GEORGIA POWER COMPANY

VOGTLE ELECTRIC GENERATING PLANT

UNIT 2, CYCLE 4

STARTUP TEST REPORT

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1.0 INTRODUCTION

The Vogtle Electric Generating Plant Startup Test Report summarizes results for tests performed as required by plant procedures following a core refueling. The report provides a brief synopsis of each test and gives a comparison of measured values with design parameters, Technical Specifications, or values assumed in the FSAR safety analysis.

Unit 2 is a four loop Westinghouse PWR which is rated at 3565 MW_{th}. The cycle 4 core loading consists of 193 17 x 17 fuel assemblies.

Unit 2 began commercial operations on May 19, 1989 and has completed the first three cycles with the following average burnups:

Cycle 1	Completed	09/14/90	17,161 MWD/MTU
Cycle 2	Completed	03/09/92	17,008 MWD/MTU
Cycle 3	Completed	09/08/93	18,814 MWD/MTU

One Hundred Fifty Seven of the 193 assemblies comprising Cycle 4 are based upon the VANTAGE 5 design.

2.0 UNIT 2 CYCLE 4 CORE REFUELING

REFERENCES

Westinghouse WCAP-13799, The Nuclear Design Report for the Vogtle Electric Generating Plant, Unit 2, Cycle 4

SUMMARY

The off load of the Cycle 3 core commenced on September 20, 1993 and was completed on September 24, 1993. Core reload commenced on October 2, 1993 and was completed on October 5, 1993. The as-loaded Cycle 4 core is shown in Figures 1 through 5 which give the location of each fuel assembly and insert. The Cycle 4 core has a nominal design lifetime of 20,200 MWD/MTU and consists of 8 Region 3, 28 Region 4A, 48 Region 5A, 28 Region 5B, 49 Region 6A, and 32 Region 6B assemblies. Fuel assembly inserts consist of 53 full length control rods, two secondary sources, and 138 thimble plugs. Assemblies in Regions 6A and 6B have a total of 8064 Integral Fuel Burnable Absorber rods, the pellets of which are coated for a total length of 129 inches and offset upwards 1.5 inches from the center of the fuel stack

3.0 CONTROL ROD DROP TIME MEASUREMENT

PURPOSE

The purpose of this test was to measure the drop time of all control rods under hot, full flow conditions in the reactor coolant system to ensure compliance with Technical Specification 3.1.3.4 requirements.

SUMMARY OF RESULTS

For the hot, full flow conditions ($T_{avg} \geq 551\ ^{o}F$ and all reactor coolant pumps operating), Technical Specification 3.1.3.4 requires that the rod drop time from the fully withdrawn position shall be ≤ 2.7 seconds from the beginning of stationary gripper coil voltage decay until dash pot entry. All rod drop times were measured to be less than 2.7 seconds. The mean drop time was determined to be 1.605 seconds. The rod drop time results for dash pot entry are presented in Table 1.

4.0 INITIAL CRITICALITY

PURPOSE

The purpose of this test was to achieve initial reactor criticality under carefully controlled conditions, establish the power range for performance of low power physics testing, and operationally verify the calibration of the reactivity computer.

SUMMARY OF RESULTS

Initial reactor criticality for Unit 2 Cycle 4 was achieved, by dilution, at 0512 hours on October 18, 1993. The reactor was stabilized at the following critical conditions: RCS temperature 557 ^{o}F, Intermediate Range power of approximately 1×10^{-8} Amps, RCS boron concentration of 1864 ppm, and Control Bank D at 186 steps. Following stabilization, the point of adding nuclear heat was determined and a checkout of the reactivity computer was successfully accomplished. In addition, Source and Intermediate Range Nuclear Instrumentation overlap data were taken during the flux increase preceding initial criticality to demonstrate that adequate overlap existed.

5.0 ALL RODS OUT ISOTHERMAL TEMPERATURE COEFFICIENT AND BORON ENDPOINT MEASUREMENT

PURPOSE

The objectives of these measurements were to determine the hot, zero power isothermal and moderator temperature coefficients for the all rods out (ARO) configuration and to measure the boron endpoint concentration.

