Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690 - 0767

February 9, 1987

Mr. Harold R. Denton
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC. 20555

Subject: Dresden Station Unit 3
Dresden Unit 3 Cycle 10 Single Loop Operations
Stability Test Report
NRC Docket No. 50-249

Reference: Letter from I.M. Johnson to H.R. Denton
dated November 26, 1986

Dear Mr. Denton:

The above referenced letter transmitted to you the Dresden Station Unit 3 Cycle 10 Test Report summary. This report was submitted in accordance with previous requests from the NRC staff and provisions of our technical specifications.

The single loop operation stability tests were not included as a part of this earlier transmittal due to the delays in the Unit 3 startup program. These results are now available for your review and are being transmitted through this letter. This test is required by the NRC Safety Evaluation Report for the Dresden 3 Technical Specifications Amendment No. 87

Please address any concerns regarding this matter to this office.

Very truly yours,

Irene M. Johnson

I. M. Johnson
Nuclear Licensing Administrator

/klj

cc: NRC Resident Inspector-Dresden
J. Stang-NRR

encl. Dresden 3 Cycle 10 Startup Test No. 5
2710K

A001
1/1

DRESDEN UNIT 3

CYCLE 10

STARTUP TEST NO. 5

STABILITY COMPARISON BETWEEN DUAL LOOP OPERATION AND SINGLE LOOP OPERATION

PURPOSE

The intent of this test is twofold: 1) to examine Local Power Range Monitor (LPRM) and Average Power Range Monitor (APRM) noise levels (peak-to-peak oscillations) in Region II of Figure 5.1 during Dual Loop Operation (DLO) and Single Loop Operation (SLO). Region II is defined as the operating region above 80% Flow Control Line (FCL) between 39% and 45% total core flow. 2) To collect baseline LPRM and APRM noise levels while in SLO outside of Region II for use in stability surveillances should SLO become necessary during D3C10.

BACKGROUND

In early 1984, General Electric released Service Information Letter No. 380, rev. 1, which discussed BWR Core Thermal Hydraulic Stability. This was followed by, in 1986, a NRC Generic Letter titled "Technical Resolution of Generic Issue B-19-Thermal Hydraulic Stability (Generic Letter No. 86-02)." Both these documents stress the fact that BWR's exhibit less margin to thermal hydraulic stability when operating in the low flow/high power region of the allowed operating map. This is generally not a concern, however, with low power density plants such as Dresden Units 2 and 3. This type of instability is not considered a safety concern because it is easily detectable and readily suppressed by control rod insertions or core flow increases. Furthermore, analyses have shown that should instability occur and go undetected, violation of applicable safety limits will not occur.

The parameter used to measure reactor stability is called the decay ratio which yields information on how effectively small power excursions are dampened by reactor feedback mechanisms (the smaller the decay ratio the more effective the damping; a decay ratio greater than 1.00 indicates an unstable condition). Because of the uncertainties inherent in Exxon's method for predicting reactor decay ratios, the NRC specified in Generic Letter 86-02 that plants with calculated decay ratios exceeding 0.75 must establish operating provisions which provide for the detection and suppression of flux oscillations in operating regions of potential instability. Although Exxon's calculated decay ratio for Dresden 3 Cycle 10, 0.53, was well below this value, the NRC raised concern over the fact that Dresden 3 was receiving 9x9 fuel, a non-conventional fuel design typically less stable than 8x8 fuel.

For this reason, Dresden submitted stability monitoring Technical Specifications for SLO, and was further requested to perform a Dresden 3, Cycle 10 startup test to measure and compare peak-to-peak noise levels in SLO and DLO while operating in the low flow/high power region of the operating map (see Reference 1). The results of this test are included herein.

It should be noted that this test does not attempt to measure the reactor decay ratio. However, a measurement of local and core wide noise levels can provide valuable stability information. Tests performed at Brown's Ferry, see Reference 2, indicate that SLO will exhibit higher noise levels primarily due to increased turbulence in the downcommer region. The increase in turbulence is a result of crossflow between the active and inactive jet pumps. For plants with ample margin to stability, these noise levels will increase with core flow. This information will be used to evaluate the data collected during this test.

