CYCLE 4 STARTUP TEST REPORT

Cycle 4 operations commenced August 8, 1980 with the withdrawal of the first control rod. The startup test program was conducted from July 18, 1980 through October 25, 1980, in accordance with Reactor Analyst Procedure (RAP) 7.1.17, titled Refuel Startup Program, Revision 3. When reference is made to values of core thermal power and core flow, these are nominal values rather than exact percentages.

CONTROL ROD DRIVE TESTS

Control rod drive coupling checks were satisfactorily completed on August 17, 1980. In addition, the insert and withdrawal times for rods were checked and adjusted as required.

Prior to reaching 40% rated core thermal power, control rod scram time testing was conducted in accordance with RAP 7.3.10 titled Control Rod Scram Time Evaluation, Revision 3. This test requires that each control rod be scrammed from position 48 (full out) with reactor pressure > 950 psig. The results of these tests are tabulated below.

Results:

Control Rod Notch Position Observed	Technical Specification (Seconds)	Average of 137 Rods (Seconds)
46	0.338	0.312
38	0.923	0.719
24	1.992	1.452
04	3.554	2.569

The average of the scram insertion times for the three fastest operable control rods for all groups of four control rods a in two-t -two array were less than the maximum allowed by the technical specifications.

SHUTDOWN MARGIN DEMONSTRATION

A shutdown margin (SDM) demonstration was performed August 8, 1980 in accordance with Reactor Analyst Procedure 7.3.9 Revision 2. The required SDM was 0.38% Δk + R + temperature defect. The fuel vendor has calculated that the value of R is 0.15%. After calculating the temperature defect and uncertainty, the required SDM was determined to be 0.78% Δk. Sufficient control rods were withdrawn to demonstrate a SDM of 0.80% Δk. The calculated SDM based on the in-sequence critical data was 1.69%.

INSEQUENCE CRITICAL

Based on data supplied by the fuel vendor, the first critical was estimated to be notch 10 of the eleventh rod of group 2 with a reactor water temperature of 145°F. The actual data was group 2, rod 14, notch 08, reactor water temperature 155°F, period 89 seconds, indicating good agreement between predicted and actual data.

REACTIVITY ANOMALY CHECK

A comparison of the expected and actual control rod density was performed at 100% core thermal power (CTP) and 100% rated core flow. The control rod inventory was 418 notches which was in close agreement. with the predicted value of 421 notches. The ±1% reactivity boundaries were 80 to 720 notches.

POWER DISTRIBUTION MEASUREMENTS

Core power distribution was monitored throughout the startup using the process computer. Following significant changes in control rod pattern and power level, a complete power distribution measurement was performed using the Traversing In-core Probe (TIP) system. Core parameters were maintained within technical specification limits.

TIP REPRODUCIBILITY

Four successive traces were run in the common channel for each TIP machine. Computer reduction of the data calculated a random noise of 1.46% and a total uncertainty of 3.14%, well below the 8.7% assumed by the vendor in the statistical analysis performed for the licensing topical report (NEDG-24011-P-A) for the reload fuel application.

CORE POWER SYMMETRY

Core power symmetry was checked at 25%, 50%, 75% and 100% CTP. Mirror symmetric fuel assemblies checked at 100% CTP and 100% core flow using the process computer indicate a maximum difference of less than 10%.

CORE LOAD NG

A copy of the final core loading is attached as Figure 1. Irradiated fuel returned to the core is designated EA or LJ5 or LJ6 or LJB. There were 160 new fuel assemblies, designated LJM, (136 bundles with 2.82 w/o U-235, 24 bundles with 2.65 w/o U-235) loaded during the refueling outage. The new fuel was of the P8 x 8 R design with an active fuel length of 150 inches and received 100 mil channels.

Figures 2a - 2d show the approximate irradiated bundle average exposure following refueling. A zero indicates a new fuel assembly.

The new fuel assemblies contain burnable poison in the form of $Gd0_3$. The concentration and location is proprietary to the fuel vendor.

Figure 3 shows the rod sequence control system (RSCS) designations for the A and B rod withdrawal sequences.

