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

Subject: Duke Energy Carolinas, LLC
Oconee Nuclear Station, Unit 1
Docket Numbers 50-269
Renewed Operating License DPR-38
Unit 1 Cycle 28 Startup Testing Report

Pursuant to the requirements in Section 16.13.9, "Startup Report," from the Selected Licensee Commitments (SLC) Manual, Duke Energy Carolinas, LLC (Duke Energy) hereby submits to the Nuclear Regulatory Commission (NRC) the Oconee Nuclear Station Unit 1, Cycle 28 (O1C28) Startup Testing Report. SLC 16.13.9 requires [in part] that Duke Energy submit a startup report if modifications may have significantly altered the nuclear, thermal or hydraulic performance of the unit and that the report be submitted within 90 days following the completion of the startup test program.

The basis of the attached startup report is to provide the Staff with the satisfactory results from the O1C28 startup tests which incorporate the unit's first:

- 24-month cycle,
- Full core loading of AREVA Mark B-HTP fuel,
- Cycle to contain fuel with Gadolinia in batch quantities.

If you have any questions or require additional information, please contact Stephen C. Newman, Senior Engineer, Oconee Regulatory Affairs, at (864) 873-4388.

This letter and its attachment do not contain NRC commitments.

Sincerely,

TPGillespie
T. Preston Gillespie, Jr.
Vice President
Oconee Nuclear Station

Attachment

IE26
NRR

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DUKE ENERGY

OCONEE NUCLEAR STATION

OCONEE 1 CYCLE 28

STARTUP TESTING REPORT

Part 1: Fuel and Core Design

Part 2: Zero Power Physics Test

Part 3: Power Escalation Test

Prepared by: Nicolas Hernandez

OCONEE 1 CYCLE 28
Startup Testing Report
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Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design

1.0 Summary

The Unit 1 Cycle 28 (O1C28) core consists of 177 Mk B-HTP fuel assemblies, each of which is a 15 by 15 array containing 208 fuel pins, 16 guide tubes and one incore instrument guide tube. The fuel consists of dished-end, cylindrical pellets of uranium dioxide. Both the reinserted fuel and fresh fuel are clad in M5 and have M5 guide tubes. The O1C28 fuel assemblies have nominal fuel loading of 488.5 kg uranium, with minor reductions in batches with Gadolinium content.

The O1C28 core loading for this cycle consists of the following:

45 fresh Mk B-HTP fuel assemblies with 4.44 wt% U-235 each with various Gadolinia (Gad) loadings and layouts (designated Batches 30A, 30B, 30C, 30D, 30E, 30F, 30G). Description of these fuel assemblies is provided in figures 2 – 9.

28 fresh Mk B-HTP fuel assemblies with 4.14 wt% U-235 each with a Gadolinia (Gad) loading and layout (designated Batch 30H). Description of these fuel assemblies is provided in figure 10.

68 reinserted Mk B-HTP fuel assemblies with 4.17 wt% U-235 each containing 16 radially zoned reduced enrichment fuel pins at 3.87 wt% U-235 (designated Batch 29)

28 reinserted Mk B-HTP fuel assemblies with 3.46 wt% U-235 each containing 16 radially zoned reduced enrichment fuel pins at 3.16 wt% U-235 (designated Batch 28C)

8 reinserted Mk B-HTP fuel assemblies with 3.76 wt% U-235 each containing 16 radial zoned reduced enrichment fuel pins at 3.46 wt% U-235 (designated Batch 28D)

Figure 1 shows the batch loading pattern.

All non-Gad pins have 6.05 inch blanket regions (top and bottom) enriched to 2.50 wt% U-235. All Gad pins have 9.9 inch blanket regions (top and bottom) enriched to 2.50 wt% U-235. The core periphery is composed of Batch 29, 28C, and 28D assemblies. All batches of fuel assemblies are distributed throughout the core interior except Batch 28D fuel assemblies which are located only on the periphery of the core. No fuel assemblies or burnable poison rod assemblies from the spent fuel pool are being used in O1C28.

Oconee 1 Cycle 28 will operate in a rods-out, feed and bleed mode. Core reactivity control is supplied mainly by soluble boron and is supplemented by 61 full length Ag-In-Cd control rods, Gadolinia which is incorporated into some of the fuel pellets, & 36 fresh burnable poison rod assemblies (BPRAs). In addition to the full length control rods, eight Inconel

(gray) axial power shaping rods (APSRs) are provided for additional control of the axial power distribution.

Oconee 1 Cycle 28 is the third 24 Month Cycle at Oconee. It also is the third full core at Oconee made up entirely of Mk-B-HTP fuel and the third Oconee cycle to contain fuel with Gadolinia in batch quantities. Oconee 2 Cycle 26 was the first Oconee cycle to implement all of those changes. 24 Month Cycle designs allow the three-unit Oconee site to reduce refueling outages by one every other year, resulting in a significant cost savings.

24 Month Cycle designs generally require more feed assemblies than 18 month designs. To design an efficient 24 Month Cycle, Gadolinia integral burnable absorber is necessary to allow feed fuel assemblies to reside in control rod locations. This allows movement of the feed fuel away from the core periphery and reduces the cycle leakage. To obtain more accurate calculation results for Gadolinia, the CASMO-3 code was upgraded to the newer version CASMO-4. License Amendment Requests (LARs) for the transition to Gadolinia burnable absorber, CASMO-4 code, and 24-month design cycles were approved prior to cycle startup.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 1: O1C28 Final Core Load Map

