SEMIANNUAL OPERATING REPORT
JANUARY 1, 1975 THROUGH JUNE 30, 1975
UNIT NOS. 1 AND 2
SURRY POWER STATION

DOCKET NOS. 50-280 AND 50-281
LICENSE NOS. DPR-32 AND DPR-37

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NOTICE

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

August 29, 1975

Mr. Norman C. Moseley, Director
Office of Inspection and Enforcement
Region II - Suite 818
U.S. Nuclear Regulatory Commission
230 Peachtree Street, Northwest
Atlanta, Georgia 30303

Serial No. 673
PO&M/JTB:clw

Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Dear Mr. Moseley:

Pursuant to Technical Specification 6.6.A for the Surry Power Station, Unit Nos. 1 and 2, the Virginia Electric and Power Company hereby submits forty (40) copies of the Semiannual Operating Report, SOR-6, covering the period January 1, 1975 through June 30, 1975.

Very truly yours,

for C. M. Stallings
Vice President-Power Supply
and Production Operations

Enclosures

cc: Mr. K. R. Goller
39 copies

SEMI-ANNUAL OPERATING REPORT

JANUARY 1, 1975 THROUGH JUNE 30, 1975

SURRY POWER STATION

UNIT NOS. 1 AND 2

DOCKET NOS.: 50-280
50-281

OPERATING LICENSE NOS.: DPR-32
DPR-37

REPORT NO.: SOR - 6

VIRGINIA ELECTRIC AND POWER COMPANY

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1.0 INTRODUCTION

This report is submitted to the Nuclear Regulatory Commission pursuant to Surry Power Station, Unit Nos. 1 and 2, Technical Specification 6.6, "Station Reporting Requirements", which states:

A. Routine Operating Reports

A report covering a six-month period shall be submitted in writing to the Director of the Regional Regulatory Operations Office within 60 days after January 1 and July 1 of each year. The due date of the first report shall be determined from the date of initial criticality and shall cover the period from the date the operating license was issued to the end of the report period. Such reports are due within 60 days after the end of each reporting period.

The information reported herein also satisfies additional reporting requirements established in other technical specifications and the Nuclear Regulatory Commission. In order to facilitate the referencing of material in this report with the applicable reporting requirements, an index cross-referencing the report section number and the reporting requirement is given in Section 12.0.

2.0 NON-RADIOLOGICAL MONITORING PROGRAM - THERMAL AND PHYSICAL CHARACTERISTICS

The Non-radiological Monitoring Program - Thermal and Physical Characteristics applies to the monitoring of the temperature-salinity distribution in the ten (10) mile segment of the James River centered at Hog Island. The objective of the program is to determine the relationship between the thermal discharge and the physical-chemical characteristics of the water mass within the ten (10) mile tidal segment of the James River and the effects of the operation of the Surry Power Station on the physical and chemical variables of the James River Estuary.

2.1 TEMPERATURE MONITORING

Summary

The temperature monitoring program encompasses the segment of the James River Estuary which extends below the intake of the Surry Power Station upstream to the southern shore of Jamestown Island. Temperatures have been continuously monitored and recorded at eight (8) locations located throughout the estuarine segment approximately as shown in Figure 2.1.1-1. Near surface and bottom temperatures are recorded as indicated on the figure.

Results

The results of the temperature monitoring program are summarized in Sections 2.1.1, 2.1.2, and 2.1.3. It should be noted that the attached data do not include the station in lower Cobham Bay (No. 12) and the three (3) monitoring stations on Transect 3 (Nos. 9, 10, 11) as shown in Figure 2.1.1-1. These four (4) monitoring stations were to be installed by December 31, 1972; however, due to circumstances beyond the control of the licensee these stations were not made fully operational until June, 1975.

The licensee had installed monitoring equipment with direct readout capabilities at these twelve stations. However, this equipment, which was purchased from Westinghouse Electric Corporation, proved entirely unsatisfactory and unreliable and has been retired. A new system supplied by the Environmental Devices Corporation and consisting of individual temperature recording units has been installed. The problems associated with the Westinghouse system and its replacement have been discussed in letters to the Directorate of Licensing.

The licensee has made every reasonable effort to place the new system in operation. In the interim period, data from the eight (8) existing circular chart records was maintained and are reported herein. Future reports will contain data from the new system.

For a comparison of field data and physical model predictions see Thermal Effects of the Surry Nuclear Power Plant on the James River, Virginia, Part IV. Results of Monitoring Physical Parameters During the First Year of Plant Operation by G. C. Parker, E. A. Shearls, and C. S. Fang, Special Report No. 51 in Applied Marine Science and Ocean Engineering, Virginia Institute of Marine Science, February, 1974.

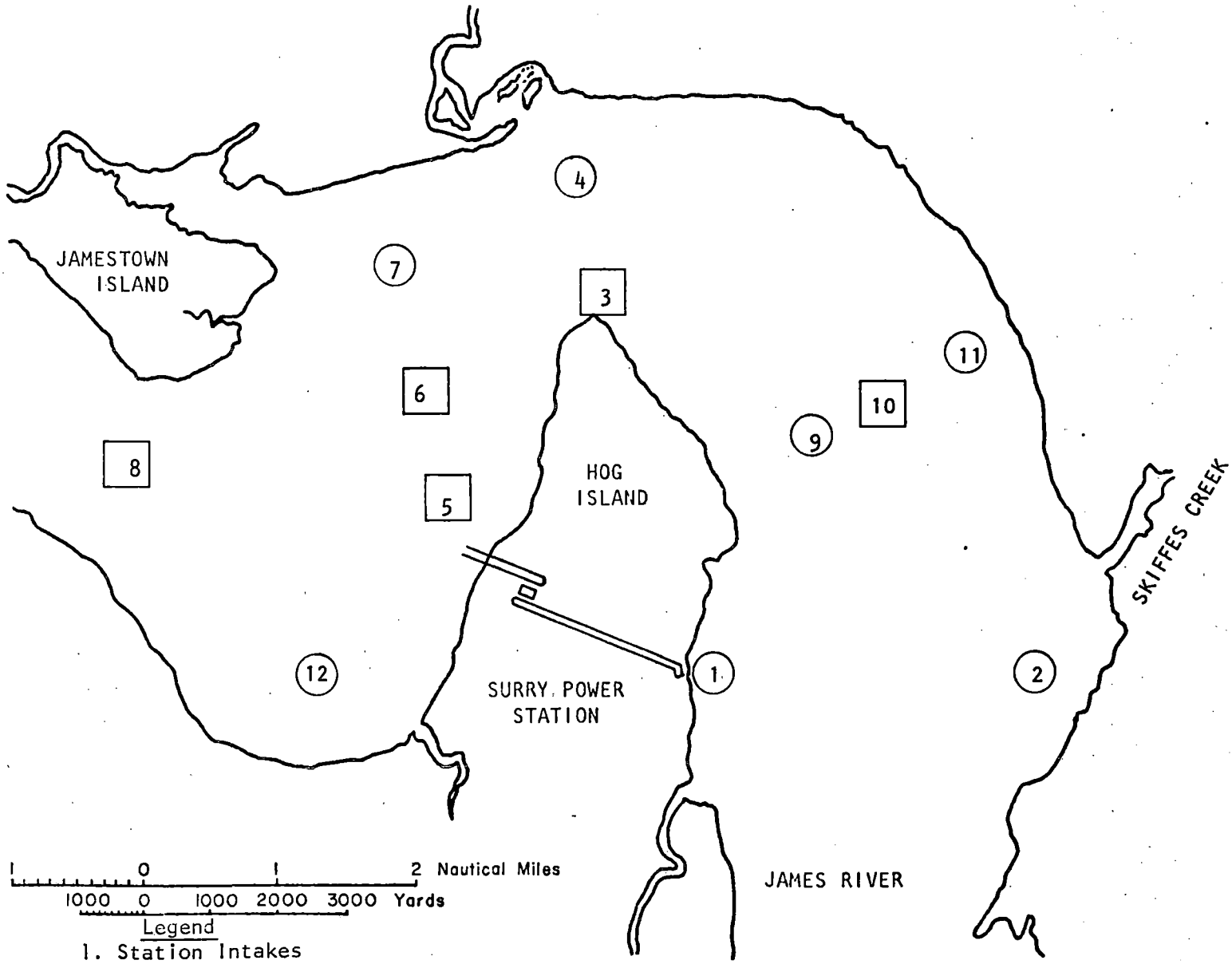
2.1.1 TEMPERATURE MONITORING STATIONS IN THE JAMES RIVER

Figures 2.1.1-1 through 2.1.1-15 summarize the results of the temperature monitoring program in the James River. The maximum and minimum river water temperature is indicated for each day of the report period. For the periods for which data are not provided, the monitoring equipment was inoperable or being repaired.

Figure 2.1.1-1

TEMPERATURE MONITORING STATIONS

SURRY POWER STATION



Legend

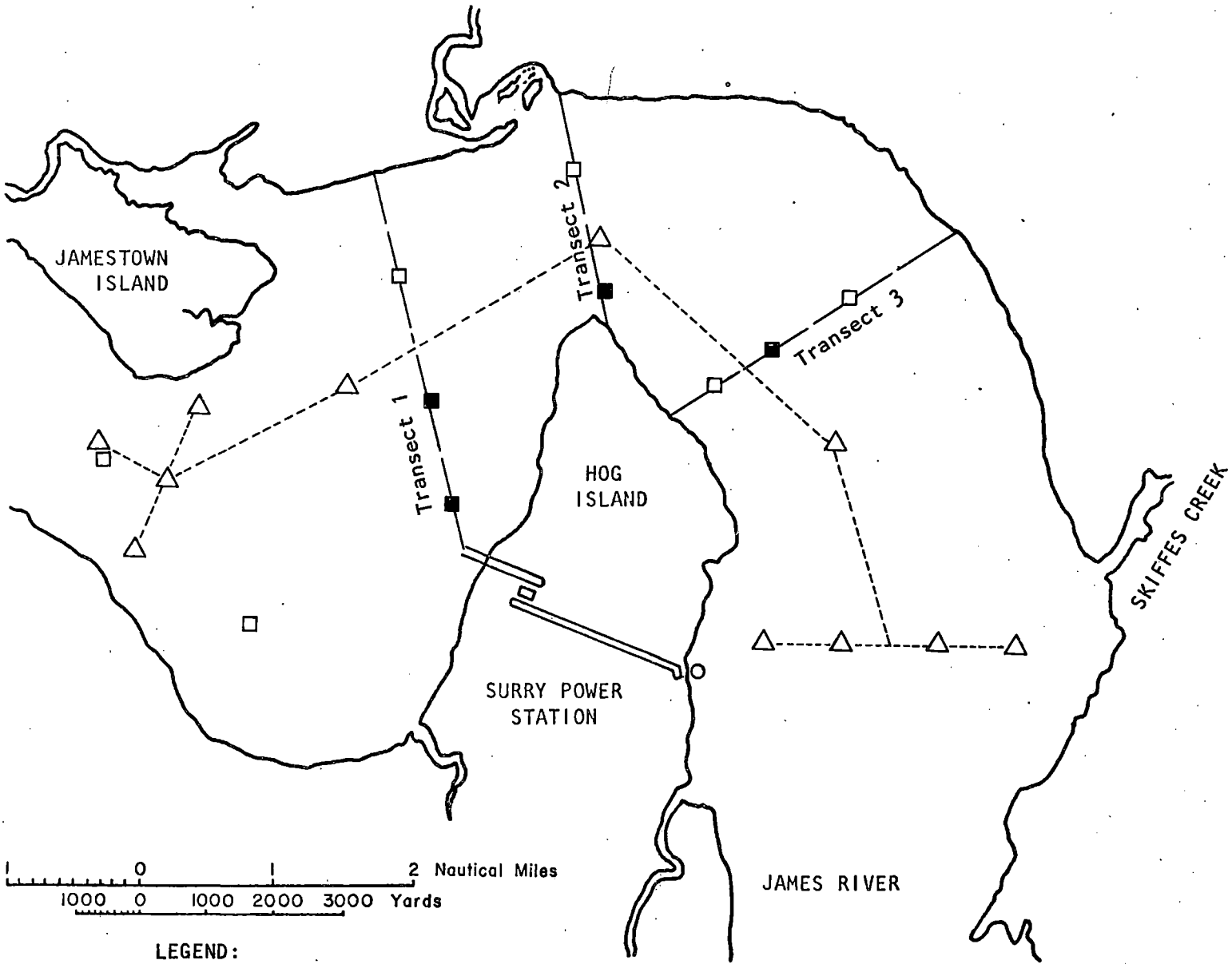
1. Station Intakes
2. Deepwater Shoals
3. Hog Point-South
4. Hog Point-North
5. Cobham Bay-South
6. Cobham Bay-Middle
7. Cobham Bay-North
8. Jamestown Island
9. Transect 3
10. Transect 3
11. Transect 3
12. Lower Cobham Bay

○ Near Surface Temperature

□ Near Surface and Bottom Temperature

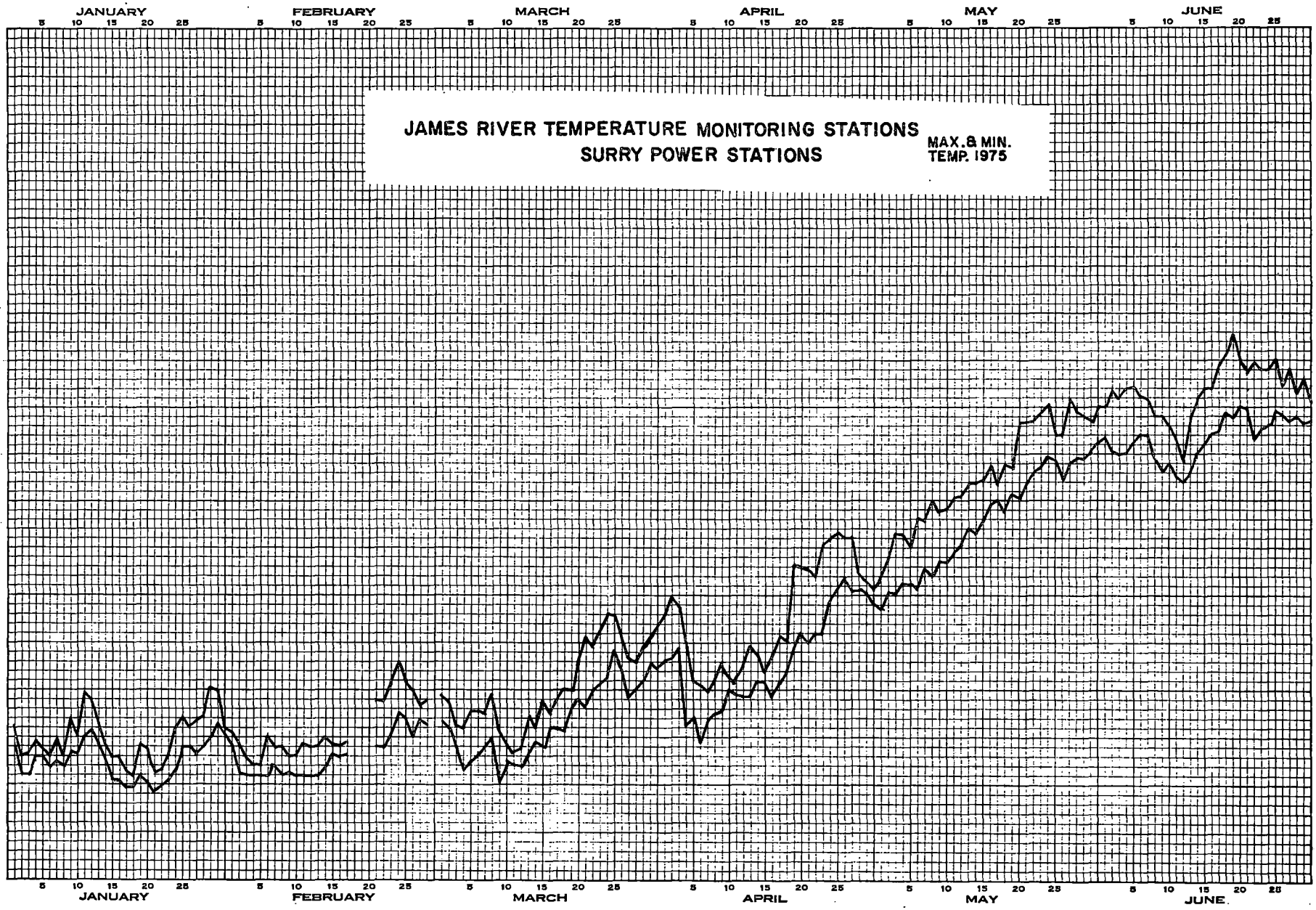
Figure 2.1.1-2

TEMPERATURE AND SALINITY
MONITORING STATIONS



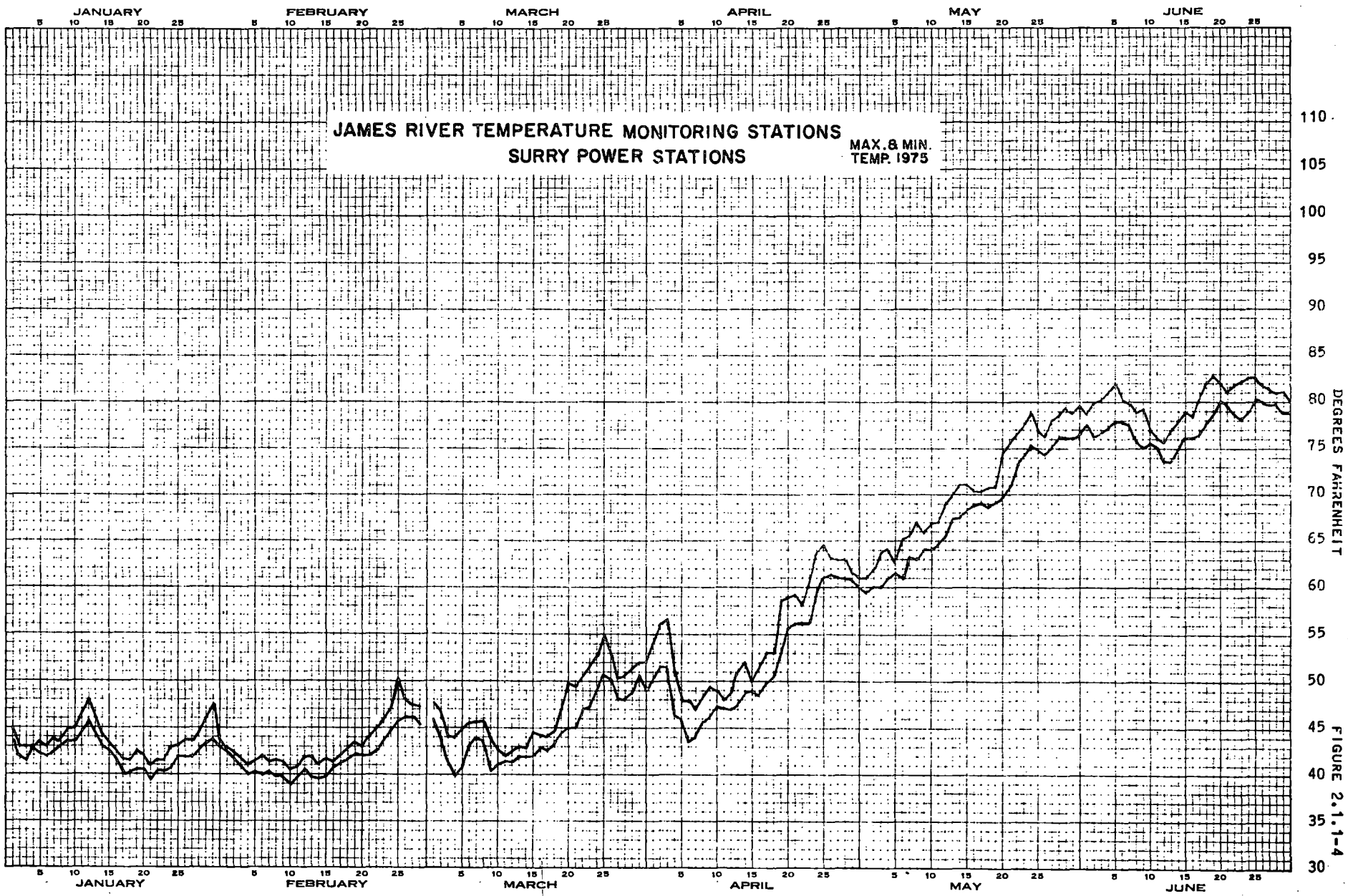
LEGEND:

- △ Monthly Salinity - Temperature Profile Station
- ○ Continuous Salinity - Temperature Monitoring Station
- □ Near Surface Temperature Monitoring Station
- ■ Near Surface and Bottom Temperature Monitoring Station
- ---- Boat Cruise



