

CYCLE 5 STARTUP TEST REPORT

Cycle 5 operations commenced March 6, 1982 with the withdrawal of the first control rod. The startup test program was conducted from February 7, 1982 through April 8, 1982, in accordance with Reactor Analyst Procedure (RAP) 7.1.17, titled Refuel Startup Program, Revision 4. 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 March 14, 1982. 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 Reactor Analyst Procedure 7.3.10 titled Control Rod Scram Time Evaluation, Revision 5. 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:

<u>Control Rod Notch Position Observed</u>	<u>Technical Specification (Seconds)</u>	<u>Average of 137 Rods (Seconds)</u>
46	0.338	0.329
38	0.923	0.739
24	1.992	1.479
04	3.554	2.593

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

Control rod drive 30-19 did not scram the first time it was tested. Because it exceeded the 7.0 second maximum time for 90% insertion, it was declared inoperable and fully inserted. Both scram pilot air solenoids were replaced. Subsequently, the drive was tested satisfactorily.

INSEQUENCE CRITICAL/SHUTDOWN MARGIN CALCULATION

Based on data supplied by the fuel vendor, criticality was estimated to occur on notch 12 of the tenth rod of group 2 with a reactor water temperature of 155°F. Actual criticality occurred at group 2, rod 11, notch 08, reactor water temperature 160°F, period 102 seconds, indicating good agreement between predicted and actual data. The shutdown margin calculated during the in-sequence critical was 1.66%.

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 266 notches which was in close agreement with the predicted value of 305 notches. The $\pm 1\%$ reactivity boundaries were 5 to 605 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 2.44% and a total uncertainty of 2.09%, well below the 8.7% assumed by the vendor in the statistical analysis performed for the licensing topical report (NEDE-24011-P-A) for the reload fuel application.

CORE POWER SYMMETRY

Core power symmetry was checked at 30%, 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 approximately 6.1%.

CORE LOADING

A copy of a final core loading is attached as Figure 1. Irradiated fuel returned to the core is designated LJ5, LJ6, LJB or LJM. There were 188 new fuel assemblies, designated LJX or LJZ, (128 bundles with 2.84 w/o U-235, 60 bundles with 2.99 w/o U-235) loaded during the refueling outage. The new fuel was of the P8x8R design with an active fuel length of 150 inches and received new 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 Gd_2O_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. 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 Reactor Analyst Procedure 7.1.17 and Surveillance Test 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 Surveillance Test F-ST-24C and Surveillance Test 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 was 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 of limiting power density compared satisfactorily with results obtained using off-line computer calculations.

9. Reactor Analyst Procedure 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. Reactor Analyst Procedure 7.3.7, "Core Flow Evaluation and Indication Calibration", was performed at 98%, 93%, and 100% CTP. The results of the March 24, 1982 tests at 98% CTP indicated that one jet pump square root converter was not functioning properly. Following replacement of the device, core flow was calculated to be within approximately 2.2% of the indicated core flow.