(X)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						NJ0CXG 28C	NJ0CXJ 28C	UDMC56 29	NJ0CWG 28C	NJ0CWX 28C					
B				NJ0D0H 28D	UDMC65 29	UDMD14 C2AW1 30C	UDMD06 30B	UDMD01 C2AL1 30A	UDMD08 30B	UDMD16 C2AX1 30C	UDMC25 29	NJ0D0R 28D			
C			NJ0CXP 28C	UDMD38 30F	UDMD30 C35T 30E	UDMD22 BF4V 30D	UDMC30 C2AM1 29	UDMC62 29	UDMC59 C2AN1 29	UDMD24 BF51 30D	UDMD32 C35A 30E	UDMD40 30F	NJ0CX0 28C		
D		NJ0D0P 28D	UDMD41 30F	UDMC10 C2CG 29	UDMC32 29	UDMC60 A07T 29	UDMD48 BF53 30H	UDMC39 C2CH 29	UDMD55 BF5D 30H	UDMC27 A07X 29	UDMC24 29	UDMC23 C2CJ 29	UDMD42 30F	NJ0D0N 28D	
E		UDMC16 29	UDMD33 C35C 30E	UDMC64 29	UDMC41 C2AP1 29	UDMD57 BF5L 30H	UDMC21 C2CF 29	UDMD66 BF4M 30H	UDMC51 C350 29	UDMD67 BF5N 30H	UDMC20 C2AR1 29	UDMC04 29	UDMD34 C35P 30E	UDMC11 29	
F	NJ0CWT 28C	UDMD17 C2AY1 30C	UDMD25 BF5E 30D	UDMC26 A07N 29	UDMD47 BF5P 30H	UDMC12 C2C71 29	UDMD72 BF4U 30H	NJ0CX5 C2AJ1 28C	UDMD50 BF5H 30H	UDMC07 C2C81 29	UDMD61 BF5R 30H	UDMC01 A07Y 29	UDMD26 BF4W 30D	UDMD18 C2AZ1 30C	NJ0CWV 28C
G	NJ0CWW 28C	UDMD09 30B	UDMC37 C2AT1 29	UDMD62 BF57 30H	UDMC29 C351 29	UDMD58 BF58 30H	NJ0CXA C2AK1 28C	UDMC58 29	NJ0CWE C2CE 28C	UDMD59 BF54 30H	UDMC06 C352 29	UDMD54 BF55 30H	UDMC17 C2AU1 29	UDMD10 30B	NJ0CWR 28C
H	UDMC44 29	UDMD02 C2C91 30A	UDMC15 29	UDMC40 C2CK 29	UDMD56 BF4N 30H	NJ0CX2 C2CR 28C	UDMC48 29	UDMD45 C2C01 30G	UDMC49 29	NJ0CXT C2CU 28C	UDMD46 BF4P 30H	UDMC50 C2CL 29	UDMC09 29	UDMD03 C2CA1 30A	UDMC52 29
K	NJ0CXD 28C	UDMD11 30B	UDMC47 C2AV1 29	UDMD65 BF50 30H	UDMC05 C362 29	UDMD53 BF52 30H	NJ0CWP C2CV 28C	UDMC66 29	NJ0CXN C2CW 28C	UDMD52 BF4T 30H	UDMC18 C35N 29	UDMD70 BF5C 30H	UDMC68 C2C21 29	UDMD05 30B	NJ0CX9 28C
L	NJ0CWH 28C	UDMD19 C2C11 30C	UDMD27 BF4Y 30D	UDMC61 A07J 29	UDMD69 BF5T 30H	UDMC67 C2CC 29	UDMD64 BF4X 30H	NJ0CXK C2CX 28C	UDMD73 BF5G 30H	UDMC35 C2CD 29	UDMD63 BF5K 30H	UDMC19 A080 29	UDMD21 BF5F 30D	UDMD13 C35K 30C	NJ0CX3 28C
M		UDMC53 29	UDMD35 C35E 30E	UDMC28 29	UDMC31 C2C31 29	UDMD60 BF5U 30H	UDMC54 C35R 29	UDMD68 BF4R 30H	UDMC36 C356 29	UDMD51 BF5M 30H	UDMC02 C2C41 29	UDMC13 29	UDMD29 C361 30E	UDMC14 29	
N		NJ0D03 28D	UDMD43 30F	UDMC03 C2CM 29	UDMC63 29	UDMC55 A07G 29	UDMD71 BF5A 30H	UDMC42 C2CN 29	UDMD49 BF5J 30H	UDMC46 A07E 29	UDMC33 29	UDMC57 C31C 29	UDMD37 30F	NJ0D0A 28D	
O			NJ0CWL 28C	UDMD44 30F	UDMD36 C35H 30E	UDMD28 BF59 30D	UDMC34 C2C51 29	UDMC43 29	UDMC22 C2C61 29	UDMD23 BF56 30D	UDMD31 C35J 30E	UDMD39 30F	NJ0D00 28C		
P				NJ0D0C 28D	UDMC38 29	UDMD20 C35L 30C	UDMD12 30B	UDMD04 C2CP 30A	UDMD07 30B	UDMD15 C35M 30C	UDMC45 29	NJ0D0G 28D			
R						NJ0CWM 28C	NJ0CWJ 28C	UDMC08 29	NJ0CXW 28C	NJ0CXL 28C					

(Z)

Fuel ID
Control Component ID & Type (A = APSR, B = BPRA**, C = CRA)
Fuel Batch

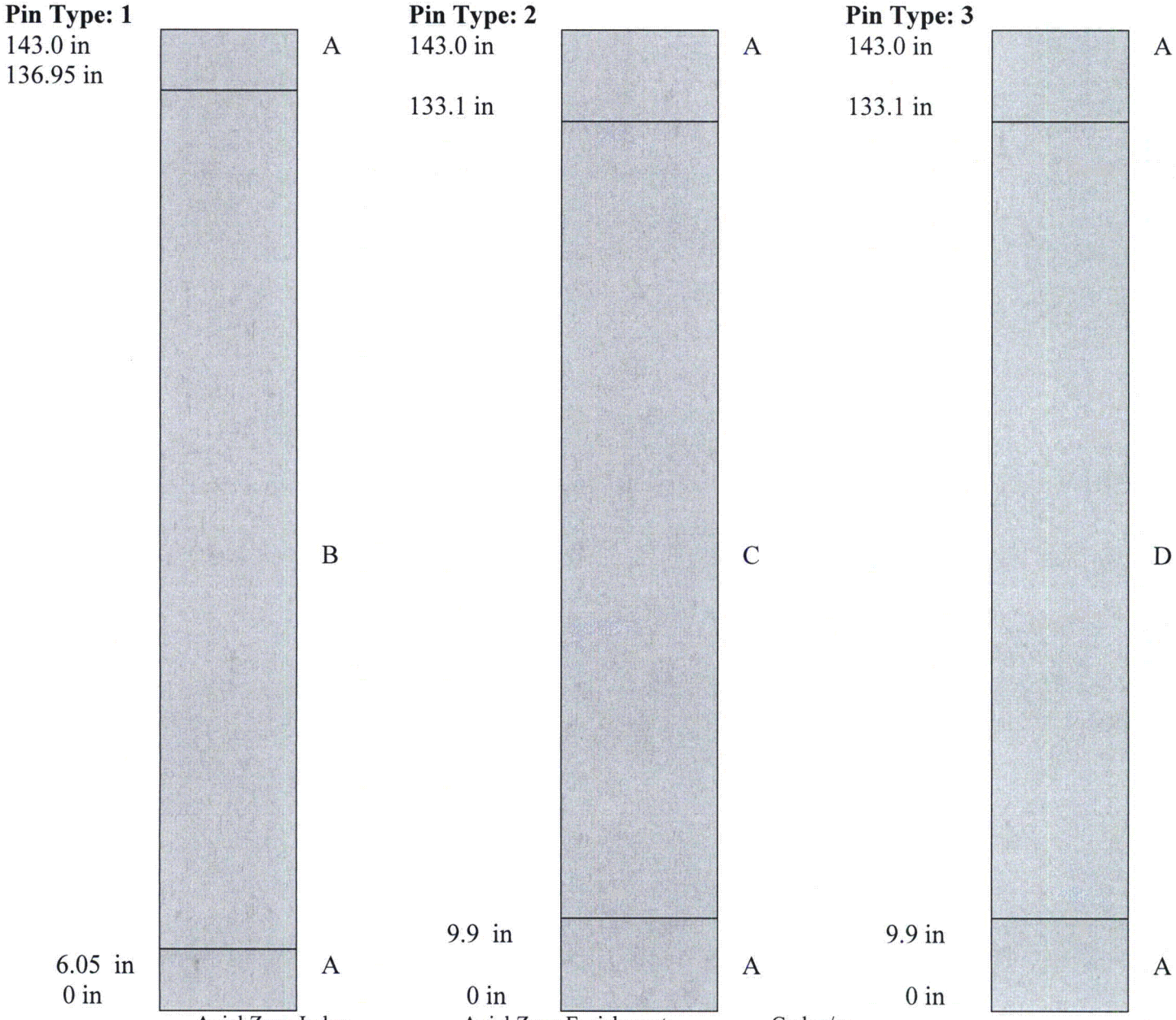
ote: All fuel batches are Mk-B-HTP fuel assemblies.

