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ONS-2017-004

January 12, 2017

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

Duke Energy Carolinas, LLC (Duke Energy)
Oconee Nuclear Station (ONS) Units 1 and 3
Docket Nos. 50-269 and 50-287
Renewed License Nos. DPR-38 and DPR-55

Subject: Submittal of Core Operating Limits Report (COLR) for Units 1 and 3

Attached, pursuant to Oconee Technical Specification 5.6.5.d, is an information copy of the COLR for Oconee Unit 1, Cycle 30, and Oconee Unit 3, Cycle 29.

If you have any questions regarding this submittal, please contact Stephen C. Newman, Oconee Regulatory Affairs, at 864-873-4388.

Sincerely,

A handwritten signature in black ink that reads 'Thomas D. Ray'. The signature is fluid and cursive, with the first name 'Thomas' being the most prominent.

Thomas D. Ray
Vice President,
Oconee Nuclear Station

Attachment 1: Oconee Unit 1 Cycle 30 COLR
Attachment 2: Oconee Unit 3 Cycle 29 COLR

ADD
NRR

cc w/attachments :

Ms. Catherine. Haney
Administrator Region II
U.S. Nuclear Regulatory Commission
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Mr. Eddy Crowe
NRC Senior Resident Inspector
Oconee Nuclear Station

Attachment 1

Oconee Unit 1 Cycle 30 COLR

Oconee 1 Cycle 30 Core Operating Limits Report AD-EG-ALL-1176 (Rev. 0)	ONEI-0400-470
	Rev. 0

Manual Certification Form

Page		1	of	22
Section 1				
Plant:	Oconee	Unit:	1	Quality Level: 1
Title:	Oconee 1 Cycle 30 Core Operating Limits Report			
Duke Energy File Number:	ONEI-0400-470	Revision Number:	0	
Section 2				
Vendor:	N/A	For Vendor Manuals Only		
Vendor Document Number:	N/A			
Section 3 (Only required when routing a manual for hardcopy signature)				
Responsible Engineer: (or vendor name & P.O. Number, if applicable) N/A				
Prepared By:	L.C. James II (signed electronically)	Date:		
Design Verified By:	J.D. Forster (signed electronically)	Date:		
Approved By:	R.R. St.Clair (signed electronically)	Date:		
Approved By Owner: (N/A except when document revision is prepared, Design Verified, and approved above by a vendor)		Date:		
Section 4				
Revision Description: ORIGINAL ISSUE (REVISION 0)				
NOTES: <ul style="list-style-type: none"> The O1C30 COLR requires the reload 50.59 to be approved prior to implementation and fuel loading. Revision 0 may become effective anytime during NO MODE between cycles 29 and 30, but it must become effective prior to entering MODE 6 at the onset of cycle 30. The O1C30 COLR will cease to be effective during NO MODE between cycles 30 and 31. 				
Section 5 (For both columns, include page numbers, locations, and other identifying information)				
Material Removed from Manual		Material Inserted into Manual		
		Pages 1 through 22		

Oconee 1 Cycle 30

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5.6.5	Core Operating Limits Report (COLR)	None	References

SLC Number		NRC Approved Methodology Reference #	COLR Parameter
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Section 2.0 Core Operating Limits - Not Error Adjusted (NOT FOR PLANT USE)

TS Number	Technical Specification	NRC Approved Methodology Reference #	COLR Parameter
2.1.1	Safety Limits	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Variable Low RCS Pressure Protective Limits Axial Power Imbalance Protective Limits
3.2.1	Regulating Rod Position Limits	1, 3, 4, 5, 7, 8, 9, 10	Rod Index Limits
3.2.3	Quadrant Power Tilt (QPT)	1, 3, 7, 9, 10	Quadrant Power Tilt Limits

Oconee 1 Cycle 30

1.0 Error Adjusted Core Operating Limits

The Core Operating Limits Report for O1C30 has been prepared in accordance with the requirements of TS 5.6.5. The core operating limits within this report have been developed using NRC approved methodology identified in References 1 through 11. The RPS protective limits and maximum allowable setpoints are documented in References 12 through 14. These limits are validated for use in O1C30 by References 15 through 16. The O1C30 analyses assume a design flow of 108.5% of 88,000 gpm per RCS pump, radial local peaking ($F_{\Delta h}$) of 1.714, an axial peaking factor (F_z) of 1.5, and an EOC (< 100 ppmB) Tav_g reduction for up to 10°F provided 4 RCPs are in operation and Tav_g does not decrease below 569°F.

The error adjusted core operating limits included in Section 1 of the report incorporate all necessary uncertainties and margins required for operation of the O1C30 reload core.

1.1 References

1. Oconee Nuclear Design Methodology Using CASMO-4 / SIMULATE-3, DPC-NE-1006-PA, SE dated August 2, 2011.
2. Oconee Nuclear Station Reload Design Methodology II, DPC-NE-1002-A, SE dated July 21, 2011.
3. Oconee Nuclear Station Reload Design Methodology, NFS-1001-A, SE dated July 21, 2011.
4. ONS Core Thermal Hydraulic Methodology Using VIPRE-01, DPC-NE-2003-PA, SE dated July 21, 2011.
5. Thermal Hydraulic Statistical Core Design Methodology, DPC-NE-2005-PA, SE dated October 29, 2008.
6. Fuel Mechanical Reload Analysis Methodology Using TACO3 and GDTACO, DPC-NE-2008-PA, SE dated July 21, 2011.
7. UFSAR Chapter 15 Transient Analysis Methodology, DPC-NE-3005-PA, SE dated April 29, 2016.
8. Thermal Hydraulic Transient Analysis Methodology, DPC-NE-3000-PA, SE dated July 21, 2011.
9. BAW-10192P-A, BWNT LOCA - BWNT Loss of Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, Revision 0, SER dated February 18, 1997.
10. BAW-10164P-A, Rev. 4 and 6, RELAP5/MOD2-B&W - An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis, SERs dated April 9, 2002 and June 25, 2007, respectively.
11. BAW-10227P-A, Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel, Rev. 1, June 2003 (SER to BAW-10186P-A dated June 18, 2003).
12. RPS RCS Pressure & Temperature Trip Function Uncertainty Analyses and Variable Low Pressure Safety Limit, OSC-4048, Revision 6, September 2010.
13. Power Imbalance Safety Limits and Tech Spec Setpoints Using Error Adjusted Flux-Flow Ratio of 1.094, OSC-5604, Revision 4, April 2011.
14. ΔT_c and EOC Reduced Tav_g Operation, OSC-7265, Revision 1, June 2002.
15. O1C30 Maneuvering Analysis, OSC-11546, Revision 1.
16. O1C30 Reload Safety Evaluation, OSC-11634, Revision 0.

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Miscellaneous Setpoints

BWST boron concentration shall be greater than **2500** ppm and less than **3000** ppm.
Referred to by TS 3.5.4.

Spent fuel pool boron concentration shall be greater than **2500** ppm.
Referred to by TS 3.7.12.

The equivalent of at least **1100** cubic feet of **11,000** ppm boron shall be maintained in the CBAST.
Referred to by TS SLC 16.5.13.

CFT boron concentration shall be greater than **2300** ppm. The average boron concentration in the CFT's shall be less than **4000** ppm. Referred to by TS 3.5.1.

RCS and Refueling canal boron concentration shall be greater than **2220** ppm and less than **3000** ppm.
Referred to by TS 3.9.1.

Shutdown Margin (SDM) shall be greater than **1%** $\Delta k/k$.
Referred to by TS 3.1.1.

Moderator Temperature Coefficient (MTC) shall be less than:
Linear interpolation is valid within the table provided.
Referred to by TS 3.1.3.

MTC x 10 ⁻⁴	
$\Delta p / ^\circ F$	% FP
+0.70	0
+0.525	20
0.00	80
0.00	100
0.00	120

Departure from Nucleate Boiling (DNB) parameter for RCS loop pressure shall be
Referred to by TS 3.4.1.

4 RCP:	measured hot leg pressure > 2125 psig
3 RCP:	measured hot leg pressure > 2125 psig

DNB parameter for RCS loop average temperature shall be:
Referred to by TS 3.4.1.

The measured Tav_g must be less than COLR limits minus instrument uncertainty. ΔT_c is the setpoint value selected by the operators.

	Max Loop Tav _g (Incl 2°F unc)	
$\Delta T_c, ^\circ F$	4 RCP Op	3 RCP Op
0	581.0	581.0 *
1	581.4	581.2
2	581.8	581.4
3	582.1	581.7
4	582.5	581.9
5	582.9	582.1

* This limit is applied to the loop with the lowest loop average temperature consistent with the NOTE in SR 3.4.1.2. All other temperature limits apply to the maximum loop Tav_g.

DNB parameter for RCS loop total flow shall be:

4 RCP:	Measured \geq 109.5 %df
3 RCP:	Measured \geq 74.7 % of 4 RCP min flow

Referred to by TS 3.4.1.

Regulating rod groups shall be withdrawn in sequence starting with group 5, group 6, and finally group 7.
Referred to by TS 3.2.1.

Regulating rod group overlap shall be **25% \pm 5%** between two sequential groups.
Referred to by TS 3.2.1.

Misaligned, dropped, or inoperable rods may be excluded from control rod group average calculations when determining if overlap requirements are met as these situations are explicitly addressed by TS 3.1.4 (Control Rod Group Alignment Limits), TS 3.1.5 (Safety Rod Position Limits), and TS 3.2.3 (Quadrant Power Tilt).

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Steady State Operating Band

EFPD	Rod Index		APSR %WD	
	Min	Max	Min	Max
0 to 615	292 ± 5	300	30	40
615 to EOC	292 ± 5	300	100	100

Quadrant Power Tilt Setpoints

Core Power Level, %FP	Steady State		Transient		Maximum
	0 - 30	> 30	0 - 30	> 30	
Full Incore	7.61	3.50	9.40	7.11	16.55
Out of Core	6.09	2.35	7.72	5.63	14.22
Backup Incore	3.87	2.25	4.81	3.63	10.07

Referred to by TS 3.2.3

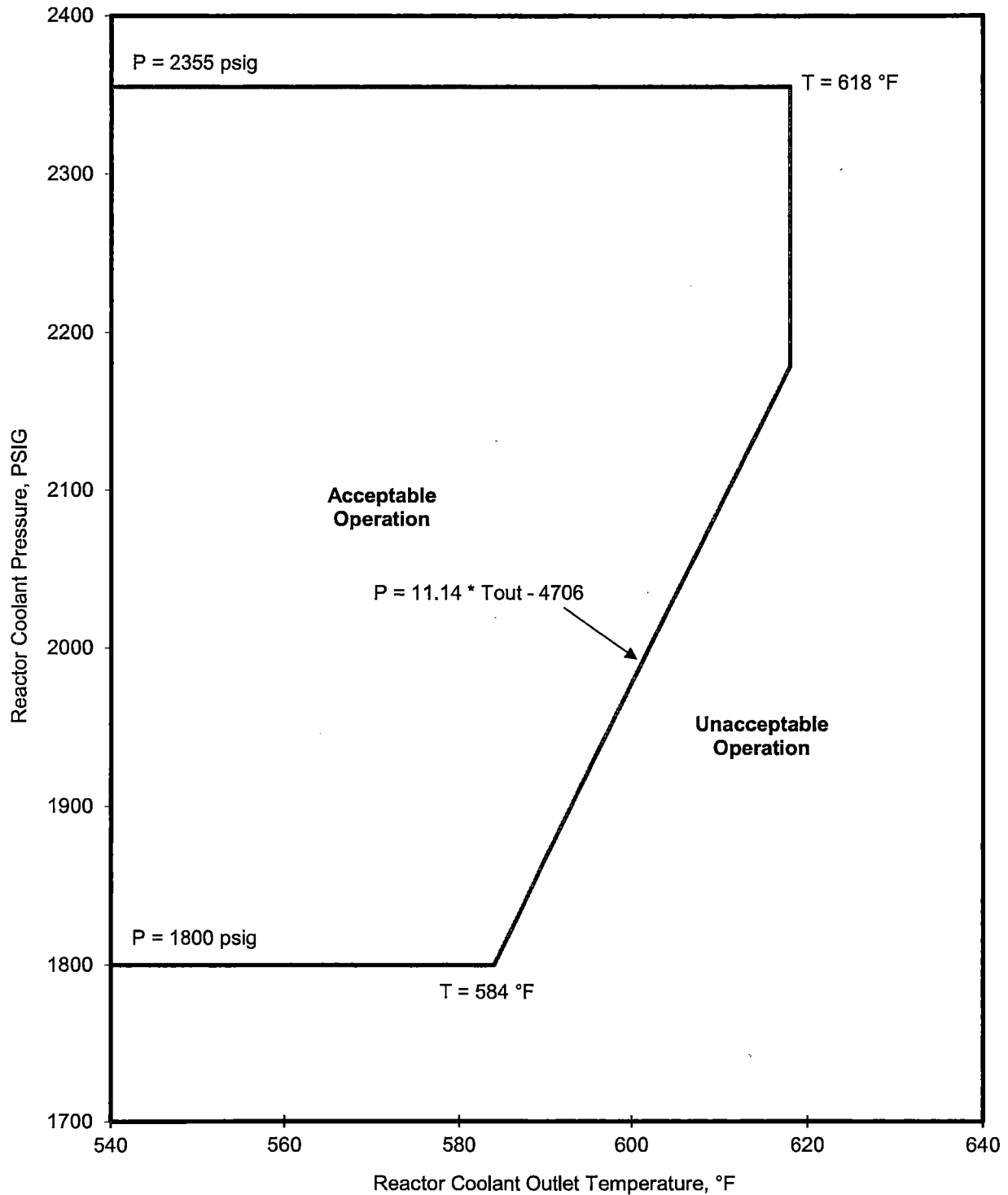
Correlation Slope (CS)

1.15

Referred to by TS 3.3.1 (SR 3.3.1.3).