WISRB-B FUEL SERIAL NUMBERS

```

      LJ6 LJ5 LJ5 LJ5 LJ5 LJ5 LJ5 LJ5 LJ5 LJ6
      282 331 330 339 334 353 365 350 348 296
      LJ6 LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJ6
      271 516 558 551 510 579 607 599 566 562 499 286
      LJ5 LJ5 LJ5 LJM LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJM LJ5 LJ5 LJ5
      342 333 338 498 322 931 316 879 310 358 886 344 980 356 572 357 354 361
      LJ6 LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJ6
      272 569 528 495 489 003 593 026 557 038 016 601 018 511 996 493 555 598 526 285
      LJ5 LJM LJB LJZ LJB LJX LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ5
      336 581 336 043 348 947 378 892 303 879 379 389 877 320 981 386 968 334 006 327 609 358
      LJ5 LJM LJZ LJM LJZ LJM LJZ LJM LJZ LJM LJX LJX LJM LJZ LJM LJZ LJM LJZ LJM LJZ LJM LJ5
      332 564 010 504 020 468 007 492 047 462 990 915 458 013 533 032 463 052 591 001 559 359
      LJ5 LJM LJB LJZ LJB LJX LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ5
      325 501 301 053 391 910 390 893 402 955 335 279 919 387 903 409 911 388 029 359 582 340
      LJ6 LJM LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJ6
      274 556 585 937 456 954 577 961 554 880 471 988 917 467 949 546 978 552 977 459 960 539 570 287
J6 LJM LJB LJZ LJB LJZ LJB LJX LJM LJB LJB LJX LJB LJB LJX LJB LJB LJM LJX LJB LJZ LJB LJZ LJB LJM LJ6
83 578 362 040 401 055 411 897 550 332 293 956 340 351 926 367 331 590 905 397 050 383 028 298 503 297
J5 LJM LJX LJM LJX LJM LJX LJM LJB LJX LJM LJB LJX LJX LJB LJM LJZ LJB LJM LJX LJM LJX LJM LJX LJM LJ5
28 540 991 520 939 497 953 525 342 998 537 261 923 950 312 542 056 343 563 882 494 983 565 876 545 345
J5 LJM LJB LJZ LJB LJZ LJB LJX LJB LJM LJM LJX LJB LJB LJX LJM LJM LJB LJX LJB LJZ LJB LJZ LJB LJM LJ5
47 522 308 041 325 049 381 924 284 475 484 887 291 314 922 573 535 309 921 400 034 299 045 338 543 360
J5 LJM LJX LJM LJX LJM LJX LJM LJX LJB LJX LJB LJX LJX LJB LJX LJB LJX LJM LJX LJM LJX LJM LJX LJM LJ5
29 476 989 514 913 469 888 470 881 352 906 347 995 966 371 957 364 974 452 979 451 993 524 914 592 351
J5 LJM LJB LJZ LJB LJX LJB LJX LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ5
44 538 302 042 382 946 354 895 286 885 353 930 305 306 928 365 920 321 916 376 948 395 012 337 547 355
J5 LJM LJB LJZ LJB LJX LJB LJX LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ6
66 544 307 019 399 878 280 872 319 970 370 958 368 366 952 294 889 287 938 350 925 412 023 295 512 254
J5 LJM LJX LJM LJX LJM LJX LJM LJX LJB LJX LJB LJX LJX LJB LJX LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ6
74 480 969 574 870 454 883 455 985 282 927 317 929 901 289 369 332 943 460 944 461 951 523 894 597 249
J5 LJM LJB LJZ LJB LJZ LJB LJX LJB LJM LJM LJX LJB LJB LJX LJM LJM LJB LJX LJB LJZ LJB LJZ LJB LJM LJ6
56 576 360 040 270 015 380 971 355 604 483 875 315 324 962 482 568 363 891 392 024 283 054 345 553 251
J6 LJM LJX LJM LJX LJM LJX LJM LJB LJZ LJM LJB LJX LJX LJB LJM LJZ LJB LJM LJX LJM LJX LJM LJX LJM LJ6
58 509 918 584 992 610 935 645 311 031 500 374 936 994 330 596 017 377 588 941 575 907 521 973 536 259
J6 LJM LJB LJZ LJB LJZ LJB LJX LJM LJB LJB LJX LJB LJB LJX LJB LJB LJM LJX LJB LJZ LJB LJZ LJB LJM LJ6
93 349 290 022 404 011 393 268 561 292 373 873 349 369 976 285 329 507 896 385 014 413 025 304 517 312
      LJ6 LJM LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJX LJM LJ6
      308 531 513 942 473 984 583 934 496 967 472 972 904 457 982 529 890 518 945 465 909 520 595 321
      LJ6 LJM LJB LJZ LJB LJX LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ6
      250 594 288 039 405 975 398 933 406 965 326 281 987 394 908 384 912 410 027 357 589 261
      LJ5 LJM LJZ LJM LJX LJM LJZ LJM LJX LJM LJX LJX LJM LJZ LJM LJZ LJM LJZ LJM LJZ LJM LJ6
      370 587 046 606 999 474 004 603 997 453 963 898 466 044 586 009 464 005 486 008 530 262
      LJ6 LJM LJB LJZ LJB LJX LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJX LJB LJX LJB LJZ LJB LJM LJ6
      244 478 300 033 341 874 396 932 297 964 407 403 986 318 902 408 940 323 030 346 534 265
      LJ6 LJM LJM LJM LJM LJM LJZ LJM LJZ LJM LJZ LJZ LJM LJZ LJM LJZ LJM LJM LJM LJM LJ6
      310 560 477 502 608 037 571 035 506 021 051 515 002 505 036 519 600 487 488 323
      LJ5 LJ5 LJ5 LJM LJB LJX LJB LJX LJB LJB LJX LJB LJX LJB LJM LJ6 LJ6 LJ6
      364 371 268 567 339 959 296 871 372 328 884 375 900 313 602 256 269 257
      LJ6 LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJM LJ6
      309 548 532 485 491 541 527 490 481 479 508 324
      LJ6 LJ6 LJ5 LJ5 LJ5 LJ6 LJ6 LJ6 LJ6 LJ6
      299 246 367 369 372 260 255 252 263 313

```

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

JF CALCULATION, UNPIN LUF DRUM AREA.