LIMITATIONS AND ACTIONS

a) The A and C levels of nine LPRM strings representing each octant of the core and the center of the core shall be operable prior to performing this test.

b) During SLO, reactor operation above 80% FCL below 39% total core flow (Region I of Figure 5.1) is not permitted per Technical Specification 3.6.H.3.b. The low flow/high power region of the operating map typically exhibits less margin to stability than other regions. Instabilities may result in LPRM and APRM oscillations significantly greater than normal noise levels.

c) During SLO, reactor operation in Region II without LPRM and APRM baseline data is not permitted per Technical Specification 3.6.H.3.c.ii.

d) If LPRM and APRM noise levels are three times greater than their baseline values, stable operation must be restored within two hours per Technical Specification 3.6.H.3.c.iv.

e) If the reactor remains in SLO for an extended period (more than 24 hours), the following restrictions required per Technical Specification 3.6.H.3.f. must be implemented within 24 hours after shutting down one recirculation pump:

   1) Reduce the APRM scram and rod block setpoints by 3.5%.

   2) Reduce the Rod Block Monitor (RBM) rod block setpoint by 4.0%.

   3) Increase the Minimum Critical Power Ratio (MCPR) Safety Limits and Operating Limits by 0.03.

   4) Reduce the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) Operating Limits by 30%.

CRITERIA

a) During SLO in Region II, the measured LPRM and APRM noise levels should remain below the Technical Specification limit of three times their baseline values (collected outside of Region II).

b) The LPRM and APRM noise levels measured in Region II during DLO should be significantly less than those measured during SLO at approximately the same power/flow conditions.

c) SLO noise levels should increase proportionally with core flow while operating on a constant rod line.

RESULTS AND DISCUSSION

On December 3, 1986, LPRM and APRM noise levels were measured during DLO and SLO in accordance with Special Procedure 86-6-102, "Acquisition of APRM/LPRM Noise Levels During Dual Loop and Single Loop Operation." The power maneuvers performed to accumulate the necessary data are depicted in Figure 5.2. Although no specific criteria has been established for comparing noise levels during DLO and SLO in Region II, DLO should certainly exhibit noise levels less than SLO. Although the noise levels are expected to be greater in SLO, they should not increase such that measuring reactor local and core wide power becomes difficult.

Initially, noise levels were measured during DLO (at various flows) at approximately 100% FCL in Region II. Following this phase of the test, SLO was commenced by first tripping the A recirculation pump. Prior to operating in Region II, LPRM and APRM noise levels for each active recirculation loop were measured below 80% FCL between 39% and 45% total core flow and reduced to baseline data (see Table 5.1). Then at approximately 100% FCL in Region II, LPRM and APRM noise levels for each active recirculation loop were measured again and compared to their baseline values. The average of these noise levels was less than the Technical Specification requirement of three times their baseline values, exhibiting adequate margin to instabilities in the low flow/high power region of the operating map. The results are summarized in Table 5.1.

It should be noted that the measured neutron noise levels with the A Loop active were greater than those with the B Loop active. This was attributed to an increase of 5% of rated core thermal power with the A Loop active (see Figure 5.3).

During SLO, the APRM noise levels increased as core flow increased (see Figure 5.3 and Table 5.2). The increase in APRM noise was associated to the increase in core flow noise related to turbulence in the downcomer region which is produced by crossflow between the inactive and active jet pumps. The LPRM noise levels in Table 5.2 follow the same trend as the APRM noise levels. This indicates that the observed increase in neutron noise levels was not due to core-wide or local instability phenomona.

The average LPRM and APRM noise levels during SLO and DLO in Region II were also compared. As expected, noise levels observed during SLO were found to be greater than those during DLO. This demonstrates that DLO in the low flow/high power region of the operating map exhibits more operating margin to instabilities than SLO, furthermore, SLO in Region II should not present any operational difficulties since noise levels were not excessive. The results are summarized in Table 5.3.