Oconee 1 Cycle 30
Variable Low RCS Pressure RPS Setpoints

Referred to by TS 3.3.1



Oconee 1 Cycle 30

Referred to by TS 2.1.1 and TS Table 3.3.1-1

Maximum Allowable RPS Power Imbalance Limits

	% FP	% Imbalance
4 Pumps	0.0	-35.0
	90.0	-35.0
	<i>P_{max}</i> => 109.4	-14.4
	<i>P_{max}</i> => 109.4	14.4
	90.0	35.0
	0.0	35.0
3 Pumps	0.0	-35.0
	62.3	-35.0
	<i>P_{max}</i> => 81.7	-14.4
	<i>P_{max}</i> => 81.7	14.4
	62.3	35.0
	0.0	35.0

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Operational Power Imbalance Setpoints

Referred to by TS 3.2.2

	%FP	Full Incore	Backup Incore	Out of Core
4 Pumps	0.0	-28.0	-27.2	-27.5
	80.0	-28.0	-27.2	-27.5
	90.0	-28.0	-24.0	-24.3
	100.0	-17.7	-17.5	-17.7
	102.0	-15.6	-15.6	-15.6
	102.0	15.6	11.0	11.6
	100.0	17.7	13.1	13.7
	90.0	28.0	24.0	24.5
	80.0	28.0	28.0	28.0
	0.0	28.0	28.0	28.0
3 Pumps	0.0	-28.0	-27.2	-27.5
	63.1	-28.0	-	-
	63.5	-	-	-27.5
	63.8	-	-27.2	-
	77.0	-13.2	-13.2	-13.2
	77.0	13.2	13.2	13.2
	63.1	28.0	28.0	28.0
	0.0	28.0	28.0	28.0

Referred to by TS 3.2.2

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RPS / Operational Power Imbalance Setpoints

Operation with 4 RCS Pumps, BOC to EOC

Referred to by TS 3.2.2 and TS 3.3.1

% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	
107.9	-14.4	14.4				
106.0	-16.4	16.4				
105.0	-17.5	17.5				
104.0	-18.5	18.5				
103.0	-19.6	19.6				
102.0	-20.7	20.7	-15.6	15.6	-15.6	11.6
101.0	-21.7	21.7	-16.7	16.7	-16.7	12.7
100.0	-22.8	22.8	-17.7	17.7	-17.7	13.7
99.0	-23.9	23.9	-18.7	18.7	-18.4	14.8
98.0	-24.9	24.9	-19.8	19.8	-19.0	15.9
97.0	-26.0	26.0	-20.8	20.8	-19.7	16.9
96.0	-27.0	27.0	-21.8	21.8	-20.3	18.0
95.0	-28.1	28.1	-22.9	22.9	-21.0	19.1
94.0	-29.2	29.2	-23.9	23.9	-21.7	20.2
93.0	-30.2	30.2	-24.9	24.9	-22.3	21.3
92.0	-31.3	31.3	-25.9	25.9	-23.0	22.3
91.0	-32.3	32.3	-27.0	27.0	-23.6	23.4
90.4	-33.0	33.0	-27.6	27.6	-24.0	24.1
90.0	-33.0	33.0	-28.0	28.0	-24.3	24.5
89.0	-33.0	33.0	-28.0	28.0	-24.6	24.9
88.0	-33.0	33.0	-28.0	28.0	-24.9	25.2
87.0	-33.0	33.0	-28.0	28.0	-25.3	25.6
86.0	-33.0	33.0	-28.0	28.0	-25.6	25.9
85.0	-33.0	33.0	-28.0	28.0	-25.9	26.3
84.0	-33.0	33.0	-28.0	28.0	-26.2	26.6
83.0	-33.0	33.0	-28.0	28.0	-26.5	27.0
82.0	-33.0	33.0	-28.0	28.0	-26.9	27.3
81.0	-33.0	33.0	-28.0	28.0	-27.2	27.7
80.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
0.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	

Oconee 1 Cycle 30

RPS / Operational Power Imbalance Setpoints

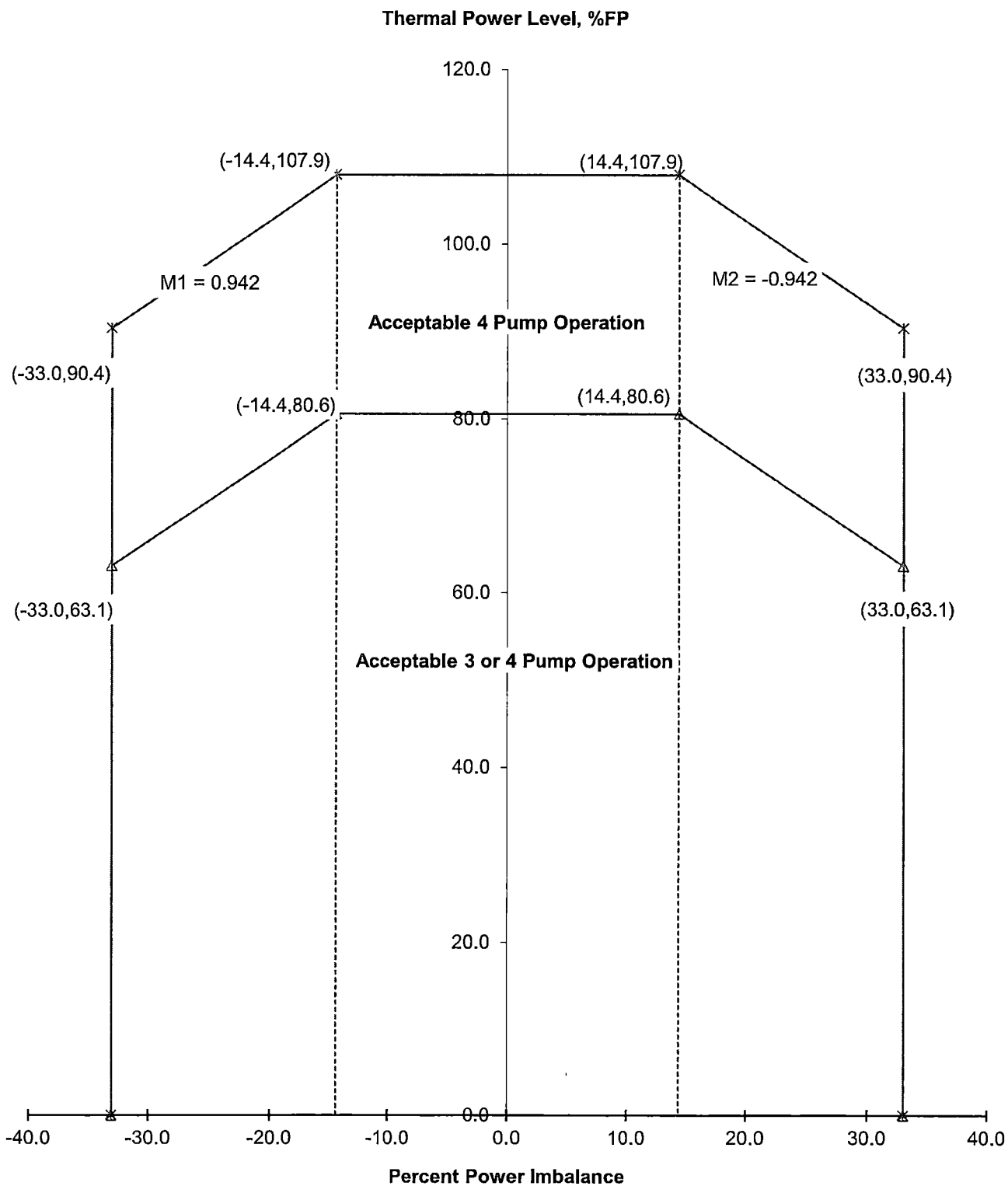
Operation with 3 RCS Pumps, BOC to EOC

Referred to by TS 3.2.2 and TS 3.3.1

% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	
80.6	-14.4	14.4				
80.0	-15.0	15.0				
79.0	-16.1	16.1				
78.0	-17.1	17.1				
77.0	-18.2	18.2	-13.2	13.2	-13.2	13.2
76.0	-19.3	19.3	-14.3	14.3	-14.3	14.3
75.0	-20.3	20.3	-15.3	15.3	-15.3	15.3
74.0	-21.4	21.4	-16.4	16.4	-16.4	16.4
73.0	-22.4	22.4	-17.4	17.4	-17.4	17.4
72.0	-23.5	23.5	-18.5	18.5	-18.5	18.5
71.0	-24.6	24.6	-19.6	19.6	-19.6	19.6
70.0	-25.6	25.6	-20.6	20.6	-20.6	20.6
69.0	-26.7	26.7	-21.7	21.7	-21.7	21.7
68.0	-27.8	27.8	-22.8	22.8	-22.8	22.8
67.0	-28.8	28.8	-23.8	23.8	-23.8	23.8
66.0	-29.9	29.9	-24.9	24.9	-24.9	24.9
65.0	-30.9	30.9	-25.9	25.9	-25.9	25.9
64.0	-32.0	32.0	-27.0	27.0	-27.0	27.0
63.5	-32.5	32.5	-27.5	27.5	-27.5	27.5
63.1	-33.0	33.0	-28.0	28.0	-27.5	28.0
63.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
62.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
61.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
60.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
0.0	-33.0	33.0	-28.0	28.0	-27.5	28.0
% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	

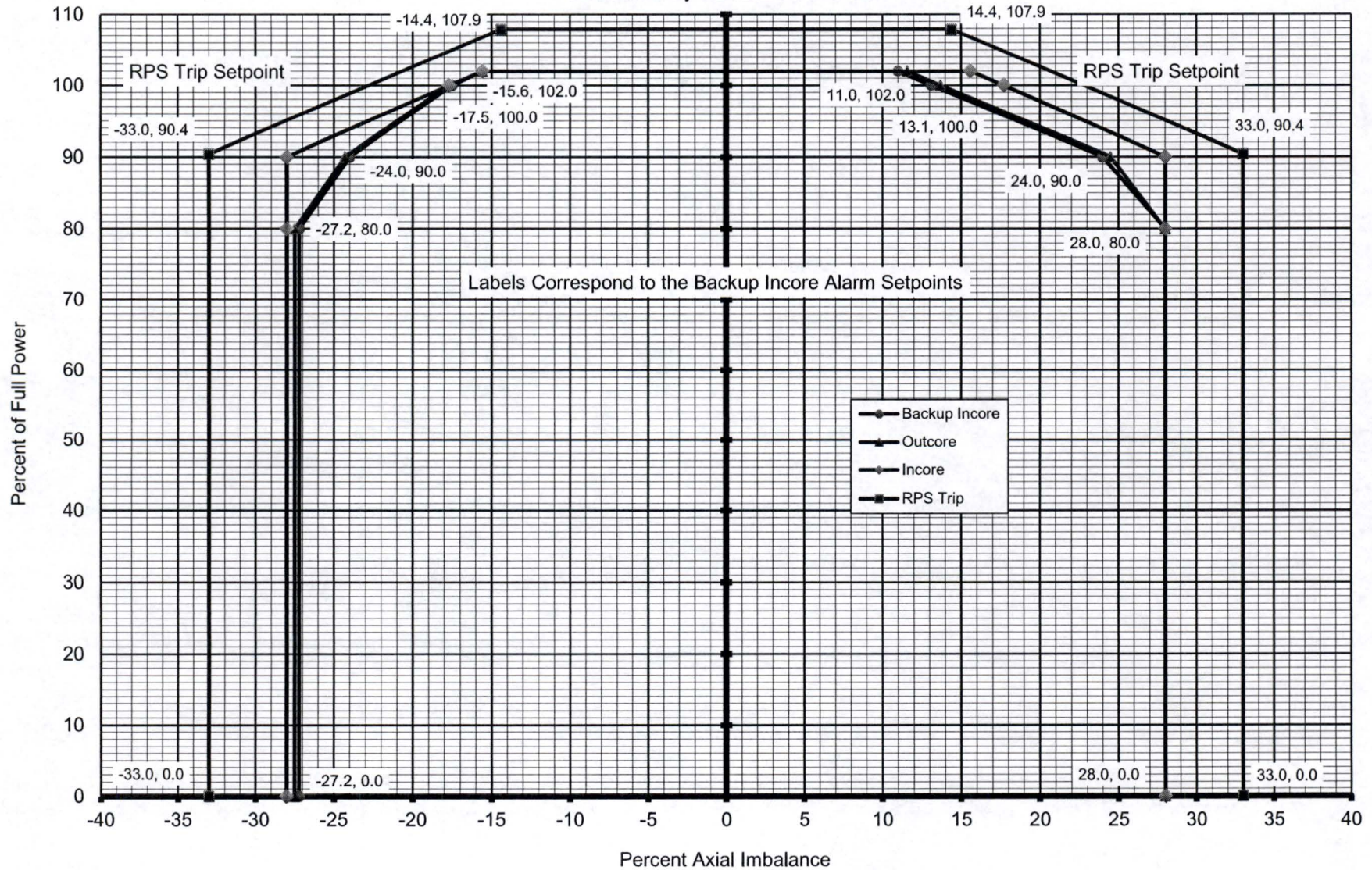
Oconee 1 Cycle 30
RPS Power Imbalance Setpoints