** All BPRAs are Mk–B5:

BF4M - BF4R = 2.00 wt% B_4C BPRA
BF4T - BF5J = 2.50 wt% B_4C BPRA
BF5K - BF5U = 3.00 wt% B_4C BPRA

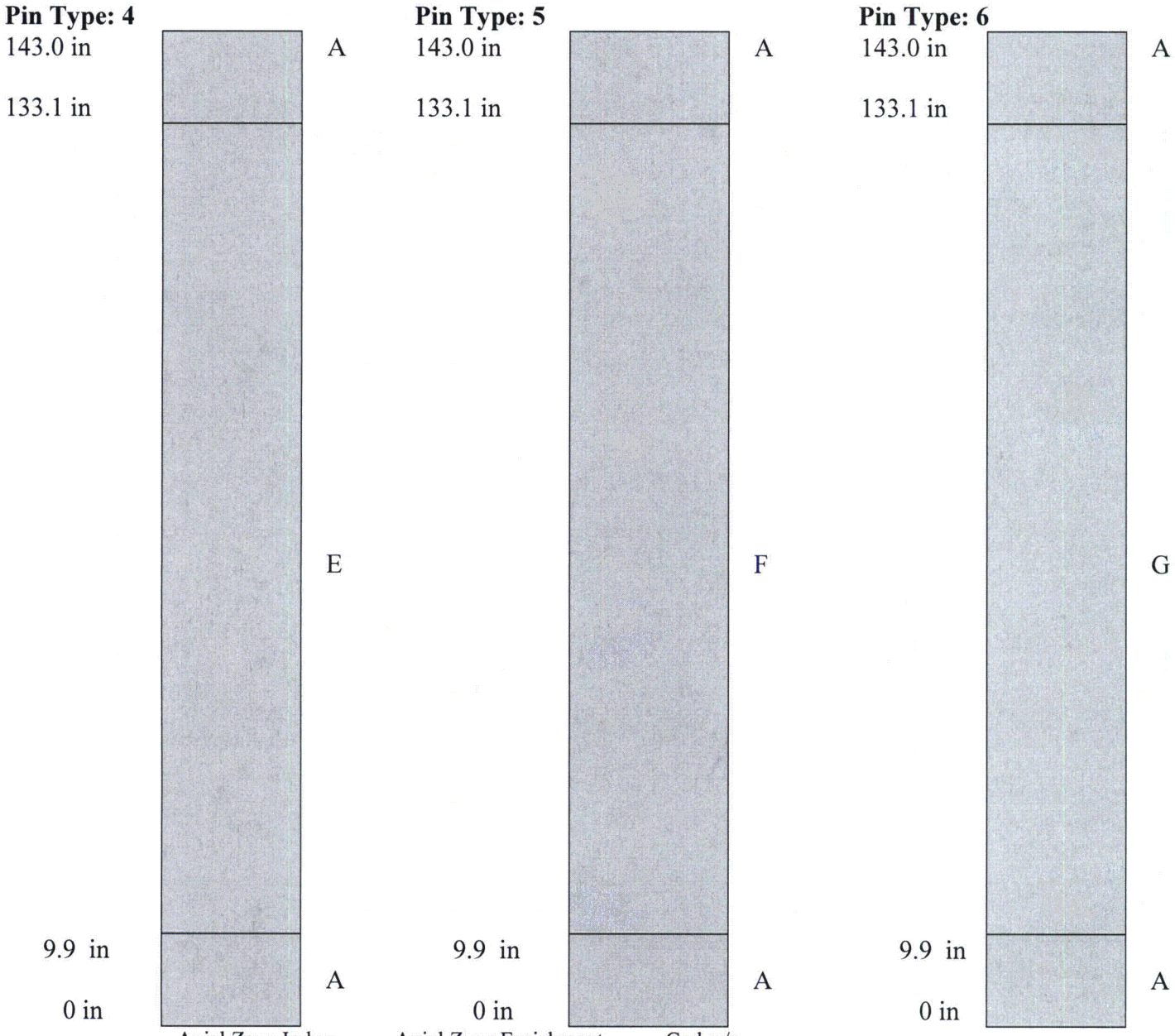
Note: Fresh fuel assemblies are shaded. All other fuel assemblies are from O1C27.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 2: Pin Type Axial Profiles with Enrichment Table for Oconee 1 Batch 30



Axial Zone Index	Axial Zone Enrichment	Gad w/o
A	2.50 (Blanket)	0.0
B	4.44 (Primary)	0.0
C	3.55 (Gad Carrier)	4.0
D	3.10 (Gad Carrier)	6.0
E	2.66 (Gad Carrier)	8.0
F	3.77 (Gad Carrier)	2.0
G	4.14 (Primary)	0.0
H	3.31 (Gad Carrier)	4.0