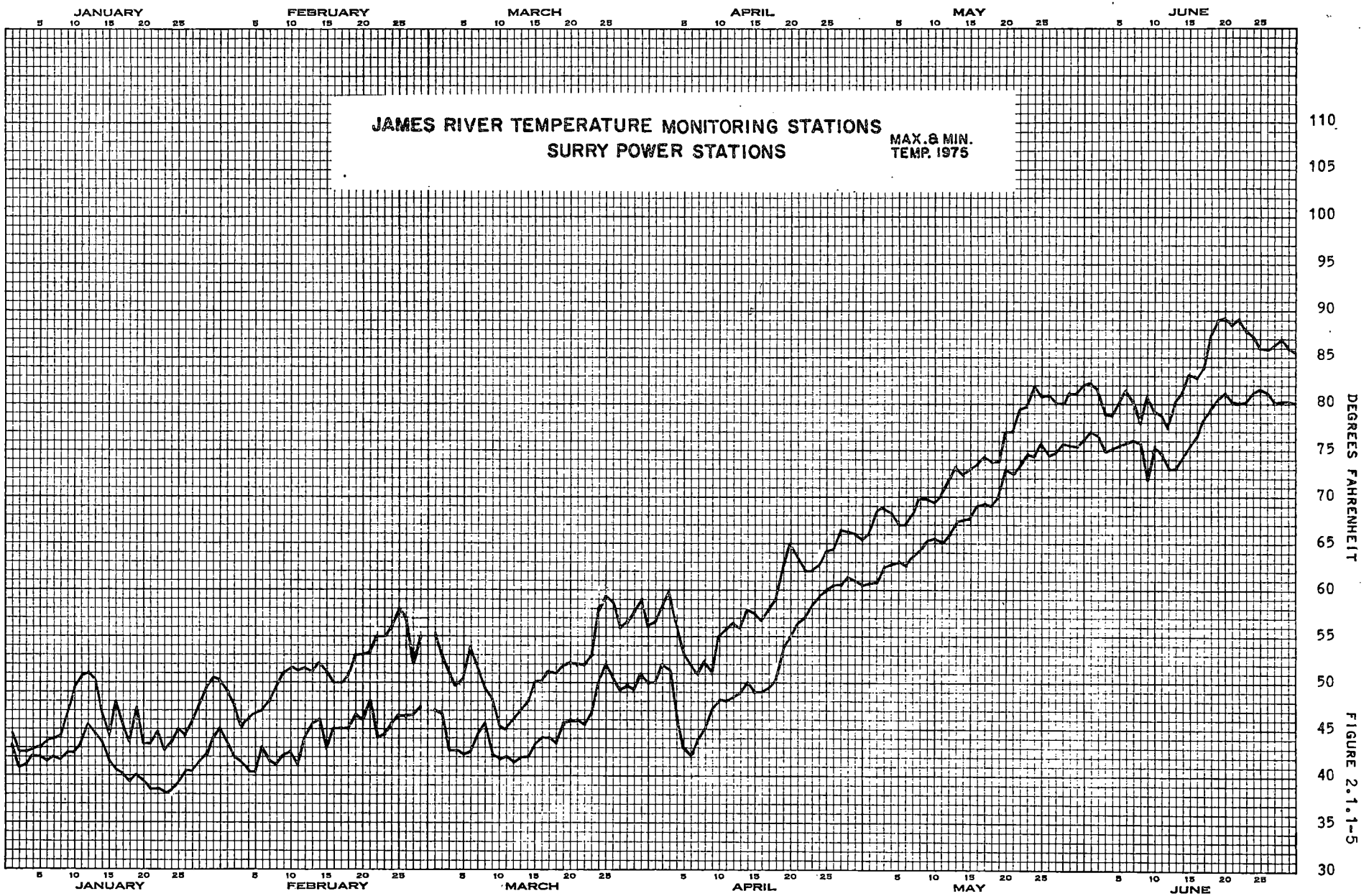
STATION INTAKES

FIGURE 2.1.1-3



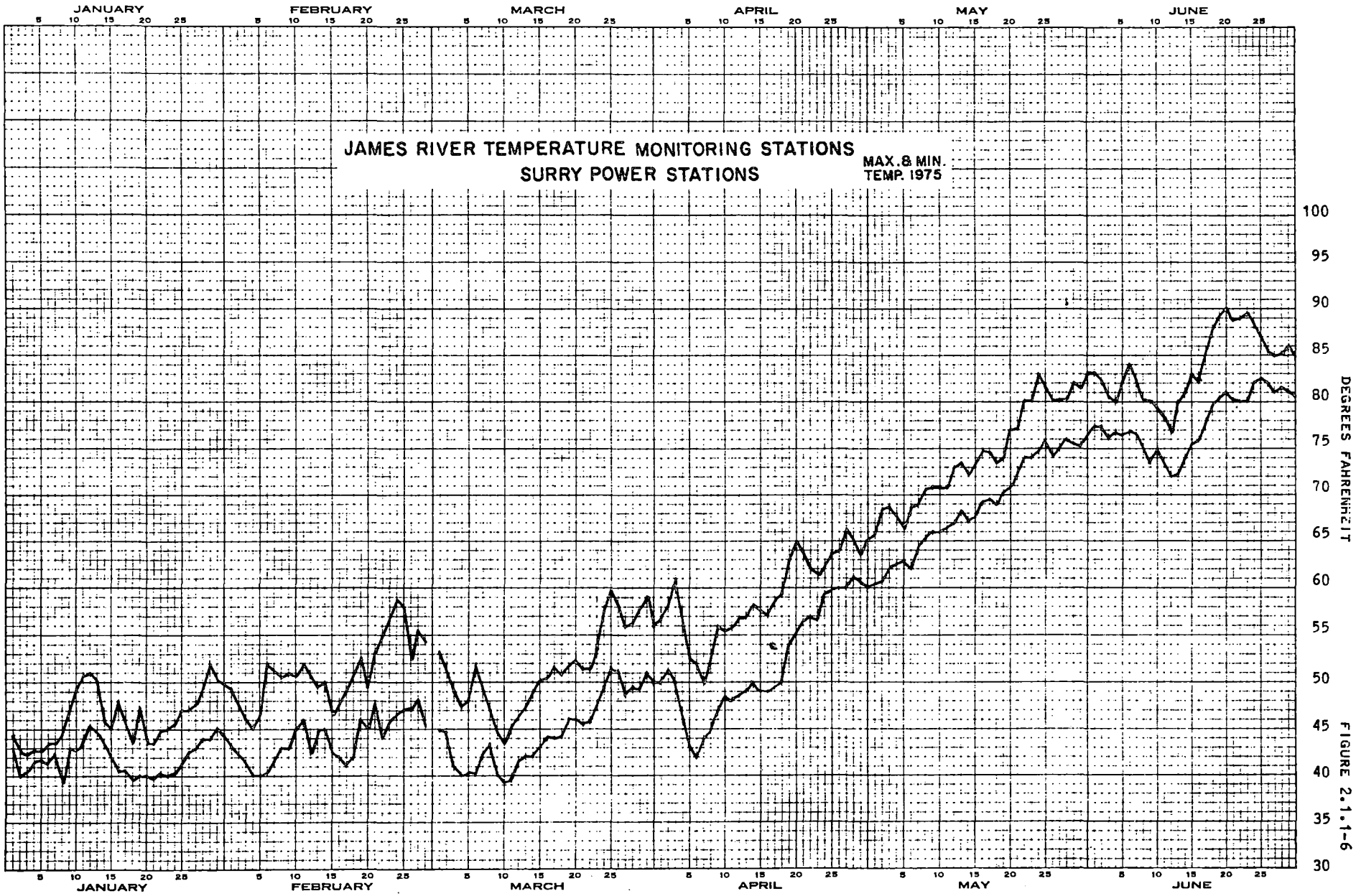
DEEP WATER SHOALS MID DEPTH

FIGURE 2.1.1-4



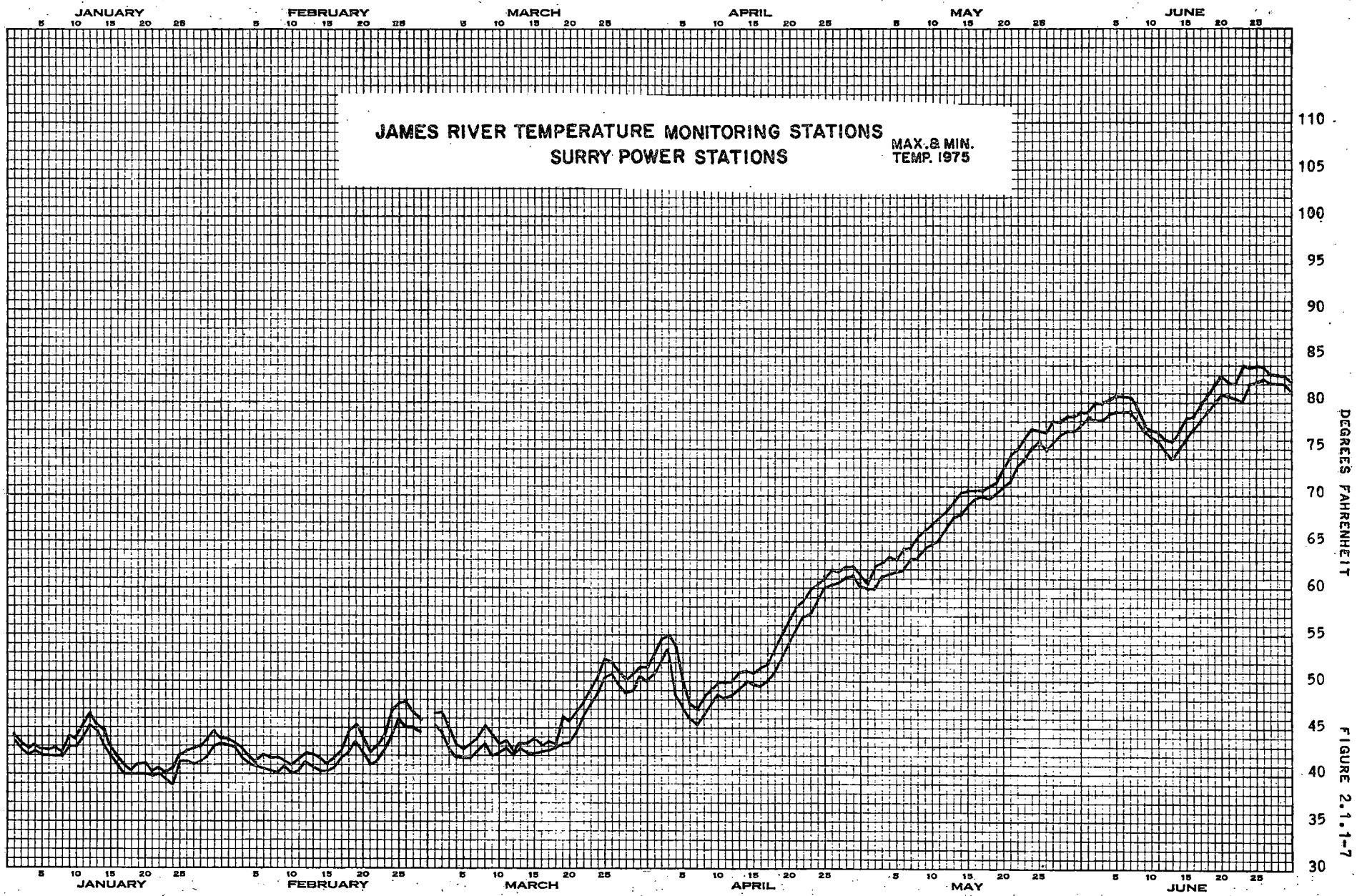
HOG POINT SOUTH MID DEPTH

FIGURE 2.1.1-5



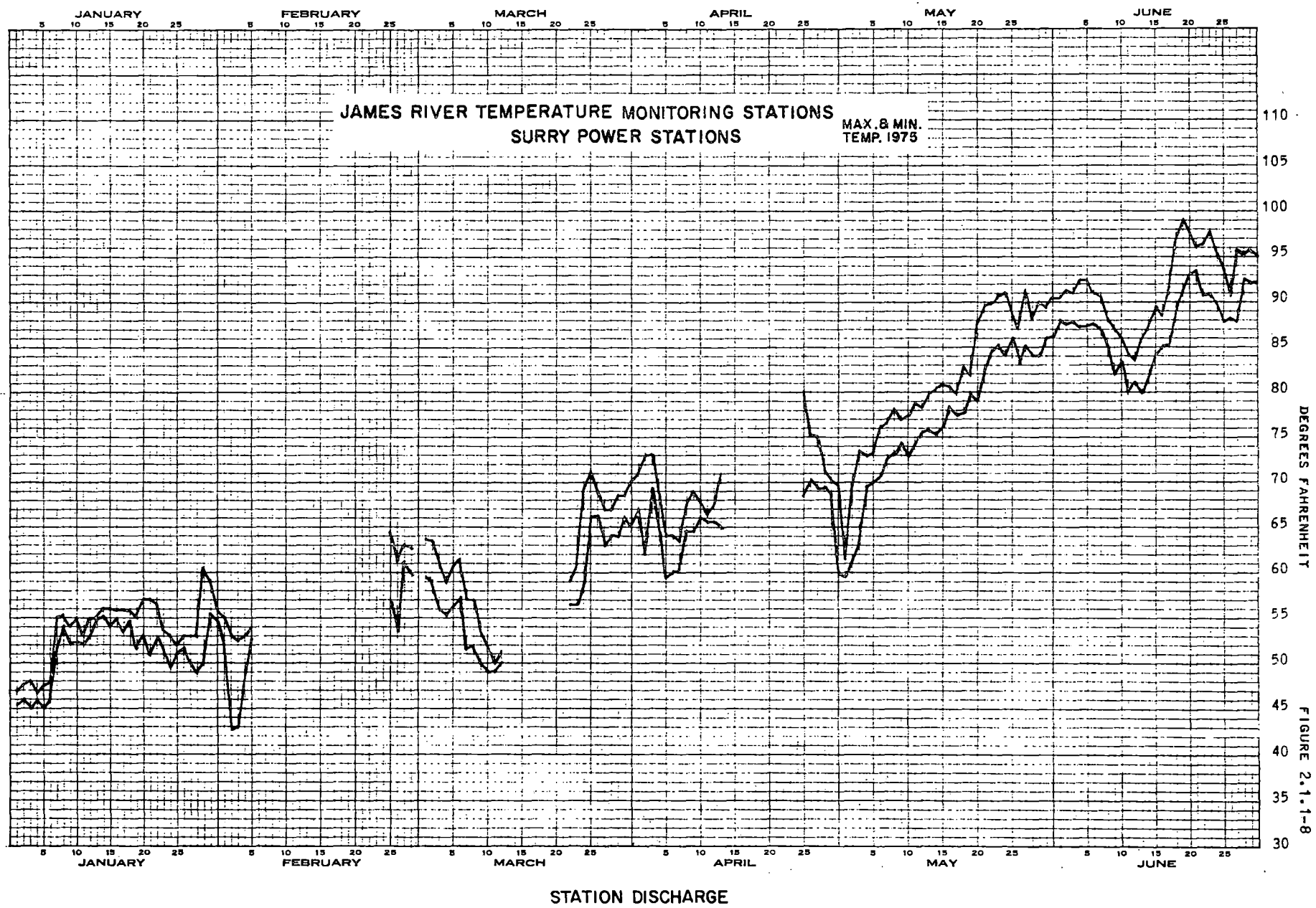
HOG POINT SOUTH BOTTOM

FIGURE 2.1.1-6



HOG POINT NORTH MID DEPTH

FIGURE 2.1.1-7


JAMES RIVER TEMPERATURE MONITORING STATIONS
SURRY POWER STATIONS
MAX. & MIN.
TEMP. 1975
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
5 10 15 20 25
110
105
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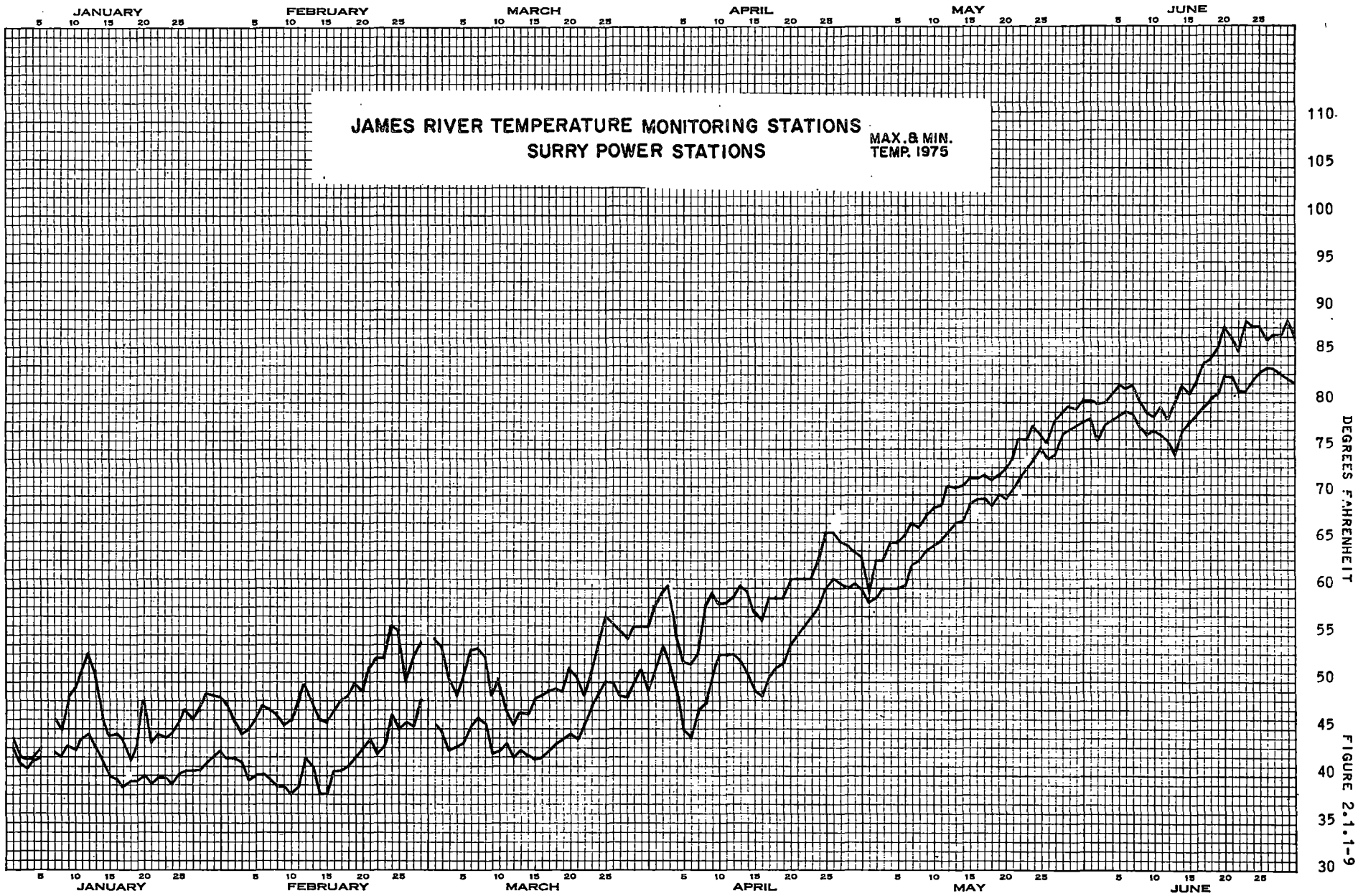
DEGREES FAHRENHEIT
STATION DISCHARGE