During the refueling operation, each fuel move was checked by an individual, other than the operator performing the move, and verified independently by a third individual. Two lines of communication were established between the refuel bridge and the control room. Following loading, a core verification was conducted (and video-taped and examined later by quality assurance personnel) to verify the correct placement and orientation of each assembly.

ADDITIONAL TESTS

1. Tests were performed in accordance with RAP 7.1.17 and F-ST-5C to verify that there is approximately one decade overlap between the source range monitor and intermediate range monitor (IRM) systems, and between the IRM and average power range monitor (APRM) systems.

2. Reactor core isolation cooling and high pressure coolant injection flow rate tests were performed in accordance with F-ST-24C and F-ST-4B and demonstrated compliance with the technical specifications.

3. Both the rod worth minimizer and rod sequence control system functioned properly during the startup test program.

4. Since some TIP tubing were replaced, the TIP alignment and logic limits were checked and adjusted as required.

5. New computer software was installed during the outage. Extensive testing was performed prior to and during the startup in accordance with the vendor's recommendations.

6. The APRM system was calibrated to core thermal power and satisfactorily tracked power changes.

7. Heat balances were calculated manually and used to verify the process computer calculations.

8. Process computer calculations of fuel assembly parameters, maximum average planar linear heat generation rate, minimum critical power ratio, and maximum fraction limiting power density compared satisfactorily with results obtained using off-line computer calculations.

9. RAP 7.3.18, "Pressure Regulator Tests," was performed satisfactorily when it was verified that an induced pressure transient of 10 psi was controlled by the electro-hydraulic control system pressure regulator. In addition, transfer from the primary to back-up pressure regulator was demonstrated following a simulated failure of the primary regulator.

10. RAP 7.3.7, "Core Flow Evaluation and Indication Calibration," was performed at 75%, 89% and 96% CTP. The results of the September 12, 1980 tests at 96% CTP showed a calculated core flow of 72.2 Mlb/hr while the indicated core flow was 77.1 Mlb/hr.

    After adjustment of the amplifier gains, the calibration was repeated September 16, 1980. Calculated core flow was 75.3 Mlb/hr with an indicated core flow of 76.4 Mlb/hr.