SUMMARY OF RESULTS

The isothermal temperature coefficient was measured to be + 3.14 pcm/^{O}F which met the design acceptance criteria of being within $\pm$ 2 pcm/^{O}F of + 2.69 pcm/^{O}F. This gave a calculated moderator temperature coefficient of + 5.21 pcm/^{O}F which included a Doppler coefficient of - 1.57 pcm/^{O}F and a burnup dependent correction factor of 0.5 pcm/^{O}F and was within the Technical Specification limit of + 7.0 pcm/ ^{O}F. Therefore no rod withdrawal limits were required to be established.

The measured ARO critical boron concentration of 1878 ppm was within the design review criterion of $\pm$ 50 ppm of the design value of 1852 ppm.

6.0 CONTROL AND SHUTDOWN BANK WORTH MEASUREMENTS

PURPOSE

The objective of the bank worth measurements was to determine the integral worth of each control and shutdown bank for comparison with design values.

SUMMARY OF RESULTS

The rod worth measurements were performed using the bank interchange (rod swap) method in which the worth of the bank having the highest design worth (the Reference Bank) is measured using the standard boron dilution method and the remaining control and shutdown banks worth's are derived from the reference bank reactivity needed to offset full insertion of the bank under test. The control and shutdown bank worth measurement results are given in Table 2.

7.0 STARTUP AND POWER ASCENSION

PURPOSE

The purpose of the power ascension program was to provide direction for Intermediate and Power Range detector calibration prior to startup and as needed during power ascension and to perform measurements and provide calibration data for incore-excore detector axial flux difference, core hot channel factor, Reactor Coolant System ΔT, and Reactor Coolant System flow at specified power level plateaus.

SUMMARY OF RESULTS

Full core flux maps were obtained at 33.4%, 47.4%, 74.4% and 99.8% power. Hot channel factors were evaluated at each power plateau and the results are shown on Table 3. Reactor Coolant Flow was determined from precision calorimetric measurements at 92.5% power. Calibration constants for DELTA-T were determined at 74.4% power.

8.0 REACTOR COOLANT SYSTEM FLOW MEASUREMENT

PURPOSE

The purpose of this test was to determine the flow rate in each reactor coolant loop to confirm that the total flow met the minimum flow requirement given in Technical Specification 3.2.5.

SUMMARY OF RESULTS

The total flow was determined to be 397,872.8 gpm which is ≥ the Technical Specification minimum limit of 384,509 gpm.

TABLE 1

CONTROL ROD DASH POT ENTRY TIMES

CONTROL ROD LOCATION	DASH POT ENTRY TIME (msec)	CONTROL ROD LOCATION	DASH POT ENTRY TIME (msec)
D02	1684	M08	1588
B12	1616	H06	1574
M14	1686	H10	1618
P04	1632	F08	1592
B04	1648	K08	1600
D14	1632	F02	1578
P12	1590	B10	1598
M02	1618	K14	1558
G03	1592	P06	1596
C09	1644	B06	1644
J13	1604	F14	1612
N07	1552	P10	1612
C07	1586	K02	1568
G13	1624	H02	1564
N09	1598	B08	1584
J03	1608	H14	1564
E03	1560	P08	1572
C11	1576	F06	1694
L13	1642	F10	1554
N05	1580	K10	1566
C05	1604	K06	1718
E13	1636	D04	1552
N11	1638	M12	1600
L03	1618	D12	1600
H04	1544	M04	1602
D08	1630	H08	1612
H12	1618		

Sample Size = 53   Mean = 1.605 seconds   2 Sigma Limits = 1.530 and 1.681 seconds

Control rods D02, M14, F06, and K06 fell outside the 2 Sigma limits and were dropped an additional six times. The drop times for the extra drops were measured to be between 1.544 and 1.690 seconds. These Drop Times were consistent with the drop times of the other rods.

