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U. S. Nuclear Regulatory Commission
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Subject: Duke Energy Carolinas, LLC
Oconee Nuclear Station Unit 2, Docket Number 50-270
Core Operating Limits Report (COLR) for Unit 2 Cycle 29

Pursuant to Oconee Technical Specification 5.6.5.d, attached is an information copy of the Core Operating Limits Report (COLR) for Oconee Unit 2, Cycle 29, ONEI-0400-491, Revision 0.

If you have any questions, please direct them to Stephen C. Newman, Lead Nuclear Engineer at 864-873-4388.

Sincerely,

H. Todd Grant
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Attachment

A001
NRR

cc:

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DUKE ENERGY.

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Scurlock, Alyse M.	Originator	9/26/2017
Forster, Joy D	Verifier	9/26/2017
Phelps, Timothy P	Cross Disciplinary Reviewer	9/26/2017
Presnell, G Michael	Approver	9/26/2017

Notes :

Manual Certification Form

Section 1

Plant: Oconee Unit: 2 Quality Level: 1

Title: Oconee 2 Cycle 29 Core Operating Limits Report

Duke Energy File Number: ONEI-0400-491 Revision Number: 0

Section 2

Vendor: N/A

Vendor Document Number: N/A

For Vendor 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:	A.M. Scurlock (signed electronically)	Date:
Design Verified By:	J.D. Forster (signed electronically)	Date:
Approved By:	G.M. Presnell (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:

- The O2C29 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 O2C29 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 2 Cycle 29

Table Of Contents

Section 1.0 Error Adjusted Core Operating Limits

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

Oconee 2 Cycle 29

1.0 Error Adjusted Core Operating Limits

The Core Operating Limits Report for O2C29 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 O2C29 by References 15 and 16. The O2C29 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 (Fz) of 1.5, and an EOC (< 100 ppmB) Tavg reduction for up to 10°F provided 4 RCPs are in operation and Tavg 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 O2C29 reload core.

1.1 References

1. DPC-NE-1006-PA, Oconee Nuclear Design Methodology Using CASMO-4 / SIMULATE-3, NRC SE issued August 2, 2011.
2. DPC-NE-1002-A, Oconee Nuclear Station Reload Design Methodology II, SE dated July 21, 2011.
3. NFS-1001-A, Oconee Nuclear Station Reload Design Methodology, SE dated July 21, 2011.
4. DPC-NE-2003-PA, ONS Core Thermal Hydraulic Methodology Using VIPRE-01, SE dated July 21, 2011.
5. DPC-NE-2005-PA, Thermal Hydraulic Statistical Core Design Methodology, SE dated October 29, 2008.
6. DPC-NE-2008-PA, Fuel Mechanical Reload Analysis Methodology Using TACO3 and GDTACO, SE dated July 21, 2011.
7. DPC-NE-3005-PA, UFSAR Chapter 15 Transient Analysis Methodology, SE dated April 29, 2016.
8. DPC-NE-3000-PA, Thermal Hydraulic Transient Analysis Methodology, SE dated July 21, 2011.
9. BAW-10192P-A, Revision 0, BWNT LOCA - BWNT Loss of Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, 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, Revision 1, Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel, June 2003 (SER to BAW-10186P-A dated June 18, 2003).
12. OSC-4048, Revision 6, RPS RCS Pressure & Temperature Trip Function Uncertainty Analyses and Variable Low Pressure Safety Limit.
13. OSC-5604, Revision 4, Power Imbalance Safety Limits and Tech Spec Setpoints Using Error Adjusted Flux-Flow Ratio of 1.094.
14. OSC-7265, Revision 1, ΔTc and EOC Reduced Tavg Operation.
15. OSC-11652, Revision 1, O2C29 Maneuvering Analysis.
16. OSC-11713, Revision 1, O2C29 Reload Safety Evaluation.

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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%** Δk/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 Δρ / °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 Tavg must be less than COLR limits minus instrument uncertainty. ΔTc is the setpoint value selected by the operators.

	Max Loop Tavg (Incl 2°F unc)		
ΔTc, °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 Tavg.

DNB parameter for RCS loop total flow shall be:
Referred to by TS 3.4.1.
4 RCP: Measured ≥ **108.5** %df
3 RCP: Measured ≥ **74.7** % of 4 RCP min flow

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% ± 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

	Rod Index		APSR %WD	
EFPD	Min	Max	Min	Max
0 to 639	292 ± 5	300	30	40
639 to EOC	292 ± 5	300	100	100

Quadrant Power Tilt Setpoints

	Steady State		Transient		Maximum
Core Power Level, %FP	0 - 30	> 30	0 - 30	> 30	> 0
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

