

Prairie Island
Startup Physics Test Report
Unit 2 Cycle 6

1.0 Introduction

The Prairie Island Unit 2 reactor had 41 reload fuel assemblies manufactured by Exxon Nuclear Company installed in 1981 during the fifth refueling for that facility.

2.0 Startup Physics Test - Introduction

Reference 1 identified the startup related tests conducted for the Unit 1 Cycle 5 startup. Tests described in detail with analytical results in that report included the following:

- (a) Zero Power Isothermal Temperature Coefficient
- (b) Control Banks' Rod Worth
- (c) Critical Boron Concentration
- (d) Boron Worth
- (e) Power Distribution Measurements

This report provides test results for the above tests conducted during the startup of Prairie Island Nuclear Generating Plant, Unit 2. The procedures used in the startup test program were the most recent revision reviewed by the Plant Operations Committee.

3.0 Startup Physics Tests - Results

Table 1 summarizes the following data for each test performed.

- (a) Test
- (b) Procedure/Effective Revision
- (c) Parameter
- (d) Measured Value
- (e) Acceptance Criteria

4.0 Summary

The data presented in Table 1 shows acceptable agreement with the acceptance criteria. The five TOPROD assemblies also exhibited acceptable agreement with the acceptance criteria. The Quadrant Power Tilt Ratio (QPTR) was outside the acceptance criteria at HZP. Due to the marginal quality of data at this power level and the fact that QPTR's at higher powers met the acceptance criteria, this deviation was judged to have no safety significance by the Operations Committee.

5.0 Reference

- (1) Letter, L O Mayer (NSP) to J G Keppler (NRC) dated August 1, 1979.

Table 1
Unit 2 Cycle 6 Startup Test Results

1.0 HZP Isothermal Temperature Coefficient

Procedure: D32
Revision: 2 (2/19/81)

<u>Test Condition</u>	<u>Measured α_{iso}</u>	<u>Acceptance Criteria</u>
ARO	-2.21 pcm/F	<0 pcm/F

2.0 Control Banks' Worth Measurements

Procedure: D30
Revision: 3 (2/19/81)

<u>Test Condition</u>	<u>Measured Worth</u>	<u>Acceptance Criteria</u>
Control Bank D	1074 pcm	957 pcm \pm 15%
Control Bank C	1400 pcm	1307 pcm \pm 15%
Control Bank B	539 pcm	616 pcm \pm 15%
Control Bank A	1791 pcm	1656 pcm \pm 15%
All Control Banks	4804 pcm	4536 pcm \pm 10%

3.0 Critical Boron Concentration

Procedure: D34
Revision: 1 (9/6/79)

<u>Test Condition</u>	<u>Measured Value</u>	<u>Acceptance Criteria</u>
All Rods Out	1644 ppm	1638 \pm 50 ppm
D+C+B+A In	1133 ppm	1104 \pm 50 ppm

4.0 Differential Boron Worth

Procedure: D30
Revision: 3 (2/19/81)

<u>Test Condition</u>	<u>Measured α_B</u>	<u>Acceptance Criteria</u>
<All Control Banks>	-9.4 pcm/ppm	-8.5 $\frac{\text{pcm}}{\text{ppm}} \pm 10\%$

Power Distribution Measurements

Procedure: SP2116
 Revision: 6 (1/8/81)

<u>Plant Condition</u>	<u>Parameter</u>	<u>Value</u>	<u>Acceptance Criteria</u>
HZP, ARO	$\text{MAX}(\text{RRI}_m - \text{RRI}_p) / \text{RRI}_p$		
	$P_i > 0.9$	-7.5%	+ 10%
	$P_i < 0.9$	10.9%	+ 15%
	F_Q^{N*}		
	Maximum	2.37 at z = 8.4ft	<4.29 at z = 8.4ft
	Limiting	2.36 at z = 9.0ft	<4.26 at z = 9.0ft
	F_H^{N**}	1.50	<1.85
	QPTR	1.032	<1.02
48% Power	$\text{MAX}(\text{RRI}_m - \text{RRI}_p) / \text{RRI}_p$		
	$P_i > 0.9$	+4.3%	+ 10%
	$P_i < 0.9$	+4.1%	+ 15%
	F_Q^N		
	Maximum	1.92 at z = 7.0ft	<4.37 at z = 7.0ft
	Limiting	1.91 at z = 7.4ft	<4.35 at z = 7.4ft
	F_H^N	1.45	<1.71
	QPTR	1.019	<1.02
99% Power	$\text{MAX}(\text{RRI}_m - \text{RRI}_p) / \text{RRI}_p$		
	$P_i > 0.9$	-4.2%	+ 10%
	$P_i < 0.9$	5.9%	+ 15%
	F_Q^N		
	Maximum	1.79 at z = 5.8ft	<2.21 at z = 5.8ft
	Limiting	1.78 at z = 7.4ft	<2.17 at z = 7.4ft
	F_H^N	1.44	<1.55
	QPTR	1.017	<1.02

* Values include uncertainties of 1.05 and 1.03
 Criteria is $(2.21/P) \times K(z) \times \text{BU}(E_j)$

** Values include uncertainties of 1.04.
 Criteria is $1.5 \times [1 - 0.3(1-P)]$

Legend

HZP	Hot Zero Power
ARO	All Rods Out
RRI_m	Reaction Rate Integral - measured
RRI_p	Reaction Rate Integral - predicted
Pi	Relative assembly power
QPTR	Quadrant Power Tilt Ratio
α_{iso}	isothermal temperature coefficient pcm/ $^{\circ}$ F
α_b	boron worth pcm/ppm
<All Control Banks>	average value overall control banks