08-06-80

FIGURE 1

ISER/ISRBB FUEL SERIAL NUMBERS

52									EA	EA	EA	EA	EA	EA	EA	EA	EA	EA											
									156	538	508	219	292	252	181	478	542	284											
								EA	LJB	LJM	LJB	LJM	LJB	LJB	LJM	LJB	LJM	LJB	EA										
50								203	378	470	381	456	310	358	459	400	452	386	236										
					EA	EA	EA	LJB	EA	LJB	EA	LJB	LJM	LJM	LJB	EA	LJB	EA	LJB	EA	EA	EA							
48					412	520	193	348	221	379	213	411	580	565	397	270	389	179	034	223	543	510							
				EA	LJB	LJM	LJB	LJM	LJB	LJM	LJB	LJM	LJ5	LJ5	LJM	LJB	LJM	LJB	LJM	LJB	LJM	LJB	EA						
46				390	316	469	284	504	352	537	353	427	336	358	494	365	542	364	591	309	451	344	351						
			EA	LJB	LJB	LJ6	LJB	LJ5	LJM	LJ5	LJB	LJ6	LJM	LJM	LJ6	LJB	LJ5	LJM	LJ5	LJB	LJ6	LJB	LJB	EA					
44			275	308	391	271	354	341	514	337	322	278	530	547	297	356	349	524	362	376	286	388	338	301					
			EA	LJM	LJ6	LJM	LJ5	LJM	LJ6	LJM	LJ5	LJM	LJ6	LJ6	LJ4	LJ5	LJM	LJ6	LJM	LJ5	LJM	LJ6	LJM	EA					
42			536	462	274	484	338	525	283	501	339	522	273	286	543	365	582	297	563	357	573	287	458	492					
			EA	LJB	LJB	LJ5	LJM	LJ5	LJB	LJ6	LJB	EA	LJM	LJM	EA	LJB	LJ6	LJB	LJ5	LJM	LJ5	LJB	LJB	EA					
40			231	336	335	325	585	342	342	270	340	268	581	609	137	351	284	343	361	539	340	279	327	178					
		EA	LJB	LJM	LJ5	LJM	LJ5	LJM	LJ5	LJM	LJ5	LJM	EA	EA	LJM	LJ5	LJM	LJ5	LJM	LJ5	LJM	LJ5	LJM	LJB	EA				
38		152	301	550	335	554	326	558	333	528	344	556	247	226	570	355	598	354	562	343	546	352	590	359	165				
	EA	LJB	EA	LJB	LJM	LJ6	LJB	LJ5	LJM	EA	LJB	EA	LJM	LJM	EA	LJB	EA	LJM	LJ5	LJB	LJ6	LJM	LJB	EA	LJB	EA			
36	147	401	157	361	557	282	333	332	577	257	347	162	578	503	176	371	237	552	359	331	296	601	312	217	383	259			
	EA	LJM	LJB	LJM	LJ5	LJM	LJ6	LJM	EA	LJM	LJ5	LJM	LJ5	LJ5	LJM	LJ5	LJM	EA	LJM	LJ6	LJM	LJ5	LJM	LJB	LJM	EA			
34	503	471	382	475	327	495	277	564	189	540	330	510	328	345	599	350	545	235	559	291	555	346	535	395	467	489			
	EA	LJB	EA	LJB	LJB	LJ5	LJB	LJ5	LJB	LJ5	LJB	LJ6	LJB	LJB	LJ6	LJB	LJ5	LJB	LJ5	LJB	LJ5	LJB	LJB	EA	LJB	EA			
32	168	402	294	293	362	329	286	334	305	347	291	280	325	299	294	314	360	306	353	321	351	298	367	142	387	246			
	EA	LJM	LJB	LJM	LJ6	LJM	EA	LJM	EA	LJM	LJ6	LJM	EA	EA	LJM	LJ6	LJM	EA	LJM	EA	LJM	LJ6	LJM	LJB	LJM	EA			
30	242	468	390	492	275	551	208	498	192	476	281	489	224	286	493	295	592	146	572	141	566	290	533	409	463	194			
	EA	LJB	LJM	LJ6	LJM	LJ6	LJM	EA	LJM	LJ5	LJB	EA	LJ6	LJ6	EA	LJB	LJ5	LJM	EA	LJM	LJ6	LJM	LJ6	LJM	LJB	EA			
28	271	302	593	272	579	279	569	280	516	331	303	244	276	289	214	320	348	499	158	526	293	607	285	511	337	273			
	EA	LJB	LJM	LJ6	LJM	LJ6	LJM	EA	LJM	LJ6	LJB	EA	LJ6	LJ6	EA	LJB	LJ6	LJM	EA	LJM	LJ6	LJM	LJ6	LJM	LJB	EA			
26	239	307	571	310	541	302	560	245	548	246	297	225	306	319	188	318	263	508	171	488	316	527	323	505	295	204			
	EA	LJM	LJB	LJM	LJ6	LJM	EA	LJM	EA	LJM	LJ6	LJM	EA	EA	LJM	LJ6	LJM	EA	LJM	EA	LJM	LJ6	LJM	LJB	LJM	EA			
24	185	474	398	603	305	485	140	567	183	480	300	608	211	210	519	314	597	134	602	258	481	320	586	384	464	289			
	EA	LJB	EA	LJB	LJB	LJ5	LJB	LJ5	LJB	LJ5	LJB	LJ6	LJB	LJB	LJ6	LJB	LJ6	LJB	LJ6	LJB	LJ6	LJB	LJB	EA	LJB	EA			
22	186	406	269	373	290	374	319	372	368	356	315	301	278	283	315	324	251	366	260	287	249	304	285	218	394	175			
	EA	LJM	LJB	LJM	LJ5	LJM	LJ6	LJM	EA	LJM	LJ5	LJM	LJ6	LJ6	LJM	LJ6	LJM	EA	LJM	LJ6	LJM	LJ6	LJM	LJB	LJM	EA			
20	552	472	399	604	373	502	304	587	295	509	367	491	258	259	490	252	536	265	530	318	600	267	568	412	457	507			
	EA	LJB	EA	LJB	LJM	LJ6	LJB	LJ5	LJM	EA	LJB	EA	LJM	LJM	EA	LJB	EA	LJM	LJ6	LJB	LJ6	LJM	LJB	EA	LJB	EA			
18	200	404	197	374	506	299	292	370	583	230	317	290	549	517	206	289	233	518	262	329	313	515	330	264	413	177			
		EA	LJB	LJM	LJ6	LJM	LJ6	LJM	LJ5	LJM	LJ5	LJM	EA	EA	LJM	LJ6	LJM	LJ6	LJM	LJ6	LJM	LJ6	LJM	LJB	EA				
16		169	288	561	248	496	247	532	371	477	366	531	297	229	595	254	487	269	479	268	529	266	507	357	250				
			EA	LJB	LJB	LJ6	LJM	LJ5	LJB	LJ6	LJB	EA	LJM	LJM	EA	LJB	LJ6	LJB	LJ6	LJM	LJ6	LJB	LJB	EA					
14			216	300	326	250	513	364	311	311	349	232	478	534	296	369	325	377	257	520	261	281	346	276					
			EA	LJM	LJ6	LJM	LJ5	LJM	LJ6	LJM	LJ5	LJM	LJ6	LJ6	LJM	LJ6	LJM	LJ6	LJM	LJ6	LJM	LJ6	LJM	EA					
12			493	453	308	483	368	605	298	594	369	576	307	322	553	255	589	312	588	256	482	321	466	512					
			EA	LJB	LJB	LJ6	LJB	LJ5	LJM	LJ6	LJB	LJ6	LJM	LJM	LJ6	LJB	LJ6	LJB	LJ6	LJM	LJ6	LJB	LJB	EA					
10			202	360	405	309	280	363	574	245	339	303	544	512	317	313	264	523	253	350	324	410	345	159					
				EA	LJB	LJM	LJB	LJM	LJB	LJM	LJB	LJM	LJ6	LJ6	LJM	LJB	LJM	LJB	LJM	LJB	LJM	LJB	EA					
08				419	296	454	355	606	282	500	370	610	244	265	575	294	596	332	486	363	461	375	313						
					EA	EA	EA	LJB	EA	LJB	EA	LJB	LJM	LJM	LJB	EA	LJB	EA	LJB	EA	EA	EA							
06					305	496	249	341	243	407	205	393	584	521	385	281	403	163	323	201	551	435							
								EA	LJB	LJM	LJB	LJM	LJB	LJB	LJM	LJB	LJM	LJB	EA										
04								278	396	455	380	473	372	328	465	392	460	408	190										
									EA	EA	EA	EA	EA	EA	EA	EA	EA	EA											
02									263	541	368	240	277	255	266	371	355	288											
	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51			