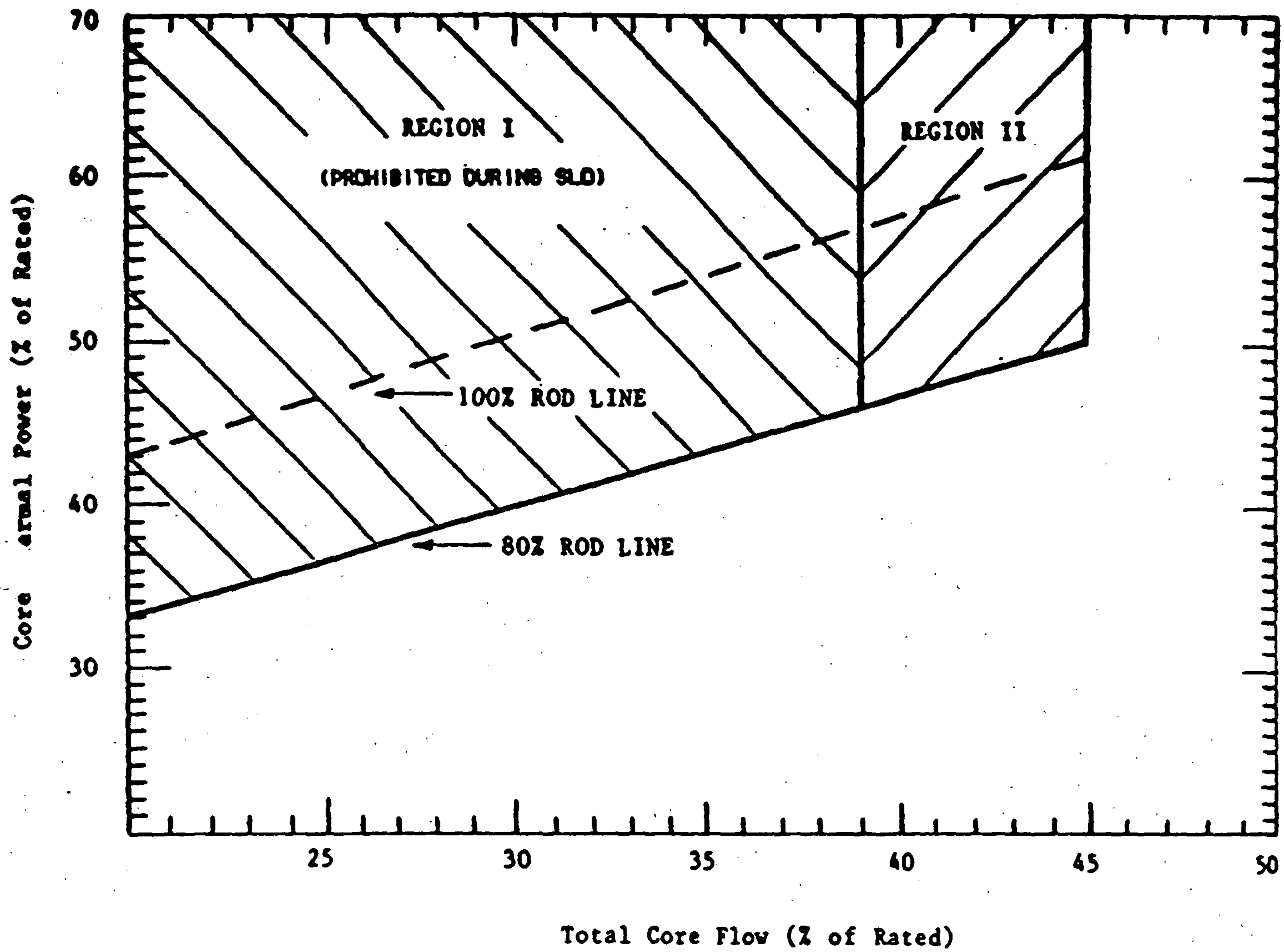
Based on the results of this testing, it can be concluded that Region II of the operating map exhibits adequate margin to power/flow instabilities in SLO and DLO. As expected, DLO was significantly more stable than SLO, demonstrating that stability monitoring Technical Specifications are not required during DLO. Furthermore, the current SLO stability surveillances required by Technical Specifications are adequate for detecting any core wide or local instabilities.