TABLE 2

SUMMARY OF CONTROL AND SHUTDOWN ROD BANK WORTH MEASUREMENTS

BANK	PREDICTED INTEGRAL BANK WORTH AND REVIEW CRITERIA (pcm)	MEASURED BANK WORTH (pcm)	PERCENT DIFFERENCE
Control A	366 ± 100	328.8	- 10.2
Control B	645 ± 100	617.6	- 4.2
Control C	764 ± 115	741.1	- 3.0
Control D	588 ± 100	563.6	- 4.1
Shutdown A	264 ± 100	265.0	+ 0.4
Shutdown B (Reference)	809 ± 81	778.5	- 3.8
Shutdown C	439 ± 100	426.5	- 2.8
Shutdown D	439 ± 100	426.2	- 2.9
Shutdown E	371 ± 100	345.8	- 6.8
All Banks	4685 + 469	4493.1	- 4.1

TABLE 3

SUMMARY OF POWER ASCENSION FLUX MAP DATA

Parameter	Map 92	Map 93	Map 95	Map 96
Average % Power	33.4	47.4	74.4	99.8
LOPAR $F^N_{\Delta H}$ Limit	1.821	1.772	1.647	1.529
LOPAR $F^N_{\Delta H}$ Measured	0.7833	0.7974	0.7884	0.7724
VANTAGE 5 $F^N_{\Delta H}$ Limit	1.980	1.910	1.776	1.651
VANTAGE 5 $F^N_{\Delta H}$ Measured	1.5611	1.5760	1.5538	1.5489
Transient F_Q Limit	4.0412	4.0411	2.7742	1.8826
Most Limiting $F_Q(Z)$ + 2%	2.2446	2.0898	2.0248	1.8494
Core Average AFD (%)	2.6	1.6	- 1.3	- 2.9
Core Average Axial Offset (%)	7.864	3.424	- 1.700	- 2.912