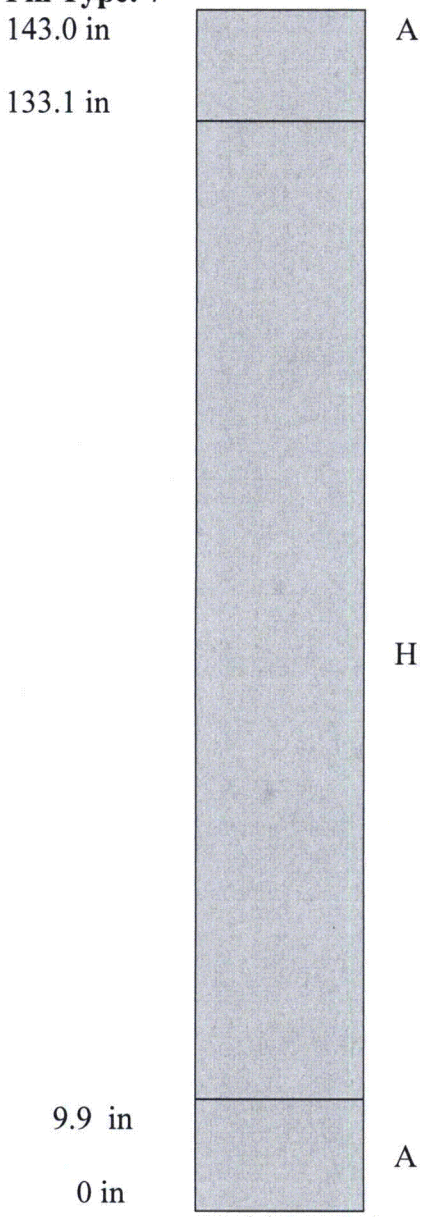
Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 2: Pin Type Axial Profiles with Enrichment Table for Oconee 1 Batch 30 (Continued)



Axial Zone Index	Axial Zone Enrichment	Gad w/o
A	2.50 (Blanket)	0.0
B	4.44 (Primary)	0.0
C	3.55 (Gad Carrier)	4.0
D	3.10 (Gad Carrier)	6.0
E	2.66 (Gad Carrier)	8.0
F	3.77 (Gad Carrier)	2.0
G	4.14 (Primary)	0.0
H	3.31 (Gad Carrier)	4.0

Figure 2: Pin Type Axial Profiles with Enrichment Table for Oconee 1 Batch 30 (Continued)

Pin Type: 7



Axial Zone Index	Axial Zone Enrichment	Gad w/o
A	2.50 (Blanket)	0.0
B	4.44 (Primary)	0.0
C	3.55 (Gad Carrier)	4.0
D	3.10 (Gad Carrier)	6.0
E	2.66 (Gad Carrier)	8.0
F	3.77 (Gad Carrier)	2.0
G	4.14 (Primary)	0.0
H	3.31 (Gad Carrier)	4.0

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 3: Oconee 1 Cycle 28 Fuel Pin Map, Batch 30A

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
1	1	2	1	1	○	1	1	1	○	1	1	2	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	1	1	2	1	1	2	1	1	2	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	2	1	1	2	1	1		1	1	2	1	1	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	2	1	1	2	1	1	2	1	1	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	2	1	1	○	1	1	1	○	1	1	2	1	1
1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

○ No "BPRA"

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 4: Oconee 1 Cycle 28 Fuel Pin Map, Batch 30B

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
1	1	3	1	1	○	1	1	1	○	1	1	3	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	1	1	3	1	1	3	1	1	3	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	3	1	1	3	1	1		1	1	3	1	1	3	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	3	1	1	3	1	1	3	1	1	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	3	1	1	○	1	1	1	○	1	1	3	1	1
1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

○ NO BPRA

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 5: Oconee 1 Cycle 28 Gad Pattern & Fuel Pin Map, Batch 30C

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	2	○	1	1	1	○	2	1	1	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	2	1	1	1	1	2	1	1	1	1	2	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	2	1	1	▥	1	1	2	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	2	1	1	1	1	2	1	1	1	1	2	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	1	1	2	○	1	1	1	○	2	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

○ NO BPRA

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 6: Oconee 1 Cycle 28 Gad Pattern & Fuel Pin Map, Batch 30D

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	2	1	1	1	1	1	1	1	1	1	1	1	2	1
1	1	1	1	1	⊖	1	1	1	⊖	1	1	1	1	1
1	1	1	⊖	1	1	1	1	1	1	1	⊖	1	1	1
1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
1	1	⊖	1	1	⊖	1	1	1	⊖	1	1	⊖	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	2	1	1	▥	1	1	2	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	⊖	1	1	⊖	1	1	1	⊖	1	1	⊖	1	1
1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
1	1	1	⊖	1	1	1	1	1	1	1	⊖	1	1	1
1	1	1	1	1	⊖	1	1	1	⊖	1	1	1	1	1
1	2	1	1	1	1	1	1	1	1	1	1	1	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

⊖ "BPRA" rod (2.50 wt % B4C)

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 7: Oconee 1 Cycle 28 Gad Pattern & Fuel Pin Map, Batch 30E

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	2	1	1	2	1	1	1	1	1	2	1	1	2	1
1	1	1	1	1	○	1	1	1	○	1	1	1	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	2	1	1	4	1	1	4	1	1	4	1	1	2	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	4	1	1	▥	1	1	4	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	2	1	1	4	1	1	4	1	1	4	1	1	2	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	1	1	1	○	1	1	1	○	1	1	1	1	1
1	2	1	1	2	1	1	1	1	1	2	1	1	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

○ NO BPRA

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 8: Oconee 1 Cycle 28 Gad Pattern & Fuel Pin Map, Batch 30F

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	5	○	1	1	1	○	5	1	1	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	5	1	1	1	1	5	1	1	1	1	5	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	5	1	1	▥	1	1	5	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	5	1	1	1	1	5	1	1	1	1	5	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	1	1	5	○	1	1	1	○	5	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

○ NO BPRA

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 9: Oconee 1 Cycle 28 Gad Pattern & Fuel Pin Map, Batch 30G

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	4	○	1	1	1	○	4	1	1	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	4	1	1	1	1	4	1	1	1	1	4	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	4	1	1	▥	1	1	4	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	○	1	1	○	1	1	1	○	1	1	○	1	1
1	1	4	1	1	1	1	4	1	1	1	1	4	1	1
1	1	1	○	1	1	1	1	1	1	1	○	1	1	1
1	1	1	1	4	○	1	1	1	○	4	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

○ NO BPRA

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 1: Fuel and Core Design
Figure 10: Oconee 1 Cycle 28 Gad Pattern & Fuel Pin Map, Batch 30H