REFERENCE

1. J. Wojnarowski letter to H. Denton, "Dresden Station Unit 3 Supplement to Proposed License Amendment - Cycle 10 Reload NRC Docket No. 50-249," dated April 18, 1986.

2. Browns Ferry Nuclear Power Plant Unit 1 Stability Tests, February 9, 1985.

FIGURE 5.1
CORE THERMAL POWER VERSUS CORE FLOW



DRESDEN 3 CYCLE 10
SINGLE LOOP OPERATION STABILITY TEST SCHEDULE

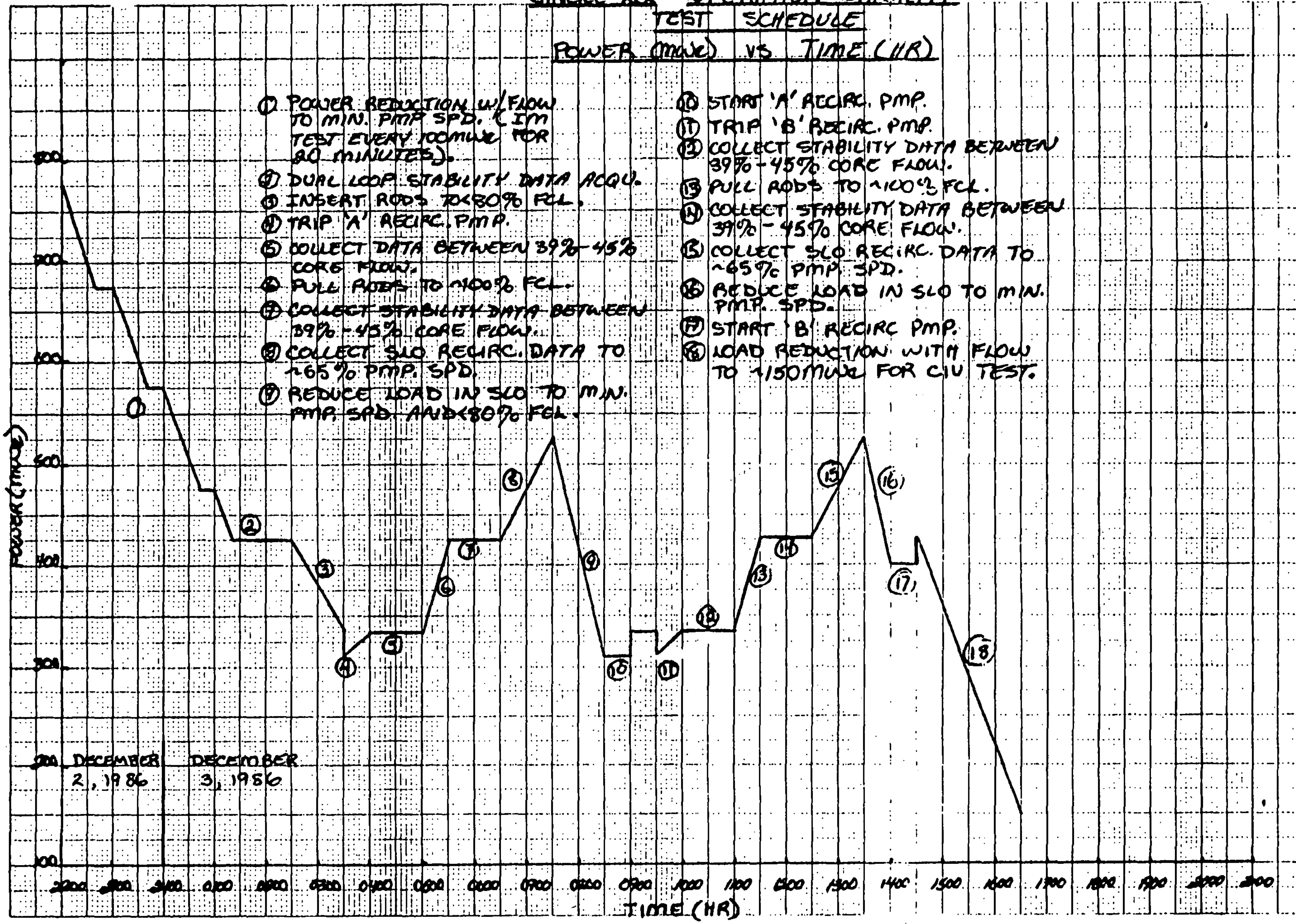
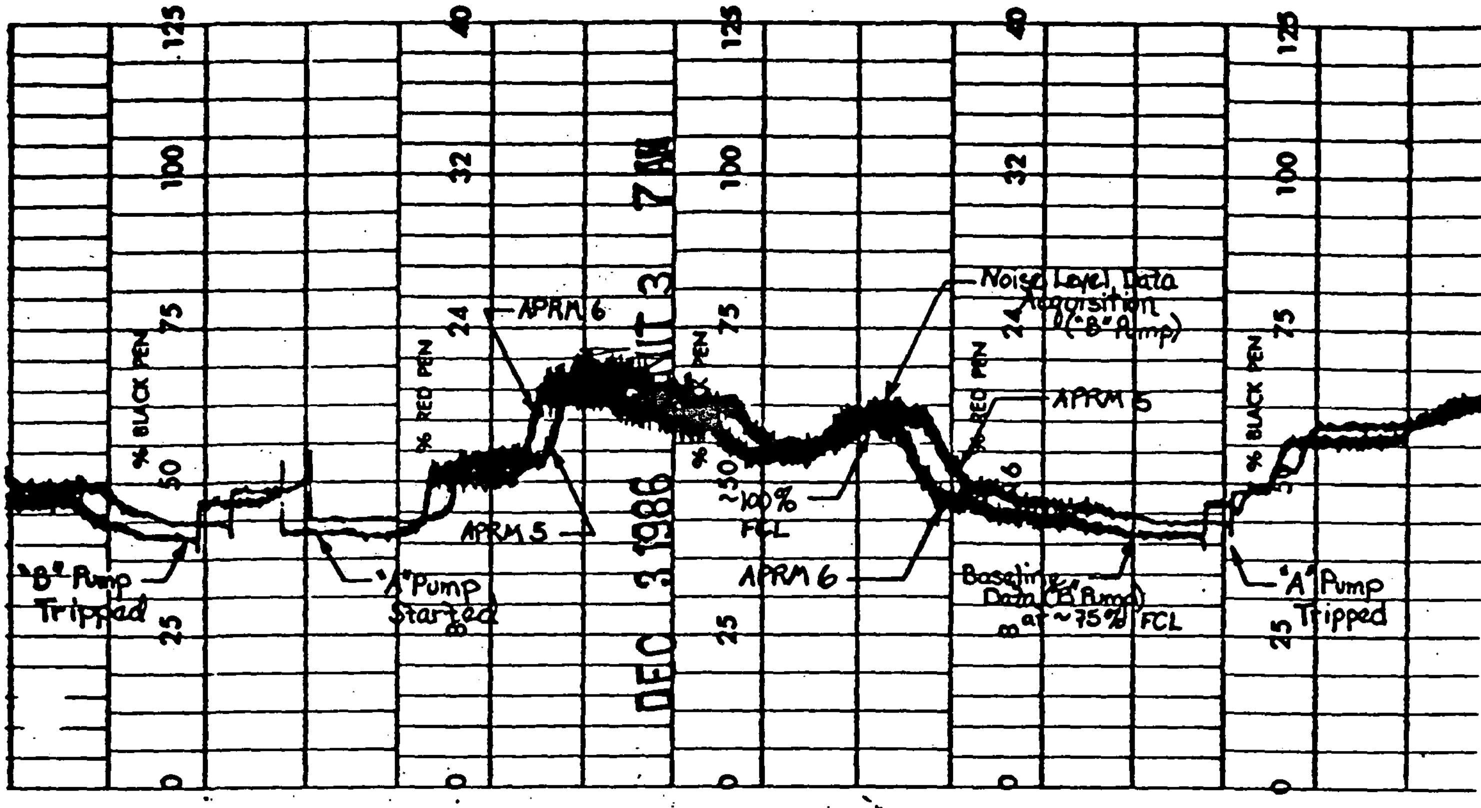