EBUN BUNDLE EXPOSURES FITZPATRICK 1 QUADRANT 1 1356 10/16/80

	1	3	5	7	9	11	13	15	17	19	21	23	25	
52									19474.	19425.	18769.	18504.	18291.	52
50								19611.	6876.	Ø.	7101.	Ø.	7641.	50
48						19959.	19632.	18985.	8313.	19321.	7948.	17952.	6878.	Ø.	48
46					19860.	7878.	Ø.	7471.	Ø.	7484.	Ø.	7615.	Ø.	12854.	46
44				19330.	7965.	7137.	13953.	7786.	13814.	Ø.	13890.	6863.	13680.	Ø.	44
42				18875.	Ø.	14168.	Ø.	12833.	Ø.	12551.		12501.	Ø.	13795.	42
40				18408.	7225.	7179.	12021.	Ø.	13222.	6421.	14031.	6496.	18490.	Ø.	40
38			19319.	7716.	Ø.	13043.	Ø.	14053.	Ø.	11914.	Ø.	11083.	Ø.	17541.	38
36		19010.	7466.	18410.	7715.	Ø.	13011.	6078.	12100.	Ø.	18432.	6043.	18215.	Ø.	36
34		19368.	Ø.	7443.	Ø.	13835.	Ø.	14055.	Ø.	17474.	Ø.	11450.	Ø.	12012.	34
32		18634.	6861.	19122.	5761.	6996.	11894.	6467.	11531.	5771.	11062.	6562.	14561.	4843.	32
30		18414.	Ø.	6476.	Ø.	13427.	Ø.	18428.	Ø.	19333.		14305.	Ø.	16133.	30
28		19297.	7128.	Ø.	13026.	Ø.	15182.	Ø.	18500.	Ø.	12401.	4741.	16351.	14097.	28
	1	3	5	7	9	11	13	15	17	19	21	23	25	