Referred to by TS 3.3.1 and TS Table 3.3.1-1



Oconee 1 Cycle 30
Imbalance Setpoints for 4 Pump Operation, BOC to EOC
 Referred to by TS 3.2.2 and TS 3.3.1

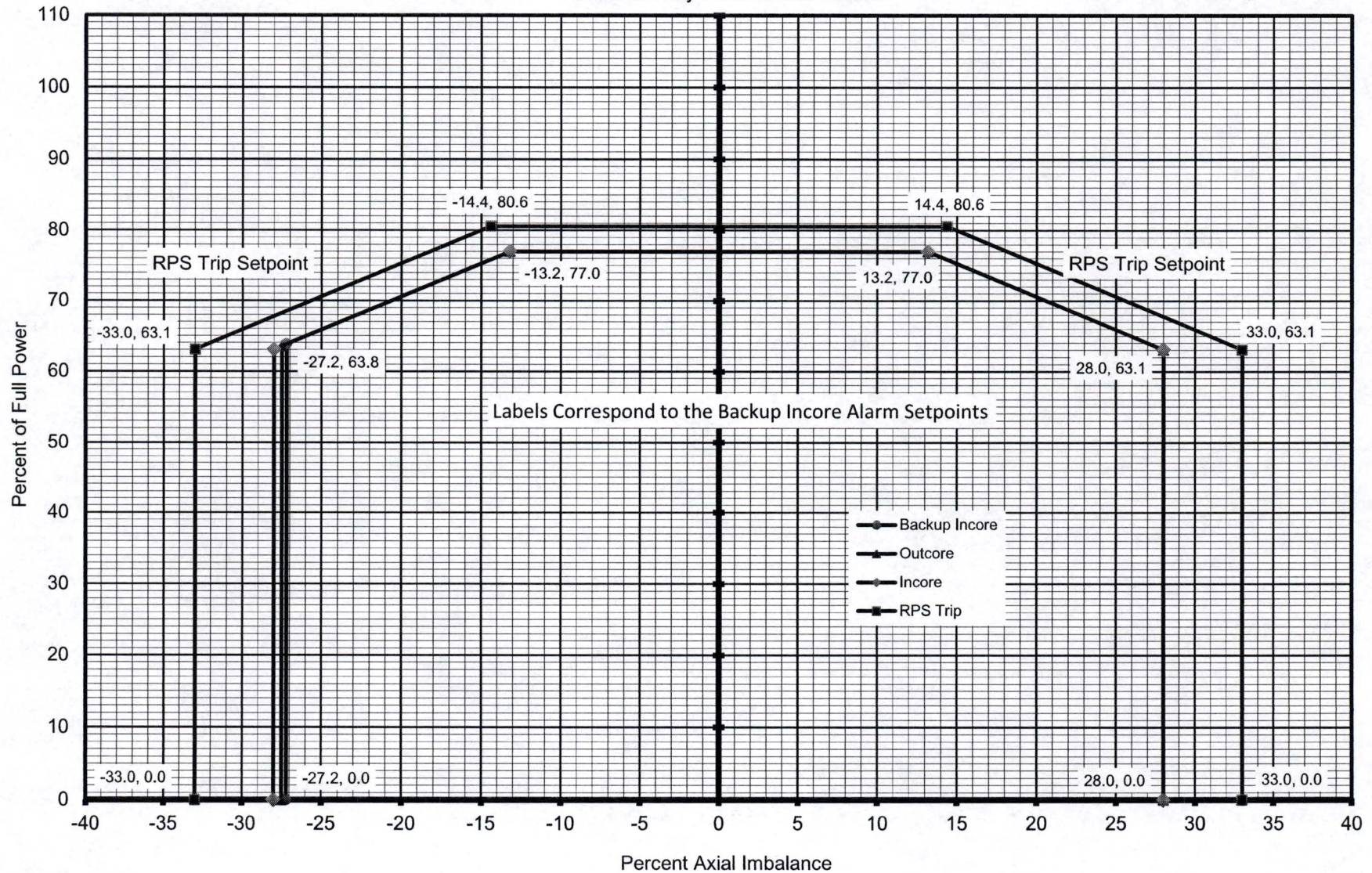
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Oconee 1 Cycle 30
Imbalance Setpoints for 3 Pump Operation, BOC to EOC
Referred to by TS 3.2.2 and TS 3.3.1

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Oconee 1 Cycle 30
Operational Rod Index Setpoints

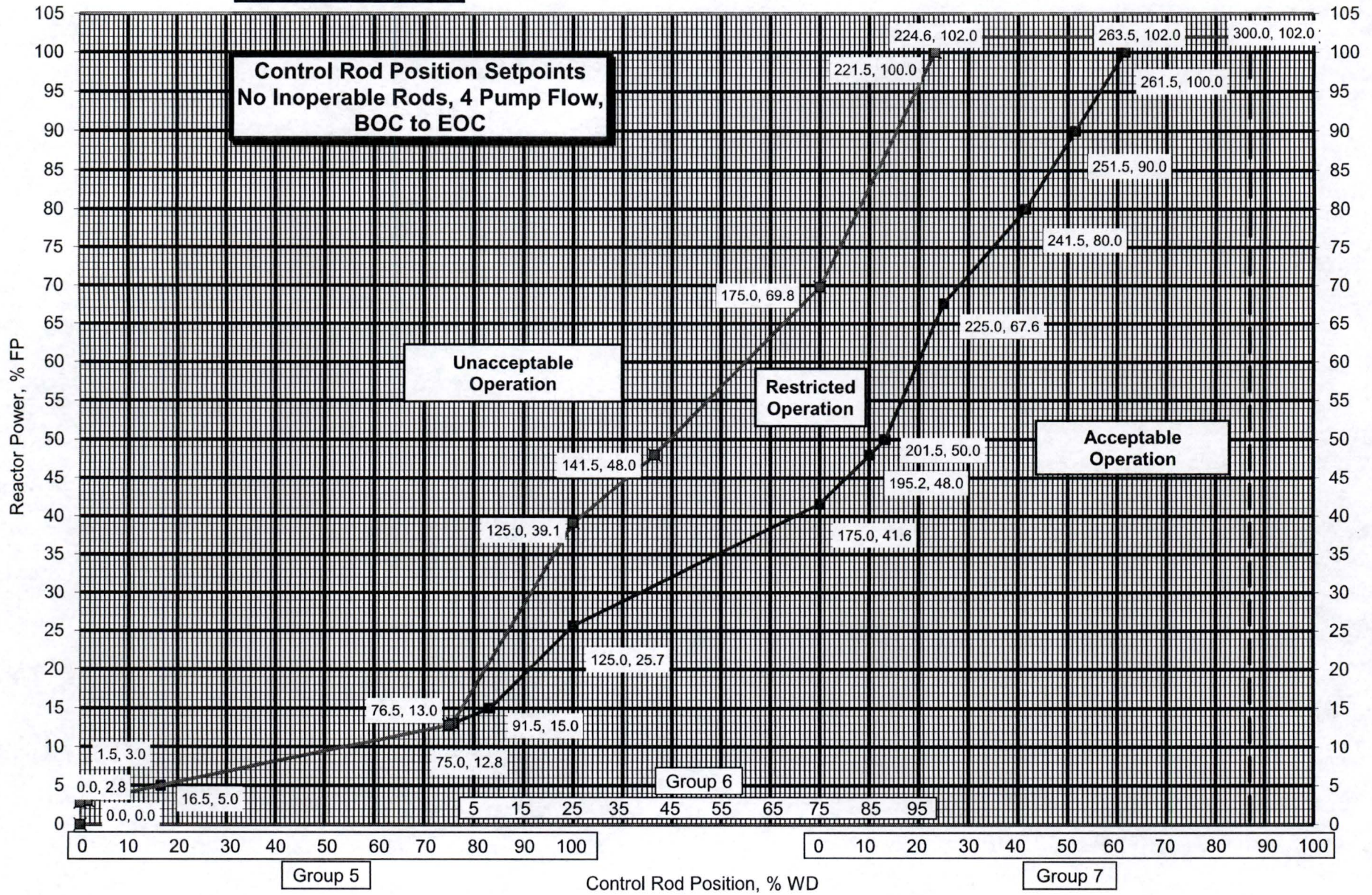
Referred to by TS 3.2.1

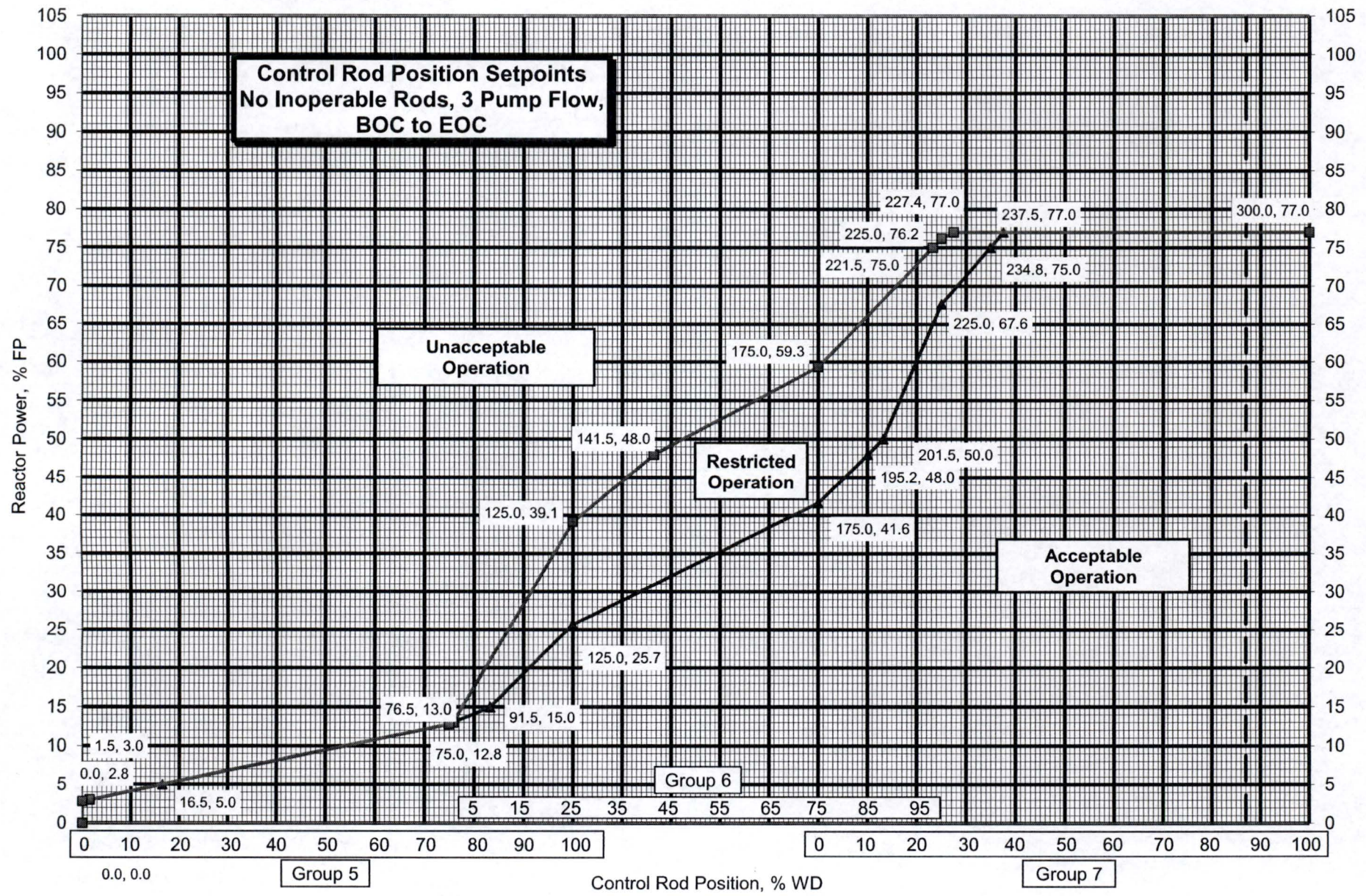
	%FP	RI Insertion Setpoint		RI Withdrawal Setpoint
		No Inop Rod	1 Inop Rod	
4 Pumps	102.0	263.5	283.4	300
	100.0	261.5	281.5	300
	90.0	251.5	271.9	300
	80.0	241.5	262.3	300
	50.0	201.5	233.4	300
	48.0	195.2	231.5	300
	15.0	91.5	165.5	300
	13.0	76.5	161.5	300
	5.0	16.5	93.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300
3 Pumps	77.0	237.5	285.2	300
	75.0	234.8	281.5	300
	50.0	201.5	235.2	300
	48.0	195.2	231.5	300
	15.0	91.5	165.5	300
	13.0	76.5	161.5	300
	5.0	16.5	93.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300