FIGURE 1

UNIT 2 CYCLE 4 REFERENCE LOADING PATTERN

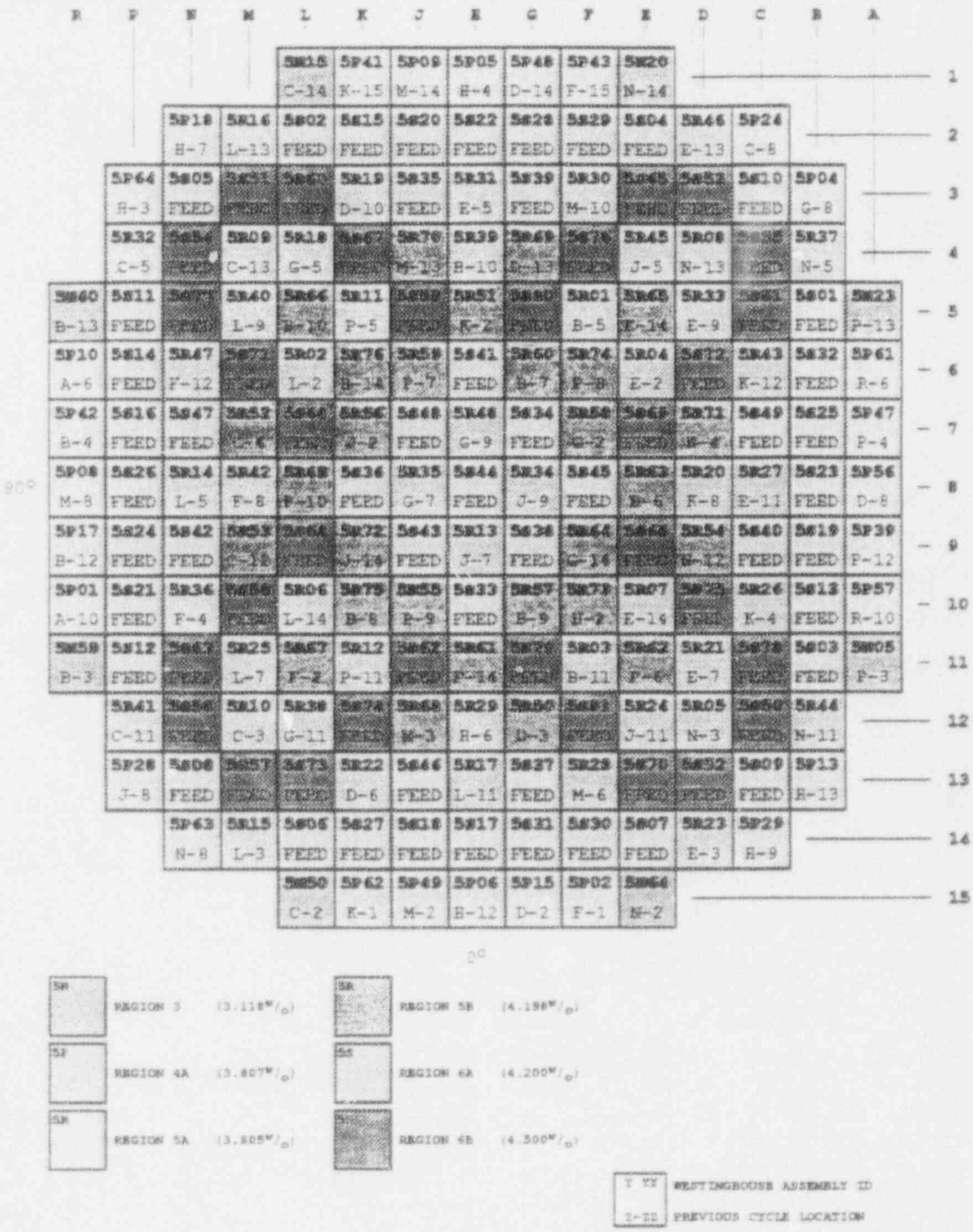
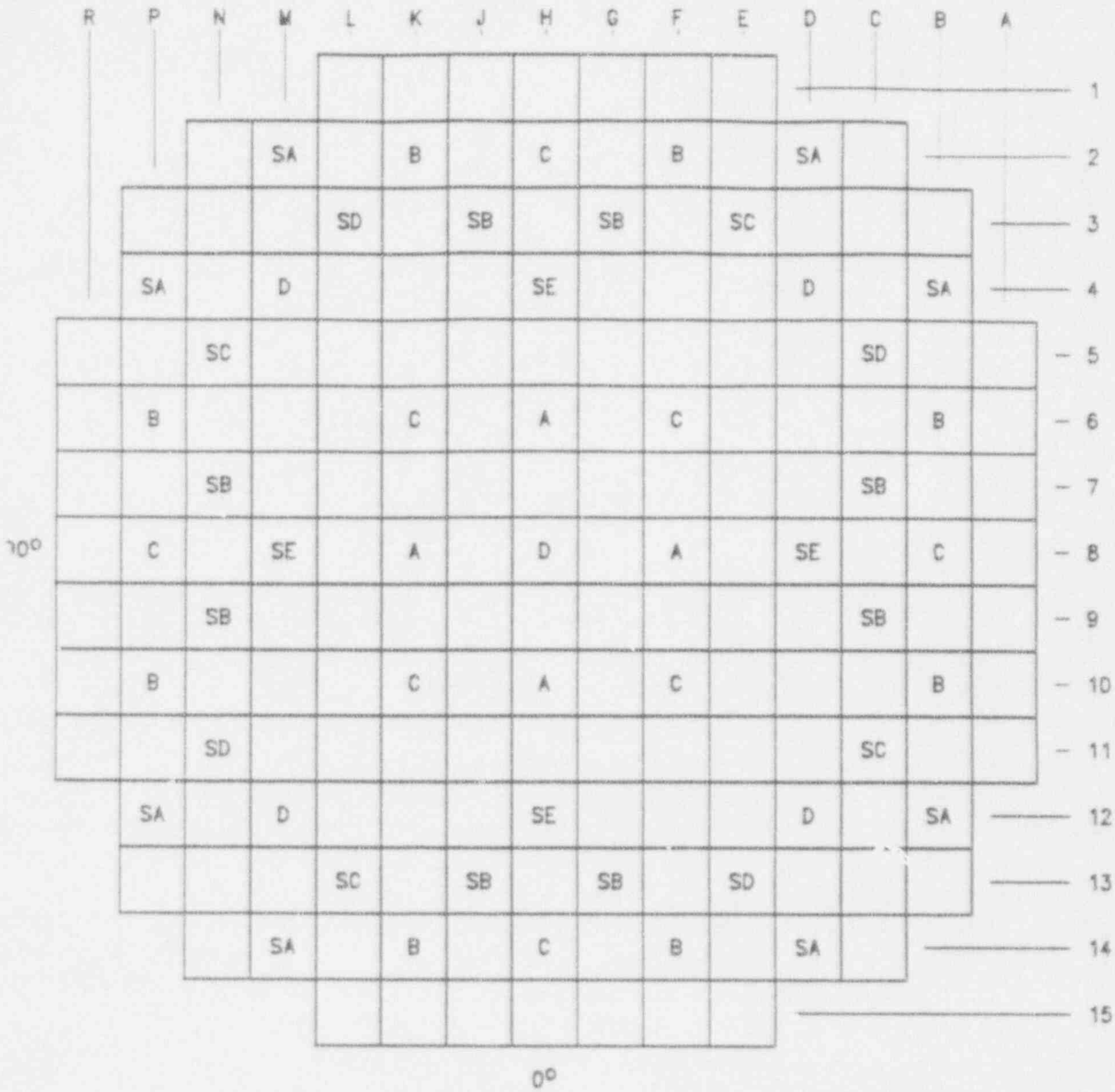