Figure 2a

EBUN BUNDLE EXPOSURES FITZPATRICK 1 QUADRANT 2 1356 10/16/80

	27	29	31	33	35	37	39	41	43	45	47	49	51	
52	17904.	18075.	18675.	19725.	19968.									52
50	7649.	Ø.	7093.	Ø.	6876.	19911.								50
48	Ø.	6881.	17941.	7951.	19418.	8326.	19481.	19449.	19670.					48
46	12858.	Ø.	7621.	Ø.	7483.	Ø.	7472.	Ø.	7878.	19940.				46
44	Ø.	13662.	6865.	13887.	Ø.	13795.	7798.	13932.	7142.	7963.	18946.			44
42	1775.	Ø.	12498.	Ø.	12541.	Ø.	12831.	Ø.	14152.	Ø.	18847.			42
40	Ø.	18323.	6493.	14019.	6416.	13224.	Ø.	12001.	7181.	7223.	18434.			40
38	17529.	Ø.	11065.	Ø.	11914.	Ø.	14048.	Ø.	13046.	Ø.	7717.	19251.		38
36	Ø.	18416.	6051.	18488.	Ø.	12095.	6083.	13013.	Ø.	7713.	18441.	7456.	19598.	36
34	12003.	Ø.	11459.	Ø.	18402.	Ø.	14055.	Ø.	13830.	Ø.	7442.	Ø.	19635.	34
32	4841.	14564.	6559.	11057.	5765.	11525.	6465.	11899.	7001.	5767.	18995.	6863.	18003.	32
30	15725.	Ø.	14298.	Ø.	18[illegible].	Ø.	18418.	Ø.	13422.	Ø.	6475.	Ø.	18315.	30
28	14108.	16694.	4739.	12396.	Ø.	18668.	Ø.	15172.	Ø.	13041.	Ø.	7127.	19536.	28
	27	29	31	33	35	37	39	41	43	45	47	49	51	

Figure 2b

10/16/80

EBUN BUNDLE EXPOSURES FITZPATRICK 1 QUADRANT 3 1356 10/16/80

	27	29	31	33	35	37	39	41	43	45	47	49	51	
26	14103.	16568.	4742.	12403.	0.	19[illegible].	0.	15205.	0.	13031.	0.	7121.	19285.	26
24	16180.	0.	14314.	0.	18977.	0.	17089.	0.	13440.	0.	6468.	0.	18142.	24
22	4851.	14581.	6555.	11046.	5768.	11545.	6468.	11890.	7000.	5770.	18842.	6867.	18393.	22
20	12010.	0.	11474.	0.	18454.	0.	14069.	0.	13826.	0.	7435.	0.	19663.	20
18	0.	18421.	6055.	18486.	0.	12098.	6078.	12986.	0.	7717.	18530.	7475.	19013.	18
16	17768.	0.	11083.	0.	11903.	0.	14065.	0.	13046.	0.	7713.	19028.		16
14	0.	17958.	6496.	14018.	6416.	13212.	0.	12015.	7177.	7218.	18476.			14
12	13781.	0.	12489.	0.	12552.	0.	12842.	0.	14172.	0.	18794.			12
10	0.	13666.	6867.	13904.	0.	13801.	7787.	13922.	7142.	7966.	18738.			10
8	12854.	0.	7621.	0.	7478.	0.	7474.	0.	7872.	19947.				8
6	0.	6880.	17911.	7950.	19359.	8314.	18897.	19218.	19779.					6
4	7642.	0.	7077.	0.	6875.	19604.								4
2	18146.	18543.	18761.	19695.	19945.									2
	27	29	31	33	35	37	39	41	43	45	47	49	51	