Oconee 1 Cycle 30
Shutdown Margin Rod Index Setpoints

Referred to by TS 3.2.1

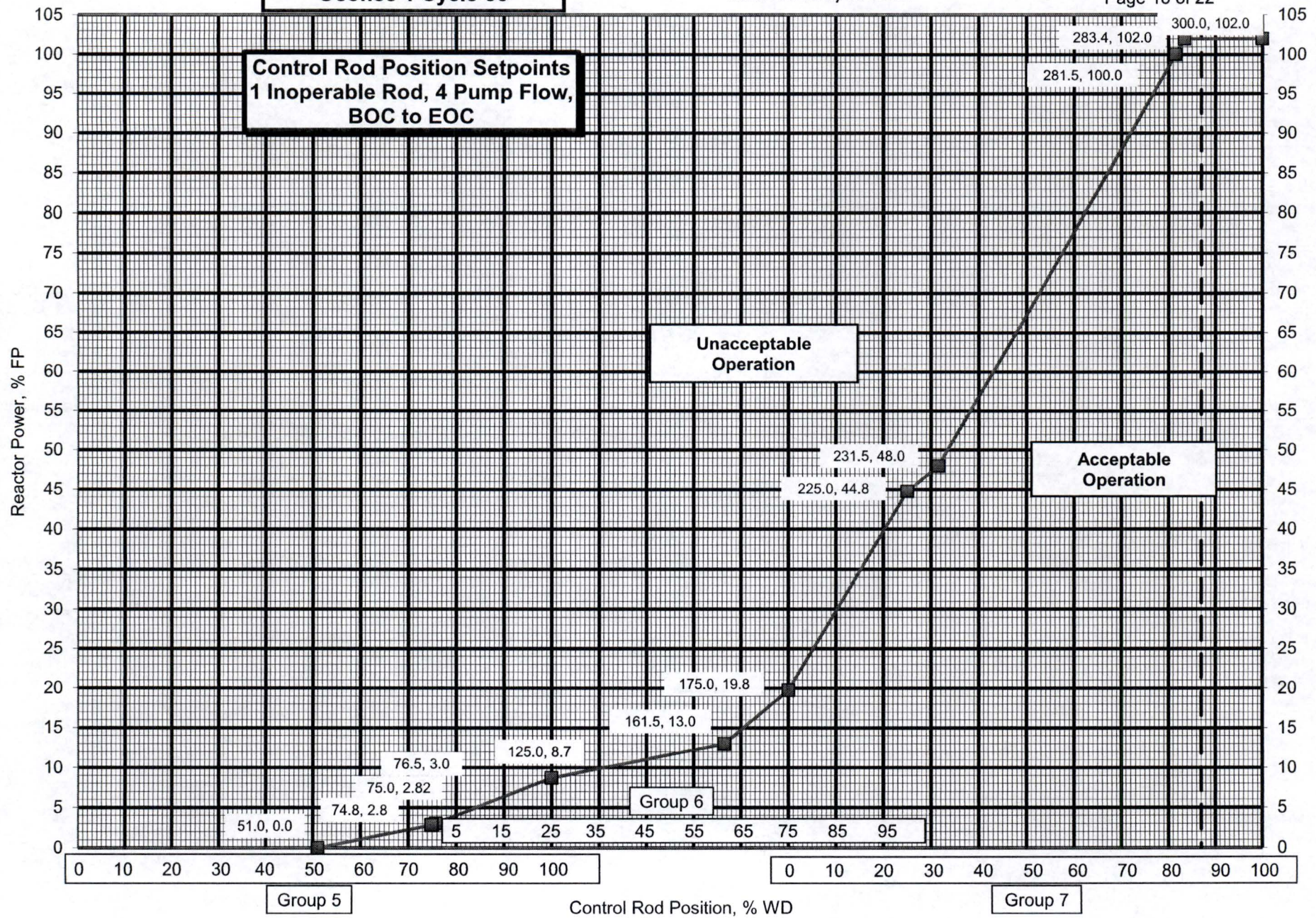
	%FP	RI Insertion Setpoint		RI Withdrawal Setpoint
		No Inop Rod	1 Inop Rod	
4 Pumps	102.0	224.6	283.4	300
	100.0	221.5	281.5	300
	48.0	141.5	231.5	300
	13.0	76.5	161.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300
3 Pumps	77.0	227.4	285.2	300
	75.0	221.5	281.5	300
	48.0	141.5	231.5	300
	13.0	76.5	161.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300





Referred to by TS 3.2.1

Oconee 1 Cycle 30

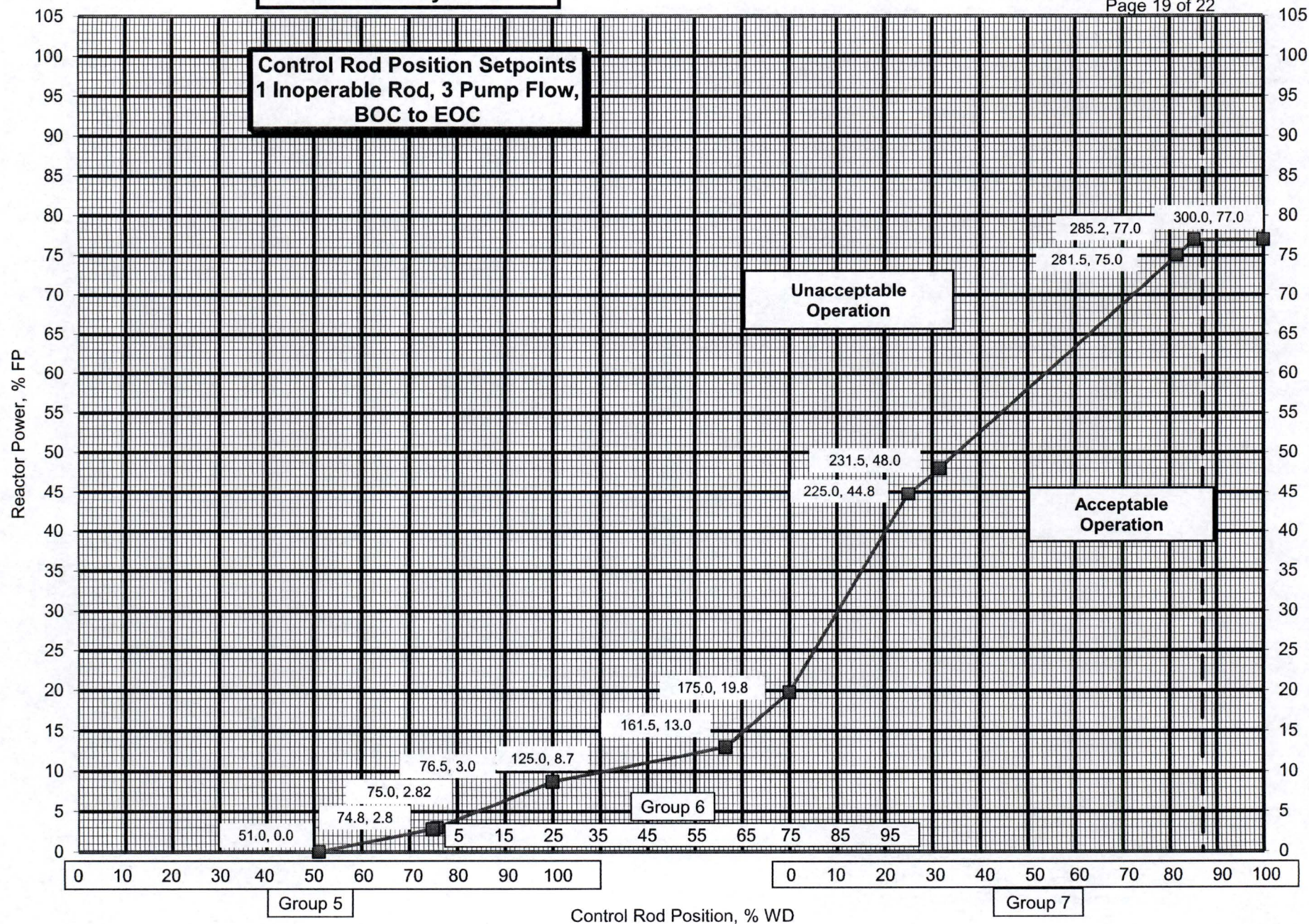


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Referred to by TS 3.2.1

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2.0 Core Operating Limits -- Not Error Adjusted

The data provided on the following pages satisfies a licensing commitment to identify specific parameters before instrumentation uncertainties are incorporated.

References provided in section 1 of this COLR identify the sources for the data which follows.

Information provided in this section should not be used in plant procedures.

Quadrant Power Tilt Limits

Referred to by TS 3.2.3

	Steady State		Transient		Maximum
Core Power Level, %FP	0 - 30	> 30	0 - 30	> 30	> 0
Quadrant Power Tilt, %	10.00	5.40	12.00	9.44	20.00

Variable Low RCS Pressure Protective Limits

Referred to by TS 2.1.1

Core Outlet Pressure psia	Reactor Coolant Outlet Temperature, °F	
	3 RCS Pumps	4 RCS Pumps
1800	581.0	578.3
1900	590.0	587.3
2000	598.9	596.3
2100	607.9	605.2
2200	616.9	614.2
2300	625.9	623.2

Oconee 1 Cycle 30

Axial Power Imbalance Protective Limits

Referred to by TS 2.1.1

Not for Plant Use

	%FP	RPS	Operational
4 Pumps	0.0	-35.0	-39.0
	80.0	-	-39.0
	90.0	-35.0	-35.8
	100.0	-	-28.4
	109.4	-14.4	-
	109.4	14.4	-
	100.0	-	23.5
	90.0	35.0	36.0
	80.0	-	39.5
	0.0	35.0	39.5
3 Pumps	0.0	-35.0	-39.0
	62.3	-35.0	-
	77.0	-	-39.0
	81.7	-14.4	-
	81.7	14.4	-
	77.0	-	39.5
	62.3	35.0	-
	0.0	35.0	39.5

Oconee 1 Cycle 30

Rod Index Limits

Referred to by TS 3.2.1

Not for Plant Use

	%FP	Operational RI Insertion Limit	Shutdown Margin RI No Inop Rod	Insertion Limit 1 Inop Rod	RI Withdrawal Limit
4 Pumps	102	262	220	280	300
	100	260	-	-	300
	90	250	-	-	300
	80	240	-	-	300
	50	200	140	230	300
	15	90	75	160	300
	5	0	0	75	300
3 Pumps	77	236	220	280	300
	50	200	140	230	300
	15	90	75	160	300
	5	0	0	75	300