FIGURE 5.2

FIGURE 5.3 APRM STRIP CHART DURING SINGLE LOOP OPERATION (APRMS 5 AND 6)



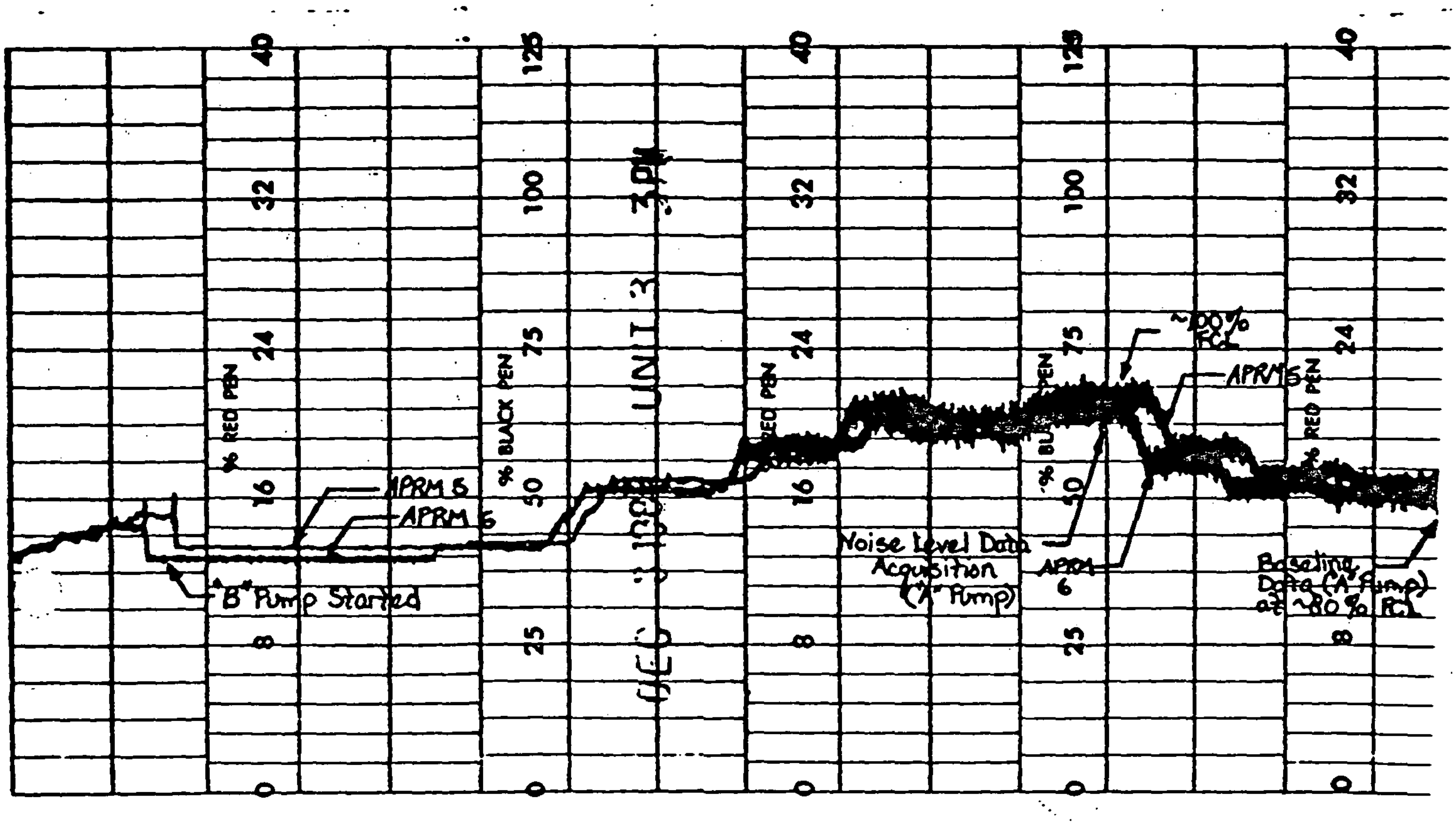


TABLE 5.1 NOISE LEVELS DURING SINGLE LOOP OPERATION †

APRM Channel	APRM Baseline Value (%)		Average APRM Noise Levels in Region II (%)		Noise / Baseline **	
	A Loop Active*	B Loop Active	A Loop Active *	B Loop Active	A Loop*	B Loop
1	2.33	1.50	3.33	2.00	1.43	1.33
2	2.10	1.25	3.50	1.67	1.67	1.34
3	2.00	1.00	3.67	1.83	1.84	1.83
4	2.33	1.50	3.50	2.00	1.50	1.33
5	2.33	1.17	3.67	1.67	1.58	1.43
6	2.27	1.17	3.33	2.10	1.47	1.78

LPRM Location	LPRM Baseline Value $(\frac{W}{CM^2})$		Average LPRM Noise Levels in Region II $(\frac{W}{CM^2})$		Noise / Baseline**	
	A Loop Active*	B Loop Active	A Loop Active*	B Loop Active	A Loop*	B Loop
16-41-A/C	1.10 / 1.00	0.58 / 0.42	1.33 / 1.10	0.92 / 1.17	1.21/1.10	1.59/2.79
24-49-A/C	0.83 / 1.10	0.50 / 0.50	1.17 / 1.17	0.75 / 0.50	1.41/1.06	1.50/1.00
40-49-A/C	0.93 / 1.23	0.83 / 0.67	1.40 / 1.33	0.83 / 0.92	1.50/1.08	1.00/1.37
56-33-A/C	0.50 / 0.73	0.58 / 0.42	0.83 / 1.10	0.58 / 1.00	1.66/1.51	1.00/2.38
48-25-A/C	0.87 / 1.00	0.58 / 0.67	1.23 / 1.23	0.83 / 0.92	1.41/1.23	1.43/1.37
40-09-A/C	0.93 / 1.00	0.50 / 0.50	1.07 / 1.17	0.92 / 0.50	1.15/1.17	1.84/1.00