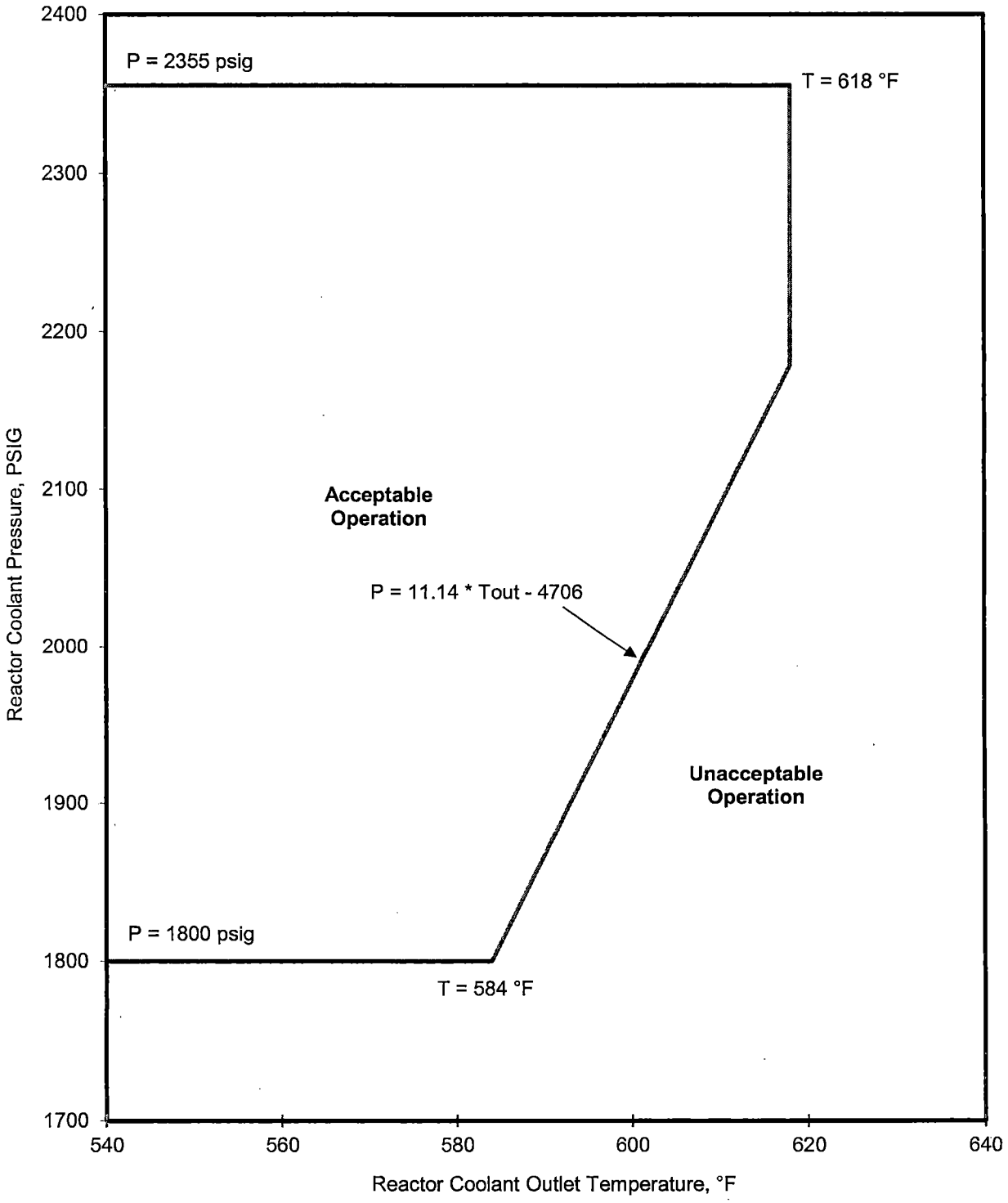
Correlation Slope (CS)

1.15

Referred to by TS 3.3.1 (SR 3.3.1.3).

Oconee 2 Cycle 29
Variable Low RCS Pressure RPS Setpoints

Referred to by TS 3.3.1



Oconee 2 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
	Pmax =>	109.4	-14.4
	Pmax =>	109.4	14.4
		90.0	35.0
		0.0	35.0
3 Pumps		0.0	-35.0
		62.3	-35.0
	Pmax =>	81.7	-14.4
	Pmax =>	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	-27.0	-27.3
	80.0	-28.0	-27.0	-27.3
	90.0	-28.0	-22.8	-23.1
	100.0	-17.7	-16.8	-17.1
	102.0	-15.6	-15.6	-15.6
	102.0	15.6	11.7	12.1
	100.0	17.7	13.4	13.8
	90.0	28.0	21.9	22.3
	80.0	28.0	25.6	25.9
	0.0	28.0	25.6	25.9
3 Pumps	0.0	-28.0	-27.0	-27.3
	63.1	-28.0	-	-
	63.7	-	-	-27.3
	64.0	-	-27.0	-
	77.0	-13.2	-13.2	-13.2
	77.0	13.2	13.2	13.2
	65.3	-	25.6	-
	65.0	-	-	25.9
	63.1	28.0	-	-
	0.0	28.0	25.6	25.9