6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
6	7	6	6	6	6	6	6	6	6	6	6	6	7	6
6	6	6	6	6	⊖	6	6	6	⊖	6	6	6	6	6
6	6	6	⊖	6	6	6	6	6	6	6	⊖	6	6	6
6	6	6	6	6	6	6	7	6	6	6	6	6	6	6
6	6	⊖	6	6	⊖	6	6	6	⊖	6	6	⊖	6	6
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
6	6	6	6	7	6	6	▥	6	6	7	6	6	6	6
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
6	6	⊖	6	6	⊖	6	6	6	⊖	6	6	⊖	6	6
6	6	6	6	6	6	6	7	6	6	6	6	6	6	6
6	6	6	⊖	6	6	6	6	6	6	6	⊖	6	6	6
6	6	6	6	6	⊖	6	6	6	⊖	6	6	6	6	6
6	7	6	6	6	6	6	6	6	6	6	6	6	7	6
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

⊖ "BPRA" rod (2.00, 2.50, or 3.00 wt % B4C)

Note: Pin type numbers are defined in Figure 2.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 2: Zero Power Physics Test

2.0 Introduction and Summary

The Oconee 1 Cycle 28 Zero Power Physics Test (ZPPT) was conducted on November 29th, 2012 per station procedure PT/0/A/0711/001. This testing was conducted to verify the nuclear parameters upon which the Oconee 1 Cycle 28 core design, safety analysis and Technical Specifications are based.

Zero Power Physics Testing measurements were made with reactor power, Reactor Coolant System (RCS) pressure and RCS temperature as required by procedure. The following nuclear parameters were measured:

(a) All-Rods-Out Critical Boron Concentration (Enclosure 1.0)

(b) Differential Boron Worth (Enclosure 1.0)

(c) Integral Rod Worth for Control Rod Groups 6 and 7 (Enclosure 2.0)

(d) Temperature and Moderator Coefficients of Reactivity (Enclosure 3.0)

The AREVA Reactivity Measurement and Analysis System (RMAS) was used to record RCS temperature, wide range power levels and control rod positions. Reactivity was calculated by the RMAS computer.

On November 29th, 2012 at 16:41, ZPPT was declared complete. All acceptance criteria were met.

2.1 Approach to Criticality

The full RCS temperature and pressure necessary for unit startup were achieved and rod withdrawal for the Control Rod Drive Trip Time Test (CRDTTT) began at 07:00 on November 28th, 2012. The CRDTTT was performed at Mode 3, hot standby conditions (>250°F and > 1% Δk/k shutdown) per station procedure PT/0/A/0300/001. Each control rod group was individually withdrawn. The CRDTTT was satisfactorily completed at 09:50 on November 28th, 2012.

Rod withdrawal for approach to criticality began on November 28th, 2012 at 23:40. The estimated critical position was calculated to be Group 7 at 77% per station procedure PT/1/A/1103/015. Criticality was achieved at 02:55 on November 29th, 2012 with rod Groups 1-6 at 100% wd (withdrawn), Group 7 at 69% wd, Group 8 at 35% wd, an RCS average temperature of 532 °F, and an RCS boron concentration of 1953 ppmB. Due to lower than ideal (for ZPPT) Group 7 control rod position, shortly after going critical

additional boron was added to the RCS such that the unit was critical at 1963 ppmB and Group 7 at 76% wd prior to proceeding on to pre-physics measurements.

2.2 Pre-Physics Measurements

After establishing stable conditions with the reactor critical, reactor power was slowly increased to perform the reactimeter checkout and approach the Point Of Adding sensible Heat (POAH). The POAH was found to be 0.08% FP per the wide range NIs. From the sensible heat determination, the upper testing limit on the wide range NIs (as indicated on the Control Room Chart Recorder) was established for ZPPT.

An on-line OAC reactimeter checkout was performed for both a positive and negative power ramp. The positive ramp involved a reactivity change of +425 μρ and the measured doubling times were within 0.38% of the predicted doubling times. The negative ramp involved a reactivity change of about -284 μρ and the measured doubling times were within 0.31% of the predicted doubling times. The measured doubling times were well within the ±5% acceptance criteria for the positive ramp and the ±7% acceptance criteria for the negative ramp.

2.3 Physics Testing

A. Essentially All Rods Out (EARO) Boron Concentration Measurement

The RCS EARO boron concentration was calculated starting from a configuration of Groups 1-6 at 100% wd, Group 7 at 77.3% wd, and APSR Group 8 at 35% wd. The control rods were moved to their essentially all rods out position (Groups 1-6 at 100% wd, Group 7 at ~80%, Group 8 at 35% wd) and the associated reactivity change was converted to a boron equivalent in ppmB. The all rods out boron concentration was then calculated and verified to be within procedure acceptance criteria. Refer to Enclosure 1.0 for more detailed results.

B. Reactivity Coefficient Measurements

The temperature coefficient measurement was made while maintaining equilibrium boron concentration in the RCS, with control rod Group 7 withdrawn to 77.4% wd and with APSR Group 8 at 35% wd. This test measured the reactivity change associated with a ramp increase in RCS temperature of approximately 3.13 °F and a subsequent decrease of 3.03 °F. The data from the two temperature ramps was averaged using the ΔT magnitudes as weighting factors. The change in reactivity was divided by the change in RCS temperature to calculate the temperature coefficient. The measured temperature coefficient was corrected for the difference in RCS average test temperature and reference temperature (532 °F). The moderator temperature coefficient was calculated by subtracting the

predicted Doppler coefficient from the measured isothermal temperature coefficient. The isothermal and moderator temperature coefficient were verified to be within the procedure acceptance criteria. Refer to Enclosure 3.0 for more detailed results.

C. Control Rod Integral Worths and Differential Boron Worth Measurement

Predicted data was used for Group 7 from 100 to 80% wd. The worth of Group 7 from ~80 to 77.3 % wd was measured during the EARO test. The worth of Group 7 from 77.3 to 0.0% wd, all of Group 6, and the top part of Group 5 was measured by steadily deborating the RCS and compensating for the resulting positive reactivity addition by inserting control rods (with no rod overlap). The reactivity changes resulting from the discrete control rod insertions were summed for each group to obtain the group integral rod worth. Each of the measured groups passed their individual acceptance criteria and total rod worth (group 7's worth and group 6's worth added together) passed its acceptance criteria. Refer to Enclosure 2.0 for more detailed results.