Attachment 2

Oconee Unit 3 Cycle 29 COLR

Oconee 3 Cycle 29 Core Operating Limits Report AD-EG-ALL-1176 (Rev. 0)	ONEI-0400-459
	Rev. 0

Manual Certification Form

		Page	1	of	22
Section 1					
Plant:	Oconee	Unit:	3	Quality Level:	1
Title:	Oconee 3 Cycle 29 Core Operating Limits Report				
Duke Energy File Number:	ONEI-0400-459	Revision Number:	0		
Section 2					
Vendor:	N/A				For Vendor
Vendor Document Number:	N/A				Manuals Only
Section 3 (Only required when routing a manual for hardcopy signature)					
Responsible Engineer: (or vendor name & P.O. Number, if applicable) N/A					
Prepared By:	D.S. Orr (signed electronically)			Date:	
Design Verified By:	A.L. Lang (signed electronically)			Date:	
Approved By:	R.R. St.Clair (signed electronically)			Date:	
Approved By Owner: (N/A except when document revision is prepared, Design Verified, and approved above by a vendor)				Date:	
Section 4					
Revision Description: ORIGINAL ISSUE (REVISION 0)					
NOTES:					
<ul style="list-style-type: none"> The O3C29 COLR requires the reload 50.59 to be approved prior to implementation and fuel loading. Revision 0 may become effective anytime during NO MODE between cycles 28 and 29, but it must become effective prior to entering MODE 6 at the onset of cycle 29. The O3C29 COLR will cease to be effective during NO MODE between cycles 29 and 30. 					
Section 5 (For both columns, include page numbers, locations, and other identifying information)					
Material Removed from Manual			Material Inserted into Manual		
			Pages 1 through 22		

Oconee 3 Cycle 29

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3.1.3	Moderator Temperature Coefficient (MTC)	1, 3, 7	MTC
3.1.4	Control Rod Group Alignment Limits	1, 3, 7, 8	Misaligned, Dropped, or Inoperable
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3.4.1	RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling Limits	4, 5, 7, 8	RCS Pressure, Temperature, and Flow
3.5.1	Core Flood Tanks (CFTs)	1, 3, 7, 8	Boron Concentration
3.5.4	Borated Water Storage Tank (BWST)	1, 3, 7, 8	Boron Concentration
3.7.12	Spent Fuel Pool Boron Concentration	1, 3, 7, 8	Boron Concentration
3.9.1	Boron Concentration (RCS and Refueling Canal)	1, 3, 7, 8	Boron Concentration
5.6.5	Core Operating Limits Report (COLR)	None	References

SLC Number	Technical Specification	NRC Approved Methodology Reference #	COLR Parameter
16.5.13	High Pressure Injection and Chemical Addition Systems	1, 3, 7, 8	Volume and Boron Concentration of Concentrated Boric Acid Storage Tank (CBAST)

Section 2.0 Core Operating Limits - Not Error Adjusted (NOT FOR PLANT USE)

TS Number	Technical Specification	NRC Approved Methodology Reference #	COLR Parameter
2.1.1	Safety Limits	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Variable Low RCS Pressure Protective Limits Axial Power Imbalance Protective Limits
3.2.1	Regulating Rod Position Limits	1, 3, 4, 5, 7, 8, 9, 10	Rod Index Limits
3.2.3	Quadrant Power Tilt (QPT)	1, 3, 7, 9, 10	Quadrant Power Tilt Limits

Oconee 3 Cycle 29

1.0 Error Adjusted Core Operating Limits

The Core Operating Limits Report for O3C29 has been prepared in accordance with the requirements of TS 5.6.5. The core operating limits within this report have been developed using NRC approved methodology identified in References 1 through 11. The RPS protective limits and maximum allowable setpoints are documented in References 12 through 14. These limits are validated for use in O3C29 by References 15 through 17. The O3C29 analyses assume a design flow of 108.5% of 88,000 gpm per RCS pump, radial local peaking ($F_{\Delta h}$) of 1.714, an axial peaking factor (F_z) of 1.5, and an EOC (< 100 ppmB) Tav_g reduction for up to 10°F provided 4 RCPs are in operation and Tav_g does not decrease below 569°F.

The error adjusted core operating limits included in Section 1 of the report incorporate all necessary uncertainties and margins required for operation of the O3C29 reload core.

1.1 References

1. Oconee Nuclear Design Methodology Using CASMO-4 / SIMULATE-3, DPC-NE-1006-PA, SE dated August 2, 2011.
2. Oconee Nuclear Station Reload Design Methodology II, DPC-NE-1002-A, SE dated July 21, 2011.
3. Oconee Nuclear Station Reload Design Methodology, NFS-1001-A, SE dated July 21, 2011.
4. ONS Core Thermal Hydraulic Methodology Using VIPRE-01, DPC-NE-2003-PA, SE dated July 21, 2011.
5. Thermal Hydraulic Statistical Core Design Methodology, DPC-NE-2005-PA, SE dated October 29, 2008.
6. Fuel Mechanical Reload Analysis Methodology Using TACO3 and GDTACO, DPC-NE-2008-PA, SE dated July 21, 2011.
7. UFSAR Chapter 15 Transient Analysis Methodology, DPC-NE-3005-PA, SE dated July 21, 2011.
8. Thermal Hydraulic Transient Analysis Methodology, DPC-NE-3000-PA, SE dated July 21, 2011.
9. BAW-10192P-A, BWNT LOCA - BWNT Loss of Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, Revision 0, SER dated February 18, 1997.
10. BAW-10164P-A, Rev. 4 and 6, RELAP5/MOD2-B&W - An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis, SERs dated April 9, 2002 and June 25, 2007, respectively.
11. BAW-10227P-A, Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel, Rev. 1, June 2003 (SER to BAW-10186P-A dated June 18, 2003).
12. RPS RCS Pressure & Temperature Trip Function Uncertainty Analyses and Variable Low Pressure Safety Limit, OSC-4048, Revision 6, September 2010.
13. Power Imbalance Safety Limits and Tech Spec Setpoints Using Error Adjusted Flux-Flow Ratio of 1.094, OSC-5604, Revision 4, April 2011.
14. ΔT_c and EOC Reduced Tav_g Operation, OSC-7265, Revision 1, June 2002.
15. O3C29 Maneuvering Analysis, OSC-11474, Revision 1.
16. O3C29 Specific DNB Evaluation, DPND-1553.63-0742, Revision 0.
17. O3C29 Reload Safety Evaluation, OSC-11539, Revision 0.

Oconee 3 Cycle 29

Miscellaneous Setpoints

BWST boron concentration shall be greater than 2500 ppm and less than 3000 ppm.
Referred to by TS 3.5.4.

Spent fuel pool boron concentration shall be greater than 2500 ppm.
Referred to by TS 3.7.12.

The equivalent of at least 1100 cubic feet of 11,000 ppm boron shall be maintained in the CBAST.
Referred to by TS SLC 16.5.13.

CFT boron concentration shall be greater than 2300 ppm. The average boron concentration in the CFT's shall be less than 4000 ppm. Referred to by TS 3.5.1.

RCS and Refueling canal boron concentration shall be greater than 2220 ppm and less than 3000 ppm.
Referred to by TS 3.9.1.

Shutdown Margin (SDM) shall be greater than 1% $\Delta k/k$.
Referred to by TS 3.1.1.

Moderator Temperature Coefficient (MTC) shall be less than:	MTC x 10 ⁻⁴	
Linear interpolation is valid within the table provided.	$\Delta p / ^\circ F$	% FP
Referred to by TS 3.1.3.	+0.70	0
	+0.525	20
	0.00	80
	0.00	100
	0.00	120

Departure from Nucleate Boiling (DNB) parameter for RCS loop pressure shall be
Referred to by TS 3.4.1.

4 RCP:	measured hot leg pressure > 2125 psig
3 RCP:	measured hot leg pressure > 2125 psig

DNB parameter for RCS loop average temperature shall be:	Max Loop Tavg (Incl 2°F unc)		
Referred to by TS 3.4.1.	$\Delta T_c, ^\circ F$	4 RCP Op	3 RCP Op
	0	581.0	581.0 *
	1	581.4	581.2
	2	581.8	581.4
	3	582.1	581.7
	4	582.5	581.9
	5	582.9	582.1

The measured Tavg must be less than COLR limits minus instrument uncertainty. ΔT_c is the setpoint value selected by the operators.

* This limit is applied to the loop with the lowest loop average temperature consistent with the NOTE in SR 3.4.1.2. All other temperature limits apply to the maximum loop Tavg.

DNB parameter for RCS loop total flow shall be:

4 RCP:	Measured ≥ 108.5 %df
3 RCP:	Measured ≥ 74.7 % of 4 RCP min flow

Referred to by TS 3.4.1.

Regulating rod groups shall be withdrawn in sequence starting with group 5, group 6, and finally group 7.
Referred to by TS 3.2.1.

Regulating rod group overlap shall be 25% \pm 5% between two sequential groups.
Referred to by TS 3.2.1.

Misaligned, dropped, or inoperable rods may be excluded from control rod group average calculations when determining if overlap requirements are met as these situations are explicitly addressed by TS 3.1.4 (Control Rod Group Alignment Limits), TS 3.1.5 (Safety Rod Position Limits), and TS 3.2.3 (Quadrant Power Tilt).

Oconee 3 Cycle 29

Steady State Operating Band

EFPD	Rod Index		APSR %WD	
	Min	Max	Min	Max
0 to 635	292 ± 5	300	30	40
635 to EOC	292 ± 5	300	100	100

Quadrant Power Tilt Setpoints

Core Power Level, %FP	Steady State		Transient		Maximum > 0
	0 - 30	> 30	0 - 30	> 30	
Full Incore	7.61	3.50	9.40	7.11	16.55
Out of Core	6.09	2.35	7.72	5.63	14.22
Backup Incore	3.87	2.25	4.81	3.63	10.07

Referred to by TS 3.2.3

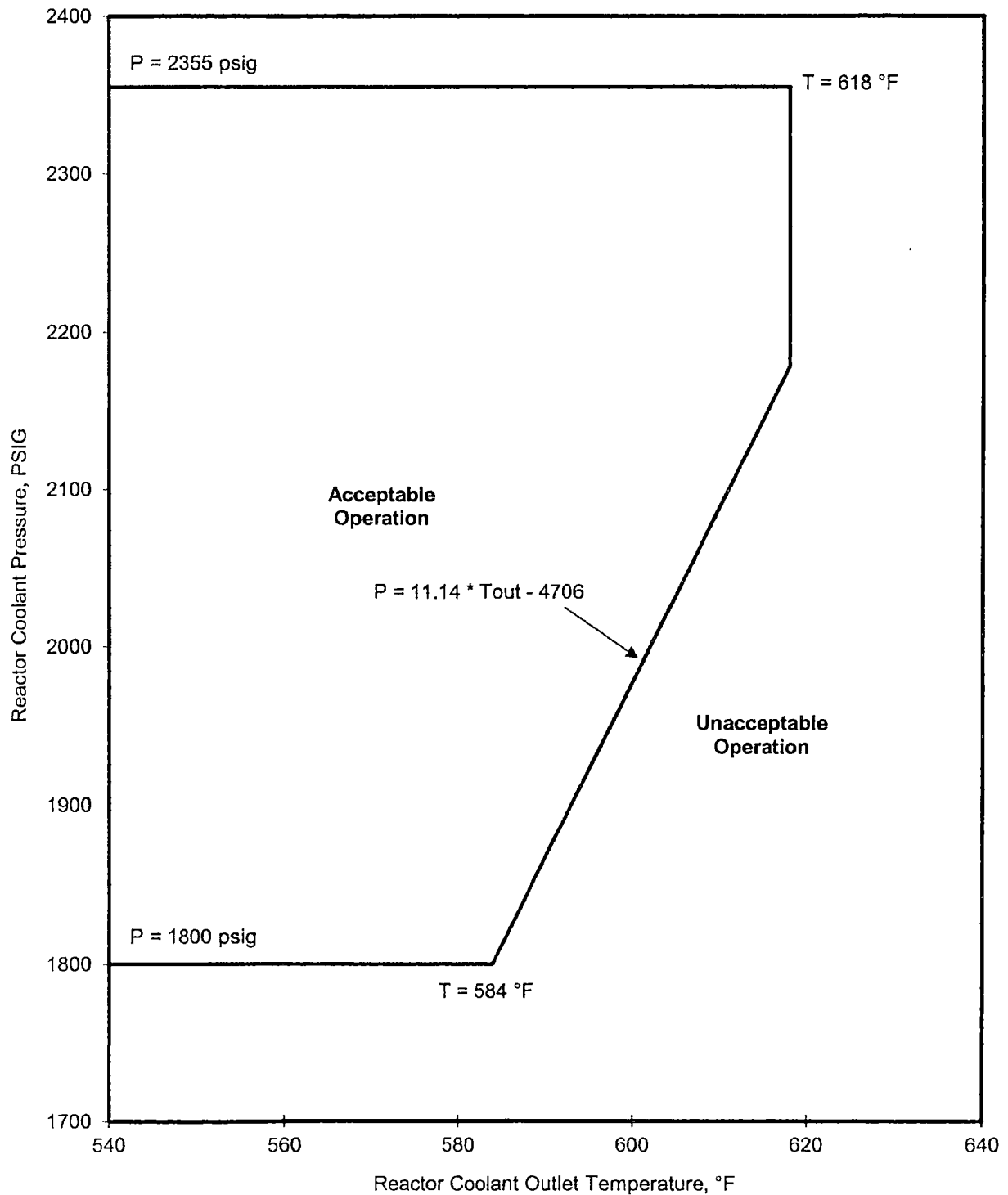
Correlation Slope (CS)

1.15

Referred to by TS 3.3.1 (SR 3.3.1.3).

