is less than 610 EFPD. The refueling boron concentration can be reduced 2.0 ppmb for every EFPD that the final Cycle 10 burnup exceeds 610 EFPD. The 610 EFPD refueling concentration is 2967. The actual end of cycle 10 was 592.790 EFPD @ 2544 MWt or 587.25 @ 2568 MWt. Using this value and the equation above the refueling boron increases to 3013 ppmb.

This limit is
referred to by
Technical
Specification
LCO 3.9.1