The differential boron worth was calculated by dividing the rod worths of the measured groups inserted between the initial and final boron samples by the corresponding change in RCS boron concentration. The initial value for the boron concentration was recorded at EARO critical equilibrium conditions. The final value of boron concentration was recorded as reactivity approached steady-state. The measured differential boron worth met procedure acceptance criteria. Refer to Enclosure 1.0 for more detailed results.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Part 3: Power Escalation Test

3.0 Introduction and Summary

The Oconee 1 Cycle 28 Power Escalation Test was performed between November 29th, 2012 and December 4th, 2012 per station procedure PT/0/A/0811/001. Testing was performed at 10% Full Power (FP), 20% FP, 40% FP, 51% FP, 73% FP, 99%FP, and 100% FP to verify nuclear parameters upon which the Oconee 1 Cycle 28 core design, safety analysis and Technical Specifications are based. The following tests and verifications were performed:

(a) Initial Core Symmetry Check at 20% FP (Enclosure 7.0);

(b) NSSS Heat Balance at 20% FP, 73% FP, and 100% FP (Enclosure 4.0);

(c) Incore Detector Checkout at 10% FP, 40% FP, and 99%FP;

(d) Power Imbalance Detector Correlation Slope Measurement at 73% FP;

(e) Core Power Distribution at 51% FP, and 100% FP (Enclosures 5.0 through 5.3 and 6.0);

(f) All-Rods-Out Critical Boron Concentration at 100% FP (Enclosure 1.0).

The unit reached the Low Power Testing (LPT) plateau at 19:00 on 11/29/12. Testing at the LPT plateau was completed at 09:30 on 11/30/12. The unit reached the Intermediate Power Testing (IMPT) plateau at 21:00 on 11/30/12. Testing at the IMPT plateau was completed at 05:40 on 12/01/12. The unit reached the Full Power Testing (FPT) plateau at 13:17 on 12/01/12. Full Power Testing (FPT), consisting of Incore Detector Checkout, Core Power Distribution, NSSS Heat Balance, All-Rods-Out Critical Boron, RCS Flow Calculation/Calibration, and update of the RPS RCS Reference Flow was performed at this plateau. FPT was concluded at 16:04 on 12/04/12. Power Escalation Testing was declared complete at 16:54 on 12/04/12.

3.1 NSSS Heat Balance/RCS Flow Verification

Off-line (non-OAC) secondary heat balance calculations were performed at 20% FP, 73% FP and 100% FP. An off-line primary heat balance was performed at 100% FP. These tests verified the accuracy of the on-line primary and secondary-side heat balance calculations. On-line calculations are another term for calculations performed by the OAC (operator aid computer) or plant computer program. The plant on-line computer accuracy was verified by performing an off-line calculation using the same inputs that feed the on-line computer. The on-line and off-line results were compared for the same period, and verified to agree within 2% FP. This same method was used to verify that RCS flow was

greater than the required flow per the Core Operating Limits Report (COLR). Normalization of the plant computer RCS flow constants (used to calculate flow from the primary delta-P instrumentation) was performed during FPT and the on-line power calculations were then verified to agree within 2% FP. Refer to Enclosure 4.0 for more detailed results.

3.2 Initial Core Symmetry Check and Core Power Distribution

Initial Core Symmetry Check was conducted at 20%. Core Power Distribution tests were conducted at 51% FP and at 100% FP. These tests verified that reactor power imbalance, quadrant power tilt and radial/total power peaks did not exceed their respective specified limits.

Specific checks were made as follows:

> Incore imbalance was compared to the error adjusted imbalance LOCA limit curve and was verified to be within specified limits (based on Core Operating Limits Report).
>
> The maximum positive quadrant power tilt was verified to be less than the error adjusted Core Operating Limits Report limit.

As a prerequisite to performing these tests, PT/0/A/0302/006 (Review and Control of Incore Instrumentation Signals) was performed at 10% FP, 40% FP and 99% FP to identify and evaluate erroneous Self Powered Neutron Detector signals.

The results of the initial core symmetry check which occurred at 20% FP can be found in Enclosure 7.0.

The core power distribution tests measure and compare the predicted values of radial and total peaking factors at 51% FP and 100% FP. All acceptance criteria were satisfied. Refer to Enclosures 5.0 - 5.3 along with Enclosure 6.0 for more detailed results.

3.3 Power Imbalance Detector Correlation

The Power Imbalance Detector Correlation was performed at 73% FP. The purpose of this test was to measure the excore to incore power imbalance correlation slopes for NI Channels 5, 6, 7, and 8, and to verify these slopes met acceptance criteria.

The excore/incore imbalance correlation slope for each NI Channel (5-8) was determined by a least squares fit of excore to incore imbalance indications. A total of 17 incore

imbalance points (updates/measurements) which ranged between –10.13% and +2.76% FP were used. All the slopes were verified to meet acceptance criteria.

3.4 All Rods Out Critical Boron Measurement at Power

The All Rods Out Critical Boron at Power measurement was made at 100% FP, and the difference between measured and predicted reactivity (in terms of ppmB) was verified to be acceptable. Refer to Enclosure 1.0 for more detailed results.

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Enclosure 1.0

ALL-RODS-OUT CRITICAL BORON CONCENTRATION
AND DIFFERENTIAL BORON WORTH RESULTS

	Zero Power ARO Critical Boron Concentration	**At-Power ARO Critical Boron Concentration**	**Differential Boron Worth**
CONDITIONS	Initial Critical 0 EFPD Gp 7 @ 77.3% wd Gp 8 @ 35% wd 1960 ppmB @ EARO	100% FP 1.0 EFPD Gp 7 @ 86.3% wd Gp 8 @ 35% wd 1484 ppmB	**Initial State:** Gp 7 @ 77% wd Gp 8 @ 35% wd 1963 ppmB **Final State:** Gp 5 @ 91% wd Gp 8 @ 35% wd 1703 ppmB
MEASURED VALUE	1983 ppmB @ ARO	1404 ppmB	-0.00672 $\%^{\Delta k}/_{k\ ppmB}$
PREDICTED VALUE	1978 ppmB @ ARO	1405 ppmB	-0.00667 $\%^{\Delta k}/_{k\ ppmB}$
DEVIATION	-5 ppmB*	+1 ppmB*	-0.71%**
ACCEPTANCE CRITERIA	Predicted ± 50 ppmB	Predicted ± 50 ppmB	±15% dev. from predicted

* (Predicted – Measured) ** $\frac{\text{(Predicted – Measured) * 100}}{\text{Measured}}$

INTEGRAL GROUP ROD WORTH MEASUREMENTS

PARAMETER	MEASURED VALUE (%Δk/k)	PREDICTED VALUE (%Δk/k)	DEVIATION* (%)	ACCEPTANCE CRITERION
Gp 7 Integral Worth	-0.9696	-0.9690	-0.1	± 15% Deviation
Gp 6 Integral Worth	-0.8895	-0.9640	+8.4	± 15% Deviation
Gp 6, & 7 Integral Worth	-1.8592	-1.9330	+4.0	± 10% Deviation

$$\% \text{ Deviation} = \frac{\text{Predicted - Measured} * 100}{\text{Measured}}$$