Referred to by TS 3.2.2

Oconee 2 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	12.1
101.0	-21.7	21.7	-16.7	16.7	-16.4	13.0
100.0	-22.8	22.8	-17.7	17.7	-17.1	13.8
99.0	-23.9	23.9	-18.7	18.7	-17.7	14.7
98.0	-24.9	24.9	-19.8	19.8	-18.3	15.5
97.0	-26.0	26.0	-20.8	20.8	-18.9	16.4
96.0	-27.0	27.0	-21.8	21.8	-19.5	17.2
95.0	-28.1	28.1	-22.9	22.9	-20.1	18.1
94.0	-29.2	29.2	-23.9	23.9	-20.7	18.9
93.0	-30.2	30.2	-24.9	24.9	-21.3	19.8
92.0	-31.3	31.3	-25.9	25.9	-21.9	20.6
91.0	-32.3	32.3	-27.0	27.0	-22.5	21.5
90.4	-33.0	33.0	-27.6	27.6	-22.9	22.0
90.0	-33.0	33.0	-28.0	28.0	-23.1	22.3
89.0	-33.0	33.0	-28.0	28.0	-23.5	22.7
88.0	-33.0	33.0	-28.0	28.0	-23.9	23.0
87.0	-33.0	33.0	-28.0	28.0	-24.4	23.4
86.0	-33.0	33.0	-28.0	28.0	-24.8	23.7
85.0	-33.0	33.0	-28.0	28.0	-25.2	24.1
84.0	-33.0	33.0	-28.0	28.0	-25.6	24.5
83.0	-33.0	33.0	-28.0	28.0	-26.0	24.8
82.0	-33.0	33.0	-28.0	28.0	-26.5	25.2
81.0	-33.0	33.0	-28.0	28.0	-26.9	25.5
80.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
0.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	

Oconee 2 Cycle 29

RPS / Operational Power Imbalance Setpoints

Operation with 3 RCS Pumps, BOC to EOC

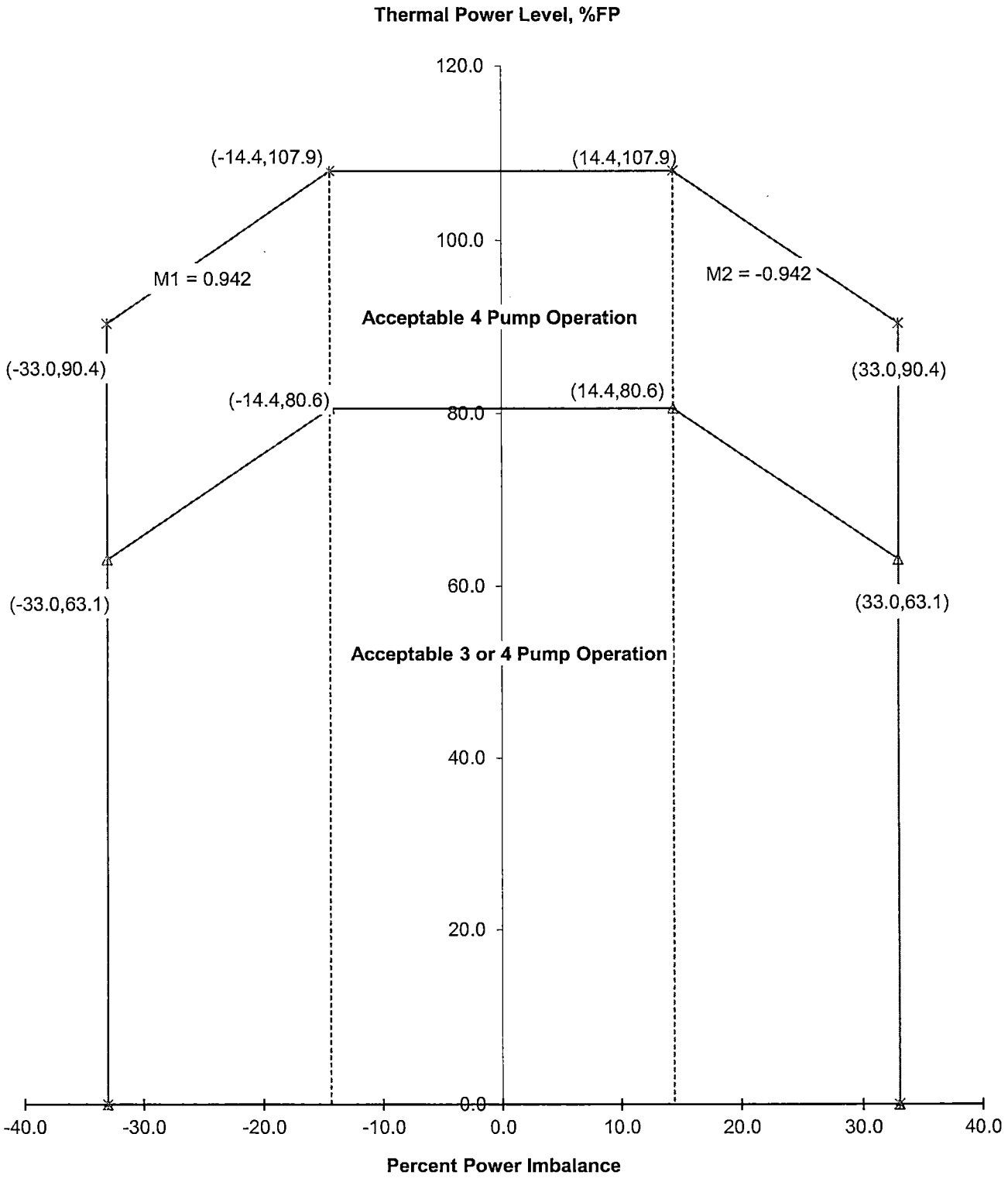
Referred to by TS 3.2.2 and TS 3.3.1

% 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	-22.5	22.5	-17.5	17.5	-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	-25.7	25.7	-20.7	20.7	-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	-22.7	22.7
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	24.8
65.0	-31.0	31.0	-26.0	26.0	-25.9	25.9
64.0	-32.0	32.0	-27.0	27.0	-27.0	25.9
63.7	-32.4	32.4	-27.4	27.4	-27.3	25.9
63.1	-33.0	33.0	-28.0	28.0	-27.3	25.9
63.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
62.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
61.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
60.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
0.0	-33.0	33.0	-28.0	28.0	-27.3	25.9
% FP	RPS Trip		Full Incore Alarm		Out of Core Alarm	