FIGURE 2

CONTROL ROD LOCATIONS



BANK IDENTIFIER	NUMBER OF LOCATIONS	BANK IDENTIFIER	NUMBER OF LOCATIONS
A	4	SA	8
B	8	SB	8
C	8	SC	4
D	5	SD	4
		SE	4

FIGURE 3

BURNABLE ABSORBER CONFIGURATIONS

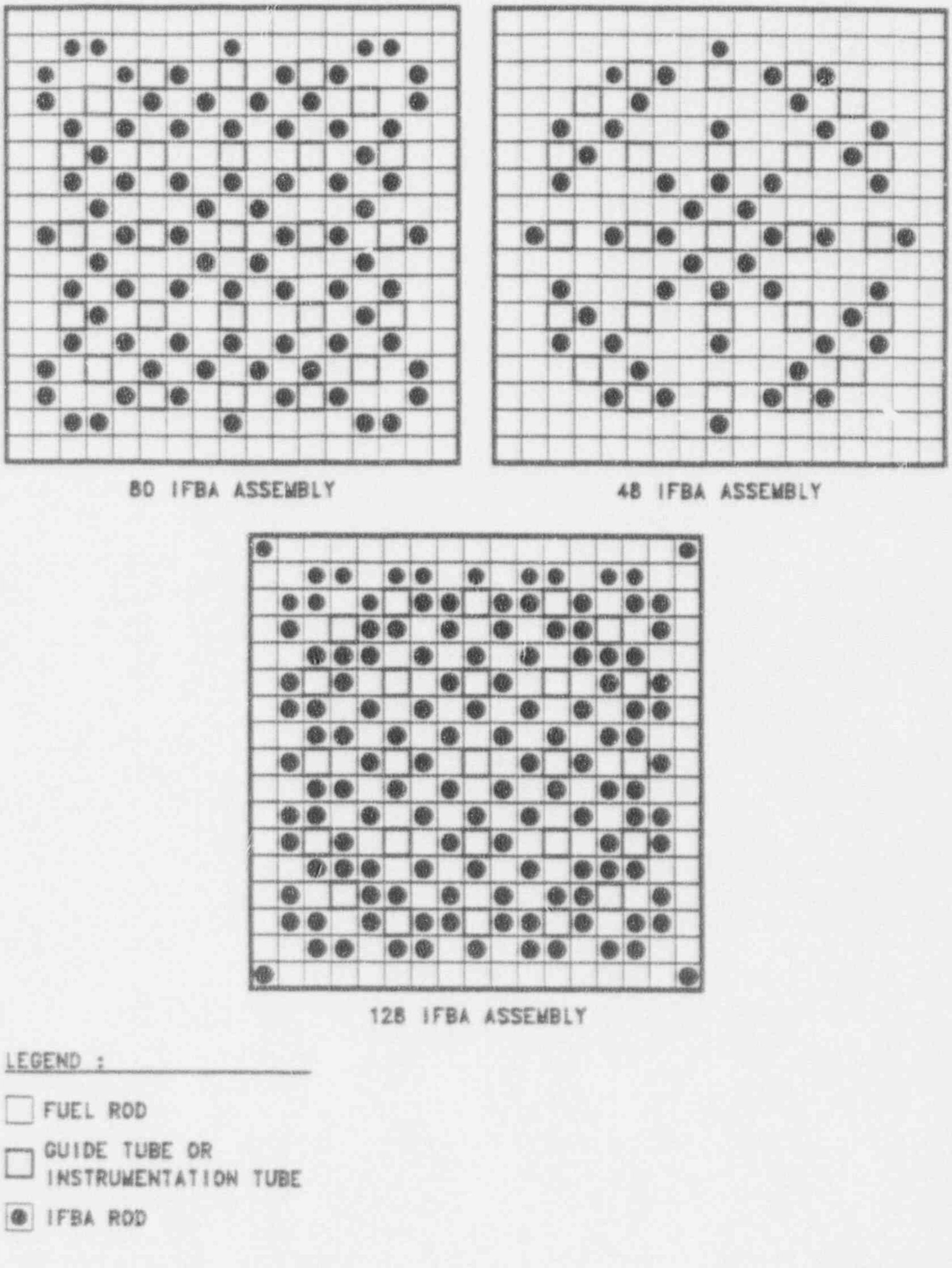
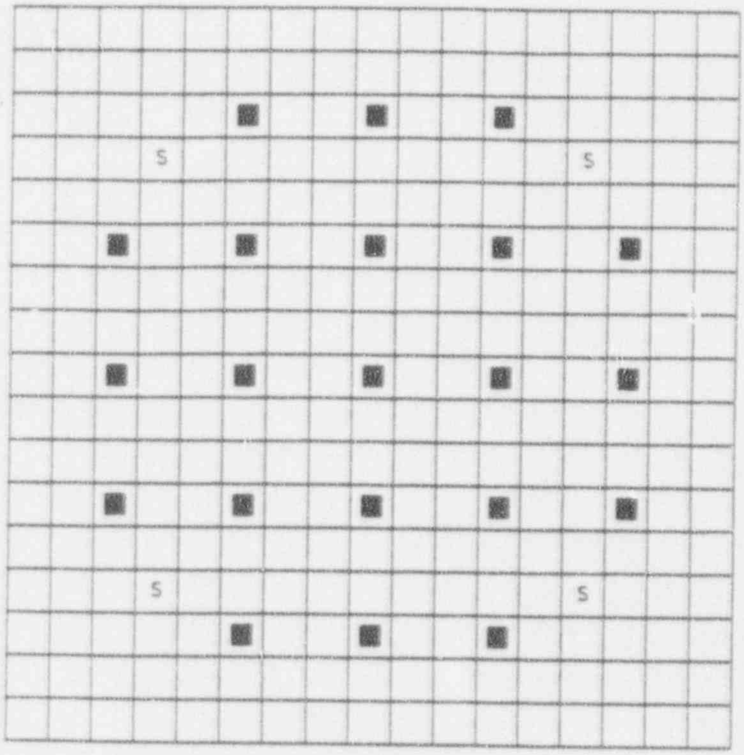


FIGURE 4

SECONDARY SOURCE ROD CONFIGURATION



Secondary Sources

S Secondary Source Rod

FIGURE 5

BURNABLE ABSORBER AND SOURCE ROD LOCATIONS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2					48I	80I	80I	80I	80I	80I	48I				
3			48I	80I	128I		128I	4SSA	128I		128I	80I	48I		
4			80I			128I				128I			80I		
5		48I	128I				128I		128I				128I	48I	
6		80I		128I				128I				128I		80I	
7		80I	128I		128I		128I		128I		128I		128I	80I	
8		80I				128I		128I		128I				80I	
9		80I	128I		128I		128I		128I		128I		128I	80I	
10		80I		128I				128I				128I		80I	
11		48I	128I				128I		128I				128I	48I	
12			80I			128I				128I			80I		
13			48I	80I	128I		128I	4SSA	128I		128I	80I	48I		
14					48I	80I	80I	80I	80I	80I	48I				
15															

90° (left side, at row 8)

0° (bottom)

TYPE	TOTAL
###I..(NUMBER OF IFBA RODS)..................	8064
#SSA..(NUMBER OF SECONDARY SOURCE RODLETS)...	8