FIGURE 2.1.1-8

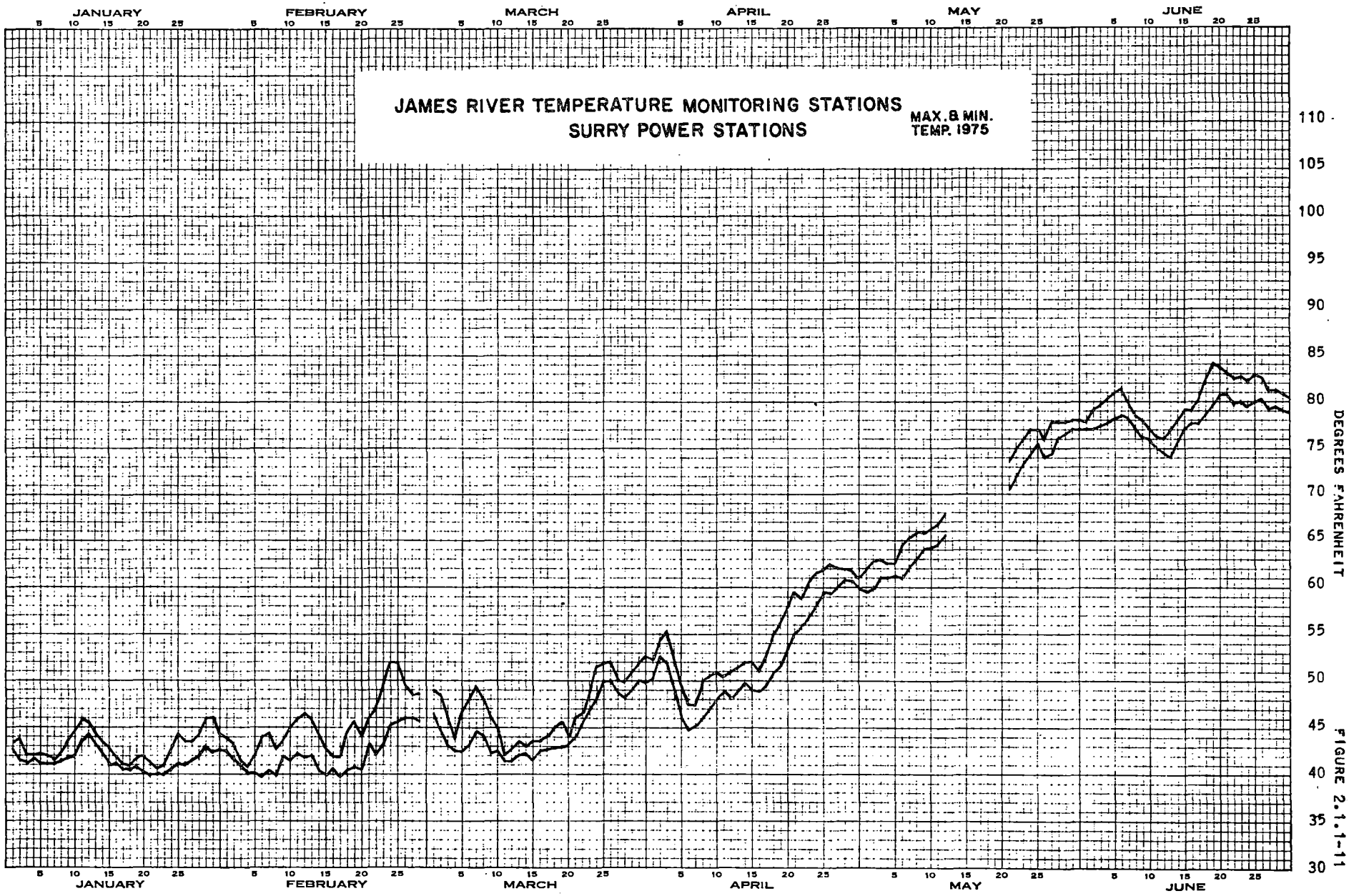


COBHAM BAY SOUTH BOTTOM DEPTH

FIGURE 2.1.1-9

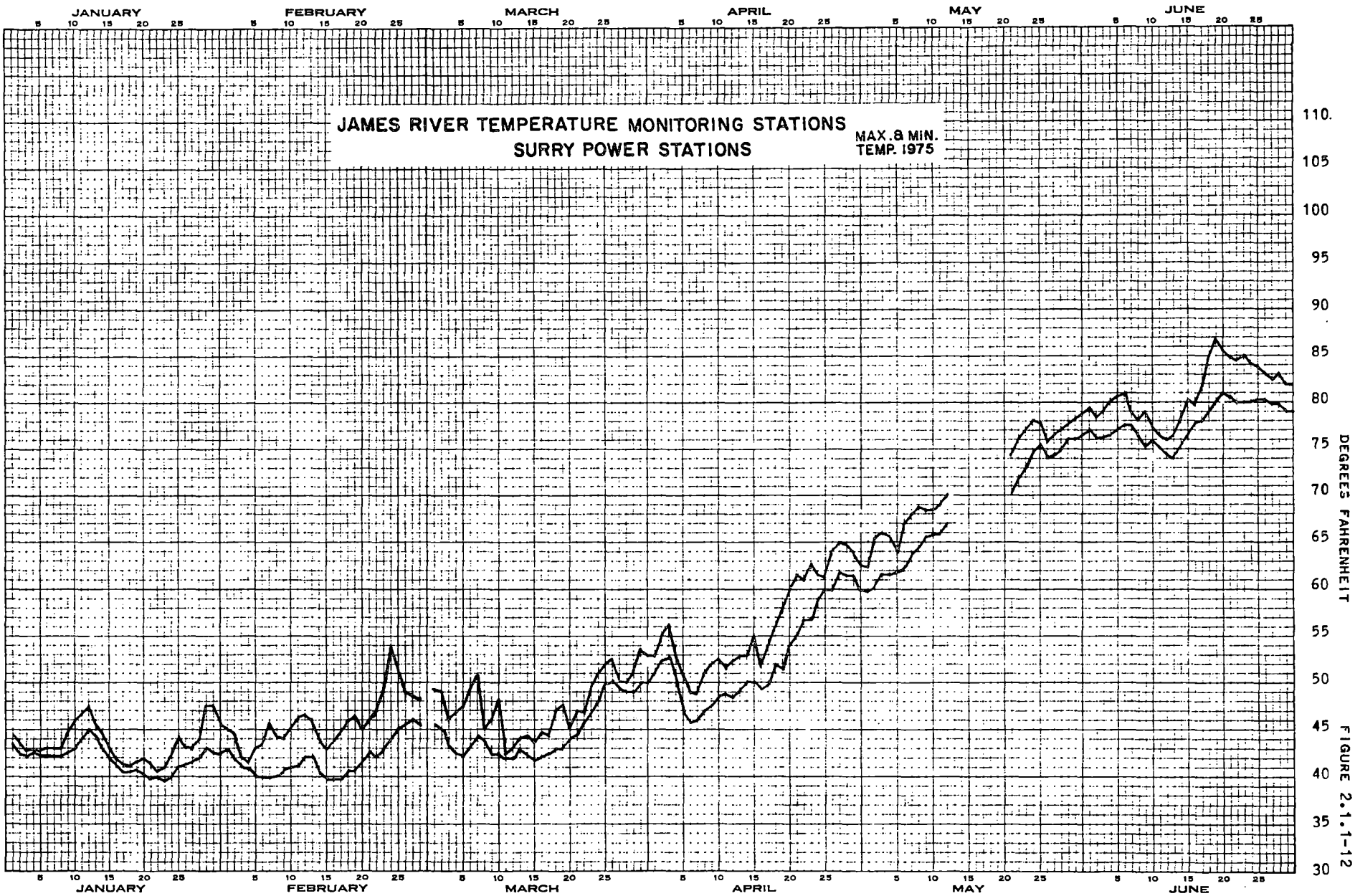
COBHAM BAY SOUTH MID DEPTH

FIGURE 2.1.1-10



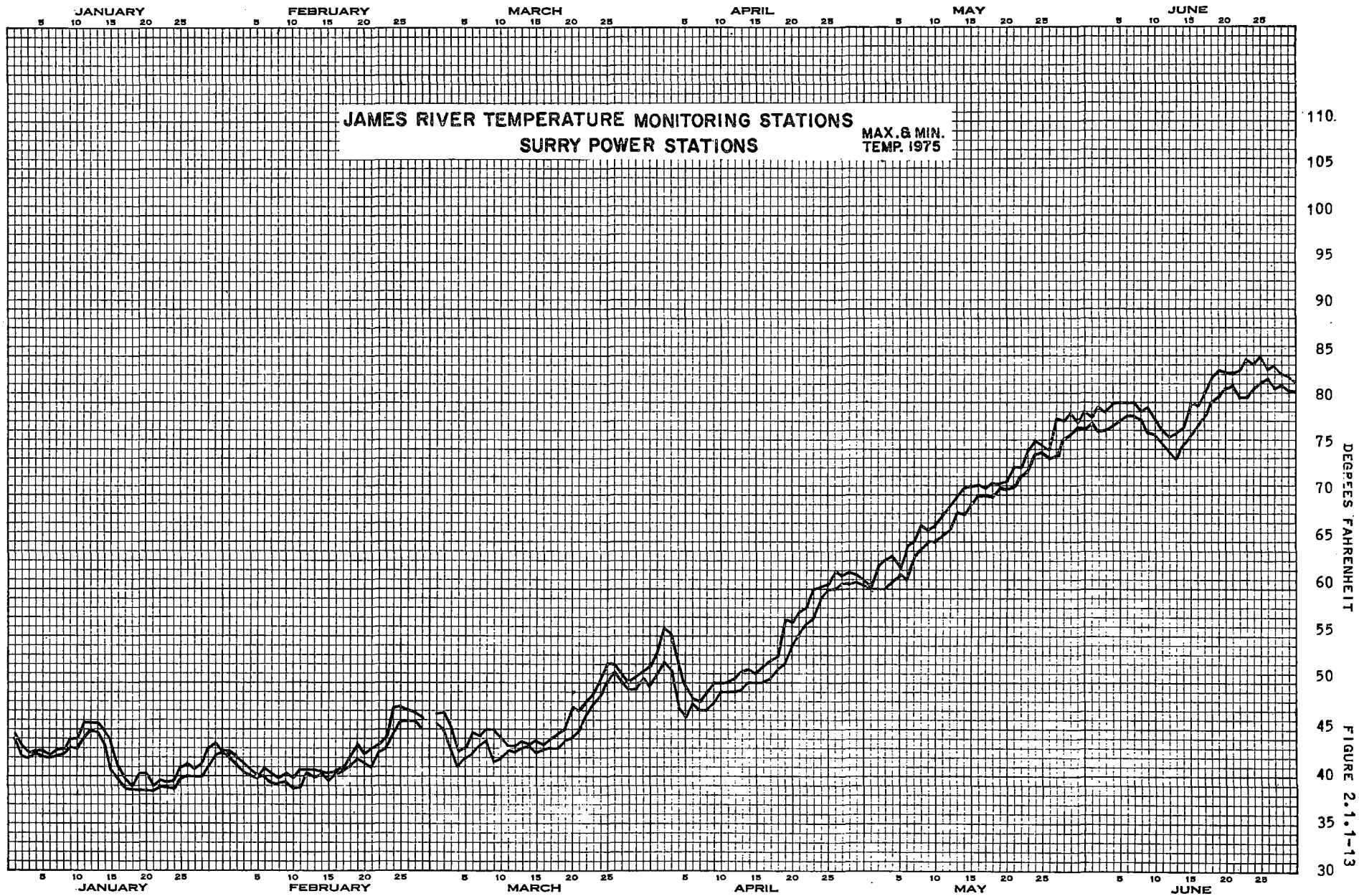
COBHAM BAY MIDDLE BOTTOM DEPTH

FIGURE 2.1.1-11



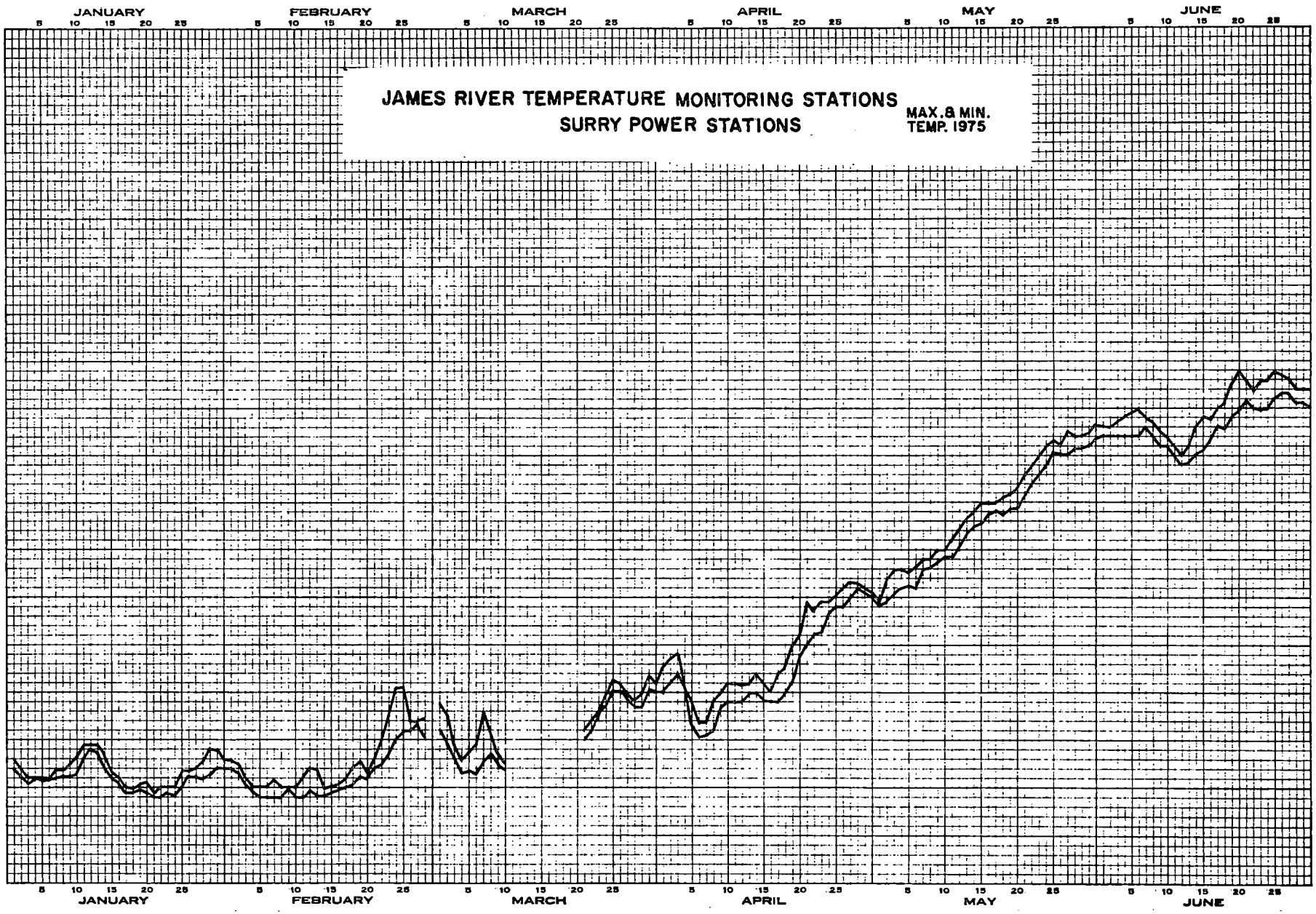
COBHAM BAY MIDDLE MID DEPTH

FIGURE 2.1.1-12



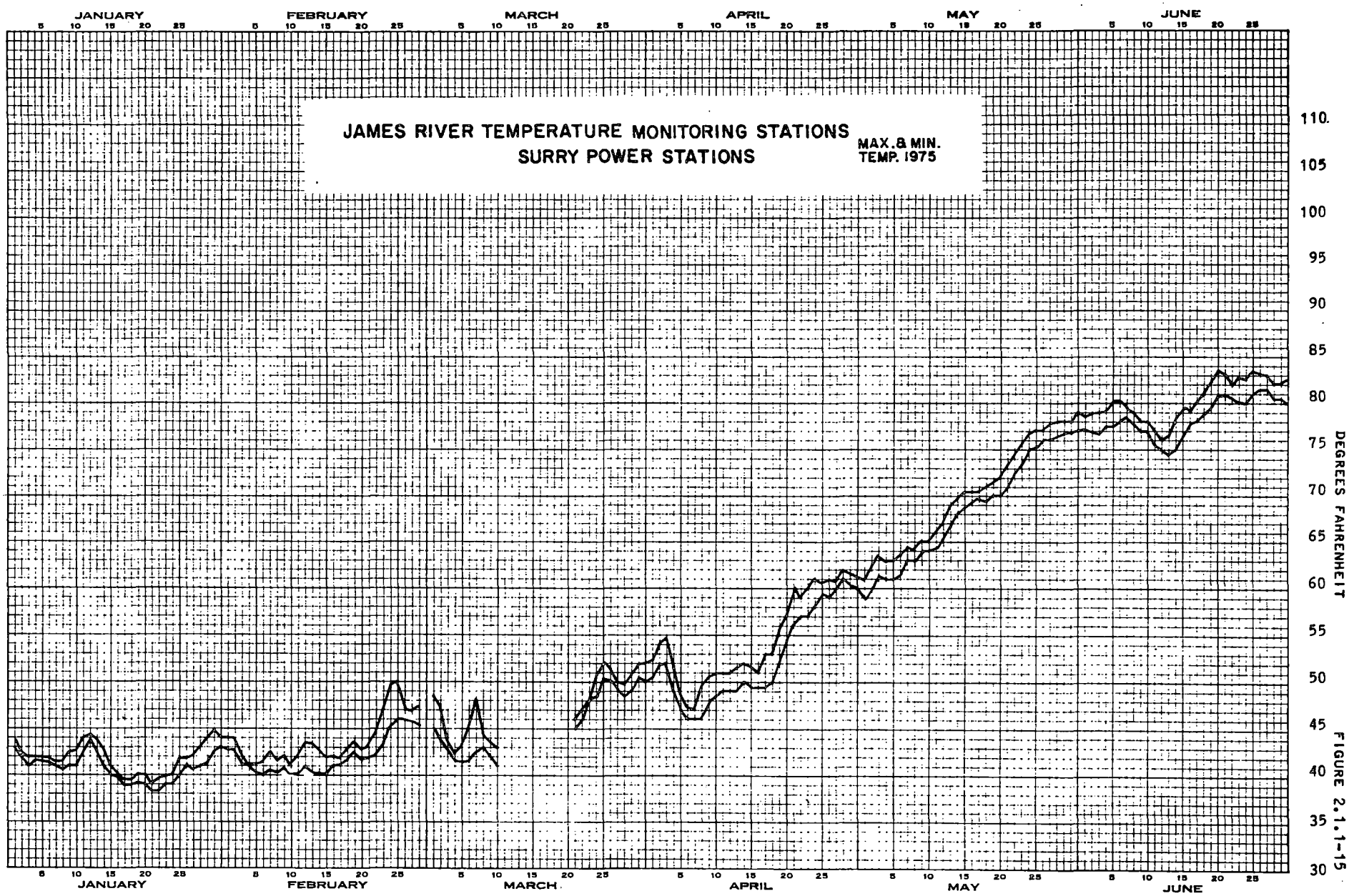
COBHAM BAY NORTH MID DEPTH

FIGURE 2.1.1-13



JAMESTOWN ISLAND MID DEPTH

FIGURE 2.1.1-14

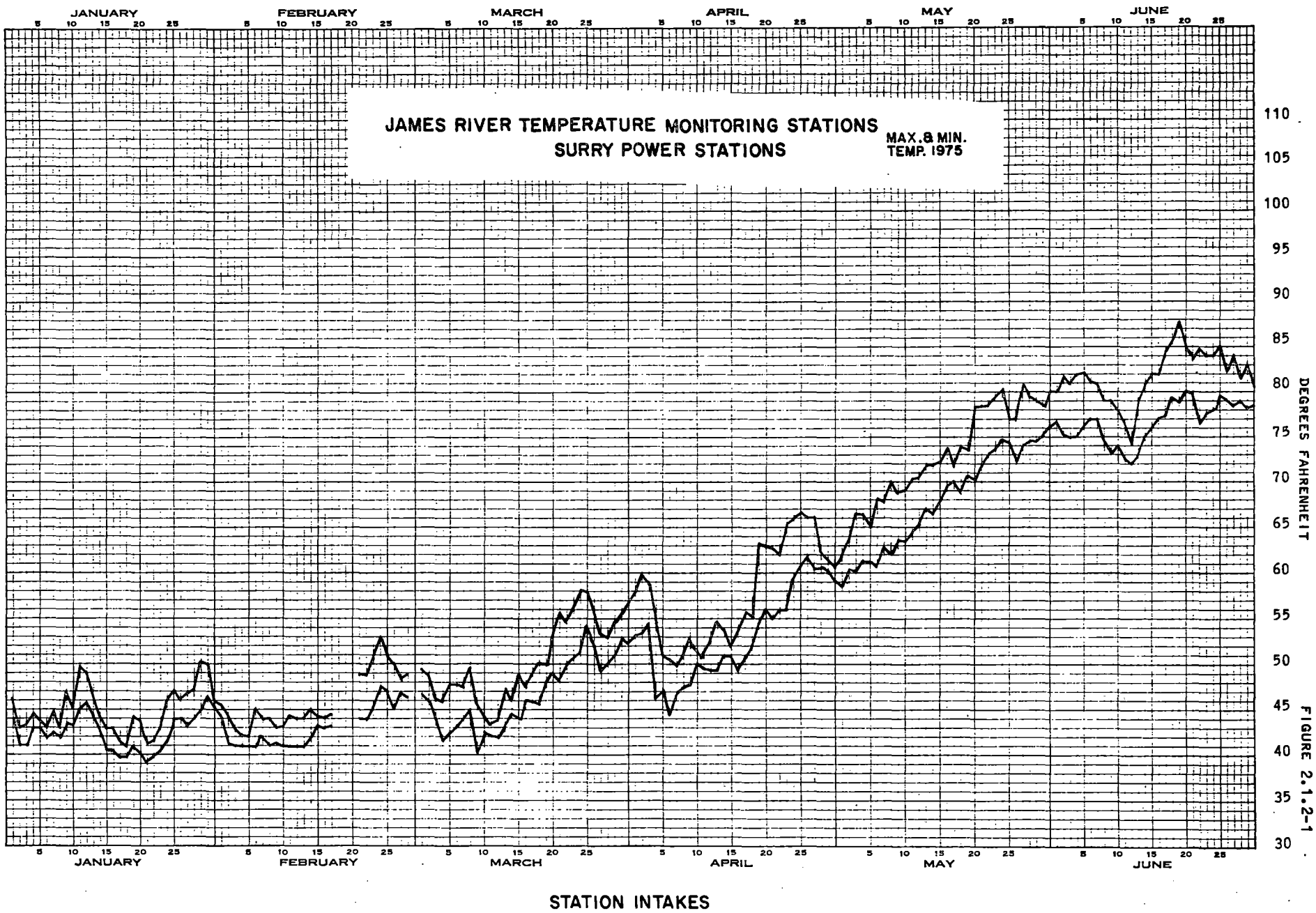


JAMESTOWN ISLAND BOTTOM DEPTH

FIGURE 2.1.1-15

2.1.2 INTAKE CANAL MONITORING STATION

Figure 2.1.2-1 summarizes the data recorded at the intake canal monitoring station. The minimum and maximum river water temperature for each day in the report period is provided. For those days for which data are not provided the monitoring station was inoperable or under repair.


JAMES RIVER TEMPERATURE MONITORING STATIONS
SURRY POWER STATIONS
MAX. & MIN.
TEMP. 1975
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FEBRUARY
MARCH
APRIL
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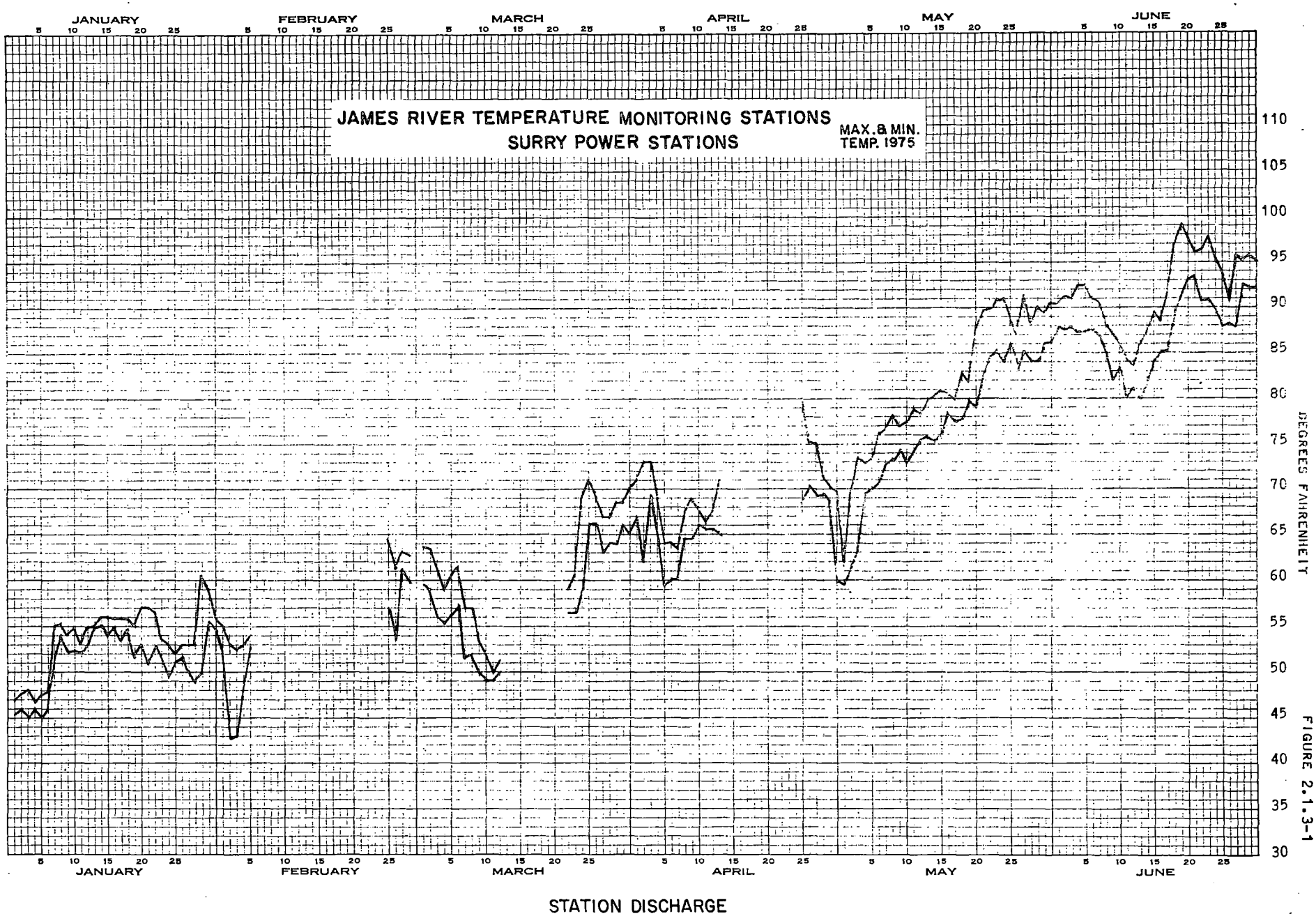
DEGREES FAHRENHEIT
STATION INTAKES

FIGURE 2.1.2-1

2.1.3 DISCHARGE CANAL MONITORING STATION

Figure 2.1.3-1 summarizes the data recorded at the discharge canal monitoring station. The minimum and maximum river water temperature for each day in the report period is provided. For those days for which data are not provided, the monitoring station was inoperable or under repair.


JAMES RIVER TEMPERATURE MONITORING STATIONS
SURRY POWER STATIONS
MAX. & MIN. TEMP. 1975
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
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DEGREES FAHRENHEIT
STATION DISCHARGE

FIGURE 2.1.3-1

2.2 SALINITY AND TEMPERATURE SPECIAL SURVEYS

Summary

The salinity and temperature monitoring program encompasses the segment of the James River Estuary which extends from the southern shore of Jamestown Island to below the intake of the Surry Power Station. The horizontal and vertical salinity and temperature of this tidal segment is determined at monthly intervals as follows: Cruises are conducted at slack before flood tide. A four (4) station transect, which is between the intake structure and Skiffes Creek, is sampled from surface to bottom at two (2) meter intervals. A second transect is made near the upper limits of the segment, the exact location of which is based on the salinity regime of the system. The approximate locations of the sampling stations and the cruise route are shown on T.S. Figure 2.2-1.

Results

Monthly temperature and salinity surveys were conducted at eleven (11) sampling stations as shown in Figure 2.2-1. Data obtained from these surveys are summarized in graphical form in Figures 2.2-2 through 2.2-13.