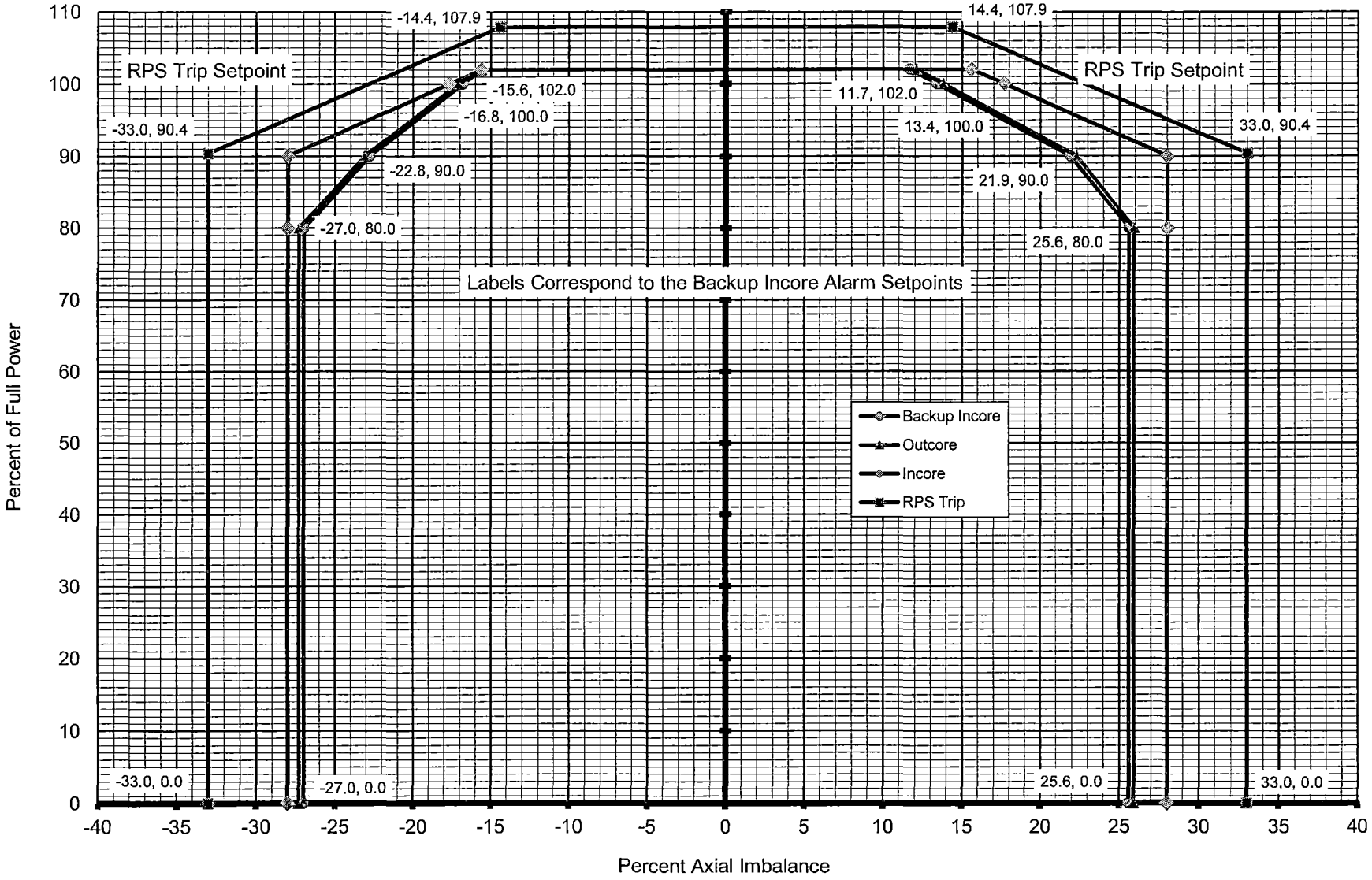
Oconee 2 Cycle 29

RPS Power Imbalance Setpoints

Referred to by TS 3.3.1 and TS Table 3.3.1-1



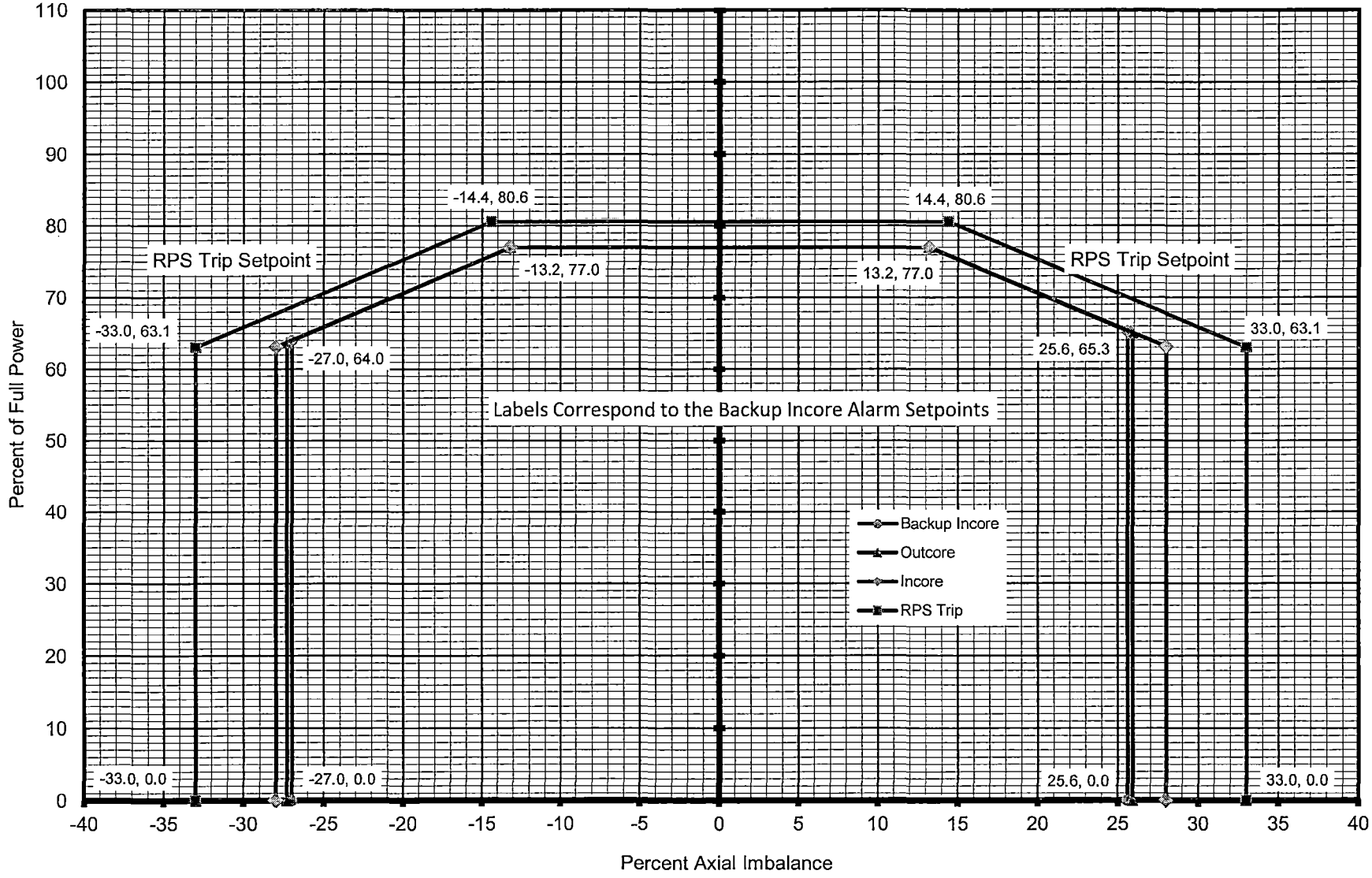
Oconee 2 Cycle 29
Imbalance Setpoints for 4 Pump Operation, BOC to EOC
Referred to by TS 3.2.2 and TS 3.3.1



Oconee 2 Cycle 29

Imbalance Setpoints for 3 Pump Operation, BOC to EOC

Referred to by TS 3.2.2 and TS 3.3.1



Oconee 2 Cycle 29

Operational Rod Index Setpoints

Referred to by TS 3.2.1

	%FP	RI Insertion Setpoint No Inop Rod	RI Insertion Setpoint 1 Inop Rod	RI Withdrawal Setpoint
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