REACTIVITY COEFFICIENTS

PARAMETER	CONDITIONS	MEASURED VALUE	PREDICTED VALUE	DEVIATION (Meas-Pred)	ACCEPTANCE CRITERIA
Hot Zero Power Temperature Coefficient (ARO)	T_{ave}=533.6 F Gp 7 @ 77.4% wd Gp 8 @ 35% wd 1966 ppmB	-0.15111 E-4 $\frac{\Delta k}{k\ ^{o}F}$	-0.13312 E-4 $\frac{\Delta k}{k\ ^{o}F}$	+0.0180 E-4 $\frac{\Delta k}{k\ ^{o}F}$	Measured -Predicted = $\pm$0.2E-4 $\frac{\Delta k}{k\ ^{o}F}$
Hot Zero Power Moderator Temperature Coefficient (ARO)	T_{ave}=533.6 F Gp 7 @ 77.4% wd Gp 8 @ 35% wd 1966 ppmB	+0.01455 E-4 $\frac{\Delta k}{k\ ^{o}F}$	+0.03254 E-4 $\frac{\Delta k}{k\ ^{o}F}$	+0.0180 E-4 $\frac{\Delta k}{k\ ^{o}F}$	Measured - Predicted = $\pm$0.2E-4 $\frac{\Delta k}{k\ ^{o}F}$ and Measured $\leq$+0.5E-4 $\frac{\Delta k}{k\ ^{o}F}$

NSSS HEAT BALANCE/RCS FLOW VERIFICATION

Test Plateau	Plant Computer Online Primary Power Level (%FP)	Plant Computer Online Sec. Power Level (%FP)	Offline[1] Calculated Primary Power Level	Offline[1] Calculated Secondary Power Level	RCS Flow [1, 2] (%DF)
LPT	19.74	20.15	19.71	20.09	115.38
IMPT	72.14	72.99	72.18	72.90	114.16
FPT	99.32	99.53	99.51	99.44	113.57

[1]Calculated by the POWCALC SDQA spreadsheet.
[2]Required to be > Core Operating Limit Report RCS flow of 108.5 % Design Flow (DF)

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Enclosure 5.0

RADIAL PEAKING FACTORS AT IMPT

	8	9	10	11	12	13	14	15
H	1,1,Gp4 1.37 1.36 0.4%	2,2 1.16 1.13 3.0%	3,4,Gp3 1.03 1.01 1.7%	4,10 1.29 1.26 1.9%	5,14,Gp7 1.18 1.18 0.3%	6,21 1.21 1.17 3.2%	7,30,Gp6 1.10 1.12 -1.9%	8,37 0.49 0.48 0.5%
K		9,3,Gp3 1.01 0.98 2.4%	10,6+8 1.23 1.23 0.1%	11,Inner,Gp1 1.36 1.38 -1.8%	12,15+20 1.29 1.28 0.3%	13,22+29,Gp5 1.21 1.21 0.4%	14,31+36 1.05 1.05 -0.3%	15,45 0.39 0.40 -1.9%
L			16,12,Gp6 1.32 1.31 0.9%	17,17+18 1.33 1.30 2.7%	18,24+27,Gp8 1.26 1.27 -0.8%	19,Outer 1.20 1.21 -0.2%	20,38+44,Gp4 0.95 0.96 -0.8%	21,46 0.28 0.28 0.9%
M				22,26,Gp5 1.35 1.36 -0.8%	23,33+34 1.30 1.30 -0.3%	24,40+42,Gp2 1.09 1.09 0.1%	25,49 0.59 0.59 0.1%	
N					26,41,Gp7 1.01 1.04 -2.8%	27,48 0.89 0.91 -2.9%	28,51 0.29 0.30 -3.5%	
O						29,52 0.34 0.34 -0.8%		

Predicted
Measured
% Dev

$$\% \text{ Dev.} = \frac{\text{Predicted - Measured} * 100}{\text{Measured}}$$

Core Conditions

Power	51 %FP
Group 5	100% wd
Group 6	100%wd
Group 7	60% wd
Group 8	35% wd
Incore Imbalance	-7.16
RCS Boron	1715 ppmB

Max 1/8 Core % Deviation is +3.2% at H13	Acceptance criteria: <+15% of Predicted
Min 1/8 Core % Deviation is -3.5% at N14	Acceptance criteria: >-15% of Predicted
Maximum Peak Deviation is +0.9%	Acceptance Criteria: <+5% of Predicted
Root Mean Square of Deviations is 1.9%	Acceptance Criteria: <7.5%

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Enclosure 5.1

TOTAL PEAKING FACTORS AT IMPT

	8	9	10	11	12	13	14	15
H	1,1,Gp4 1.69 1.81 -6.6%	2,2 1.43 1.40 2.1%	3,4,Gp3 1.28 1.24 3.4%	4,10 1.69 1.65 2.4%	5,14,Gp7 1.74 1.68 3.4%	6,21 1.63 1.55 5.0%	7,30,Gp6 1.44 1.47 -1.7%	8,37 0.63 0.61 3.0%
K		9,3,Gp3 1.23 1.20 2.6%	10,6+8 1.55 1.57 -1.5%	11,Inner,Gp1 1.76 1.79 -1.5%	12,15+20 1.72 1.73 -0.4%	13,22+29,Gp5 1.61 1.60 0.5%	14,31+36 1.37 1.37 0.6%	15,45 0.50 0.50 0.1%
L			16,12,Gp6 1.68 1.66 1.4%	17,17+18 1.72 1.69 2.2%	18,24+27,Gp8 1.68 1.71 -1.8%	19,Outer 1.59 1.59 0.1%	20,38+44,Gp4 1.26 1.26 -0.5%	21,46 0.36 0.35 3.2%
M				22,26,Gp5 1.78 1.80 -1.2%	23,33+34 1.77 1.82 -3.0%	24,40+42,Gp2 1.47 1.46 0.6%	25,49 0.78 0.77 1.0%	
N					26,41,Gp7 1.52 1.56 -2.3%	27,48 1.25 1.30 -3.8%	28,51 0.39 0.40 -2.2%	
O						29,52 0.48 0.46 3.0%		