Conclusions

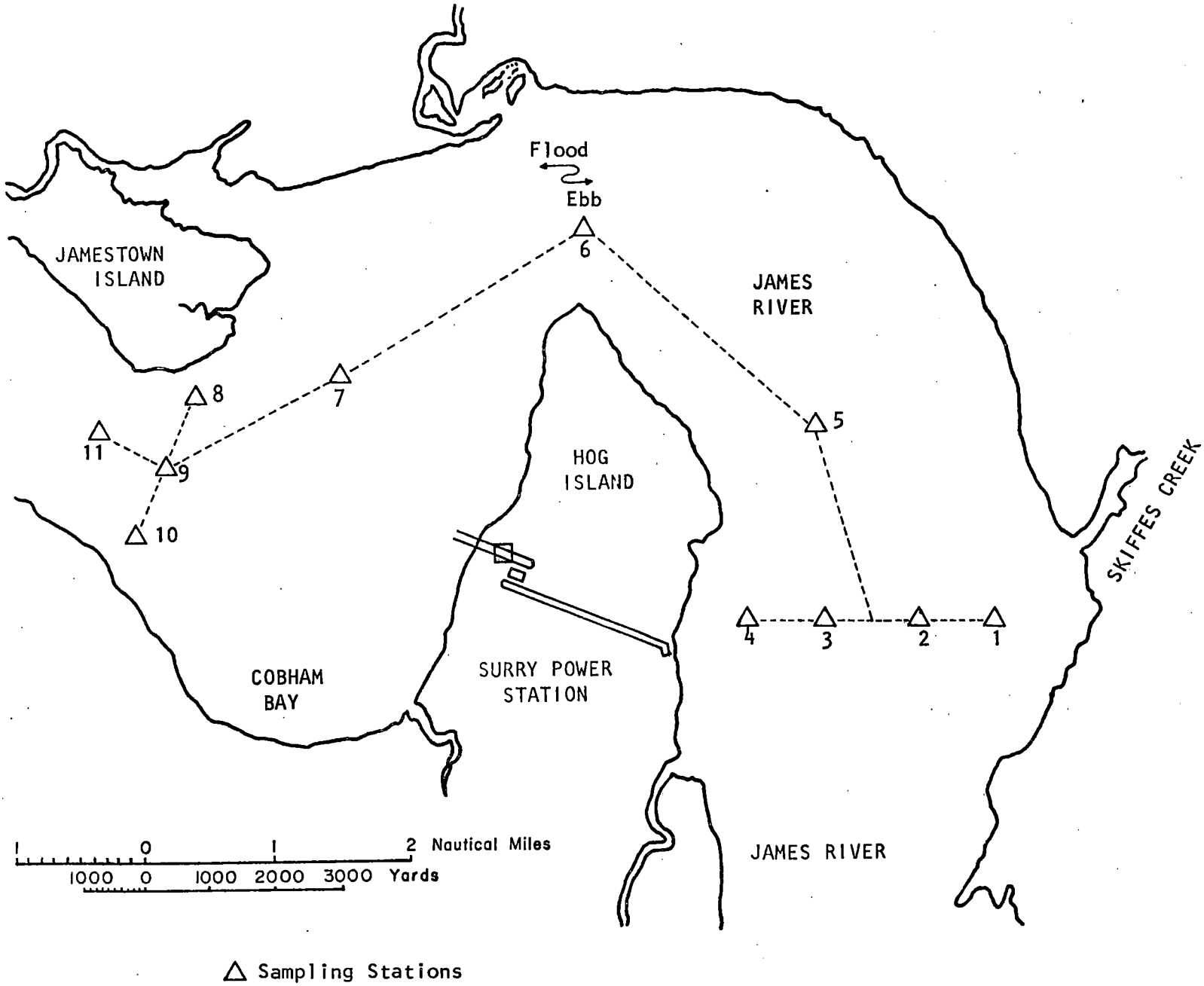
The salinity in this segment of the river varied between 0 and 4.5 parts per thousand (ppt) during the reporting period. There is no measurable difference in salinity occurring as a result of the diversion of water through the cooling system. Therefore it is concluded that the operation of the station had no significant effect on the salinity structure of the James River.

Temperature readings taken in conjunction with the salinity surveys are also presented.