24-09-A/C	0.83 / 1.00	0.58 / 0.75	1.50 / 1.33	0.83 / 0.83	1.81/1.33	1.43/1.11
16-25-A/C	1.00 / 1.00	0.83 / 0.92	1.33 / 1.67	1.00 / 1.17	1.33/1.67	1.20/1.27
32-33-A/C	0.70 / 1.00	0.50 / 0.58	0.87 / 1.07	0.67 / 0.83	1.24/1.07	1.34/1.43

† All noise levels are measured, peak-to-peak values. For APRM data, all values are in units of % power, while LPRM data is expressed in units of W/CM^2.

* Noise levels for A Loop were measured at a higher core thermal power than those for B Loop.

** These values must be below 3.00 in accordance with Technical Specifications

TABLE 5.2 NOISE LEVELS IN REGION I DURING SINGLE LOOP OPERATION †

A LOOP ACTIVE *

FCL (%)	CORE FLOW (%)	APRM NOISE LEVELS (%)						A/C LPRM NOISE LEVELS ($\frac{W}{CM^2}$)								
		CHANNELS						LOCATION								
		1	2	3	4	5	6	16-41	24-49	40-49	56-33	48-25	40-09	24-09	16-25	32-33
97.9	39.5	3.0	3.0	3.0	2.5	3.0	2.0	1.0/1.0	1.0/1.0	1.0/1.0	0.5/1.0	1.5/1.0	1.0/1.0	1.0/1.0	1.0/1.0	1.0/1.0
98.2	43.7	3.0	3.5	3.0	3.0	3.0	4.0	1.0/1.5	1.0/1.0	2.0/1.5	1.0/1.0	1.0/1.5	1.0/1.5	2.0/2.0	1.5/2.0	0.8/1.0
100.7	45.3	4.0	4.0	5.0	5.0	5.0	4.0	2.0/0.8	1.5/1.5	1.2/1.5	1.0/1.3	1.2/1.2	1.2/1.0	1.5/1.0	1.5/2.0	0.8/1.2

