DRESDEN UNIT 2
STARTUP TEST NO. 5
EXXON LTA (9x9) LOCAL STABILITY TEST

PURPOSE

The purpose of this test is to demonstrate the local power stability of an Exxon Lead Test Assembly (LTA) in Dresden 2. This is done by determining the power decay ratio based on LPRM measurements obtained during the movement of an adjacent control blade.

CRITERIA

1.) The test is to be immediately terminated in the manner described in item 3.) below if any of the following criteria are exceeded:
   a.) The LPRM signals monitoring the 9x9 assembly exhibit oscillations of a magnitude greater than 5 watts/cm^2 relative to the initial peak as observed on the strip chart recorder or RBM display.
   b.) The LPRM readings monitoring the 9x9 assembly exceed their action levels, where the action level is defined as:

   LPRM Action Level =

$$\frac{0.95\ \text{(initial LPRM reading X initial CPR for 9x9 assembly)}}{\text{(full power, full flow CPR operating limit for 9x9 assembly)}}$$

   where the initial values correspond to values obtained immediately prior to the test initiation.
   c.) APRM oscillations exceed 15% of rated, peak to peak.
   d.) The Nuclear Station Operator (NSO) observes any unexpected core condition.

2.) If sustained LPRM oscillations are observed with an amplitude that does not exceed those in step 1.) above, withdrawl of the test control blade must be immediately terminated although data acquisition may continue. When sufficient data has been accumulated, the actions in item 3.) below shall be performed.

3.) If the criteria in step 1.) above are observed, then the following test termination procedure and ensuing power ascension shall be performed in the following manner:
   a.) Immediately insert the test control blade to position 00.
   b.) Insert additional control blades as necessary to terminate unusual power oscillations.
   c.) After the oscillations have returned to pre-test noise levels, insert additional control blades to reduce flow control line (FCL) by 5%.
   d.) Increase flow by 5 MLB/HR.
   e.) Perform single-notch withdrawl of the test control blade to its position prior to stability test.
   f.) Proceed with power ascension by increasing total core flow.
   g.) Additional control blade withdrawl is permitted provided that total core flow is greater than 60 MLB/HR.
   h.) For long term corrective action, see item 4.) below.

4.) Long-term corrective action consists of the following:
   a.) Hard-wired LPRM alarms currently existing at Dresden Station will be adjusted such that power oscillations would be detected prior to achieving LPRM readings that would correspond to the MCPR Safety Limit.

b.) Station procedures will be revised such that the NSO will be required to insert control rods to suppress local oscillations if sustained or periodic alarm indications are observed.

c.) If unusual power oscillations are observed during this test, the need for additonal LPRM monitoring as well as the need for restrictions on future operations during Cycle 9 will be re-evaluated by a Dresden On-Site Review Committee. This committee will consult with CECo's Nuclear Fuel Services Department, Off-Site Review, Exxon Nuclear Company and the NRC, to determine the final recommendations based on the oscillations observed during the test.

DISCUSSION AND RESULTS

Prior to the beginning of the stability test, D2 operated at full power and steady state conditions long enough (at least 72 hours) to precondition the reactor core for full power operation. Then, on May 28, 1983, load was reduced via core flow at a rate of approximately 200 MWe/HR until minimum recirculation flow (two loop) was reached. No control rods had been moved. Once the reactor was at the proper initial conditions (full-power rod pattern, minimum recirculation flow), preparation for the test began. The initial conditions for the stability test are included on TABLES 5-1a, 5-1b, and FIGURE 5-1. Also, a Nuclear Engineer checklist (DTS 8235) was taken and the LPRM Action Levels were determined at this point. The results of the Action Level calculations are summarized in TABLE 5-2.

After the pre-test data was accumulated and the necessary calculations performed, the test began the following manner:

1.) The control room chart recorders monitoring 2 APRM's (one in each RPS channel) were switched to high speed.
2.) The 8-channel variable-speed strip chart recorder was checked to ensure proper data acquisition and put in high speed (25 mm/SEC.). The signals monitored in the eight channels were:
    a.) 3 LPRM's in a string adjacent to the 9x9 assembly (16-17B, 16-17C, 16-17D).
    b.) 3 LPRM's in a string adjacent to a nearby 8x8 assembly (16-09B, 16-09C, 16-09D).
    c.) 2 APRMS (APRMS 3 and 5).
3.) Control blade D-4 was inserted from position 38 to 00. This blade was selected due to its close promimity to the 9x9 fuel assembly in core location 15-18.
4.) Control blade D-4 was continuously withdrawn to position 38. None of the limitations given in the above CRITERIA section were exceeded. (See TABLE 5-3 for a comparison of LPRM action levels versus maximum LPRM reading during the withdrawl of D-4).
5.) Post-test data was acquired. These conditons are recorded in TABLE 5-4. The control rod pattern was identical to that in FIGURE 5-1.
6.) Upon completion of the test and verification of a decay ratio <1.0, power ascension continued as normal and all data recording devices were returned to their normal operating conditions.