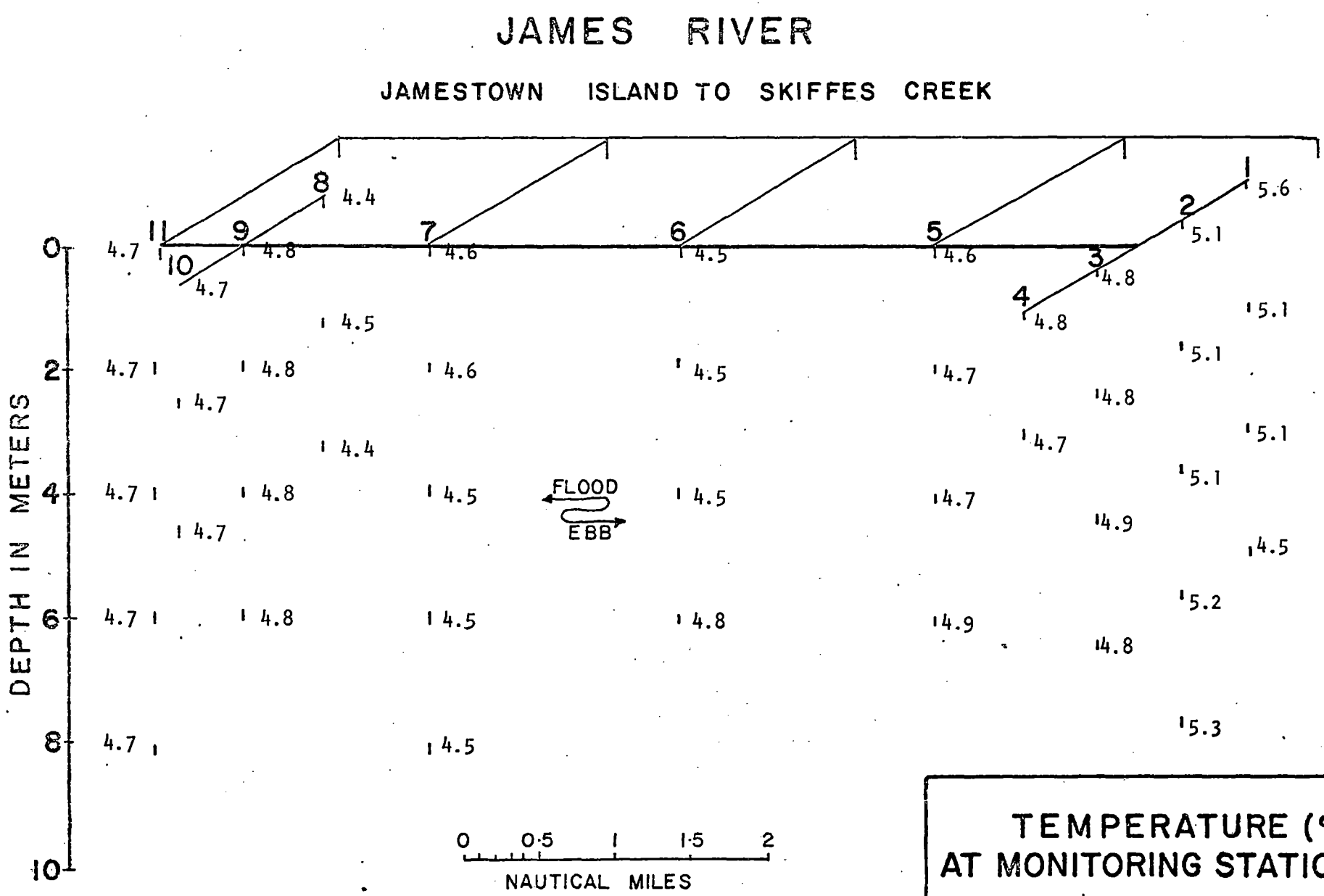
Figure 2.2-1

SURRY

POWER STATION



△ Sampling Stations



TEMPERATURE (°C) AT MONITORING STATIONS

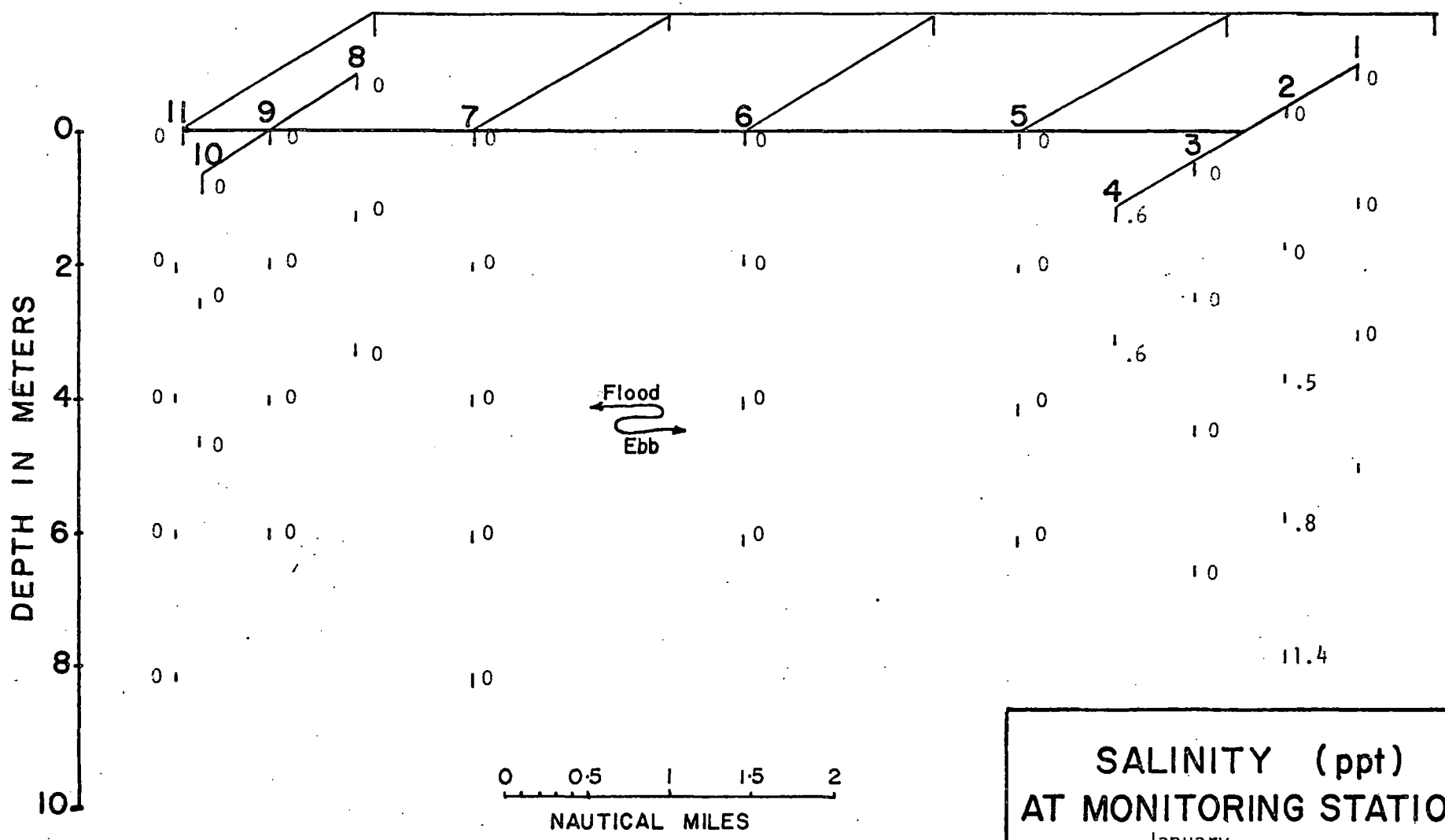
January

1975

Figure 2.2-2

JAMES RIVER

JAMESTOWN ISLAND TO SKIFFES CREEK

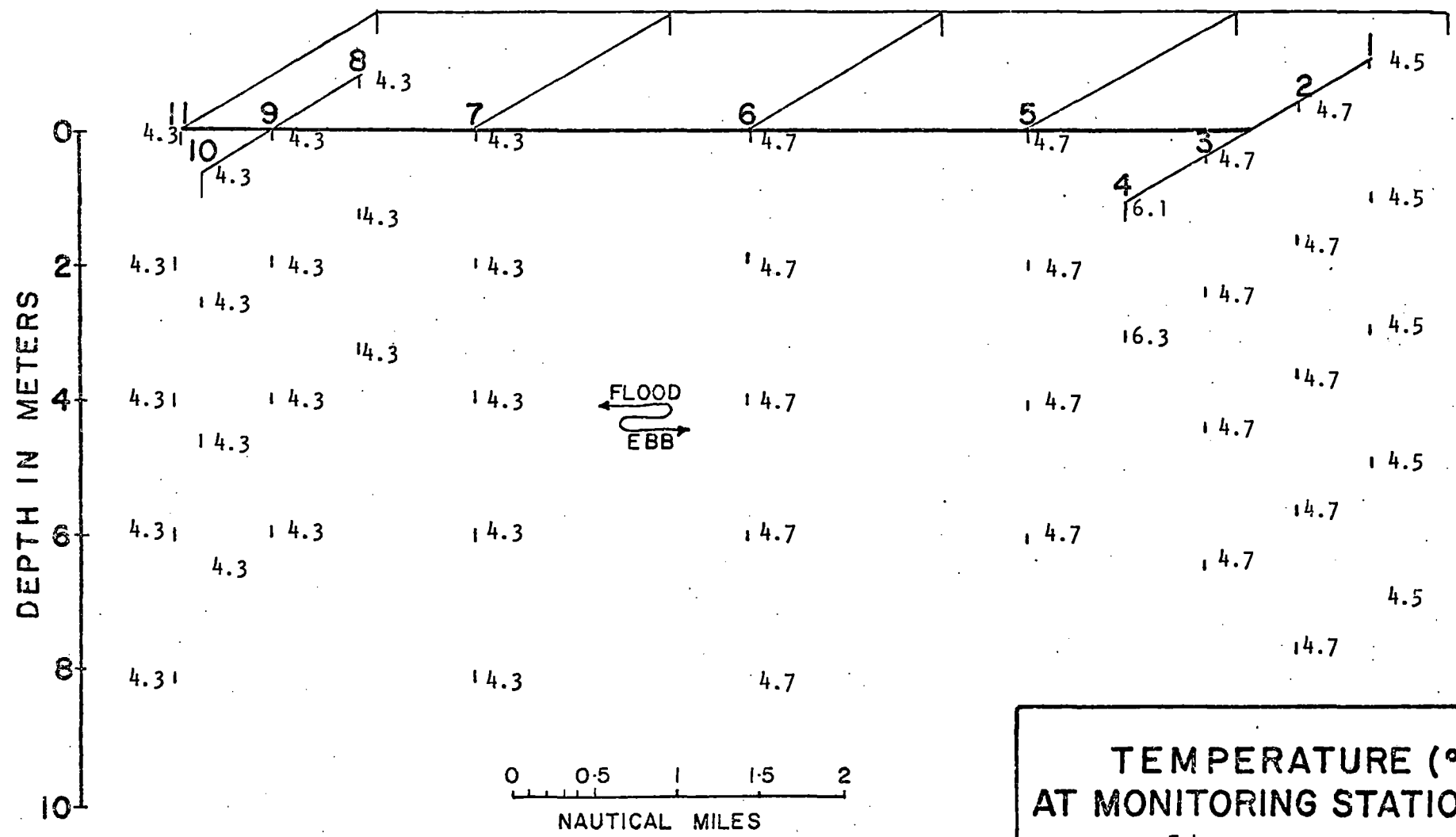


SALINITY (ppt)
AT MONITORING STATIONS
January
1975

Figure 2.2-3

JAMES RIVER

JAMESTOWN ISLAND TO SKIFFES CREEK

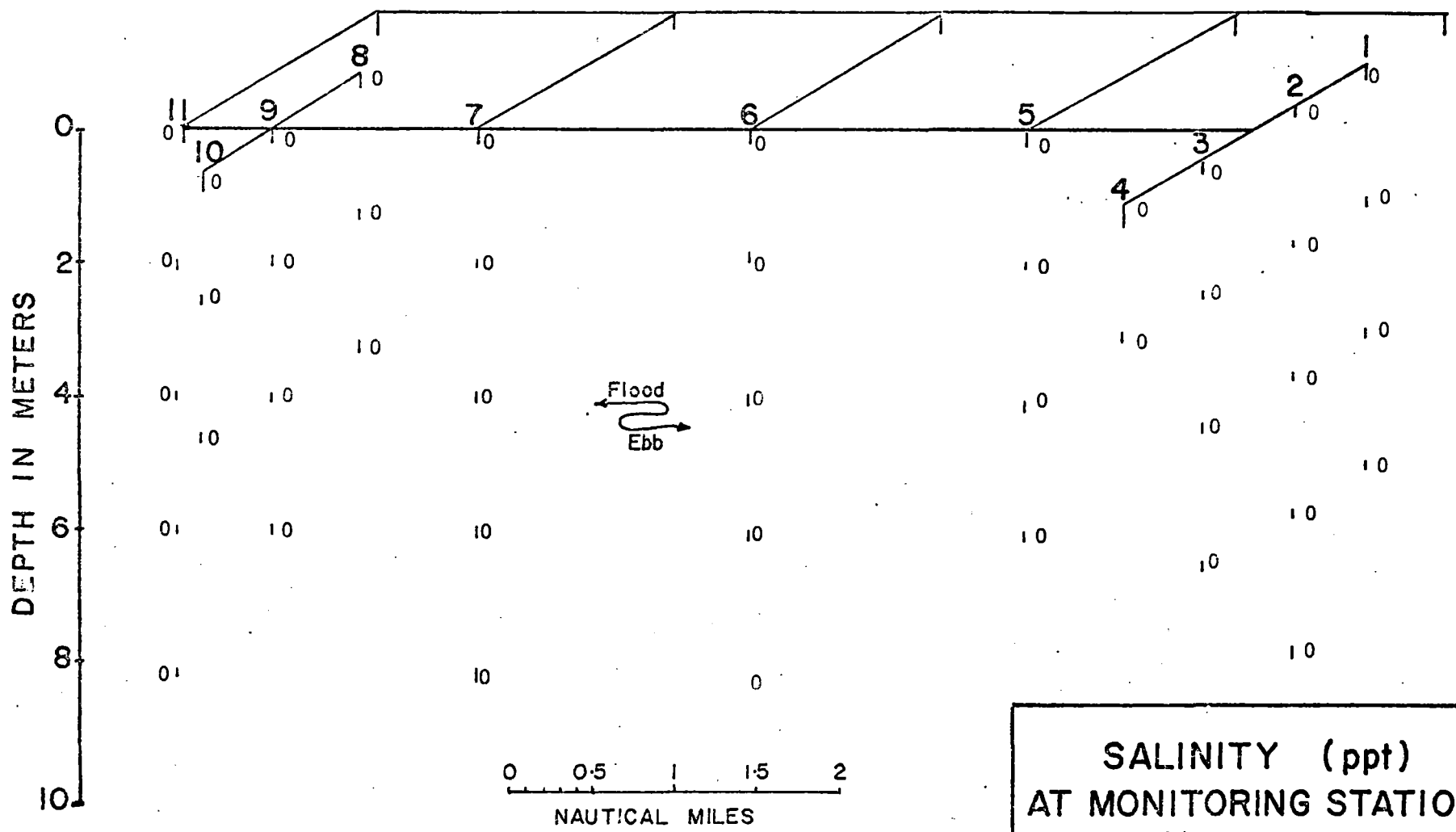


TEMPERATURE (°C) AT MONITORING STATIONS

February

1975

Figure 2.2-4

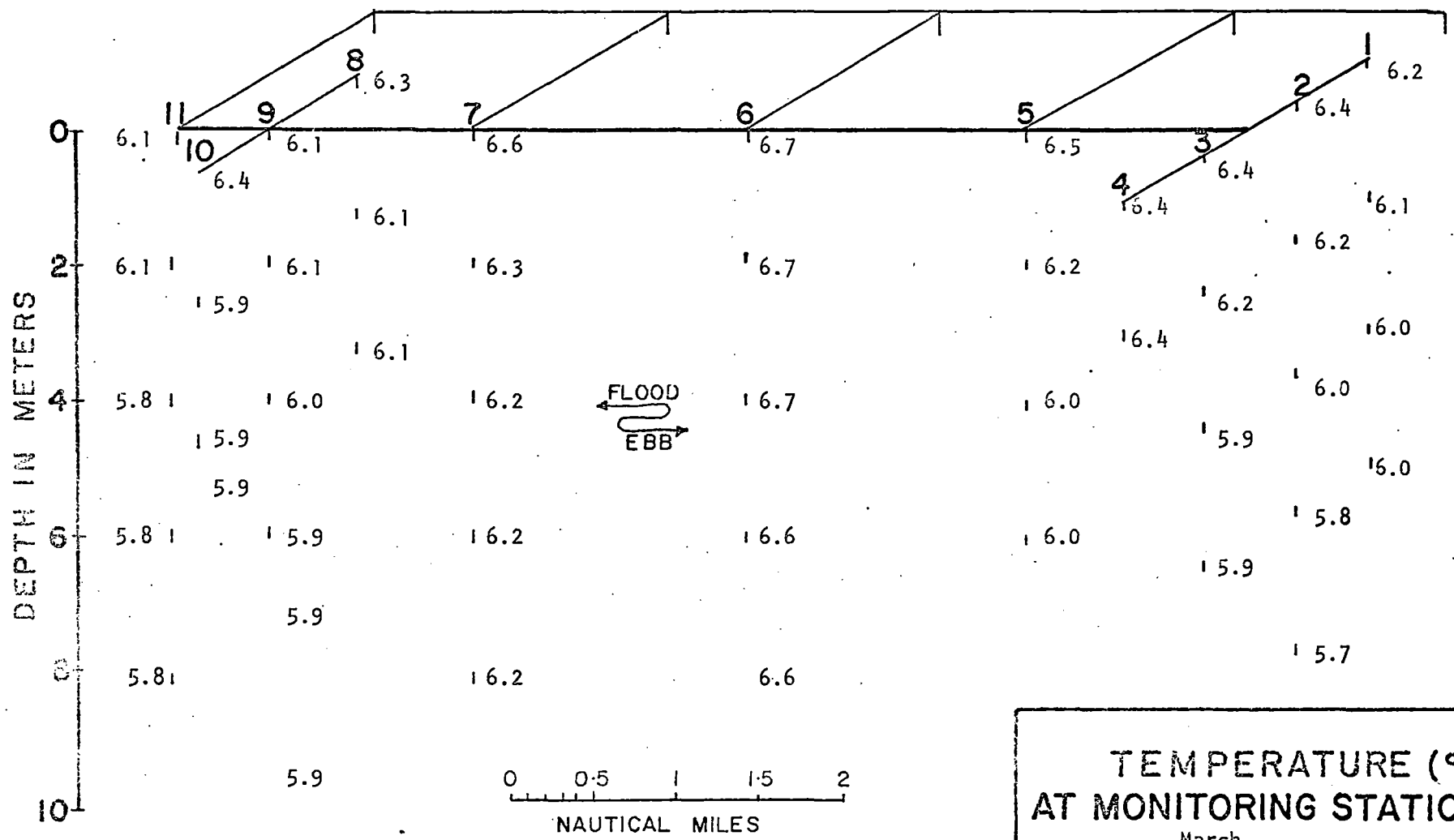


SALINITY (ppt)
AT MONITORING STATIONS
February
1975

Figure 2.2-5

JAMES RIVER

JAMESTOWN ISLAND TO SKIFFES CREEK

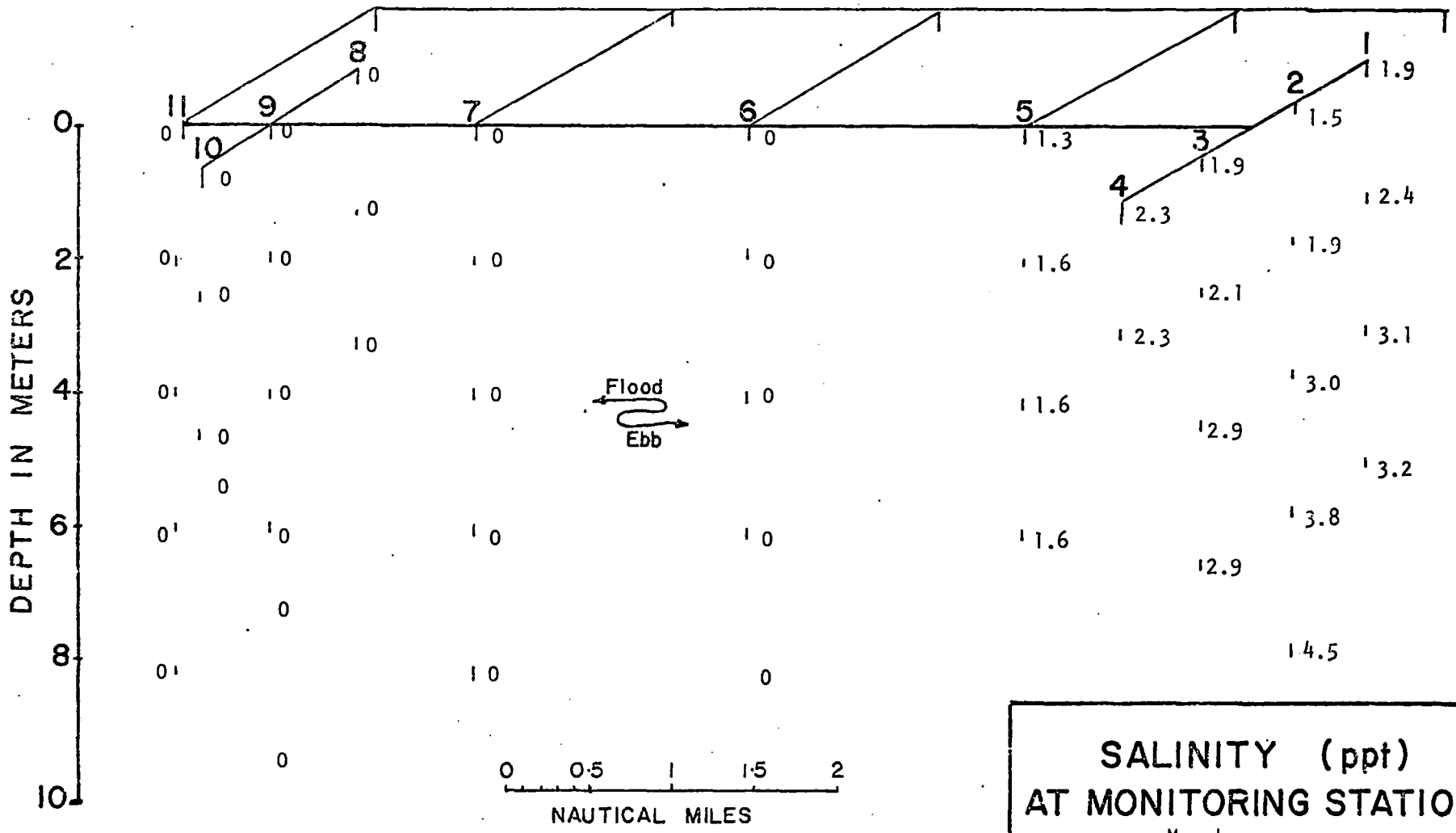


TEMPERATURE (°C)
AT MONITORING STATIONS
March
1975

Figure 2.2-6

JAMES RIVER

JAMESTOWN ISLAND TO SKIFFES CREEK

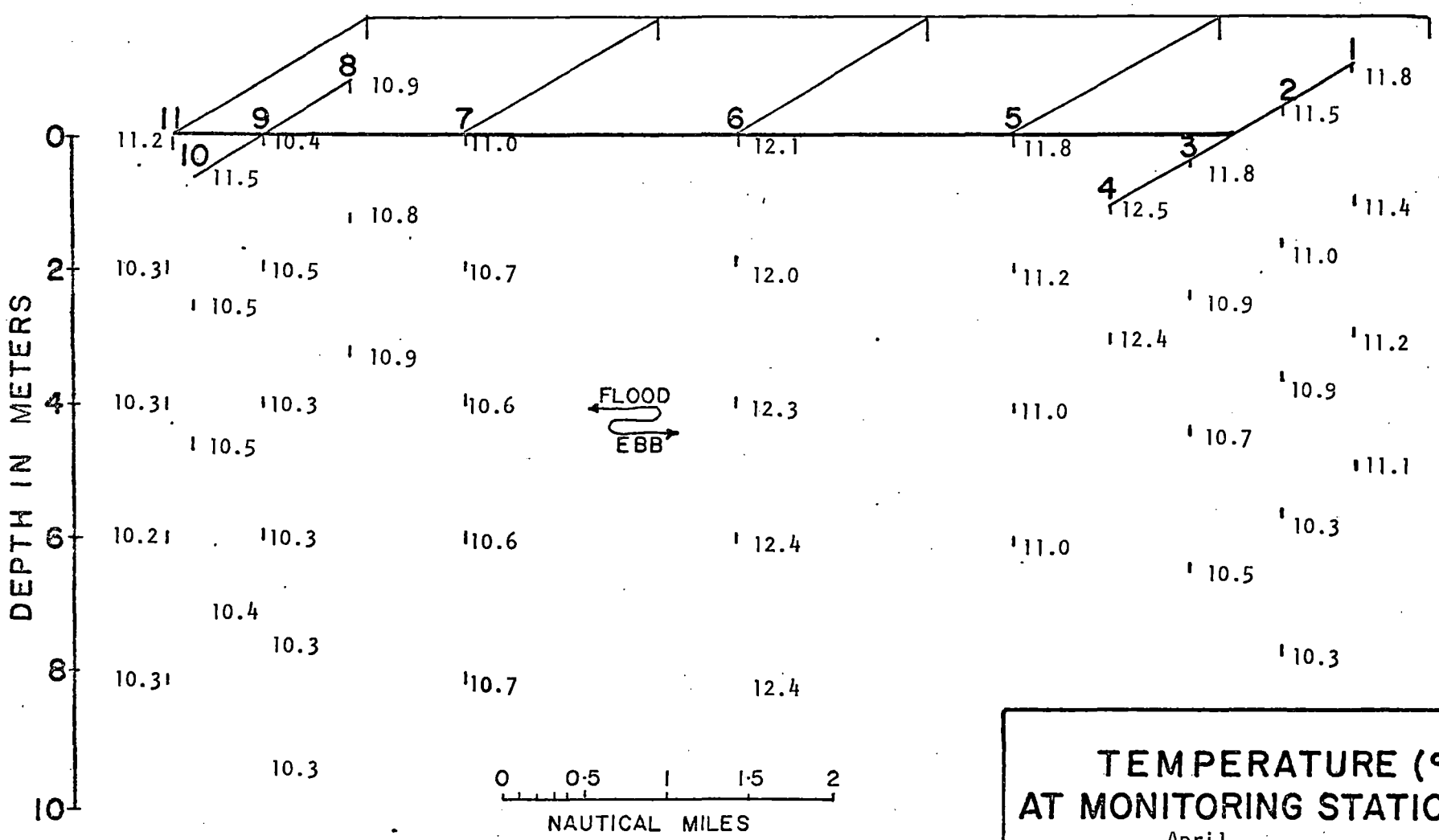


SALINITY (ppt)
AT MONITORING STATIONS
March
1975

Figure 2.2-7

JAMES RIVER

JAMESTOWN ISLAND TO SKIFFES CREEK

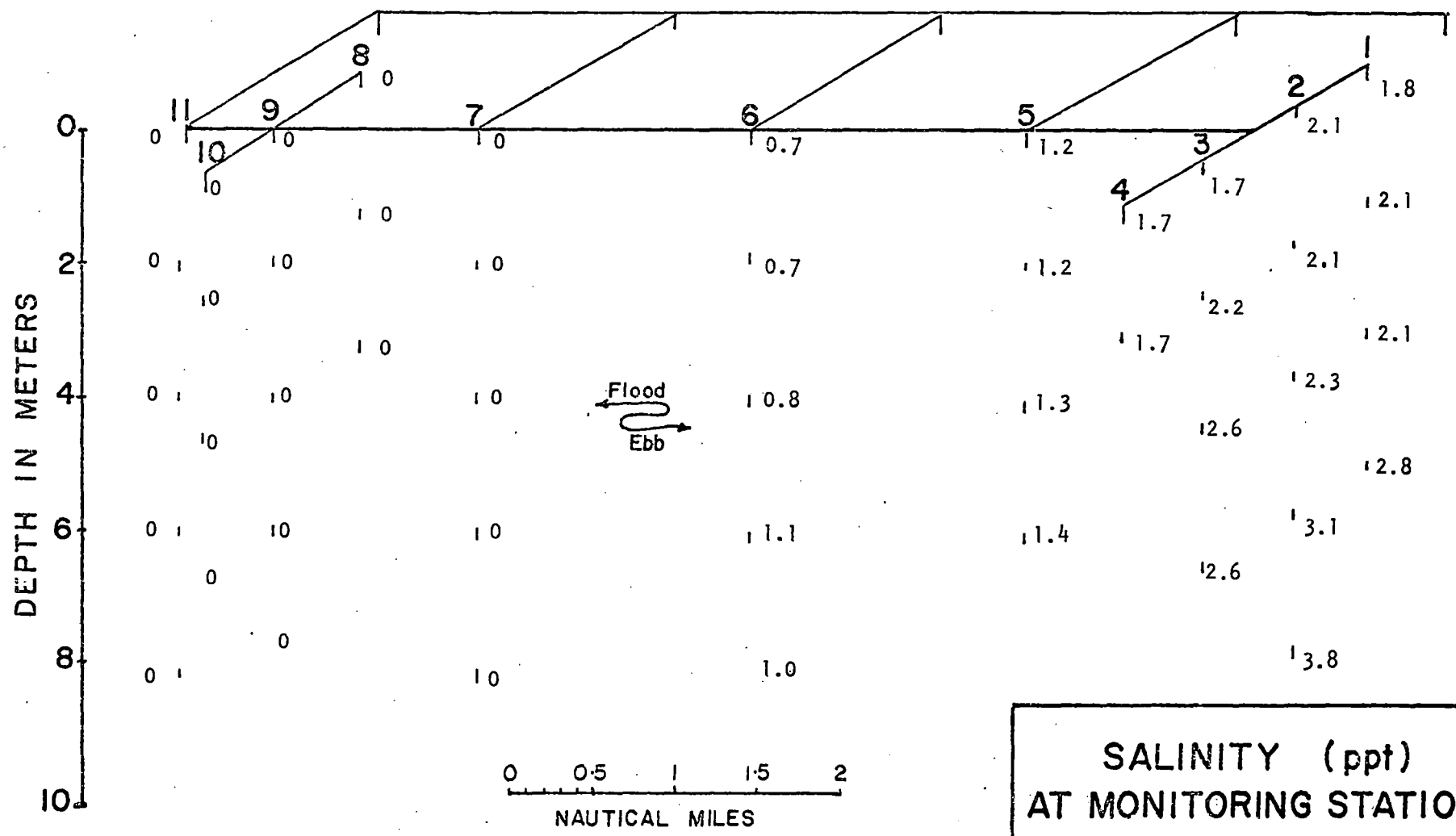


TEMPERATURE (°C) AT MONITORING STATIONS

April

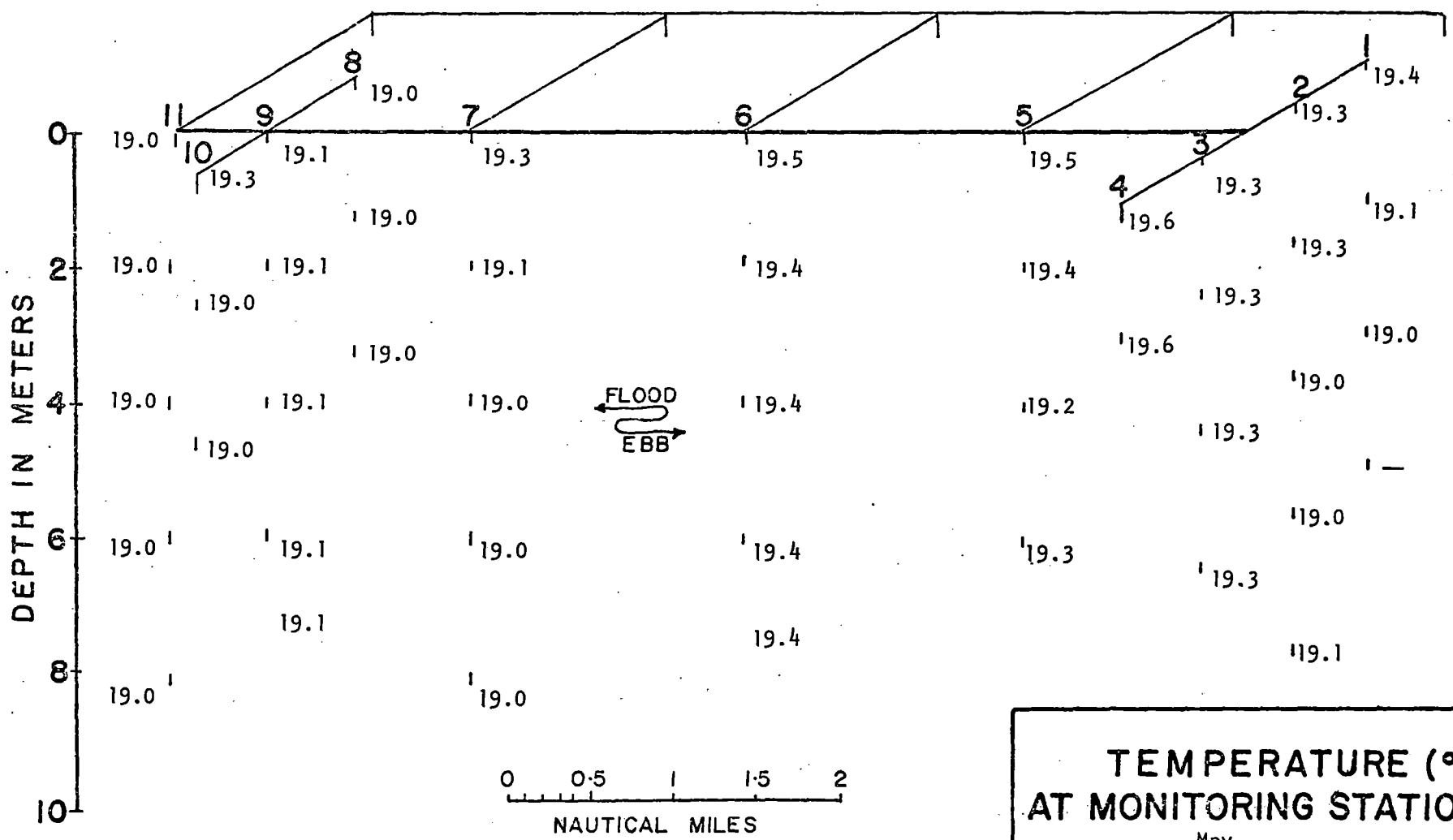
1975

Figure 2.2-8



SALINITY (ppt)
AT MONITORING STATIONS
April
1975

Figure 2.2-9



TEMPERATURE (°C)
AT MONITORING STATIONS
May
1975

Figure 2.2-10

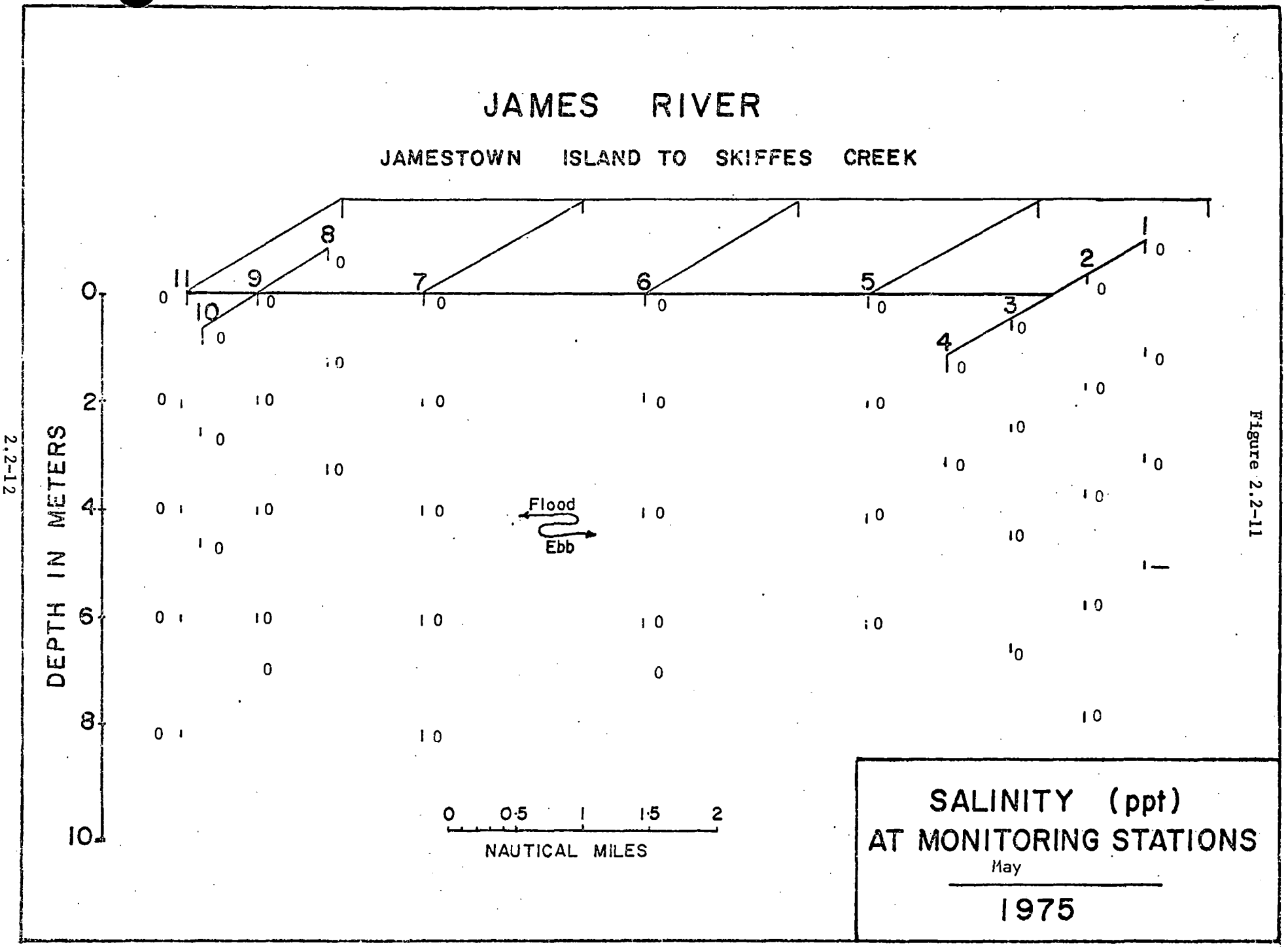
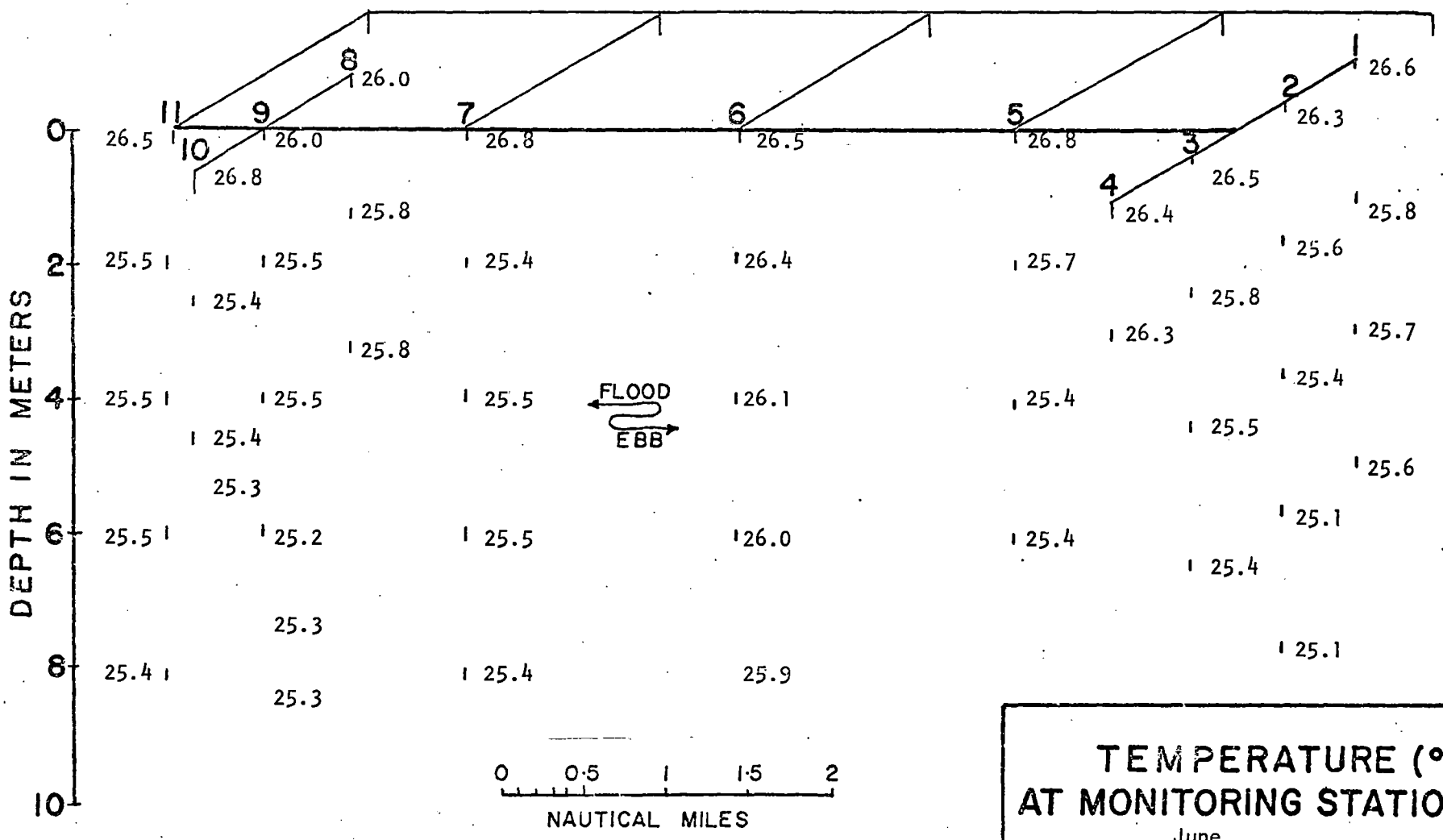
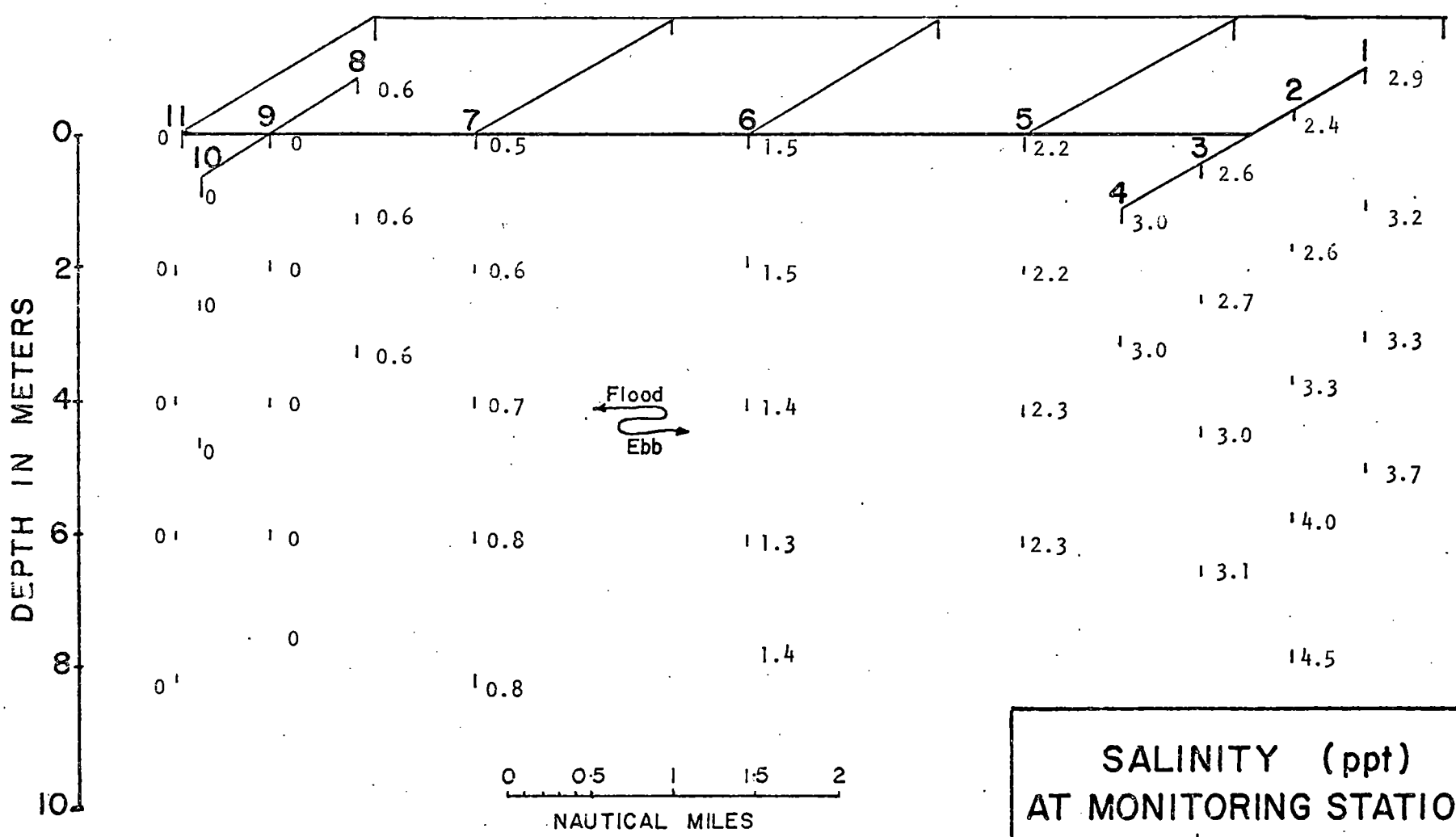