B LOOP ACTIVE

FCL (%)	CORE FLOW (%)	APRM NOISE LEVELS (%)						A/C LPRM NOISE LEVELS ($\frac{W}{CM^2}$)								
		CHANNELS						LOCATION								
		1	2	3	4	5	6	16-41	24-49	40-49	56-33	48-25	40-09	24-09	16-25	32-33
93.0	39.0	2.0	1.0	1.5	1.0	1.0	1.8	0.75/1.0	1.0/0.3	0.75/1.0	0.5/1.0	0.75/0.75	0.75/0.5	0.75/1.0	1.0/1.5	0.5/0.5
97.0	42.5	1.5	2.0	1.5	2.0	2.0	1.5	0.5/1.5	0.5/0.25	0.75/0.75	0.5/1.0	0.75/1.0	1.0/0.5	0.75/0.5	1.0/1.0	1.0/1.0
99.1	44.1	2.5	2.0	2.5	3.0	2.0	3.0	1.5/1.0	0.75/1.0	1.0/1.0	0.75/1.0	1.0/1.0	1.0/0.5	1.0/1.0	1.0/1.0	0.5/1.0

† All noise levels are measured, peak-to-peak values. For APRM data, all values are in units of % power, while LPRM data is expressed in units of W/CM^2.

* Noise levels for A Loop were measured at a higher core thermal power than those for B Loop.

TABLE 5.3 COMPARISON OF SINGLE LOO PERATION AND DUAL LOOP † OPERATION NOISE LEVELS IN REGION II

APRM Channel	Average APRM Noise Levels (%)			A Loop / Dual Loop*	B Loop / Dual Loop
	A Loop Active*	B Loop Active	Dual Loop Operation		
1	3.33	2.00	1.00	3.33	2.00
2	3.50	1.67	1.33	2.63	1.26
3	3.67	1.83	1.17	3.14	1.56
4	3.50	2.00	1.17	2.99	1.71
5	3.67	1.67	1.27	2.89	1.31
6	3.33	2.10	1.27	2.62	1.65

LPRM Location	Average LPRM Noise Levels $(\frac{W}{CM^2})$			A Loop / Dual Loop*	B Loop / Dual Loop
	A Loop Active*	B Loop Active	Dual Loop Operation		
16-41 A/C	1.33 / 1.10	0.92 / 1.17	0.50 / 0.67	2.66 / 1.64	1.84 / 1.75
24-49 A/C	1.17 / 1.17	0.75 / 0.50	0.67 / 0.55	1.75 / 2.13	1.12 / 0.91
40-49 A/C	1.40 / 1.33	0.83 / 0.92	0.83 / 0.58	1.69 / 2.29	1.00 / 1.59
56-33 A/C	0.83 / 1.10	0.58 / 1.00	0.42 / 0.43	1.98 / 2.56	1.38 / 2.32
48-25 A/C	1.23 / 1.23	0.83 / 0.92	0.50 / 0.75	2.46 / 1.64	1.66 / 1.23
40-09 A/C	1.07 / 1.17	0.92 / 0.50	0.55 / 0.50	1.94 / 2.34	1.67 / 1.00
24-09 A/C	1.50 / 1.33	0.83 / 0.83	0.50 / 0.75	3.00 / 1.77	1.66 / 1.11
16-25 A/C	1.33 / 1.67	1.00 / 1.17	0.68 / 0.67	1.96 / 2.49	1.47 / 1.75
32-33 A/C	0.87 / 1.07	0.67 / 0.83	0.50 / 0.50	1.74 / 2.14	1.34 / 1.66

† All noise levels are measured, peak-to-peak values. For APRM data, all values are in units of % power, while LPRM data is expressed in units of W/CM^2.

* Noise levels for A Loop were measured at a higher core thermal power than those for B Loop.