Oconee 3 Cycle 29
Variable Low RCS Pressure RPS Setpoints

Referred to by TS 3.3.1



Oconee 3 Cycle 29

Referred to by TS 2.1.1 and TS Table 3.3.1-1

Maximum Allowable RPS Power Imbalance Limits

	% FP	% Imbalance
4 Pumps	0.0	-35.0
	90.0	-35.0
	<i>P_{max}</i> => 109.4	-14.4
	<i>P_{max}</i> => 109.4	14.4
	90.0	35.0
	0.0	35.0
3 Pumps	0.0	-35.0
	62.3	-35.0
	<i>P_{max}</i> => 81.7	-14.4
	<i>P_{max}</i> => 81.7	14.4
	62.3	35.0
	0.0	35.0

Oconee 3 Cycle 29

Operational Power Imbalance Setpoints

Referred to by TS 3.2.2

	%FP	Full Incore	Backup Incore	Out of Core
4 Pumps	0.0	-28.0	-27.4	-27.7
	80.0	-28.0	-27.4	-27.7
	90.0	-28.0	-25.5	-25.8
	100.0	-17.7	-17.7	-17.7
	102.0	-15.6	-15.6	-15.6
	102.0	15.6	12.9	13.3
	100.0	17.7	14.4	14.7
	90.0	28.0	21.4	21.8
	80.0	28.0	26.7	27.2
	0.0	28.0	26.7	27.2
3 Pumps	0.0	-28.0	-27.4	-27.7
	63.1	-28.0	-	-
	63.3	-	-	-27.7
	63.6	-	-27.4	-
	77.0	-13.2	-13.2	-13.2
	77.0	13.2	13.2	13.2
	64.2	-	26.7	-
	63.8	-	-	27.2
	63.1	28.0	-	-
	0.0	28.0	26.7	27.2

Referred to by TS 3.2.2

Oconee 3 Cycle 29

RPS / Operational Power Imbalance Setpoints

Operation with 4 RCS Pumps, BOC to EOC

Referred to by TS 3.2.2 and TS 3.3.1

% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	
107.9	-14.4	14.4				
106.0	-16.4	16.4				
105.0	-17.5	17.5				
104.0	-18.5	18.5				
103.0	-19.6	19.6				
102.0	-20.7	20.7	-15.6	15.6	-15.6	13.3
101.0	-21.7	21.7	-16.7	16.7	-16.7	14.0
100.0	-22.8	22.8	-17.7	17.7	-17.7	14.7
99.0	-23.9	23.9	-18.7	18.7	-18.5	15.4
98.0	-24.9	24.9	-19.8	19.8	-19.3	16.1
97.0	-26.0	26.0	-20.8	20.8	-20.1	16.8
96.0	-27.0	27.0	-21.8	21.8	-20.9	17.5
95.0	-28.1	28.1	-22.9	22.9	-21.8	18.3
94.0	-29.2	29.2	-23.9	23.9	-22.6	19.0
93.0	-30.2	30.2	-24.9	24.9	-23.4	19.7
92.0	-31.3	31.3	-25.9	25.9	-24.2	20.4
91.0	-32.3	32.3	-27.0	27.0	-25.0	21.1
90.4	-33.0	33.0	-27.6	27.6	-25.5	21.5
90.0	-33.0	33.0	-28.0	28.0	-25.8	21.8
89.0	-33.0	33.0	-28.0	28.0	-26.0	22.3
88.0	-33.0	33.0	-28.0	28.0	-26.2	22.9
87.0	-33.0	33.0	-28.0	28.0	-26.4	23.4
86.0	-33.0	33.0	-28.0	28.0	-26.6	24.0
85.0	-33.0	33.0	-28.0	28.0	-26.8	24.5
84.0	-33.0	33.0	-28.0	28.0	-26.9	25.1
83.0	-33.0	33.0	-28.0	28.0	-27.1	25.6
82.0	-33.0	33.0	-28.0	28.0	-27.3	26.1
81.0	-33.0	33.0	-28.0	28.0	-27.5	26.7
80.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
0.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	

Oconee 3 Cycle 29

RPS / Operational Power Imbalance Setpoints

Operation with 3 RCS Pumps, BOC to EOC

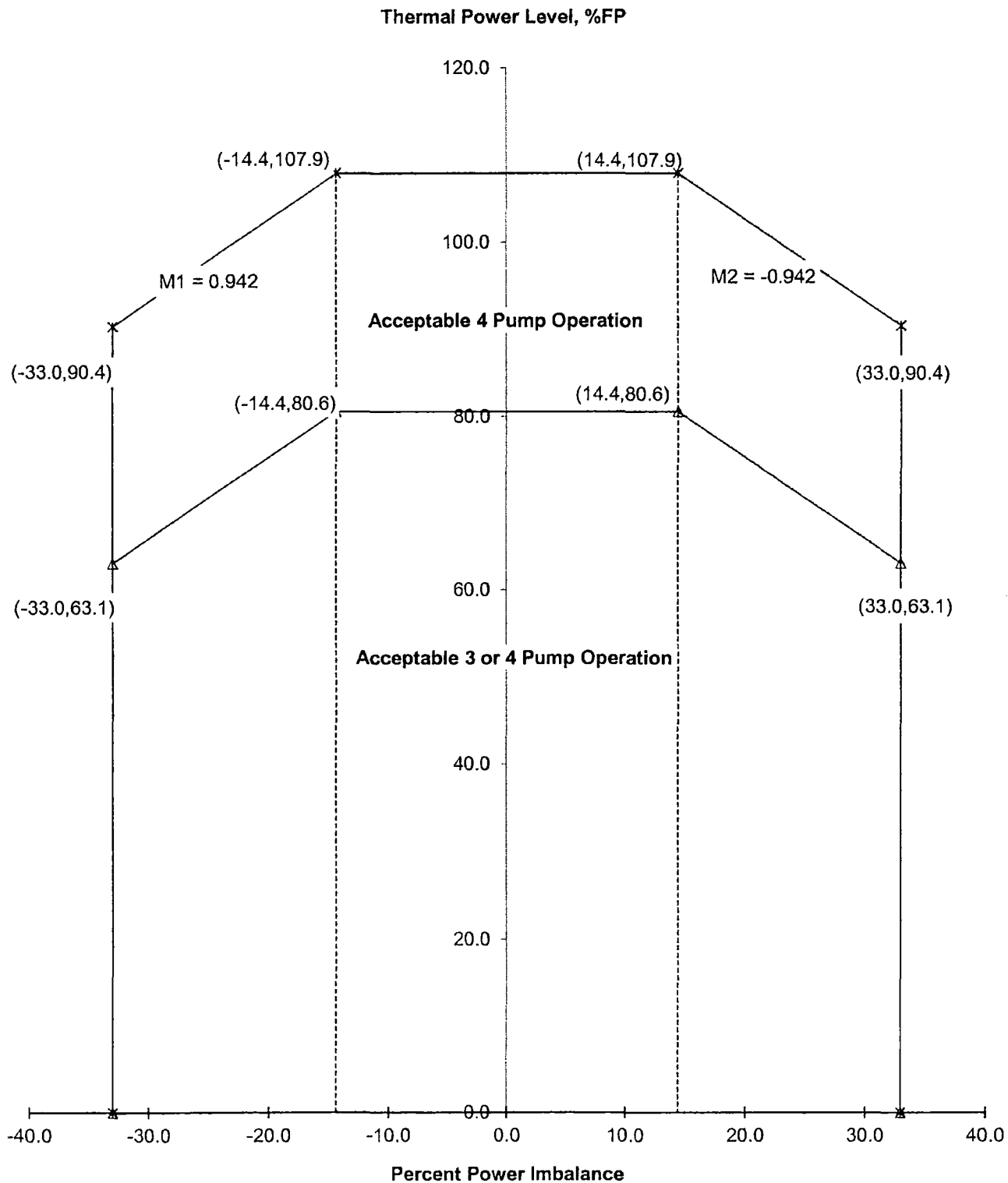
Referred to by TS 3.2.2 and TS 3.3.1

% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	
80.6	-14.4	14.4				
80.0	-15.0	15.0				
79.0	-16.1	16.1				
78.0	-17.1	17.1				
77.0	-18.2	18.2	-13.2	13.2	-13.2	13.2
76.0	-19.3	19.3	-14.3	14.3	-14.3	14.3
75.0	-20.3	20.3	-15.3	15.3	-15.3	15.3
74.0	-21.4	21.4	-16.4	16.4	-16.4	16.4
73.0	-22.4	22.4	-17.4	17.4	-17.4	17.4
72.0	-23.5	23.5	-18.5	18.5	-18.5	18.5
71.0	-24.6	24.6	-19.6	19.6	-19.6	19.6
70.0	-25.6	25.6	-20.6	20.6	-20.6	20.6
69.0	-26.7	26.7	-21.7	21.7	-21.7	21.7
68.0	-27.8	27.8	-22.8	22.8	-22.8	22.8
67.0	-28.8	28.8	-23.8	23.8	-23.8	23.8
66.0	-29.9	29.9	-24.9	24.9	-24.9	24.9
65.0	-30.9	30.9	-25.9	25.9	-25.9	25.9
64.0	-32.0	32.0	-27.0	27.0	-27.0	27.0
63.8	-32.2	32.2	-27.2	27.2	-27.2	27.2
63.3	-32.7	32.7	-27.7	27.7	-27.7	27.2
63.1	-33.0	33.0	-28.0	28.0	-27.7	27.2
63.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
62.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
61.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
60.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
0.0	-33.0	33.0	-28.0	28.0	-27.7	27.2
% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	