G TO CONTINUE A TO ABORT.

R TO RESTART, D TO DELETE, T TO TERMINATE WITHOUT DELETING, A1

EBUN	BUNDLE EXPOSURES				FITZPATRICK		1	QUADRANT 1		1332	4/19/81			
	1	3	5	7	9	11	13	15	17	19	21	23	25	
52										21927.	21683.	20365.	21006.	20635. 52
50										20971.	9786.	9297.	9302.	10006. 9445. 50
48					22238.	20360.	21041.	9365.	16769.	0.	13148.	0.	15364.	48
46					21267.	9445.	10356.	9660.	8601.	0.	8392.	0.	9762.	0. 46
44					21080.	9545.	15132.	0.	14166.	0.	12002.	0.	14723.	0. 15879. 44
42					20663.	10189.	0.	8336.	0.	7356.	0.	9388.	0.	7254. 0. 42
40					20423.	9560.	13867.	0.	13299.	0.	14853.	0.	14238.	0. 15925. 40
38					21397.	9217.	9270.	0.	7864.	0.	9665.	0.	9805.	0. 7431. 0. 38
36					21913.	9540.	17194.	0.	12739.	0.	15589.	0.	8674.	16105. 15810. 0. 16038. 36
34					20874.	9735.	0.	8791.	0.	9317.	0.	10154.	16792.	0. 9388. 16922. 0. 34
32					19852.	9649.	13270.	0.	14328.	0.	14294.	0.	14987.	9301. 8872. 0. 16167. 32
30					20477.	10235.	0.	9465.	0.	6874.	0.	7181.	0.	16443. 0. 16570. 0. 30
28					20431.	9529.	14356.	0.	15622.	0.	16154.	0.	16088.	0. 17113. 0. 16045. 28
	1	3	5	7	9	11	13	15	17	19	21	23	25	

Figure 2a

EBUN		BUNDLE EXPOSURES				FITZPATRICK		1	QUADRANT 2		1332	4/19/82	
27	29	31	33	35	37	39	41	43	45	47	49	51	
52	20629.	21003.	20374.	21676.	21926.								52
50	9448.	10005.	9300.	9296.	9782								50
48	15375.	0. 13148.	0. 1676			9. 20368.	22237.						48
46	0. 9763.	0. 8392.				9668.	10362.	9443.	21282.				46
44	15878.	0. 14720.	0. 1199.		0. 14172.	0. 15128.	9544.	21086.					44
42	0. 7252.	0. 9390.	0. 7336.	0. 8333.	0. 10204.	20667.							42
40	15924.	0. 14221.	0. 14847.	0. 13305.	0. 13870.	9567.	20405.						40
38	0. 7428.	0. 9802.	0. 9668.	0. 7868.	0. 9267.	9223.	21380.						38
36	16035.	0. 15814.	16115.	8676.	0. 15595.	0. 12731.	0. 17197.	9546.	21904.				36
34	0. 16921.	9384.	0. 16795.	10153.	0. 9319.	0. 8795.	0. 9736.	20865.					34
32	16166.	0. 8871.	9800.	14985.	0. 14282.	0. 14327.	0. 13268.	9648.	19843.				32
30	0. 16574.	0. 16440.	0. 7176.	0. 6871.	0. 9462.	0. 10226.	20481.						30
28	16039.	0. 17115.	0. 16086.	0. 16163.	0. 15623.	0. 14358.	9532.	20412.					28
27	29	31	33	35	37	39	41	43	45	47	49	51	