Figure 2c

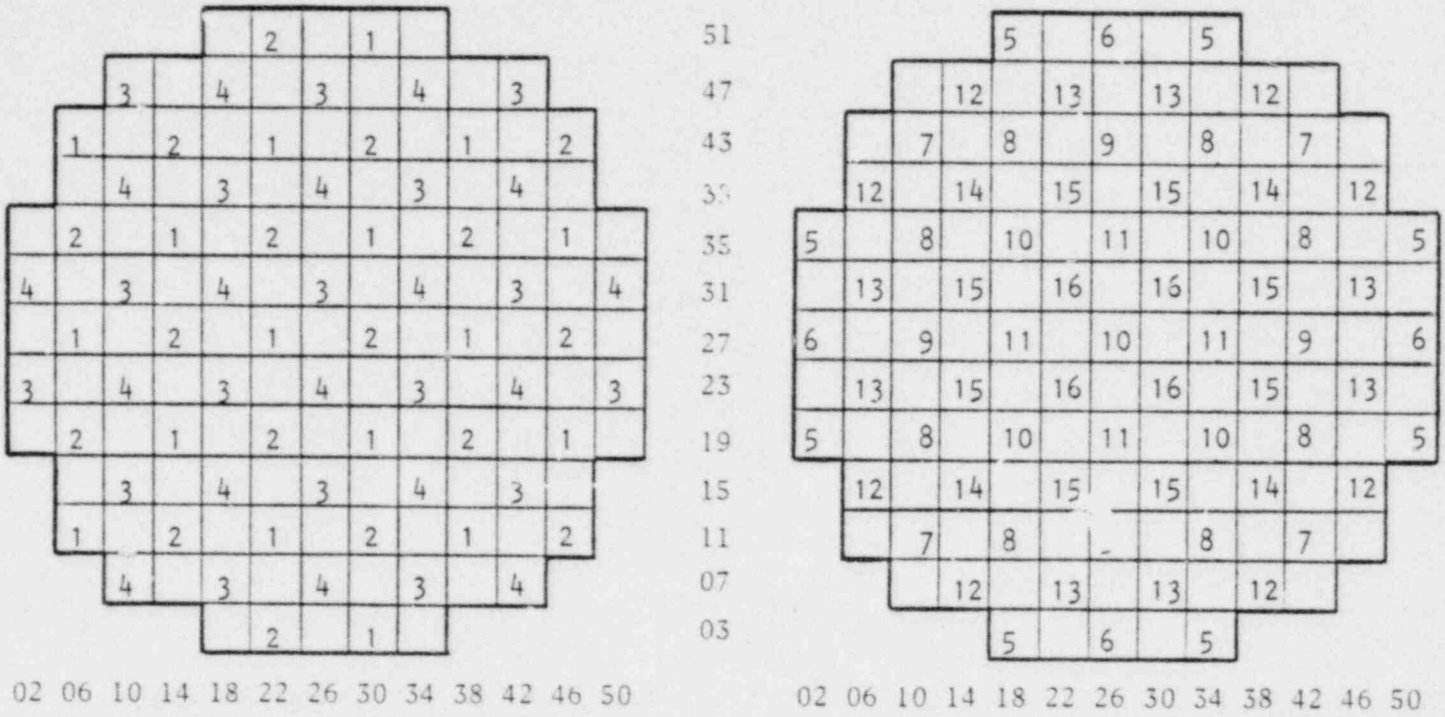
EBUN BUNDLE EXPOSURES FITZPATRICK 1 QUADRANT 4 1356 10/16/80

	1	3	5	7	9	11	13	15	17	19	21	23	25	
26	19547.	7136.	0.	13034.	0.	15185.	0.	19132.	0.	12398.	4742.	16944.	14109.	26
24	18419.	0.	6473.	0.	13433.	0.	17095.	0.	18962.	0.	14300.	0.	16378.	24
22	18730.	6859.	18893.	5773.	6994.	11887.	6467.	11541.	5767.	11068.	6564.	14566.	4848.	22
20	19657.	0.	7441.	0.	13826.	0.	14071.	0.	17477.	0.	11461.	0.	11996.	20
18	19086.	7461.	18498.	7711.	0.	12998.	6076.	12093.	0.	18552.	6049.	18184.	0.	18
16		18771.	7719.	0.	13041.	0.	14058.	0.	11921.	0.	11076.	0.	17804.	16
14			18781.	7228.	7182.	12022.	0.	13210.	6414.	14005.	6495.	18008.	0.	14
12			18461.	0.	14160.	0.	12639.	0.	12548.	0.	12498.	0.	13786.	12
10			18862.	7961.	7141.	13926.	7789.	13808.	0.	13900.	6861.	13673.	0.	10
8				19172.	7875.	0.	7468.	0.	7482.	0.	7613.	0.	12851.	8
6					19803.	19216.	19504.	8317.	19394.	7950.	17945.	6879.	0.	6
4									19399.	6876.	0.	7081.	0.	7627.	4
2										20193.	19557.	18766.	18645.	18479.	2
	1	3	5	7	9	11	13	15	17	19	21	23	25	