Oconee 3 Cycle 29

RPS Power Imbalance Setpoints

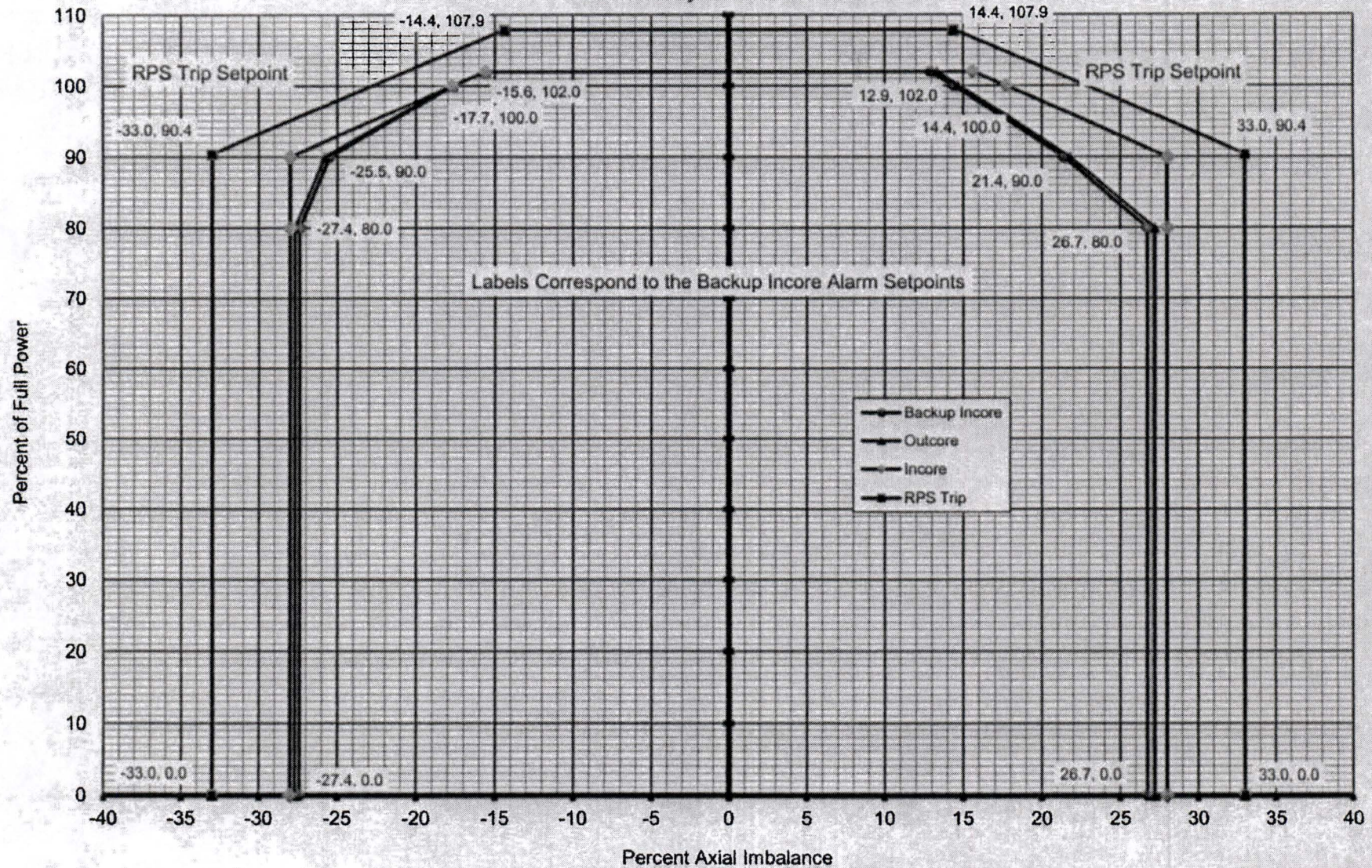
Referred to by TS 3.3.1 and TS Table 3.3.1-1



Oconee 3 Cycle 29
Imbalance Setpoints for 4 Pump Operation, BOC to EOC
Referred to by TS 3.2.2 and TS 3.3.1

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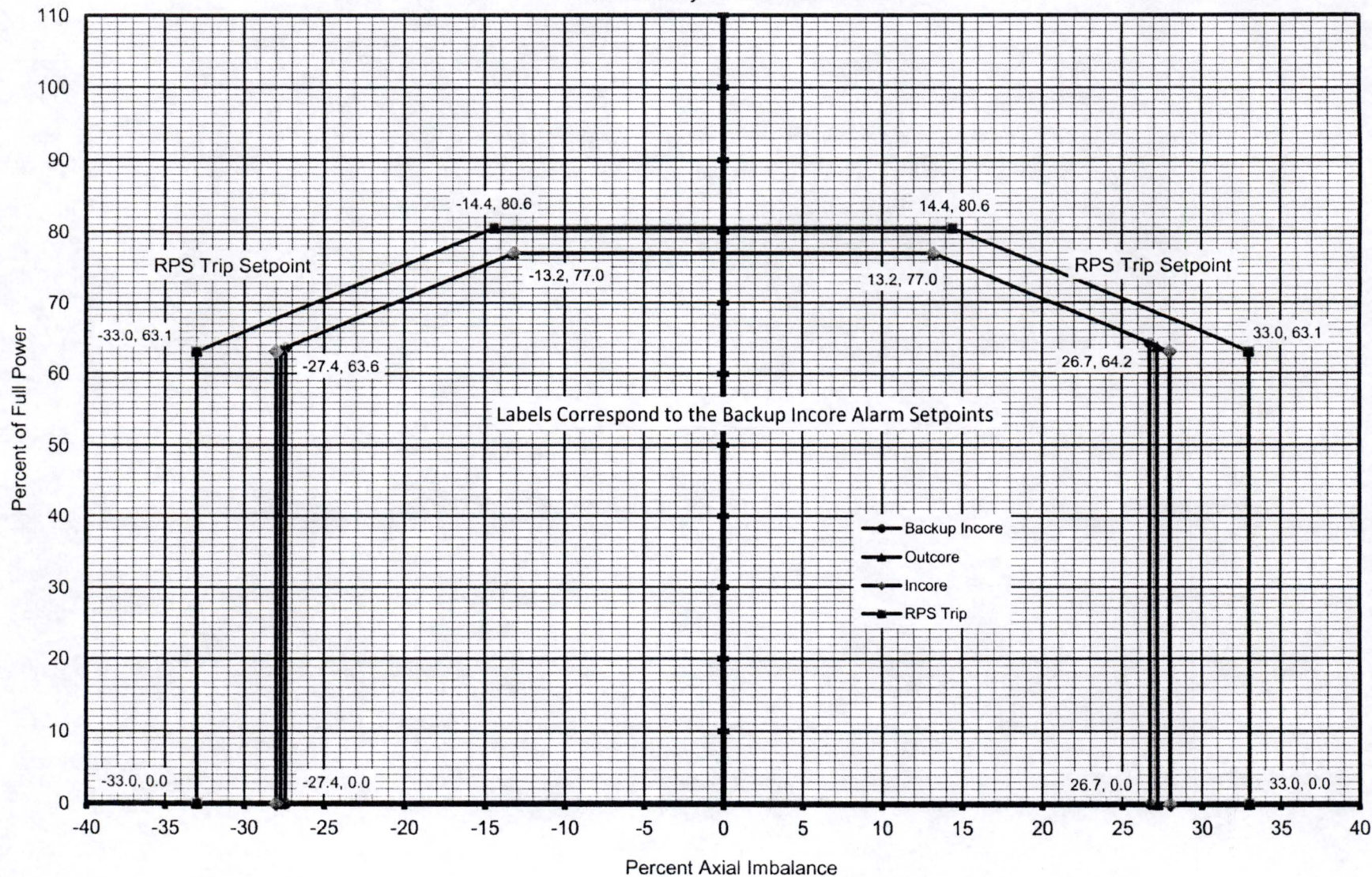
Oconee 3 Cycle 29

Imbalance Setpoints for 3 Pump Operation, BOC to EOC

Referred to by TS 3.2.2 and TS 3.3.1

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Oconee 3 Cycle 29
Operational Rod Index Setpoints

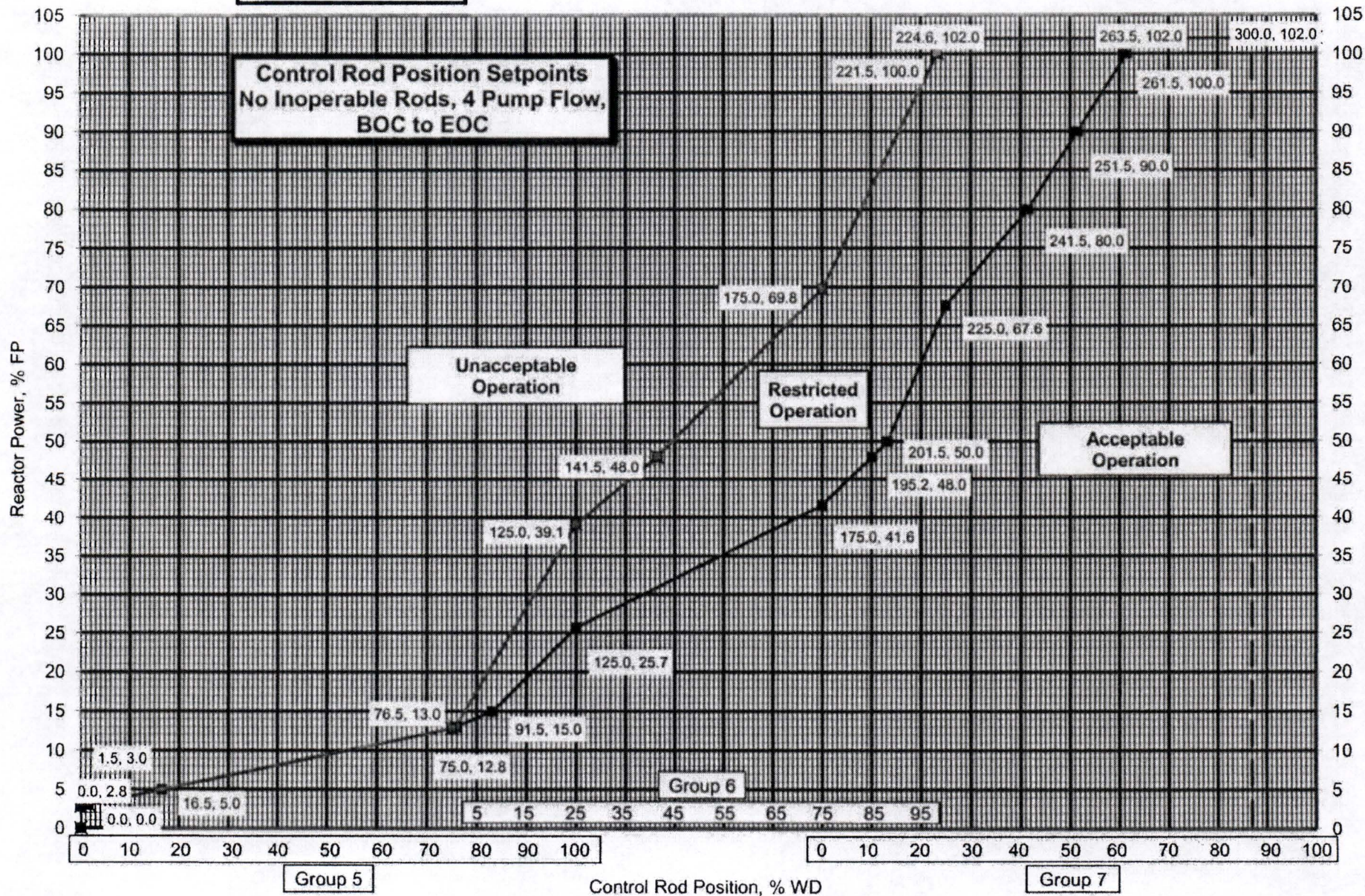
Referred to by TS 3.2.1

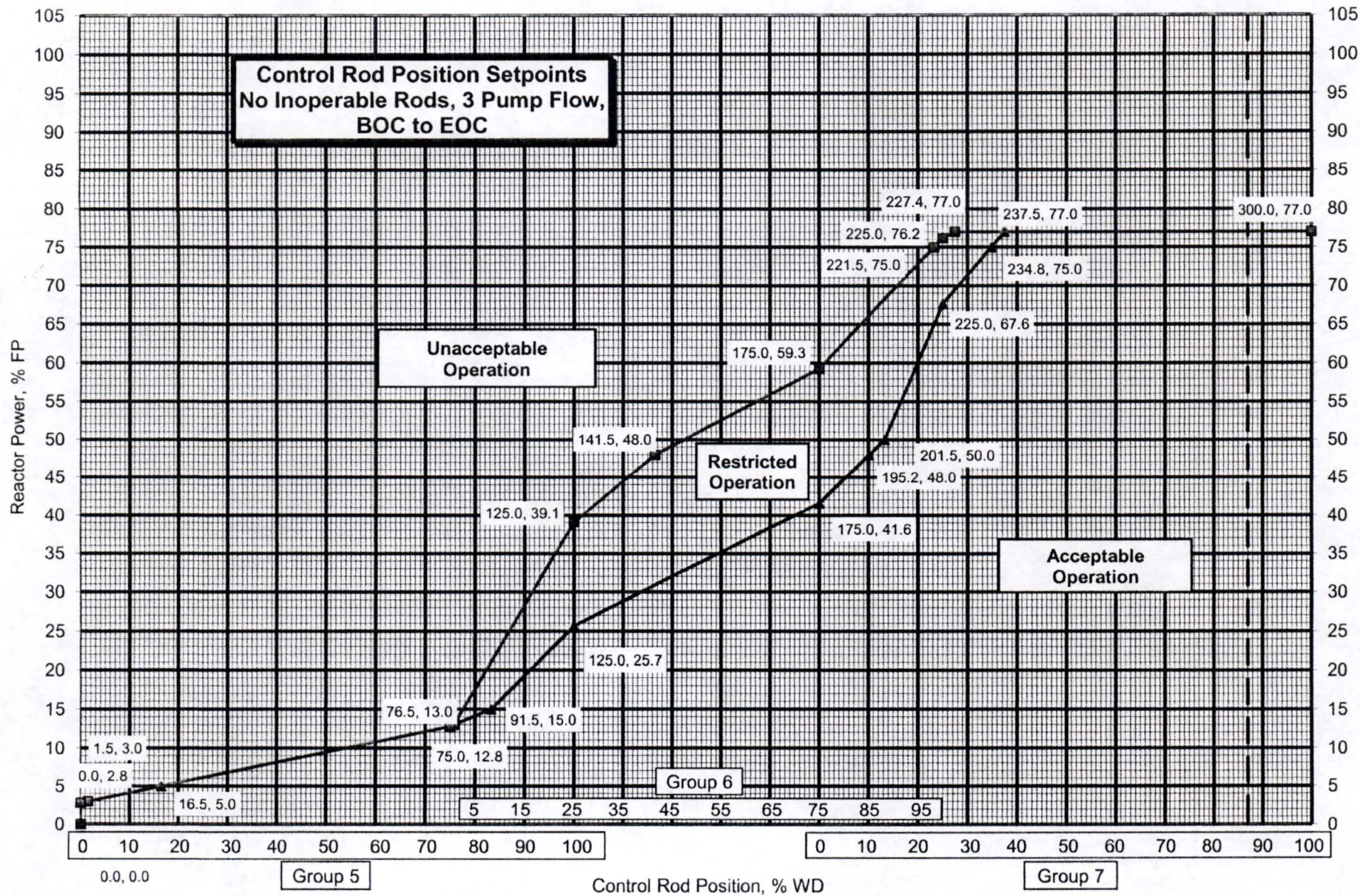
	%FP	RI Insertion Setpoint		RI Withdrawal Setpoint
		No Inop Rod	1 Inop Rod	
4 Pumps	102.0	263.5	283.4	300
	100.0	261.5	281.5	300
	90.0	251.5	271.9	300
	80.0	241.5	262.3	300
	50.0	201.5	233.4	300
	48.0	195.2	231.5	300
	15.0	91.5	165.5	300
	13.0	76.5	161.5	300
	5.0	16.5	93.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300
3 Pumps	77.0	237.5	285.2	300
	75.0	234.8	281.5	300
	50.0	201.5	235.2	300
	48.0	195.2	231.5	300
	15.0	91.5	165.5	300
	13.0	76.5	161.5	300
	5.0	16.5	93.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300