Predicted
Measured
% Dev

$$\% \text{ Dev.} = \frac{\text{Predicted - Measured} * 100}{\text{Measured}}$$

Core Conditions

Power	51 %FP
Group 5	100% wd
Group 6	100%wd
Group 7	60% wd
Group 8	35% wd
Incore Imbalance	-7.16
RCS Boron	1715 ppmB
Max 1/8 Core % Deviation is +5.0% at H13	Acceptance criteria: <+20% of Predicted
Min 1/8 Core % Deviation is -6.6% at H8	Acceptance criteria: >-20% of Predicted
Maximum Peak Deviation is +2.5%	Acceptance Criteria: <+7.5% of Predicted

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Enclosure 5.2

RADIAL PEAKING FACTORS AT FPT

	8	9	10	11	12	13	14	15
H	1,1,Gp4 1.30 1.30 0.3%	2,2 1.12 1.11 1.3%	3,4,Gp3 1.00 1.00 0.4%	4,10 1.27 1.25 1.9%	5,14,Gp7 1.29 1.27 1.6%	6,21 1.23 1.18 4.0%	7,30,Gp6 1.09 1.11 -1.7%	8,37 0.50 0.50 -0.6%
K		9,3,Gp3 0.98 0.97 0.9%	10,6+8 1.19 1.21 -1.1%	11,Inner,Gp1 1.33 1.36 -1.9%	12,15+20 1.28 1.28 0.4%	13,22+29,Gp5 1.21 1.20 1.0%	14,31+36 1.04 1.05 -0.7%	15,45 0.40 0.41 -2.7%
L			16,12,Gp6 1.28 1.27 0.4%	17,17+18 1.29 1.26 2.8%	18,24+27,Gp8 1.24 1.24 -0.4%	19,Outer 1.18 1.18 0.1%	20,38+44,Gp4 0.95 0.96 -0.6%	21,46 0.29 0.29 0.0%
M				22,26,Gp5 1.33 1.34 -0.7%	23,33+34 1.31 1.32 -0.2%	24,40+42,Gp2 1.10 1.10 0.6%	25,49 0.60 0.60 0.7%	
N					26,41,Gp7 1.13 1.15 -1.5%	27,48 0.94 0.96 -2.2%	28,51 0.31 0.32 -2.2%	
O						29,52 0.38 0.38 -1.3%		

Predicted
Measured
%Dev

$$\% \text{ Dev.} = \frac{\text{Predicted - Measured} * 100}{\text{Measured}}$$

Core Conditions

Power	100 %FP
Group 5	100% wd
Group 6	100%wd
Group 7	91% wd
Group 8	35% wd
Incore Imbalance	-3.97
RCS Boron	1398 ppmB

Max 1/8 Core % Deviation is +4.0% at H13	Acceptance criteria: <+15% of Predicted
Min 1/8 Core % Deviation is -2.7% at K15	Acceptance criteria: >-15% of Predicted
Maximum Peak Deviation is +1.8%	Acceptance Criteria: <+5% of Predicted
Root Mean Square of Deviations is 1.8%	Acceptance Criteria: <7.5%

Oconee 1 Cycle 28
STARTUP TESTING REPORT
Enclosure 5.3

TOTAL PEAKING FACTORS AT FPT

	8	9	10	11	12	13	14	15
H	1,1,Gp4 1.48 1.49 -0.9%	2,2 1.26 1.26 0.0%	3,4,Gp3 1.12 1.11 0.7%	4,10 1.45 1.44 0.3%	5,14,Gp7 1.49 1.45 2.6%	6,21 1.41 1.34 5.1%	7,30,Gp6 1.26 1.28 -1.9%	8,37 0.56 0.56 0.5%
K		9,3,Gp3 1.09 1.08 1.0%	10,6+8 1.34 1.38 -3.0%	11,Inner,Gp1 1.51 1.55 -2.4%	12,15+20 1.47 1.48 -0.7%	13,22+29,Gp5 1.39 1.38 0.6%	14,31+36 1.19 1.20 -0.5%	15,45 0.45 0.46 -2.2%
L			16,12,Gp6 1.45 1.44 0.4%	17,17+18 1.47 1.45 1.3%	18,24+27,Gp8 1.46 1.49 -1.8%	19,Outer 1.36 1.37 -0.3%	20,38+44,Gp4 1.10 1.11 -1.3%	21,46 0.32 0.32 0.9%
M				22,26,Gp5 1.53 1.54 -0.8%	23,33+34 1.52 1.58 -3.7%	24,40+42,Gp2 1.27 1.28 -0.2%	25,49 0.69 0.69 0.0%	
N					26,41,Gp7 1.32 1.35 -1.9%	27,48 1.10 1.13 -3.1%	28,51 0.36 0.37 -4.1%	
O						29,52 0.43 0.43 -0.5%		

Predicted
Measured
%Dev

% Dev. = $\frac{\text{Predicted - Measured * 100}}{\text{Measured}}$

Core Conditions

Power	100 %FP
Group 5	100% wd
Group 6	100%wd
Group 7	91% wd
Group 8	35% wd
Incore Imbalance	-3.97
RCS Boron	1398 ppmB

Max 1/8 Core % Deviation is +5.1% at H13	Acceptance criteria: <+20% of Predicted
Min 1/8 Core % Deviation is -4.1% at N14	Acceptance criteria: >-20% of Predicted
Maximum Peak Deviation is +3.3%	Acceptance Criteria: <+7.5% of Predicted

CORE POWER DISTRIBUTION DATA SUMMARY AT

IMPT AND FPT PLATEAUS

Power Level (% FP)	51	100
Group 7/8 Positions (% wd)	60/35	91/35
RCS Boron Concentration (ppmB)	1715	1398
Incore Imbalance (% FP)	-7.16	-3.97

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Core Symmetry Results at LPT

% Deviation= Highest-Lowest/AVG * 100%

Detector Number	Assembly Power	% Dev	Detector Number	Assembly Power	% Dev
6	3.60		24	3.69	
8	3.74		27	3.66	
AVG	3.67	3.81	AVG	3.68	0.82
5	4.02		23	3.47	
7	4.03		28	3.49	
9	4.00		32	3.47	
11	4.02		35	3.43	
13	4.08		39	3.44	
16	3.98		43	3.43	
19	3.99		47	3.41	
25	4.08		50	3.42	
AVG	4.03	2.48	AVG	3.45	2.32
			44	2.72	
			38	2.70	
			AVG	2.71	0.74
15	3.63		33	3.56	
20	3.58		34	3.65	
AVG	3.61	1.39	AVG	3.61	2.50
29	3.40		42	2.96	
22	3.39		40	3.04	
AVG	3.40	0.29	AVG	3.00	2.67
31	2.99				
36	2.94				
AVG	2.97	1.69			
17	3.81				
18	3.80				
AVG	3.81	0.26			