Figure 2d

ROD SEQUENCE CONTROL SYSTEM GROUP DESIGNATIONS

A SEQUENCE



B SEQUENCE

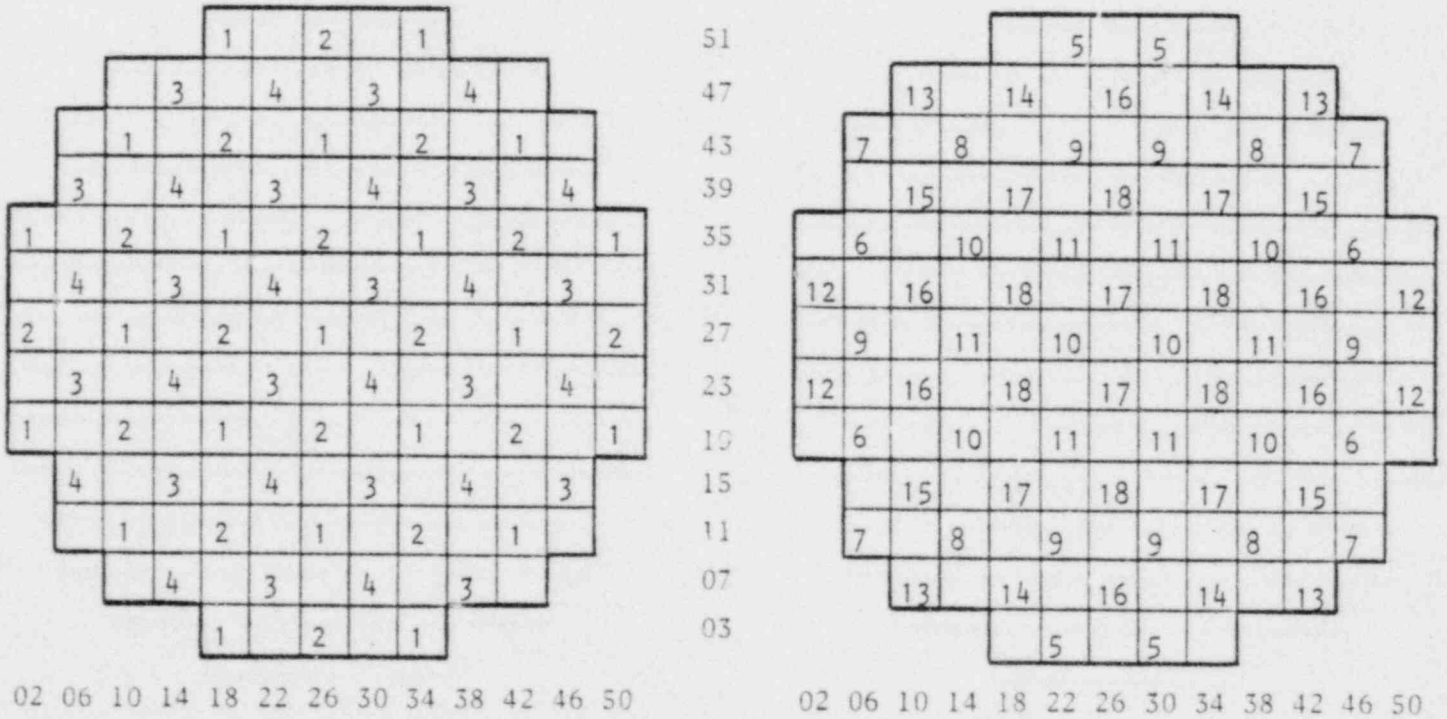


Fig. 3