Although no undamped or sustained oscillations were observed (other than those at pre-test noise levels), a determination of the decay ratio was attempted. The data is summarized in TABLE 5-5.

In addition to performing the test described above, the hard-wired LPRM alarms were adjusted on March 3, 1983, such that the LPRM alarm would alert the NSO to power oscillations prior to exceeding the MCPR Safety Limit. These values are given in TABLE 5-6. Also, station procedures were revised on April 30, 1983, to instruct the NSO to insert control rods to suppress local oscillations if sustained or periodic alarm indications are observed. Since no undamped or sustained oscillations were observed during the test, there was no need for re-evaluation of future operating strategies by a Dresden On-Site Review Committee.

TABLE 5-1a

STATE CONDITIONS PRIOR TO STABILITY TEST

MWe	MWt	CORE FLOW WT (MLB/HR)	PRESSURE (PSIA)
418.7	1373	38.18	960

TABLE 5-1b

THERMAL LIMITS PRIOR TO STABILITY TEST

	MFLCPR	MFLPD	MFLPD/FRP	MAPRAT	FDLRX	FDLRC
VALUE	0.687	0.417	0.768	0.421	0.441	0.608
LOCATION	35-34	51-26-5	51-26-5	51-26-5	51-20-5	51-20-5

TABLE 5-2

LPRM ACTION LEVEL CALCULATIONS

9x9 INFORMATION	
LOCATION	15-18
INITIAL CPR	2.324
FULL FLOW CPR (LCO)	1.380

EQUATION:

$$\text{LPRM ACTION LEVEL} = \frac{0.95\ (\text{initial LPRM Reading})\ (\text{Initial CPR For 9x9})}{(\text{Full Flow CPR Operating Limit For 9x9})}$$

LPRM	INITIAL READING	ACTION LEVEL
16-17 D	17	27.2
16-17 C	21	33.6
16-17 B	27	43.2

TABLE 5-3

LPRM ACTION LEVEL vs. MAXIMUM LPRM READING DURING STABILITY TEST

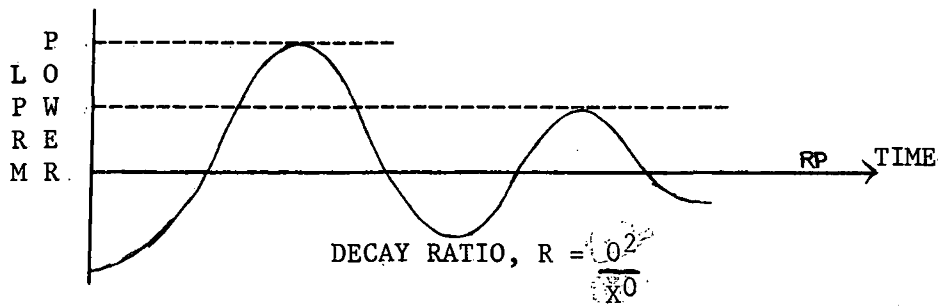
LPRM	LPRM ACTION LEVEL	MAXIMUM LPRM READING
16-17 D	27.2	20.0
16-17 C	33.6	25.5
16-17 B	43.2	30.5

TABLE 5-4

STATE CONDITIONS AFTER STABILITY TEST

MWe	MWt	CORE FLOW WT (MLB/HR)	PRESSURE (PSIA)
399.8	1320	38.24	958

TABLE 5-5



DECAY RATIO, $R = \frac{X_2}{X_0}$

LPRM	RP	X_0	X_2	R*
16-17 D	17.0	3.0	0.5	0.167
16-17 C	22.5	3.0	0.5	0.167
16-17 B	29.0	1.5	0.5	0.333

* The values included here differ slightly from those determined during the test. This difference can be attributed to the fact that the calculations during the test did not involve a detailed check of the data.

TABLE 5-6

D2 LPRM HARD-WIRED HIGH ALARM SETPOINTS

LPRM LEVEL	UPSCALE ALARM SETPOINT (W/cm^2)
A	90
B	80
C	70
D	50

FIGURE 5 - 1

CONTROL ROD PATTERN PRIOR
TO TEST

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
15															
14								36							
13															
12				38		12		28		12		38			
11															
10				12		24		12		24		12			
9															
8		36		28		12				12		28		36	
7															
6				12		24		12		24		12			
5															
4				38		12		28		12		38			
3															
2								36							
1															