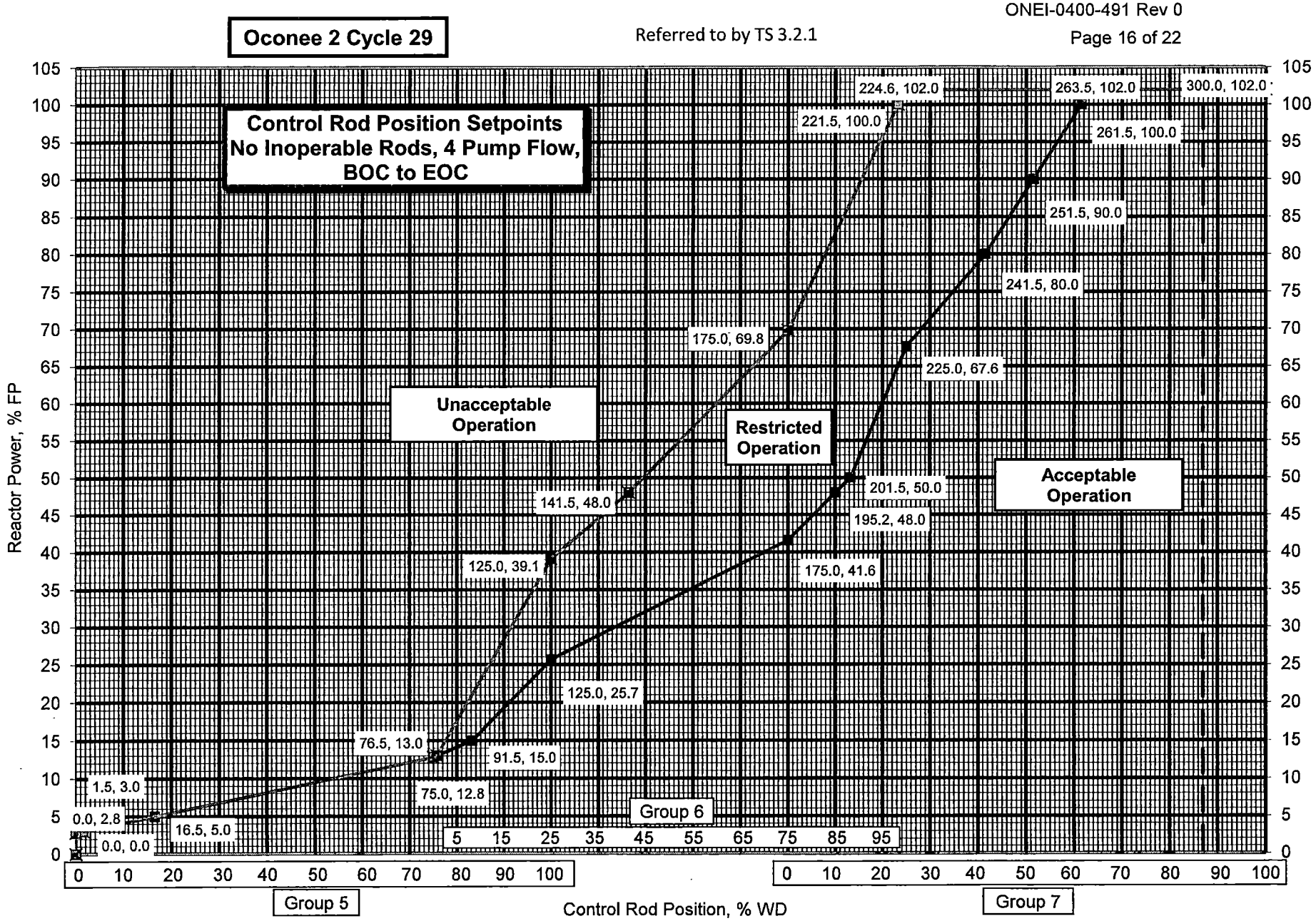
Oconee 2 Cycle 29

Shutdown Margin Rod Index Setpoints

Referred to by TS 3.2.1

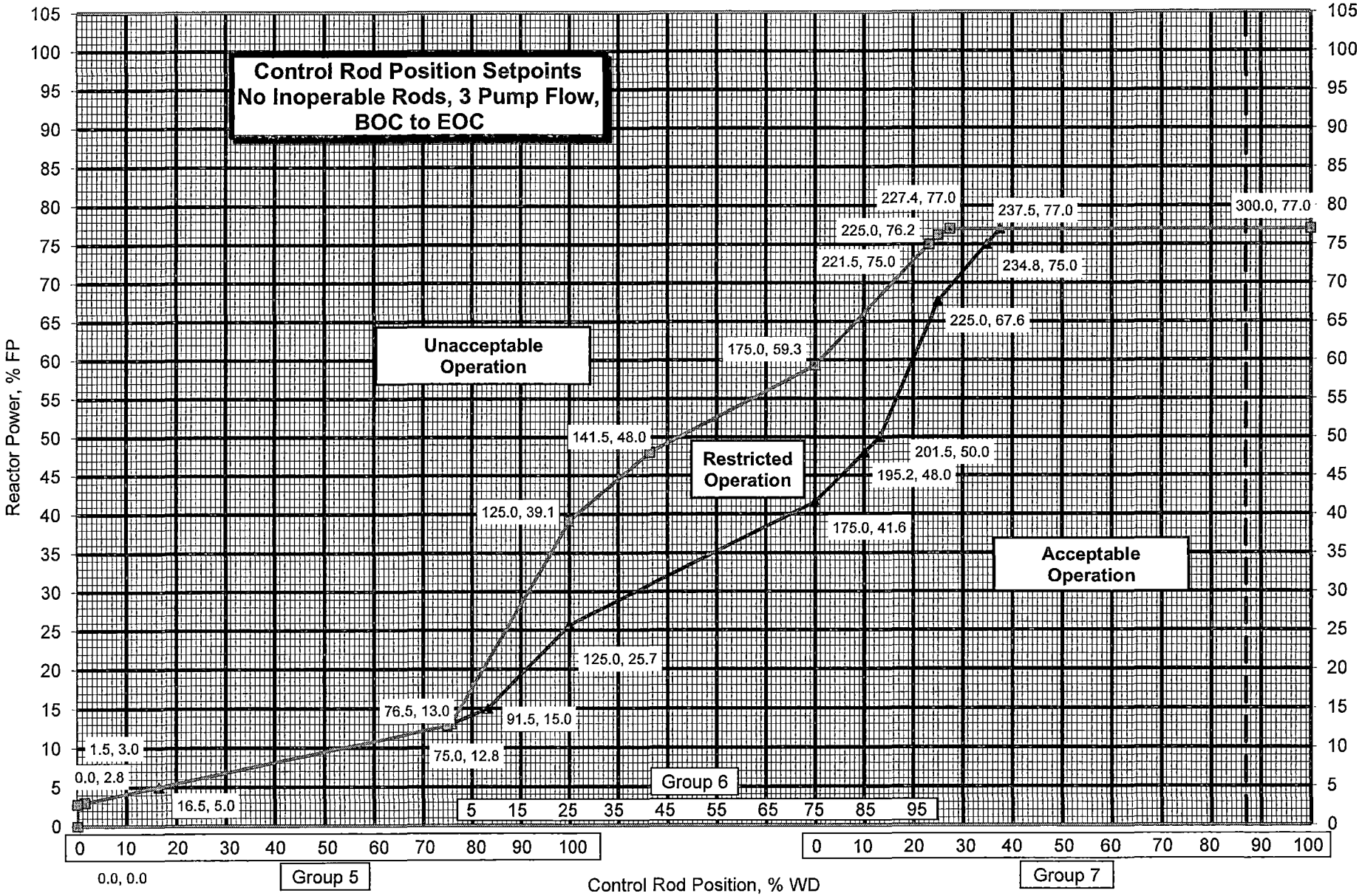
		RI Insertion Setpoint		RI Withdrawal
	%FP	No Inop Rod	1 Inop Rod	Setpoint
4 Pumps	102.0	224.6	283.4	300
	100.0	221.5	281.5	300
	48.0	141.5	231.5	300
	13.0	76.5	161.5	300
	3.0	1.5	76.5	300
	2.8	0.0	74.8	300
	0.0	0.0	51.0	300
3 Pumps	77.0	227.4	285.2	300
	75.0	221.5	281.5	300
	48.0	141.5	231.5	300
	13.0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