JAMES RIVER
JAMESTOWN ISLAND TO SKIFFES CREEK
DEPTH IN METERS
0
2
4
6
8
10
Flood
Ebb
0 0.5 1 1.5 2
NAUTICAL MILES
SALINITY (ppt)
AT MONITORING STATIONS
May
1975

Figure 2.2-11



TEMPERATURE (°C)
AT MONITORING STATIONS
June
1975

Figure 2.2-12



SALINITY (ppt)
AT MONITORING STATIONS
June
1975

Figure 2.2-13

SURRY SALINITY DATA, DAILY VALUES

OBS	MONTH	YEAR	DAY	MEAN	LOW	HIGH
1	3	75	6	1.97501	1.40411	2.23753
2	3	75	7	2.11702	1.95670	2.40729
3	3	75	8	1.84861	1.29527	2.52096
4	3	75	9	1.72929	1.67877	1.73410
5	3	75	10	3.26858	3.26858	3.26858
6	3	75	11	3.57749	3.38483	4.14762
7	3	75	12			
8	3	75	13	4.26600	4.26600	4.26600
9	3	75	14	4.06191	3.67678	4.56308
10	3	75	15	3.42271	2.12487	4.86171
11	3	75	16	2.40729	2.40729	2.40729
12	3	75	17	1.52664	1.02610	2.40729
13	3	75	18	1.18708	1.18708	1.18708
14	3	75	19	0.45763	0.35359	0.60629
15	3	75	20	0.50407	0.50407	0.50407
16	3	75	21			
17	3	75	22			
18	3	75	23			
19	3	75	24			
20	3	75	25			
21	3	75	26			
22	3	75	27	0.50407	0.50407	0.50407
23	3	75	28	0.42256	0.35359	0.50407
24	3	75	29	0.44764	0.35359	0.50407
25	3	75	30	0.41002	0.35359	0.50407
26	3	75	31	0.44675	0.35359	0.50407
27	4	75	1	0.40375	0.35359	0.50407
28	4	75	2	0.38703	0.35359	0.50407
29	4	75	3	0.37240	0.35359	0.50407
30	4	75	4			
31	4	75	5			
32	4	75	6			
33	4	75	7			
34	4	75	8			
35	4	75	9	4.79545	4.56308	5.04161
36	4	75	10	4.50914	3.97054	4.86171
37	4	75	11	4.39978	4.26600	4.74208
38	4	75	12	4.11828	3.67678	4.26600
39	4	75	13	3.61694	3.26858	4.26600
40	4	75	14	3.06903	2.80678	3.38483
41	4	75	15	2.72689	2.40729	3.38483
42	4	75	16	2.55905	2.23753	3.09478
43	4	75	17	2.70514	2.40729	3.38483
44	4	75	18	3.29798	2.97933	3.55978
45	4	75	19			
46	4	75	20	2.27340	1.84516	3.09478
47	4	75	21			
48	4	75	22	1.66055	1.40411	1.84516
49	4	75	23	2.00682	1.56848	2.52096
50	4	75	24	2.49440	2.23753	2.80678
51	4	75	25	1.95278	1.84516	2.12487
52	4	75	26	1.91529	1.56848	2.12487
53	4	75	27	1.87141	1.56848	2.12487
54	4	75	28	2.05524	1.67877	2.40729
55	4	75	29	1.93422	1.67877	2.23753

SURRY SALINITY DATA, DAILY VALUES

OBS	MONTH	YEAR	DAY	MEAN	LOW	HIGH
56	4	75	30	2.06211	1.67877	2.23753
57	5	75	1	2.03417	1.84516	2.12487
58	5	75	2	1.74224	1.67877	1.95670
59	5	75	3			
60	5	75	4	6.13155	6.13155	6.13155
61	5	75	5			
62	5	75	6			
63	5	75	7			
64	5	75	8			
65	5	75	9			
66	5	75	10			
67	5	75	11			
68	5	75	12			
69	5	75	13			
70	5	75	14			
71	5	75	15			
72	5	75	16			
73	5	75	17			
74	5	75	18			
75	5	75	19			
76	5	75	20			
77	5	75	21			
78	5	75	22			
79	5	75	23			
80	5	75	24			
81	5	75	25			
82	5	75	26			
83	5	75	27			
84	5	75	28			
85	5	75	29			
86	5	75	30			
87	5	75	31			
88	6	75	1			
89	6	75	2			
90	6	75	3			
91	6	75	4			
92	6	75	5			
93	6	75	6			
94	6	75	7			
95	6	75	8			
96	6	75	9			
97	6	75	10	5.34259	5.34259	5.34259
98	6	75	11	5.34259	5.34259	5.34259
99	6	75	12	5.34259	5.34259	5.34259
100	6	75	13	5.34259	5.34259	5.34259
101	6	75	14	4.65290	3.97054	5.34259
102	6	75	15			
103	6	75	16	4.41238	4.14762	5.04161
104	6	75	17	4.76099	4.26600	5.16183
105	6	75	18			
106	6	75	19			
107	6	75	20			
108	6	75	21			
109	6	75	22			
110	6	75	23			

SURRY SALINITY DATA, DAILY VALUES

OBS	MONTH	YEAR	DAY	MEAN	LOW	HIGH
111	6	75	24			
112	6	75	25			
113	6	75	26			
114	6	75	27			
115	6	75	28			
116	6	75	29			
117	6	75	30			

2.3 FRESHWATER DISCHARGE OF THE JAMES RIVER AT RICHMOND AND HOG ISLAND

The daily freshwater discharge of the James River and the James River and Kanawha Canal gages at Richmond have been combined and tabulated in Table 2.3-1. The calculated freshwater flow at Hog Island is also tabulated in Table 2.3-1.

The freshwater flow of the James River at Hog Island has been calculated using the flow at Richmond and the relative drainage area of the James River above and below Richmond to Hog Island. The area above Richmond is 6757 square miles and the area from Richmond to Hog Island is 2760 square miles.

Therefore:

$$B = A \times \frac{(6757 + 2760)}{6757}$$

Where: B = Flow at Hog Island

A = Flow at Richmond

The time of flow from Richmond to Hog Island is variable, being dependent upon the flow at Richmond.

TABLE 2.3-1

FRESHWATER DISCHARGE OF THE JAMES RIVER AT RICHMOND AND HOG ISLAND
JANUARY-JUNE, 1975

DATE	JAMES RIVER DISCHARGE AT RICHMOND, C.F.S.	CALCULATED JAMES RIVER DISCHARGE AT HOG POINT, C.F.S.
January 1, 1975	5,342	7,524
2	5,212	7,341
3	4,842	6,819
4	4,972	7,003
5	5,212	7,341
6	4,972	7,003
7	5,212	7,341
8	5,342	7,524
9	5,490	7,733
10	5,620	7,916
11	5,620	7,916
12	7,648	10,772
13	10,212	14,384
14	13,710	19,311
15	12,710	17,902
16	11,028	15,533
17	10,040	14,141
18	8,212	11,567
19	7,390	10,409
20	7,212	10,158
21	8,212	11,567
22	8,570	12,071
23	10,230	14,409
24	10,420	14,677
25	10,420	14,677
26	14,110	19,874
27	21,328	30,040
28	25,728	36,238
29	18,628	26,238
30	14,028	19,758
31	11,380	16,029
February 1, 1975	9,996	14,079
2	9,850	13,874
3	9,092	12,806
4	9,272	13,060
5	10,212	14,384
6	11,792	16,609
7	9,492	13,369
8	8,382	11,806
9	8,042	11,327
10	9,462	13,327
11	11,792	16,609

TABLE 2.3-1 (Cont'd)

DATE	JAMES RIVER DISCHARGE AT RICHMOND, C.F.S.	CALCULATED JAMES RIVER DISCHARGE AT HOG POINT, C.F.S.
February 12, 1975	12,174	17,147
13	15,874	22,359
14	25,010	35,227
15	29,610	41,706
16	19,810	27,902
17	15,392	21,680
18	13,992	19,708
19	13,110	18,465
20	11,792	16,609
21	11,010	15,508
22	10,402	14,651
23	9,832	13,848
24	8,732	12,299
25	8,930	12,578
26	11,010	15,508
27	10,402	14,651
28	10,022	14,116
March 1, 1975	9,462	13,327
2	8,912	12,553
3	8,212	11,567
4	7,702	10,848
5	7,052	9,933
6	6,610	9,310
7	6,152	8,665
8	6,292	8,862
9	6,152	8,665
10	6,012	8,468
11	5,822	8,200
12	6,292	8,862
13	6,760	9,521
14	13,674	19,260
15	49,810	70,157
16	59,710	84,102
17	49,940	70,340
18	52,674	74,191
19	35,845	50,488
20	79,208	111,564
21	128,540	181,049
22	88,120	124,117
23	35,464	49,951
24	24,574	34,612
25	23,438	33,012
26	21,856	30,784
27	17,292	24,356
28	15,392	21,680
29	13,492	19,003
30	15,374	21,654
31	18,292	25,764

TABLE 2.3-1 (Cont'd)

DATE	JAMES RIVER DISCHARGE AT RICHMOND, C.F.S.	CALCULATED JAMES RIVER DISCHARGE AT HOG POINT, C.F.S.
April 1, 1975	16,760	23,606
2	16,982	23,919
3	15,083	21,244
4	13,992	19,708
5	11,792	16,609
6	10,592	14,919
7	10,022	14,116
8	8,732	12,299
9	8,382	11,806
10	7,872	11,088
11	7,720	10,874
12	7,532	10,609
13	7,070	9,958
14	6,920	9,747
15	7,230	10,183
16	7,890	11,113
17	7,550	10,634
18	6,920	9,747
19	6,610	9,310
20	6,610	9,310
21	6,170	8,690
22	5,890	8,296
23	5,620	7,916
24	5,620	7,916
25	5,750	8,099
26	5,890	8,296
27	6,030	8,493
28	6,343	8,934
29	9,522	13,412
30	9,164	12,907
May 1, 1975	8,750	12,324
2	11,828	16,660
3	17,310	24,381
4	21,010	29,593
5	21,910	30,860
6	27,510	38,748
7	23,310	32,832
8	17,310	24,381
9	13,510	19,029
10	11,792	16,609
11	10,230	14,409
12	10,040	14,141
13	10,610	14,944
14	12,692	17,877
15	12,192	17,172

TABLE 2.3-1 (Cont'd)

DATE	JAMES RIVER DISCHARGE AT RICHMOND, C.F.S.	CALCULATED JAMES RIVER DISCHARGE AT HOG POINT, C.F.S.
May 16, 1975	12,210	17,198
17	12,210	17,198
18	11,410	16,071
19	11,410	16,071
20	11,410	16,071
21	10,610	14,944
22	9,670	13,620
23	8,930	12,578
24	8,060	11,353
25	7,230	10,183
26	6,760	9,521
27	6,310	8,888
28	6,920	9,747
29	7,335	10,331
30	6,928	9,758
31	9,590	13,508
June 1, 1975	9,670	13,620
2	14,570	20,522
3	13,528	19,054
4	15,128	21,309
5	11,028	15,533
6	9,868	13,899
7	8,588	12,096
8	7,070	9,958
9	6,030	8,493
10	5,602	7,890
11	5,194	7,316
12	4,954	6,978
13	5,342	7,524
14	6,460	9,099
15	5,732	8,074
16	5,074	7,147
17	5,194	7,316
18	4,806	6,769
19	4,436	6,248
20	4,288	6,040
21	3,168	4,462
22	3,720	5,240
23	3,570	5,028
24	3,200	4,507
25	3,130	4,409
26	3,538	4,983
27	5,620	7,916
28	6,490	9,141
29	6,460	9,099
30	5,212	7,341

2.5 CHEMICAL RELEASES TO THE COOLING WATER SYSTEM

Tables 2.5-1 through 2.5-6 identify and summarize the chemicals which were released to the cooling water system for the period January 1, 1975 through June 30, 1975.

SURRY POWER STATION

Table 2.5-1

CHEMISTRY REPORT

JANUARY ,1975

T.S. 6.6.A.11

PRIMARY COOLANT ANALYSIS	UNIT NO. 1			UNIT NO. 2		
	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE
Gross Radioact., µCi/ml	* 4.14E-2	* 1.10E-3	* 6.85E-3	1.80E-1	* 3.92E-3	1.06E-1
Suspended Solids, ppm	* 5.3	* 0.0	* 0.5	1.4	0.0	0.3
Gross Tritium, µCi/ml	* 7.12E-3	* 2.08E-3	* 5.35E-3	3.84E-2	1.31E-2	2.60E-2
Iodine-131, µCi/ml	*	*	*	4.70E-3	2.54E-4	2.87E-3
I-131/I-133	*	*	*	.3373	.0321	.2035
Hydrogen, cc/kg	* 34.7	* 4.4	* 12.9	34.7	* 2.0	20.3
Lithium, ppm	* 1.65	* .06	* 1.11	* .53	.14	.35
Boron-10, ppm +	*431.6	*157.9	*408.2	*144.8	37.6	69.1
Oxygen-16, ppb	* 4600	* 0	*648	0	0	0
Chloride, ppm	* .24	* .05	* .11	.08	.05	.05
pH @ 25°C	* 6.05	* 4.75	* 5.84	7.00	6.38	6.94

+ Boron-10 = Total Boron x 0.196

NON-RADIOACTIVE CHEMICAL
RELEASES, POUNDS
T.S. 4.13.A.8

Phosphate 0 Boron 654

Sulfate 0 Chromate 3.2

Remarks: * Unit Shutdown

SURRY POWER STATION

CHEMISTRY REPORT

FEBRUARY ,1975

T.S. 6.6.A.11

Table 2.5-2

PRIMARY COOLANT ANALYSIS	UNIT NO. 1			UNIT NO. 2		
	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE
Gross Radioact., µCi/ml	5.96E-1	* 1.54E-3	3.24E-1	1.84E-1	6.17E-1	1.39E-1
Suspended Solids, ppm	0.9	0.0	0.1	0.5	0.0	0.1
Gross Tritium, µCi/ml	5.71E-2	1.10E-3	3.49E-2	6.28E-2	2.90E-3	3.89E-2
Iodine-131, µCi/ml	1.62E-1	2.79E-2	1.25E-1	1.38E-2	2.26E-3	6.02E-3
I-131/I-133	.5132	.3168	.4027	.6301	.1780	.3339
Hydrogen, cc/kg	20.7	14.2	17.9	39.2	22.1	26.9
Lithium, ppm	.40	.06	.28	.46	.17	.28
Boron-10, ppm +	* 197	84.1	142	*83.7	24.5	31.4
Oxygen-16, ppb	0	0	0	0	0	0
Chloride, ppm	.09	.05	.05	.10	.05	.05
pH @ 25°C	6.60	* 5.70	6.58	7.20	6.62	7.05

+ Boron-10 = Total Boron x 0.196

NON-RADIOACTIVE CHEMICAL
RELEASES, POUNDS
T.S. 4.13.A.8

Phosphate 0 Boron 680.5

Sulfate 288 Chromate 0.71

Remarks: Unit Shutdown

SURRY POWER STATION

CHEMISTRY REPORT

MARCH ,19 75

T.S. 6.6.A.11

Table 2.5-3

PRIMARY COOLANT ANALYSIS	UNIT NO. 1			UNIT NO. 2		
	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE
Gross Radioact., µCi/ml	4.24E-1	* 4.27E-3	2.47E-1	3.23E-1	* 3.54E-2	2.09E-1
Suspended Solids, ppm	0.3	0.0	0.1	0.2	0.0	0.0
Gross Tritium, µCi/ml	6.75E-2	4.38E-2	5.71E-2	5.61E-2	1.80E-2	4.17E-2
Iodine-131, µCi/ml	1.23E-1	2.98E-2	7.06E-2	1.10E-2	5.68E-4	4.87E-3
I-131/I-133	1.388	.4138	.8332	.5228	.1464	.3849
Hydrogen, cc/kg	24.2	17.9	20.7	31.0	20.0	24.0
Lithium, ppm	.41	.25	.33	.42	.11	.25
Boron-10, ppm +	* 172	100	123	*59.6	11.6	22.3
Oxygen-16, ppb	0	0	0	0	0	0
Chloride, ppm	.09	.05	.05	.11	.05	.05
pH @ 25°C	6.62	6.20	6.42	7.48	6.68	7.16

+ Boron-10 = Total Boron x 0.196

NON-RADIOACTIVE CHEMICAL
RELEASES, POUNDS
T.S. 4.13.A.8

Phosphate 0 Boron 1181

Sulfate 576 Chromate 1.59

Remarks: * Unit Shutdown

SURRY POWER STATION

Table 2.5-4

CHEMISTRY REPORT

APRIL ,1975

T.S. 6.6.A.11

PRIMARY COOLANT ANALYSIS	UNIT NO. 1			UNIT NO. 2		
	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE
Gross Radioact., µCi/ml	4.22E-1	* 3.27E-2	2.98E-1	3.40E-1	* 2.41E-2	1.60E-1
Suspended Solids, ppm	0.2	0.0	0.0	* 2.6	0.0	0.2
Gross Tritium, µCi/ml	6.72E-2	2.45E-2	3.96E-2	6.78E-2	7.77E-3	2.93E-2
Iodine-131, µCi/ml	1.33E-1	4.77E-2	1.43E-1	1.22E-2	1.30E-3	6.72E-3
I-131/I-133	1.47	.4780	1.19	.5384	.1853	.3947
Hydrogen, cc/kg	26.3	10.5	19.7	32.1	* 0.0	16.3
Lithium, ppm	.63	.31	.43	.27	** .11	** .20
Boron-10, ppm +	** 194	**91.3	122	**463.9	.08	150.9
Oxygen-16, ppb	0	0	0	1300	0	** 117
Chloride, ppm	.09	.05	.06	.14	.05	.05
pH @ 25°C	6.70	6.35	6.53	8.35	5.10	6.83

+ Boron-10 = Total Boron x 0.196

NON-RADIOACTIVE CHEMICAL
RELEASES, POUNDS
T.S. 4.13.A.8

Phosphate 0 Boron 317

Sulfate 1390 Chromate .21

Remarks: * Unit Shutdown

** Unit in Refueling Conditions.

SURRY POWER STATION

CHEMISTRY REPORT

MAY ,19 75

T.S. 6.6.A.11

Table 2.5-5

PRIMARY COOLANT ANALYSIS	UNIT NO. 1			** UNIT NO. 2		
	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE
Gross Radioact., μCi/ml	3.13E-1	1.61E-1	2.35E-1	8.23E-2	1.40E-4	9.23E-3
Suspended Solids, ppm	0.2	0.0	.084	0.9	0.0	.28
Gross Tritium, μCi/ml	5.86E-2	1.05E-2	3.83E-2	1.26E-2	1.75E-3	8.38E-3
Iodine-131, μCi/ml	1.61E-1	6.03E-2	1.11E-1	NA	NA	NA
I-131/I-133	1.3600	.7144	.9900	NA	NA	NA
Hydrogen, cc/kg	20.0	11.2	16.5	0.0	0.0	0.0
Lithium, ppm	.76	.36	.65	.19	.00	.13
Boron-10, ppm +	131.7	74.3	88.14	488.24	433.16	465.70
Oxygen-16, ppb	.000	.000	.000	1.9	0.6	1.11
Chloride, ppm	.08	.05	.053	.07	.05	.051
pH @ 25°C	6.80	6.05	6.59	5.60	5.75	5.15

+ Boron-10 = Total Boron x 0.196

NON-RADIOACTIVE CHEMICAL
RELEASES, POUNDS
T.S. 4.13.A.8

Phosphate 16 Boron 288.94

Sulfate 572 Chromate 3.35

Remarks: * Unit Shutdown

** Unit in Refueling Conditions

SURRY POWER STATION

CHEMISTRY REPORT

JUNE ,19 75

T.S. 6.6.A.11

Table 2.5-6

PRIMARY COOLANT ANALYSIS	UNIT NO. 1			UNIT NO. 2		
	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE
Gross Radioact., µCi/ml	3.10E-1	6.44E-2	2.16E-1	9.61E-2	2.16E-3	7.49E-2
Suspended Solids, ppm	0.2	0.0	.1	3.0	0.0	0.23
Gross Tritium, µCi/ml	9.22E-2	2.41E-3	5.19E-2	3.94E-2	1.16E-3	3.11E-2
Iodine-131, µCi/ml	1.26E-1	1.02E-2	8.78E-2	*	*	*
I-131/I-133	1.82	.88	1.35	*	*	*
Hydrogen, cc/kg	25.6	15.5	18.7	23.6	0.0	12.6
Lithium, ppm	.90	.49	.62	.38	.07	.193
Boron-10, ppm +	178	67	92	472	184	316
Oxygen-16, ppb	.000	.000	.000	2.8	.000	.458
Chloride, ppm	.11	.05	.054	.12	.05	.063
pH @ 25°C	7.10	6.38	6.67	6.20	5.05	5.56

+ Boron-10 = Total Boron x 0.196

NON-RADIOACTIVE CHEMICAL
RELEASES, POUNDS
T.S. 4.13.A.8

Phosphate 0 Boron 488

Sulfate 830 Chromate .17

Remarks: * Unit 2 in Refueling Condition and Physics Testing in Progress.