Oconee 3 Cycle 29
Shutdown Margin Rod Index Setpoints

Referred to by TS 3.2.1

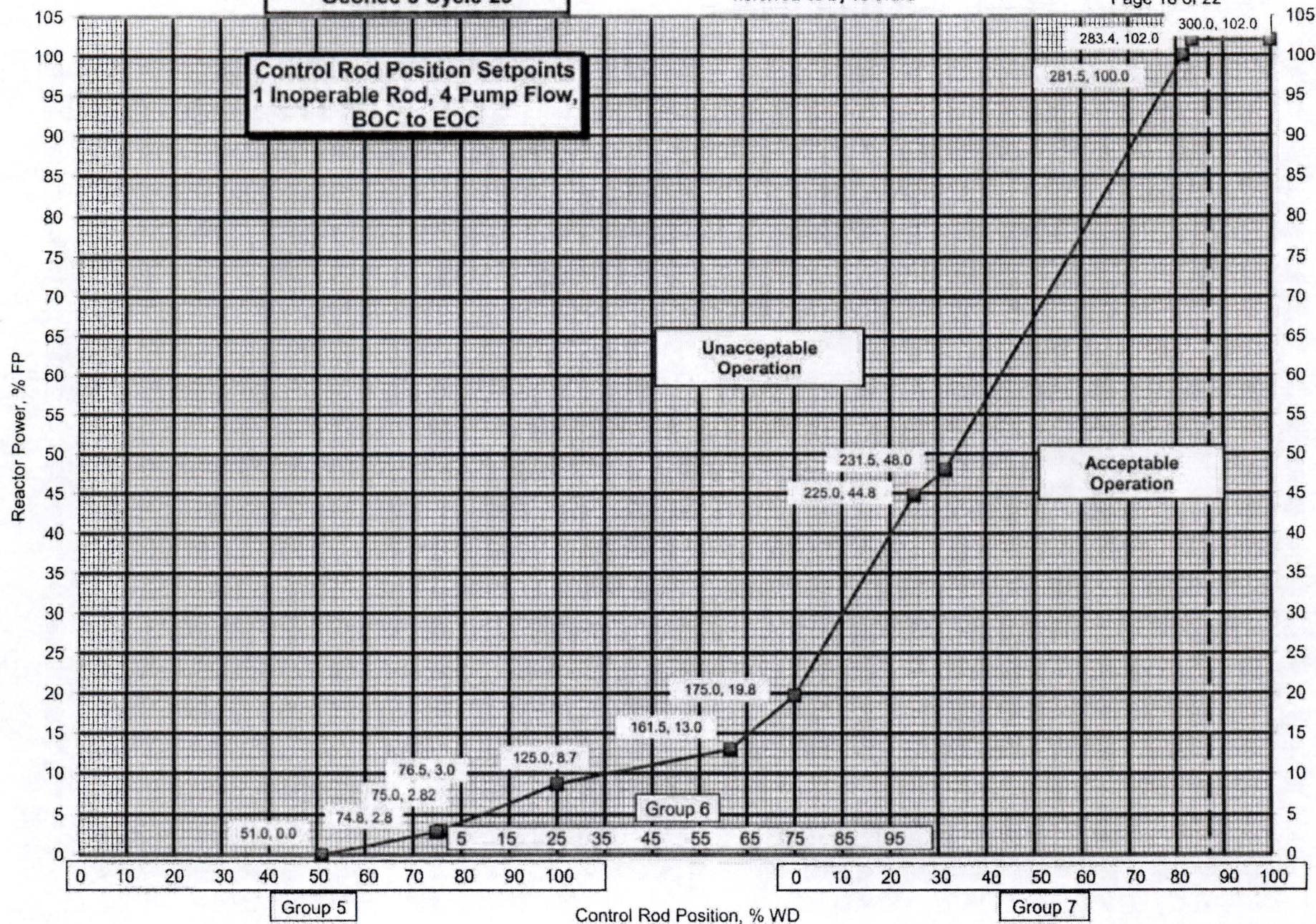
	%FP	RI Insertion Setpoint		RI Withdrawal Setpoint
		No Inop Rod	1 Inop Rod	
4 Pumps	102.0	224.6	283.4	300
	100.0	221.5	281.5	300
	48.0	141.5	231.5	300
	13.0	76.5	161.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300
3 Pumps	77.0	227.4	285.2	300
	75.0	221.5	281.5	300
	48.0	141.5	231.5	300
	13.0	76.5	161.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300

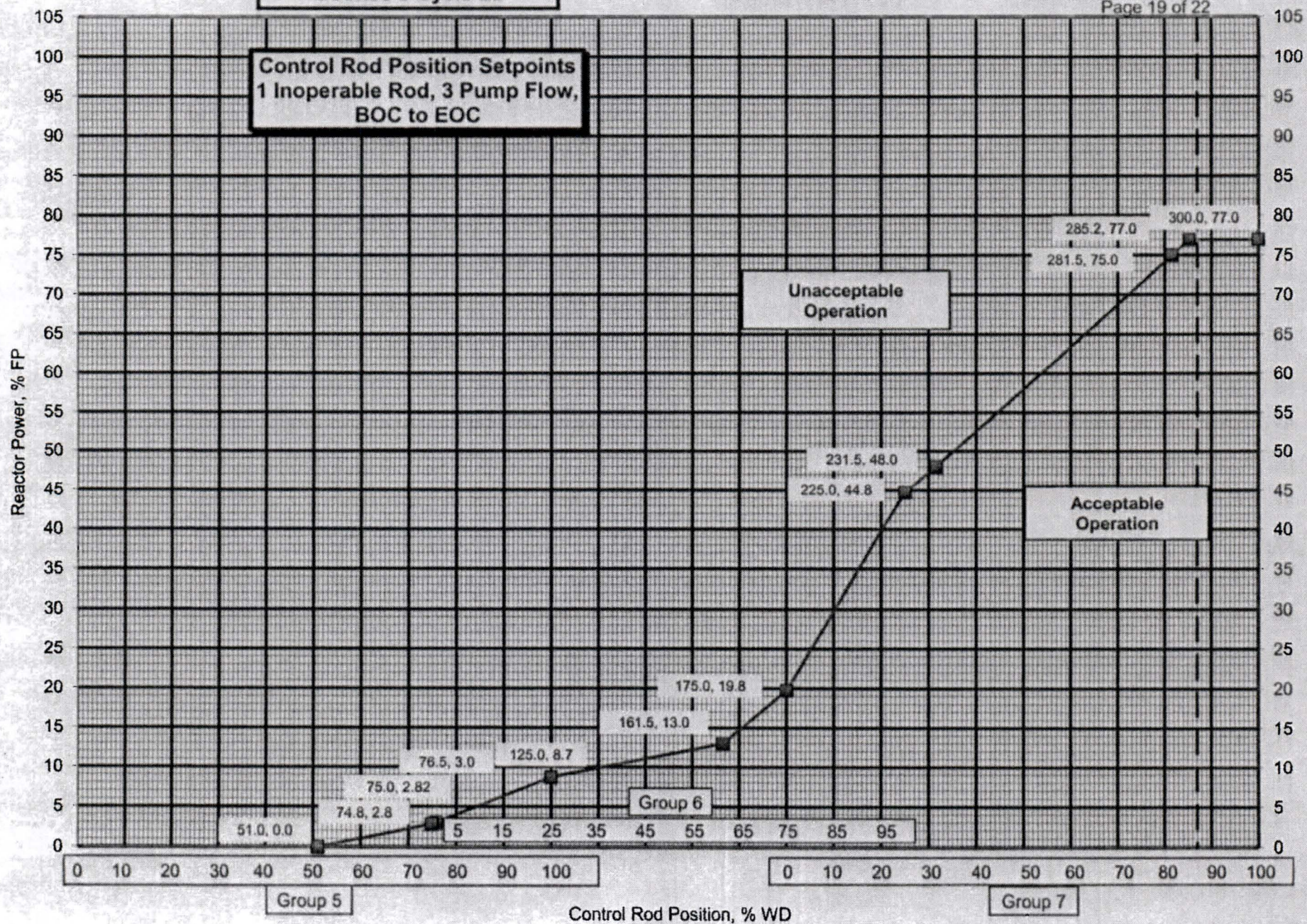




Oconee 3 Cycle 29

Control Rod Position Setpoints
1 Inoperable Rod, 4 Pump Flow,
BOC to EOC





Oconee 3 Cycle 29

2.0 Core Operating Limits -- Not Error Adjusted

The data provided on the following pages satisfies a licensing commitment to identify specific parameters before instrumentation uncertainties are incorporated.

References provided in section 1 of this COLR identify the sources for the data which follows.

Information provided in this section should not be used in plant procedures.

Quadrant Power Tilt Limits

Referred to by TS 3.2.3

	Steady State		Transient		Maximum
Core Power Level, %FP	0 - 30	> 30	0 - 30	> 30	> 0
Quadrant Power Tilt, %	10.00	5.40	12.00	9.44	20.00

Variable Low RCS Pressure Protective Limits

Referred to by TS 2.1.1

Core Outlet Pressure psia	Reactor Coolant Outlet Temperature, °F	
	3 RCS Pumps	4 RCS Pumps
1800	581.0	578.3
1900	590.0	587.3
2000	598.9	596.3
2100	607.9	605.2
2200	616.9	614.2
2300	625.9	623.2

Oconee 3 Cycle 29

Axial Power Imbalance Protective Limits

Referred to by TS 2.1.1

Not for Plant Use

	%FP	RPS	Operational
4 Pumps	0.0	-35.0	-39.2
	80.0	-	-39.2
	90.0	-35.0	-37.6
	100.0	-	-28.4
	109.4	-14.4	-
	109.4	14.4	-
	100.0	-	24.7
	90.0	35.0	32.7
	80.0	-	38.6
	0.0	35.0	38.6
3 Pumps	0.0	-35.0	-39.2
	62.3	-35.0	-
	77.0	-	-39.2
	81.7	-14.4	-
	81.7	14.4	-
	77.0	-	38.6
	62.3	35.0	-
	0.0	35.0	38.6

Oconee 3 Cycle 29

Rod Index Limits

Referred to by TS 3.2.1

Not for Plant Use

	%FP	Operational RI Insertion Limit	Shutdown Margin RI No Inop Rod	Insertion Limit 1 Inop Rod	RI Withdrawal Limit
4 Pumps	102	262	220	280	300
	100	260	-	-	300
	90	250	-	-	300
	80	240	-	-	300
	50	200	140	230	300
	15	90	75	160	300
	5	0	0	75	300
3 Pumps	77	236	220	280	300
	50	200	140	230	300
	15	90	75	160	300
	5	0	0	75	300