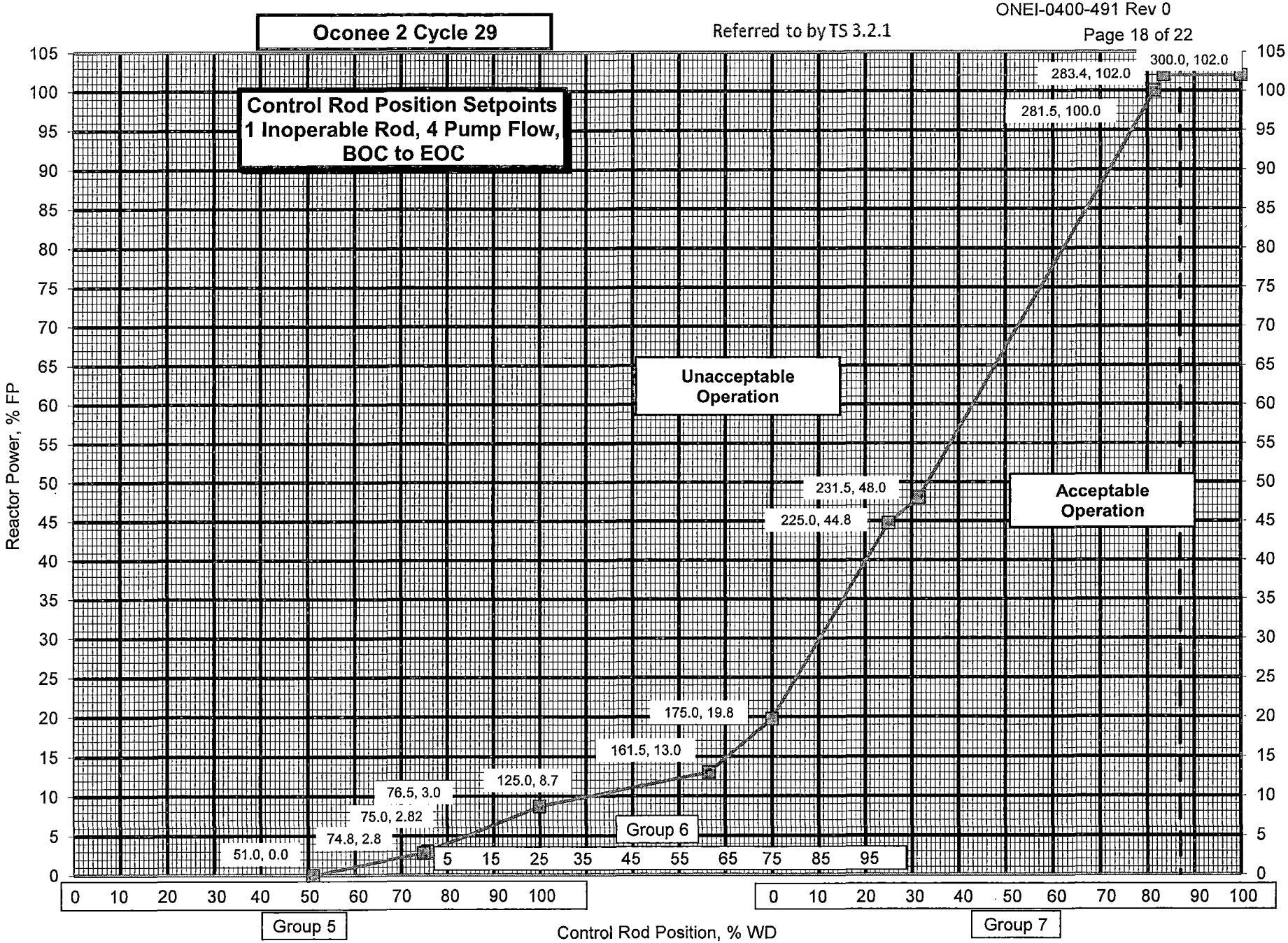


Oconee 2 Cycle 29

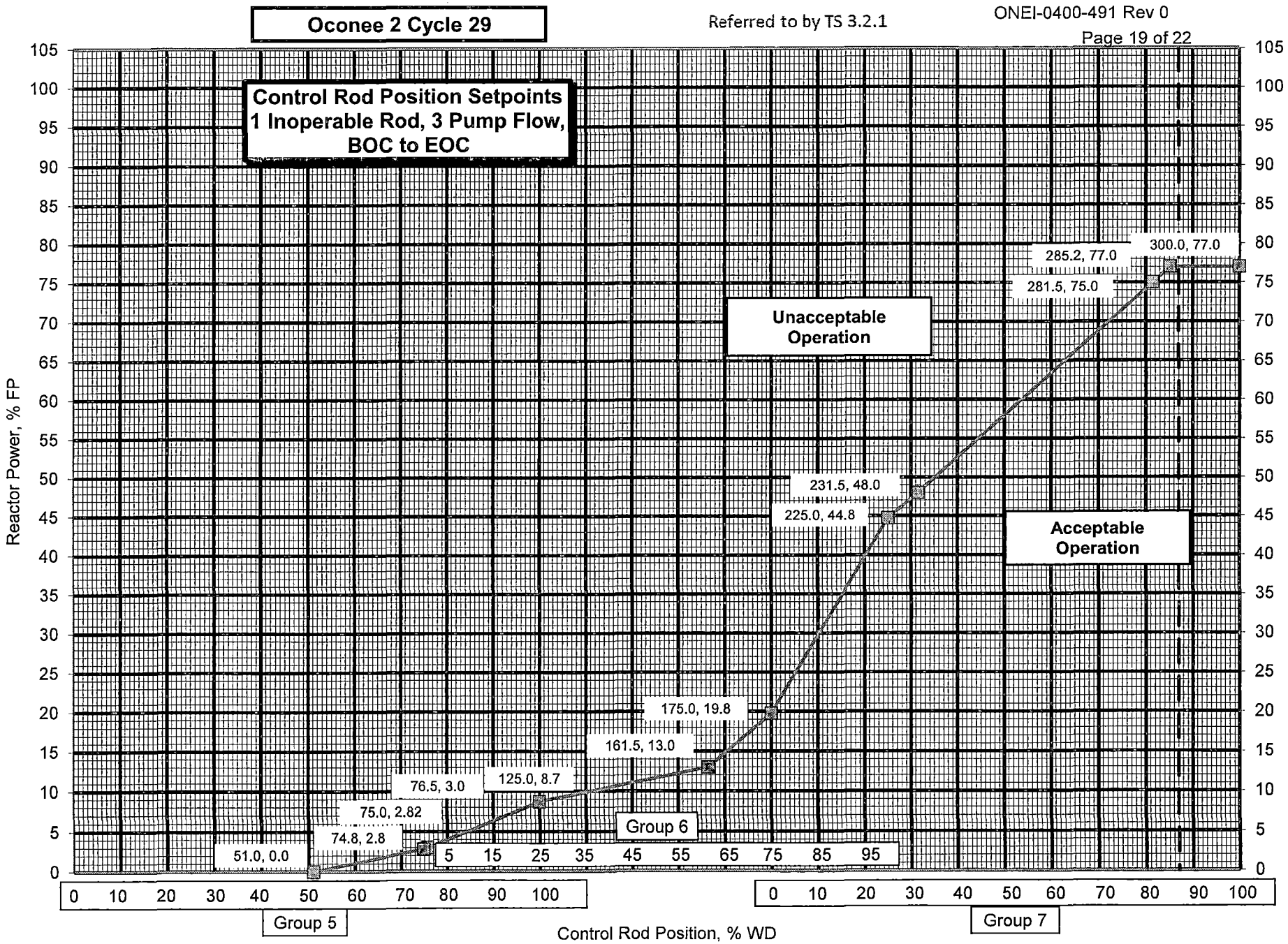
Referred to by TS 3.2.1



Referred to by TS 3.2.1



Referred to by TS 3.2.1



Oconee 2 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 2 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	-38.6
	80.0	-	-38.6
	90.0	-35.0	-34.3
	100.0	-	-27.6
	109.4	-14.4	-
	109.4	14.4	-
	100.0	-	23.6
	90.0	35.0	33.2
	80.0	-	37.0
	0.0	35.0	37.0
3 Pumps	0.0	-35.0	-38.6
	62.3	-35.0	-
	77.0	-	-38.6
	81.7	-14.4	-
	81.7	14.4	-
	77.0	-	37.0
	62.3	35.0	-
	0.0	35.0	37.0

Oconee 2 Cycle 29

Rod Index Limits

Referred to by TS 3.2.1

Not for Plant Use

	%FP	Operational RI Insertion Limit	Shutdown Margin RI Insertion Limit No Inop Rod	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