3.0 NON-RADIOLOGICAL MONITORING PROGRAM - BIOLOGICAL

The Non-radiological Monitoring Program - Biological applies to the monitoring of the biological variables in the ten (10) mile segment of the James River Estuary centered at Hog Island. The biological monitoring program which is closely related to the physical and chemical programs is conducted to determine the planktonic, nektonic, and benthic characteristics of the tidal segment centered at Hog Island and to determine biological changes that occur as a result of the operation of the Surry Power Station.

3.1 PLANKTON

Summary

Water samples for plankton analyses are collected at each of six (6) stations as indicated in Figure 3.1-1. Samples are also collected in the intake and discharge canals. Phytoplankton samples are taken monthly and are analyzed quantitatively in terms of sample volume to determine both the dominant genera of the community and the chlorophyll "a" content. Zooplankton samples are analyzed quantitatively in terms of sample volume to determine generic composition, life history stage and, where possible, species. The sampling interval is approximately monthly, taking into consideration life-history information about important species in the area which have planktonic stages in their life histories.

Results

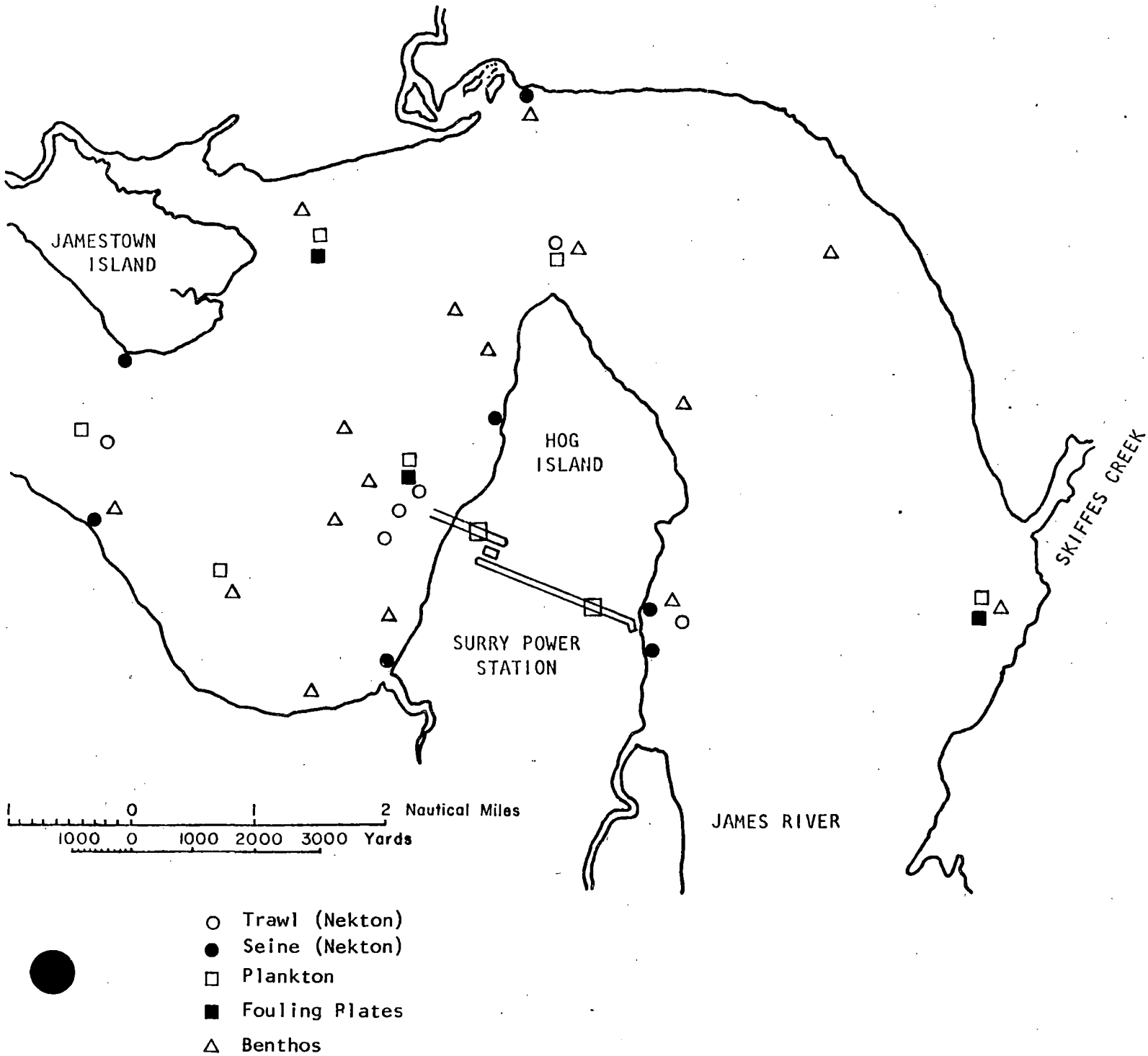
The results of this survey are contained in the report prepared by the Virginia Institute of Marine Science entitled "Vepco Surry Power Plant Study, Progress Report" dated July, 1975 which is appended to this section as Appendix 3.0.

Conclusions

Refer to the referenced report.

Figure 3.1-1

BIOLOGICAL SAMPLE STATIONS



3.2 ATTACHED BENTHIC COMMUNITY

Summary

Fouling plates that are 125- by 75-mm asbestos boards are suspended 1 meter above the bottom at the instrument tower locations shown in Figure 3.1-1 are used to obtain samples. Two vertical and two horizontal plates are suspended at each indicated location. One of each pair is removed and replaced at quarterly intervals; the other pair is left in place for one year before being removed and replaced. The benthic communities attached to the plates are analyzed for species composition and diversity.

Results

The results of this survey are contained in the report prepared by the Virginia Institute of Marine Science entitled" Vepco Surry Power Plant Study, Progress Report" dated July, 1975 which is appended to this section as Appendix 3.0.

Conclusions

Refer to the referenced report.

3.3 EPIBENTHOS

Summary

Replicate benthic grab samples are collected at the stations shown in Figure 3.1-1. Collection is made on a quarterly basis, except during June, July, and August when they are made monthly. Population characteristics such as species composition, diversity, evenness, redundancy, and richness are determined. The data are analyzed to detect changes in specific components of the epibenthic community including the brackish water clam *Rangia cuneata* and blue crab *Callinectes sapidus*.

Results

The results of this survey are contained in the report prepared by the Virginia Institute of Marine Science entitled, "Vepco Surry Power Plant Study, Progress Report" dated July, 1975 which is appended to this report as Appendix 3.0.

Conclusions

Refer to referenced report.

3.4 NEKTON

Fisheries investigations will be reported separately as results from monthly surveys and as results from special seine surveys.

3.4.1 MONTHLY SURVEYS

Monthly surveys employing beach seines and otter trawls have been conducted since May, 1970. Four years of data were analyzed and reported in the Semiannual Operating Report, January 1, 1974 through June 30, 1974 as a comparison of pre- and postoperative conditions.

Data for January - June 1975 are presented as Tables 3.4.1-1 through 3.4.1-7. The cumulative account of the number of species, diversity, evenness, and richness by gear by season is presented as Figure 3.4.1-1. For purposes of this semiannual report, winter and spring (1975) points have been added to the figure.

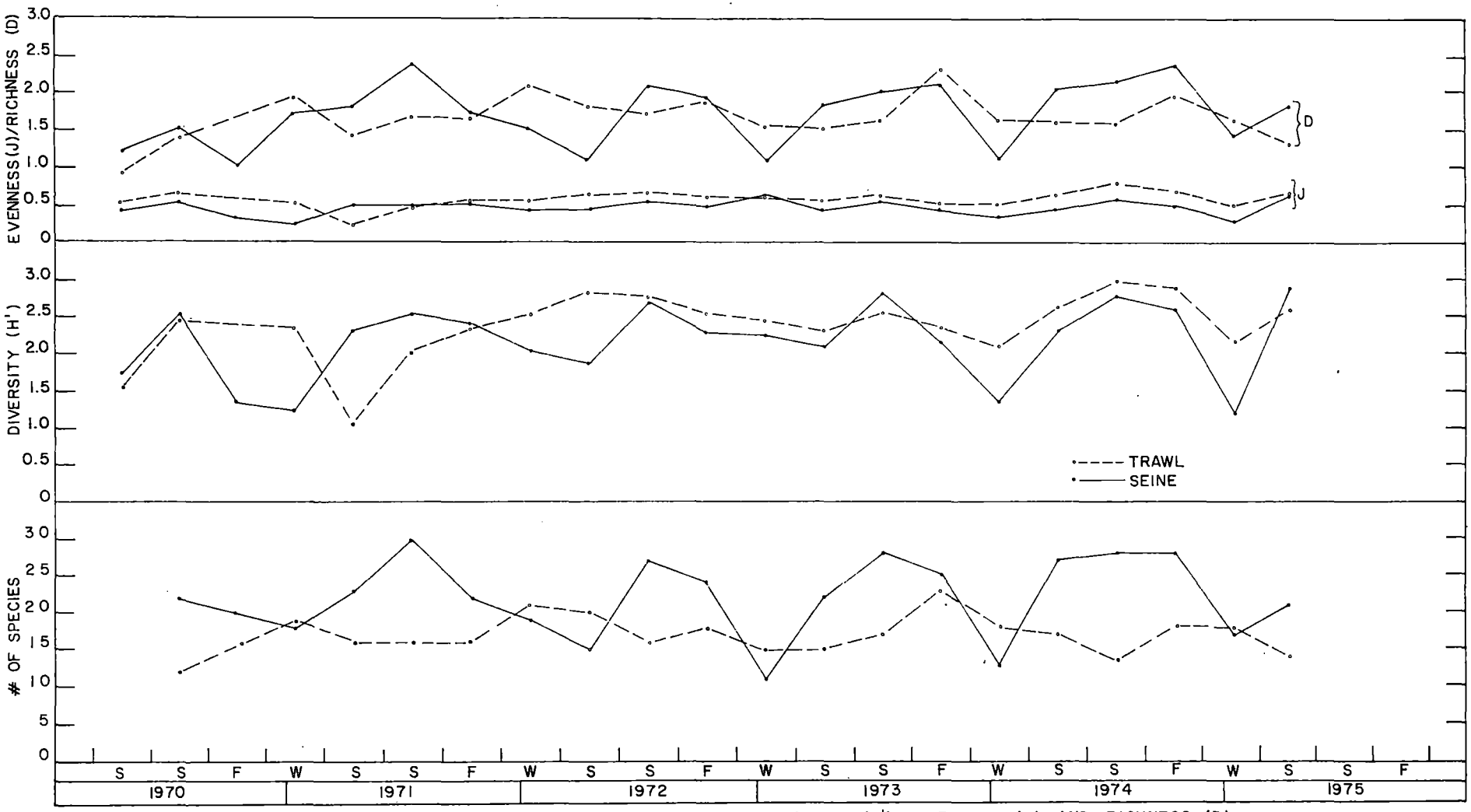


FIGURE 1: COMPOSITE OF NUMBERS OF SPECIES, DIVERSITY (H'), EVENNESS (J), AND RICHNESS (D) BY SEASON FOR SEINE AND TRAWL SAMPLES - SURRY POWER STATION

Figure 3.4.1-1

TABLE 3.4.1-1 -- H', EVENNESS, AND RICHNESS: COMPOSITES BY SEASON

	SEINE			TRAWL		
	H'	J	D	H'	J	D
Winter 1974	1.2270	0.3002	1.4661	2.1532	0.5164	1.6669
Spring 1975	2.9002	0.6603	1.8755	2.6287	0.6904	1.3495
Summer 1975	1.9798	0.4748	1.3375	1.1355	0.3282	1.0526

TABLE 3.4.1-2 -- H' FOR SEINE DATA - SURRY

STATION

DATE	INTAKE SOUTH	INTAKE NORTH	HOG POINT WEST	CHIPPOKES CREEK	GOOSE HILL	JAMESTOWN ISLAND	COLLEGE CREEK	COMPOSITE
1-75	1.9183	1.5305	0.7425	0.1933	2.0000	1.7500	0.7538	0.7201
2-75	2.3072	1.8424	0.9183	0.5116	0.2329	1.2718	0.0000	1.2603
3-75	1.8424	1.5613	1.5459	1.8940	1.8875	0.9183	1.6062	2.0957
4-75	2.1755	2.5155	2.1237	1.9877	1.7738	2.1763	2.1268	2.6966
5-75	2.3555	1.7337	2.1031	1.7714	1.9540	1.5761	2.5826	2.8001
6-75	0.2902	0.2653	2.1781	1.3782	1.5955	2.7470	2.4931	1.9798

TABLE 3.4.1-3 -- H' FOR TRAWL DATA - SURRY

STATION

DATE	HOG POINT	INTAKE	DISCHARGE NORTH	DISCHARGE MIDDLE	DISCHARGE SOUTH	GOOSE HILL	COMPOSITE
1-75	1.1951	0.4128	1.5919	0.6575	0.2046	0.8439	1.5328
2-75	1.9610	0.7219	1.4614	1.0409	1.6172	0.4060	1.4843
3-75	2.0871	1.3631	2.0605	1.2768	1.4731	1.3546	2.1597
4-75	1.6018	1.5149	1.4427	0.4427	1.0227	1.0338	2.1369
5-75	1.7826	1.8201	1.7265	2.0720	2.3197	0.7219	2.2493
6-75	2.2845	1.6802	0.6534	1.0740	0.7722	0.7219	1.1355

TABLE 3.4.1-4 -- EVENNESS FOR SEINE DATA - SURRY

STATION

Date	Intake South	Intake North	Hog Point West	Chippokes Creek	Goose Hill	Jamestown Island	College Creek	Composite
1-75	0.9591	0.9656	0.3198	0.0966	1.0000	0.8750	0.4756	0.2272
2-75	0.8925	0.9212	0.9183	0.3228	0.2329	0.8024	0.0000	0.4201
3-75	0.9212	0.9851	0.6658	0.6747	0.7302	0.9183	0.5354	0.5663
4-75	0.8416	0.8960	0.7079	0.6626	0.6318	0.6071	0.5933	0.6597
5-75	0.8391	0.7467	0.8136	0.7629	0.7559	0.6788	0.8609	0.7355
6-75	0.0967	0.0767	0.8426	0.4149	0.6872	0.8269	0.8310	0.4748

TABLE 3.4.1-5 -- EVENNESS FOR TRAWL DATA - SURRY

STATION

Date	Hog Point	Intake	Discharge North	Discharge Middle	Discharge South	Goose Hill	Composite
1-75	0.7540	0.1597	0.7960	0.2544	0.1023	0.4219	0.4614
2-75	0.8445	0.7219	0.6294	0.6567	0.8086	0.4060	0.4948
3-75	0.8074	0.5871	0.8874	0.5499	0.5247	0.8546	0.7693
4-75	0.8009	0.5396	0.5581	0.2793	0.3643	0.6523	0.6741
5-75	0.7677	0.7839	0.6679	0.8015	0.8263	0.7219	0.6502
6-75	0.8137	0.5985	0.4122	0.3580	0.2987	0.7219	0.3282

TABLE 3.4.1-6 -- RICHNESS FOR SEINE DATA - SURRY

STATION

Date	Intake South	Intake North	Hog Point West	Chippokes Creek	Goose Hill	Jamestown Island	College Creek	Composite
1-75	1.1606	0.6309	0.6034	0.3745	1.5000	1.0000	0.3359	0.9090
2-75	1.2233	1.0686	0.3869	0.3931	0.1586	0.5000	0.0000	0.9537
3-75	1.0686	0.5000	0.5661	0.9091	0.9748	0.3869	1.0083	1.3781
4-75	0.6241	0.9927	1.1273	1.2602	0.9693	1.4364	1.4606	1.6290
5-75	1.0526	0.8234	0.8905	0.7678	0.9395	0.8724	1.1499	1.5807
6-75	0.6709	0.9021	1.0292	0.8063	0.4424	1.1741	1.0630	1.3375

TABLE 3.4.1-7 -- RICHNESS FOR TRAWL DATA - SURRY

STATION

Date	Hog Point	Intake	Discharge North	Discharge Middle	Discharge South	Goose Hill	Composite
1-75	0.4255	0.6083	0.7500	0.7190	0.3599	0.5676	0.9288
2-75	1.2041	0.4307	0.7568	0.5579	0.8672	0.1920	1.0245
3-75	0.9528	0.8321	0.8074	0.6745	0.9822	0.4037	0.7489
4-75	0.5676	0.9337	0.8771	0.4160	0.9491	0.3252	0.9439
5-75	0.7798	0.8152	1.0905	0.9333	1.1274	0.3010	1.3348
6-75	1.3660	1.0426	0.3146	0.8389	0.6363	0.3010	1.0526

3.4.2 POPULATION ESTIMATES

Several fish species inhabit the waters of the James River around Hog Island at certain stages in their life cycle during certain times of the year. In an effort to estimate numbers of fish inhabiting the shore zone waters during times of expected high population density in an area from the intake structure to the discharge groin, three sample stations (Hog Point-West, Hog Point-North, Hog Point-East) were sampled (Figure 3.4.2-1). Data are reported as Table 3.4.2-1.

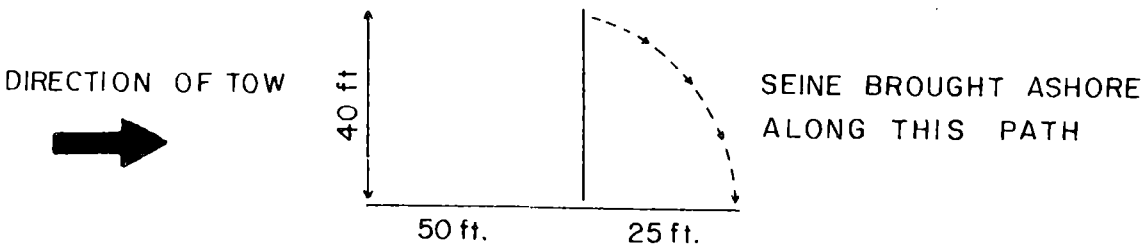
In order for population estimates to approach total populations of a species within a given area in any reliable manner, certain assumptions have to be made: (1) Fish are uniformly distributed throughout the area from the shoreline to 40 feet out from the shoreline; (2) Catch efficiency of a haul seine is about fifty percent; and (3) Sample station habitats, and therefore the entire multiplicity of shoreline habitats, are similar and equal in their ability to attract and support young fish.

That these assumptions do not hold true, especially in the oligohaline reaches of tidal estuaries, is shown by the high degree of variability between and within species, between and within stations, and between replicates of a station. However, to fulfill the requirements of this section of the Surry Technical Specifications, the following methodology was used in an attempt to estimate populations.

The shoreline between the discharge and intake, is about 30,000 feet long and provides 400 possible 75-foot sampling stations. Sample values for all species have been projected to reflect the numbers of fish occupying a 40-foot wide strip along this shore on the given sample days.

A fifty-foot haul seine having 1/4 inch bar mesh netting was used to sample a premeasured 75-foot stretch of beach. A replicate sample was taken within minutes of the first sample.

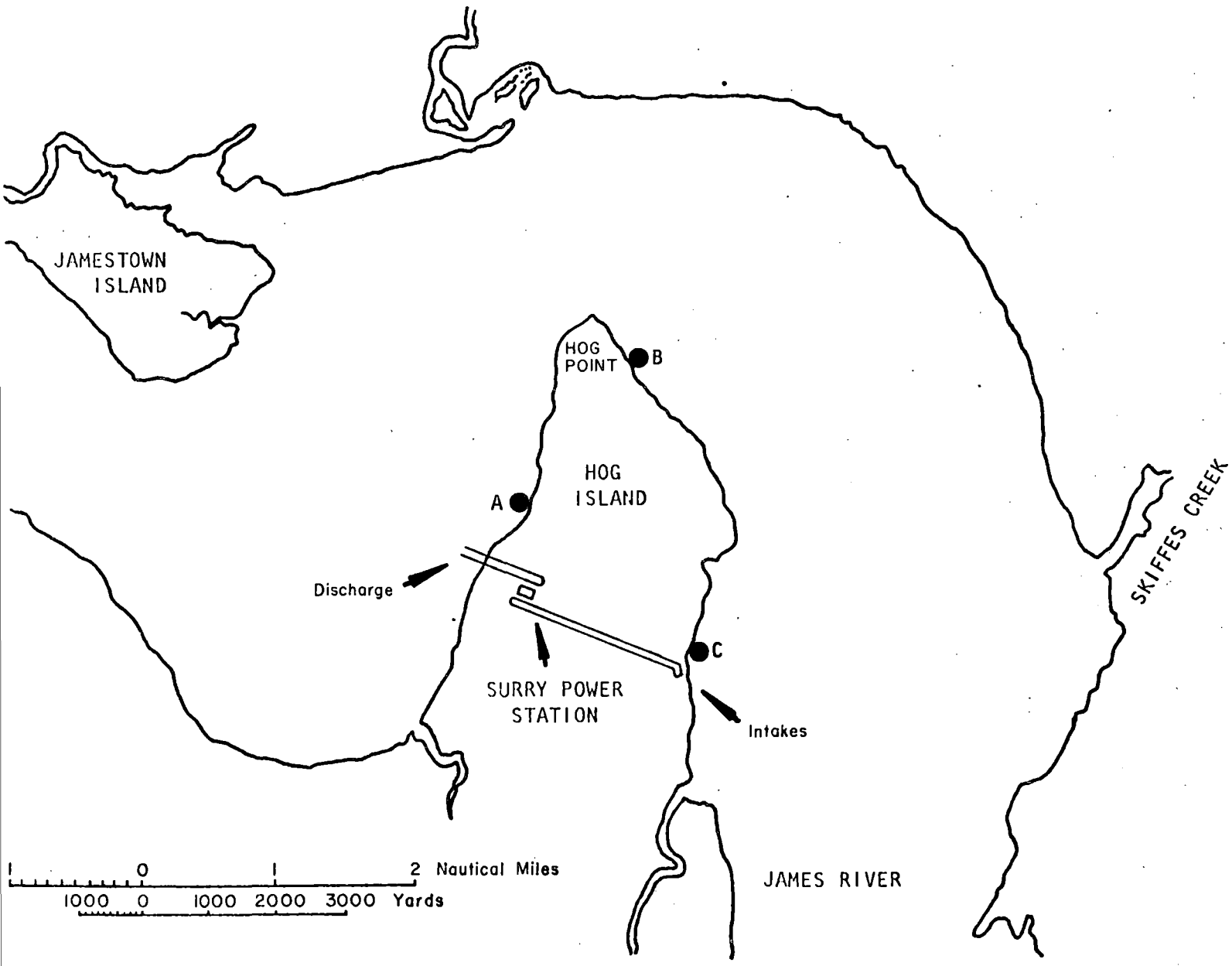
A sample consisted of stretching the seine perpendicular to the shore, hauling it 50 feet and then having the offshore man bring his end ashore in an arc about 25 feet further along the beach as shown below.