Figure 2b

EBUN		BUNDLE EXPOSURES				FITZPATRICK		1	QUADRANT 3		1332	4/19/82	
27	29	31	33	35	37	39	41	43	45	47	49	51	
26	16045.	0. 17117.	0. 16089.	0. 16156.	0. 15621.	0. 14352.	9529.	20428.					26
24	0. 16579.	0. 16434.	0. 7180.	0. 6874.	0. 9461.	0. 10234.	20474.						24
22	16162.	0. 8872.	9805.	14989.	0. 14271.	0. 14337.	0. 13271.	9642.	19838.				22
20	0. 16928.	9386.	0. 16793.	10157.	0. 9318.	0. 8798.	0. 9736.	20874.					20
18	16038.	0. 15821.	16097.	8679.	0. 15597.	0. 12749.	0. 17200.	9544.	21916.				18
16	0. 7434.	0. 9804.	0. 9566.	0. 7871.	0. 9270.	9220.	21401.						16
14	15923.	0. 14249.	0. 14841.	0. 13304.	0. 13867.	9568.	20419.						14
12	0. 7255.	0. 9388.	0. 7352.	0. 8332.	0. 10188.	20656.							12
10	15881.	0. 14723.	0. 11997.	0. 14163.	0. 15126.	9537.	21082.						10
8	0. 9766.	0. 8388.	0. 8603.	9669.	10357.	9428.	21270.						8
6	15371.	0. 13142.	0. 16772.	9362.	21049.	20353.	22230.						6
4	9445.	10008.	9286.	9297.	9783.	20942.							4
2	20647.	20996.	20387.	21683.	21902.								2
27	29	31	33	35	37	39	41	43	45	47	49	51	

Figure 2c

EBUN	BUNDLE EXPOSURES				FITZPATRICK	1	QUADRANT 4 1332 4/19/82						
	1	3	5	7	9	11	13	15	17	19	21	23	25
26	20419.	9530.	14360.	0.	15627.	0.	16156.	0.	16090.	0.	17110.	0.	16033. 26
24	20471.	10226.	0.	9463.	0.	6873.	0.	7184.	0.	16439.	0.	16569.	0. 24
22	19854.	9641.	13274.	0.	14333.	0.	14277.	0.	14983.	9803.	8874.	0.	16174. 22
20	20659.	9730.	0.	8793.	0.	9319.	0.	10154.	16791.	0.	9387.	16921.	0. 20
18	21911.	9545.	17192.	0.	12738.	0.	15592.	0.	8677.	16109.	15822.	0.	16039. 18
16		21389.	9222.	9269.	0.	7866.	0.	9667.	0.	9803.	0.	7436.	0. 16
14			20427.	9570.	13875.	0.	13310.	0.	14847.	0.	14243.	0.	15927. 14
12			20664.	10197.	0.	8334.	0.	7353.	0.	9390.	0.	7254.	0. 12
10			21080.	9536.	15134.	0.	14167.	0.	12001.	0.	14723.	0.	15884. 10
8				21275.	9428.	10355.	9670.	8615.	0.	8388.	0.	9764.	0. 8
6					22224.	20371.	21048.	9361.	16767.	0.	13153.	0.	15353. 6
4								20946.	9782.	9294.	9286.	10006.	9446. 4
2									21913.	21678.	20377.	21005.	20643. 2
	1	3	5	7	9	11	13	15	17	19	21	23	25

Figure 2d

			2		1							
		3		4		3		4		3		
	1		2		1		2		1		2	
		4		3		4		3		4		
	2		1		2		1		2		1	
4		3		4		3		4		3		4
	1		2		1		2		1		2	
3		4		3		4		3		4		3
	2		1		2		1		2		1	
		3		4		3		4		3		
	1		2		1		2		1		2	
		4		3		4		3		4		
			2		1							

02 06 10 14 18 22 26 30 34 38 42 46 50

51

47

43

39

35

31

27

23

19

15

11

07

03

			5		6		5					
			12		13		13		12			
		7		8		9		8		7		
		12		14		15		15		14		12
5		8		10		11		10		8		5
	13		15		16		16		15		13	
6		9		11		10		11		9		6
	13		15		16		16		15		13	
5		8		10		11		10		8		5
	12		14		15		15		14		12	
		7		8		9		8		7		
			12		13		13		12			
					5		6		5			

02 06 10 14 18 22 26 30 34 38 42 46 50

			1		2		1					
		3		4		3		4		3		
	1		2		1		2		1		2	
	3		4		3		4		3		4	
1		2		1		2		1		2		1
	4		3		4		3		4		3	
2		1		2		1		2		1		2
	3		4		3		4		3		4	
1		2		1		2		1		2		1
	4		3		4		3		4		3	
		1		2		1		2		1		
			4		3		4		3			
					2		1					

02 06 10 14 18 22 26 30 34 38 42 46 50

51

47

43

39

35

31

27

23

19

15

11

07

03

				5		5						
		13		14		16		14		13		
		7		8		9		9		8		7
			15		17		18		17		15	
	6		10		11		11		10		6	
12		16		18		17		18		16		12
	9		11		10		10		11		9	
12		16		18		17		18		16		12
	6		10		11		11		10		6	
		15		17		18		17		15		
		7		8		9		9		8		7
			13		14		16		14		13	
					5		5					

02 06 10 14 18 22 26 30 34 38 42 46 50