Hence, a small portion of the sample unit (about 8-10%) is not covered. The population estimates do not include an expansion for this unsampled area and thus should consistently underestimate the population values by a small amount.

It should be pointed out that all of the species sampled, within the size ranges taken, are schooling species except for possibly spottail shiner, golden shiner, channel catfish, and white perch. Schooling will also cause large variances to be associated with population estimates.

SURRY
POWER STATION



A--Hog Point-West
B--Hog Point-North
C--Hog Point-East

TABLE 3.4.2-1

Date	# Fish	# Samples	Population Est.	Standard Deviation of Estimate	Life Stage
Alosa aestivalis					
1/09/75	4	6	267	67	Juvenile
1/14/75	1	6	67	67	Juvenile
2/07/75	1	6	67	67	Juvenile
3/25/75	6	6	400	253	Juvenile
Brevoortia tyrannus					
2/07/75	1	6	67	67	Juvenile
4/28/75	11	6	733	123	Juvenile
5/08/75	2	6	133	67	Juvenile
5/23/75	165	6	11,001	3,670	Juvenile/Adult
6/09/75	3491	6	232,745	120,624	Juvenile
6/10/75	3403	6	226,878	151,018	Juvenile
Dorosoma cepedianum					
1/09/75	1	6	67	67	Juvenile
1/29/75	2	6	133	67	Adult
3/25/75	6	6	400	253	Juvenile/Adult
4/07/75	6	6	400	273	Juvenile/Adult
4/09/75	1	6	67	67	Adult
4/16/75	3	6	200	67	Juvenile/Adult
4/28/75	1	6	67	67	Adult
5/08/75	3	6	200	67	Adult
6/10/75	2	6	133	67	Adult
Dorosoma petenense					
1/09/75	1	6	67	67	Juvenile?
1/29/75	1	6	67	67	Juvenile
3/20/75	3	6	200	67	Juvenile
3/25/75	11	6	733	67	Juvenile
4/09/75	1	6	67	67	Juvenile
4/28/75	21	6	1,400	1,167	Juvenile
5/23/75	1	6	67	67	Juvenile
6/10/75	1	6	67	67	Juvenile
Anchoa mitchelli					
1/09/75	4	6	267	67	Adult
1/14/75	5	6	333	67	Adult
1/29/75	9	6	600	248	Juvenile/Adult
2/07/75	5	6	333	191	Juvenile/Adult
3/20/75	10	6	667	304	Adult
3/25/75	6	6	400	253	Adult
4/07/75	2	6	133	67	Adult
4/09/75	8	6	533	267	Adult
4/16/75	11	6	733	67	Adult
4/28/75	133	6	8,867	2,278	Adult
5/08/75	21	6	1,400	721	Adult
5/23/75	15	6	1,000	493	Adult
6/09/75	8	6	533	321	Adult
6/10/75	5	6	333	67	Adult

TABLE 3.4.2-1 (Cont'd)

Date	# Fish	# Samples	Population Est.	Standard Deviation of Estimate	Life Stage
Cyprinus carpio					
1/29/75	2	6	133	67	Adult
3/25/75	4	6	267	67	Adult
4/28/75	1	6	67	67	Adult
5/08/75	1	6	67	67	Adult
Hybognathus nuchalis					
2/21/75	6	6	400	207	Adult
3/20/75	1	6	67	67	Adult
Notomigonus crysoleucas					
1/29/75	1	6	67	67	Adult
2/07/75	1	6	67	67	Adult
3/20/75	1	6	67	67	Adult
3/25/75	10	6	667	396	Adult
4/09/75	3	6	200	67	Juvenile/Adult
4/28/75	16	6	1,067	396	Adult
5/08/75	6	6	400	327	Adult
5/21/75	4	6	267	67	Adult
5/23/75	23	6	1,533	998	Adult
6/09/75	19	6	1,267	418	Adult
6/10/75	56	6	3,734	2,156	Adult
Notropis analostanus					
1/29/75	1	6	67	67	Adult
3/25/75	1	6	67	67	Adult
Notropis hudsonius					
1/03/75	8	6	533	286	Juvenile/Adult
1/09/75	9	6	600	447	Juvenile/Adult
1/14/75	9	6	600	383	Adult
1/29/75	20	6	1,333	791	Juvenile/Adult
2/07/75	17	6	1,133	406	Juvenile/Adult
2/21/75	40	6	2,667	1,272	Juvenile/Adult
3/20/75	32	6	2,133	513	Juvenile/Adult
3/25/75	43	6	2,867	455	Juvenile/Adult
4/07/75	100	6	6,667	4,297	Juvenile/Adult
4/09/75	73	6	4,867	2,518	Juvenile/Adult
4/16/75	28	6	1,867	804	Juvenile/Adult
4/28/75	5	6	333	191	Juvenile/Adult
5/08/75	12	6	800	292	Juvenile/Adult
5/21/75	10	6	667	267	Juvenile/Adult
5/23/75	11	6	733	67	Adult
6/09/75	59	6	3,934	2,001	Juvenile/Adult
6/10/75	11	6	733	317	Adult

TABLE 3.4.2-1 (Cont'd)

Date	# Fish	# Samples	Population Est.	Standard Deviation of Estimate	Life Stage
Ictalurus catus					
1/14/75	1	6	67	67	Juvenile
Ictalurus nebulosus					
1/03/75	1	6	67	67	Adult
1/29/75	1	6	67	67	Adult?
2/21/75	1	6	67	67	Juvenile
3/20/75	4	6	267	198	Juvenile/Adult
4/07/75	4	6	267	67	Juvenile/Adult
4/16/75	1	6	67	67	Adult
Ictalurus punctatus					
4/16/75	1	6	67	67	Adult?
6/09/75	2	6	133	67	Juvenile
6/10/75	1	6	67	67	Adult
Cyprinodon variegatus					
4/16/75	1	6	67	67	Adult
Fundulus diaphanus					
1/03/75	1	6	67	67	Adult
3/25/75	1	6	67	67	Adult
4/28/75	1	6	67	67	Adult
5/08/75	1	6	67	67	Adult
5/21/75	14	6	933	409	Adult
5/23/75	1	6	67	67	Adult
6/09/75	11	6	733	191	Adult
6/10/75	8	6	533	458	Adult
Fundulus heteroclitus					
5/08/75	1	6	67	67	Adult
Membras martinica					
5/08/75	2	6	133	67	Adult

TABLE 3.4.2-1 (Cont'd)

Date	# Fish	# Samples	Population Est.	Standard Deviation of Estimate	Life Stage
Menidia beryllina					
1/03/75	17	6	1,133	191	Juvenile/Adult
1/09/75	12	6	800	310	Juvenile/Adult
1/14/75	12	6	800	146	Juvenile/Adult
1/29/75	12	6	800	343	Juvenile/Adult
2/07/75	26	6	1,733	735	Juvenile/Adult
2/21/75	32	6	2,133	667	Juvenile/Adult
3/20/75	3	6	200	67	Juvenile
3/25/75	9	6	600	171	Juvenile/Adult
4/07/75	4	6	267	67	Juvenile
4/09/75	28	6	1,867	667	Juvenile/Adult
4/16/75	12	6	800	310	Juvenile
4/28/75	9	6	600	248	Juvenile
5/08/75	15	6	1,000	306	Juvenile
5/21/75	25	6	1,667	349	Juvenile
5/23/75	13	6	867	364	Juvenile/Adult
6/09/75	7	6	467	240	Juvenile
6/10/75	4	6	267	198	Juvenile
Menidia menidia					
1/03/75	12	6	800	310	Juvenile/Adult
1/09/75	35	6	2,333	982	Juvenile/Adult
1/29/75	13	6	867	431	Juvenile/Adult
2/07/75	10	6	667	321	Adult
4/07/75	4	6	267	67	Adult
4/09/75	22	6	1,467	396	Juvenile/Adult
4/16/75	25	6	1,667	987	Juvenile/Adult
4/28/75	5	6	333	67	Adult
5/08/75	2	6	133	67	Adult
6/09/75	135	6	9,000	2,262	Juvenile
6/10/75	4	6	267	198	Juvenile
Morone americana					
5/08/75	1	6	67	67	Adult
Morone saxatilis					
6/09/75	6	6	400	207	Juvenile
Lepomis gibbosus					
3/20/75	1	6	67	67	Adult
4/28/75	1	6	67	67	Adult
5/08/75	1	6	67	67	Adult
6/09/75	1	6	67	67	Adult

TABLE 3.4.2-1 (Cont'd)

Date	# Fish	# Samples	Population Est.	Standard Deviation of Estimate	Life Stage
Etheostoma olmstedi					
3/20/75	1	6	67	67	Adult
3/25/75	1	6	67	67	Adult
Micropogon undulatus					
1/03/75	2	6	133	67	Post Larval
1/09/75	1	6	67	67	Post Larval/ Juvenile
1/14/75	7	6	467	240	Post Larval
1/29/75	30	6	2,000	593	Post Larval
2/07/75	12	6	800	273	Post Larval
3/20/75	1	6	67	67	Juvenile
4/09/75	2	6	133	67	Post Larval/ Juvenile
4/16/75	2	6	133	67	Juvenile
4/28/75	1	6	67	67	Juvenile
6/10/75	1	6	67	67	Adult
Leiostomus xanthurus					
4/28/75	22	6	1,467	933	Post Larval
5/08/75	29	6	1,933	1,188	Post Larval/ Juvenile
5/21/75	102	6	6,800	4,600	Post Larval/ Juvenile
5/23/75	5	6	333	191	Juvenile
6/09/75	253	6	16,868	5,667	Post Larval/ Juvenile
6/10/75	161	6	10,734	3,618	Juvenile
Paralichthys dentatus					
6/09/75	1	6	67	67	Juvenile

3.6 FISH MORTALITIES

Fish impingement estimates for the low-level screens for the time period of January 5, 1975 to June 28, 1975 are reported. These estimates are based on two five-minute replicates taken daily Monday through Friday and extrapolated to reflect weekly values.

The low-level screens, which were specifically designed to reduce fish impingement mortality, stopped an estimated 3,482,664 fish from entering the high level canal during this time period. Of this total, an estimated 3,264,888 individuals were returned to the river alive. The average 6 month survival was 93.8% with a range of 82% to 99%.

AVE. # CIRC. PUMPS ON : 4
SALINITY MIN. - MAX. : 4.1-5.7
TEMPERATURE MIN. - MAX. : 5.7-7.7

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

Week Of January 5 Through January 11,1975 Survival Percentage 93 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus			
039	White catfish	Ictalurus catus			
116	Brown bullhead	Ictalurus nebulosus	60 - 79	576	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius			
060	American eel	Anguilla rostrata	200 - 299	1,728	0
051	Gizzard shad	Dorosoma cepedianum	140 - 199	1,584	0
275	Threadfin shad	Dorosoma petenense	80 - 99	41,328	2,448
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis	60 - 79	6,768	1,440
037	Atlantic menhaden	Brevoortia tyrannus	80 - 99	5,904	144
103	Bay anchovy	Anchoa mitchilli	80 - 99	2,304	432
149	Tidewater silverside	Menidia beryllina	40 - 59	144	0
150	Atlantic silverside	Menidia menidia	100 - 119	3,024	144
135	Pumpkinseed	Lepomis gibbosus	80 - 99	144	0
032	White perch	Morone americana	80 - 99	144	0
033	Spot	Leiostomus xanthurus	140 - 199	432	0
005	Atlantic croaker	Micropogon undulatus	40 - 59	5,184	576
151	Hogchoker	Trinectes maculatus			
030	American shad	Alosa sapidissima	120 - 139	2,736	0
			TOTAL	72,000	5,184

AVE. NO. CIRC. PUMPS ON : 4
TEMPERATURE MIN. - MAX.: 4.7-7.7
SALINITY MIN. - MAX. : 1.0-3.0

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

Week Of JANUARY 12 Through JANUARY 18,1975 Survival Percentage 82 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus			
039	White catfish	Ictalurus catus			
116	Brown bullhead	Ictalurus nebulosus	60 - 79	192	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius			
060	American eel	Anguilla rostrata	200 - 299	312	0
051	Gizzard shad	Dorosoma cepedianum	120 - 139	1,008	0
275	Threadfin shad	Dorosoma petenense	60 - 79	7,128	1,344
026	Alewife	Alosa pseudoharengus	80 - 99	96	0
027	Blueback herring	Alosa aestivalis	80 - 99	1,656	144
037	Atlantic menhaden	Brevoortia tyrannus	100 - 119	456	0
103	Bay anchovy	Anchoa mitchilli	20 - 39	384	264
149	Tidewater silverside	Menidia beryllina	80 - 99	240	0
150	Atlantic silverside	Menidia menidia	80 - 99	816	288
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana	60 - 79	96	96
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40 - 59	96	648
151	Hogchoker	Trinectes maculatus			
144	Naked goby	Gobiosoma bosci	20 - 39	264	0
			TOTAL	12,744	2,784

AVE. NO. CIRC. PUMPS ON : 4
TEMPERATURE MIN. - MAX.: 3.7 - 5.7
SALINITY MIN. - MAX. : 1.4 - 2.4

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

Week Of January 19 Through January 25, 1975 Survival Percentage 92 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	140 - 199	288	0
039	White catfish	Ictalurus catus			
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100 - 119	864	0
060	American eel	Anguilla rostrata	200 - 299	288	0
051	Gizzard shad	Dorosoma cepedianum	140 - 199	3,456	0
275	Threadfin shad	Dorosoma petenense	80 - 99	59,904	6,192
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis	60 - 79	4,752	144
037	Atlantic menhaden	Brevoortia tyrannus	60 - 79	2,160	144
103	Bay anchovy	Anchoa mitchilli	20 - 39	432	288
149	Tidewater silverside	Menidia beryllina	60 - 79	288	288
150	Atlantic silverside	Menidia menidia	100 - 119	19,152	288
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana	80 - 99	288	144
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	20 - 39	1,152	864
151	Hogchoker	Trinectes maculatus			
128	Threespine stickleback	Gasterosteus aculeatus	60 - 79	288	0
			TOTAL	93,312	8,352

AVE. NO. CIRC. PUMPS : 5
TEMPERATURE MIN.- MAX.: 4.6 - 8.3
SALINITY MIN.- MAX. : 0.4 - 1.4

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

Week Of January 26 Through February 1,1975 Survival Percentage 94 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200 - 299	288	0
039	White catfish	Ictalurus catus			
116	Brown bullhead	Ictalurus nebulosus	200 - 299	288	0
108	Golden shiner	Notemigonus crysoleucas	140 - 199	144	0
110	Spottail shiner	Notropis hudsonius	80 - 99	288	144
060	American eel	Anguilla rostrata	200 - 299	1,872	0
051	Gizzard shad	Dorosoma cepedianum	120 - 139	8,784	144
275	Threadfin shad	Dorosoma petenense	60 - 79	346,176	21,024
026	Alewife	Alosa pseudoharengus	80 - 99		144
027	Blueback herring	Alosa aestivalis	60 - 79	19,296	2,016
037	Atlantic menhaden	Brevoortia tyrannus	80 - 99	8,064	432
103	Bay anchovy	Anchoa mitchilli	60 - 79	2,448	432
149	Tidewater silverside	Menidia beryllina	40 - 59	144	0
150	Atlantic silverside	Menidia menidia	100 - 119	7,920	864
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana	100 - 119	4,176	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40 - 59	1,440	720
151	Hogchoker	Trinectes maculatus			
030	American shad	Alosa sapidissima	120 - 139	1,440	0
			TOTAL	402,768	25,920

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 4.5-6.9
SALINITY MIN. - MAX. : 0.0-1.6

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

Week Of February 2 Through February 8,1975 Survival Percentage 92 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus			
039	White catfish	Ictalurus catus			
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100 - 119	432	0
060	American eel	Anguilla rostrata	200 - 299	1,728	0
051	Gizzard shad	Dorosoma cepedianum	120 - 139	5,616	288
275	Threadfin shad	Dorosoma petenense	60 - 79	226,512	18,864
026	Alewife	Alosa pseudoharengus	80 - 99	144	0
027	Blueback herring	Alosa aestivalis	60 - 79	12,384	1,728
037	Atlantic menhaden	Brevoortia tyrannus	100 - 119	1,584	0
103	Bay anchovy	Anchoa mitchilli	60 - 79	720	0
149	Tidewater silverside	Menidia beryllina	60 - 79	288	0
150	Atlantic silverside	Menidia menidia	100 - 119	2,448	432
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana	80 - 99	864	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	20 - 39	576	144
151	Hogchoker	Trinectes maculatus			
030	American shad	Alosa sapidissima	100 - 119	432	0
144	Naked goby	Gobiosoma bosci	40 - 59	144	0
			TOTAL	253,872	21,456

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 5.7-6.5
SALINITY MIN.-MAX. : 0.4-1.0
Survival Percentage 92 %

Week Of February 9 Through February 15,1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus			
039	White catfish	Ictalurus catus	200 - 299	288	0
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100 - 119	720	0
060	American eel	Anguilla rostrata	300 - 399	1,152	0
051	Gizzard shad	Dorosoma cepedianum	120 - 139	9,072	720
275	Threadfin shad	Dorosoma petenense	60 - 79	265,824	22,464
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis	60 - 79	25,200	3,024
037	Atlantic menhaden	Brevoortia tyrannus	80 - 99	1,008	288
103	Bay anchovy	Anchoa mitchilli	40 - 59	2,016	864
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	100 - 119	6,192	576
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40 - 59	1,152	720
151	Hogchoker	Trinectes maculatus			
030	American shad	Alosa sapidissima	120 - 139	720	0
003	Summer flounder	Paralichthys dentatus	100 - 119	144	0
			TOTAL	313,488	28,656

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 6.4-7.5
SALINITY MIN.-MAX. : 0.0-0.2
Survival Percentage 92 %

Week Of February 16 Through February 22, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	144	0
039	White catfish	Ictalurus catus	80-99,140-199	288	0
116	Brown bullhead	Ictalurus nebulosus	140-199,200-299	288	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	60-79	144	0
060	American eel	Anguilla rostrata	200-299	864	0
051	Gizzard shad	Dorosoma cepedianum	140-199	9,504	0
275	Threadfin shad	Dorosoma petenense	60-79,80-99	49,680	6,048
026	Alewife	Alosa pseudoharengus	120-139	144	0
027	Blueback herring	Alosa aestivalis	60-79	9,792	720
037	Atlantic menhaden	Brevoortia tyrannus	80-99	6,480	432
103	Bay anchovy	Anchoa mitchilli	40-59	288	0
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	100-119	1,728	0
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana	80-99	432	144
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40-59	720	144
151	Hogchoker	Trinectes maculatus	120-139,140-199	288	0
030	American shad	Alosa sapidissima	100-119,120-139	432	0
			TOTAL	81,216	7,488

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 6.2-9.5
SALINITY MIN.-MAX. : 0.0-1.0
Survival Percentage 94 %

Week Of February 23 Through March 1, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	1152	0
039	White catfish	Ictalurus catus	60-79,80-99	432	0
116	Brown bullhead	Ictalurus nebulosus	140-199	720	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100-119	864	0
060	American eel	Anguilla rostrata	200-299	2,592	0
051	Gizzard shad	Dorosoma cepedianum	140-199	9,072	0
275	Threadfin shad	Dorosoma petenense	80-99	88,560	3,168
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis	80-99	39,168	3,600
037	Atlantic menhaden	Brevoortia tyrannus	80-99	29,088	864
103	Bay anchovy	Anchoa mitchilli	60-79	23,760	3,600
149	Tidewater silverside	Menidia beryllina	40-59	288	0
150	Atlantic silverside	Menidia menidia	100-119	2,592	0
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana	100-119,120-139	2,592	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40-59	7,056	1,152
151	Hogchoker	Trinectes maculatus	140-199	432	0
052	Carp	Cyprinus carpio	300-399	144	0
030	American shad	Alosa sapidissima	100-119	1,008	144
			TOTAL	209,520	12,528

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 5.0-8.4
SALINITY MIN.-MAX. : 0.1-1.5
Survival Percentage 94 %

Week Of March 2 Through March 8, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	300-399	720	0
039	White catfish	Ictalurus catus	140-199	1,728	0
116	Brown bullhead	Ictalurus nebulosus	100-119,140-159	576	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100-119	2,448	288
060	American eel	Anguilla rostrata	200-299	2,592	0
051	Gizzard shad	Dorosoma cepedianum	140-199	13,104	576
275	Threadfin shad	Dorosoma petenense	80-99	100,512	4,464
026	Alewife	Alosa pseudoharengus	120-139	144	0
027	Blueback herring	Alosa aestivalis	60-79	24,480	2,304
037	Atlantic menhaden	Brevoortia tyrannus	80-99	8,208	720
103	Bay anchovy	Anchoa mitchilli	40-59	4,464	1,152
149	Tidewater silverside	Menidia beryllina	40-59,60-79	864	0
150	Atlantic silverside	Menidia menidia	100-119	1,872	288
135	Pumpkinseed	Lepomis gibbosus	120-139	144	0
032	White perch	Morone americana	100-119	2,448	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40-59	11,376	1,440
151	Hogchoker	Trinectes maculatus	120-139	288	0
269	Bowfin	Amia calva	600-699	288	0
030	American shad	Alosa sapidissima	100-119,120-139	1,872	0
			TOTAL	178,128	11,232

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 6
TEMPERATURE MIN.-MAX. : 5.4-7.2
SALINITY MIN.-MAX. : 2.0-4.1
Survival Percentage 94 %

Week Of March 9 Through March 15, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus			
039	White catfish	Ictalurus catus	140-199	288	0
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	80-99	720	0
060	American eel	Anguilla rostrata	200-299	528	0
051	Gizzard shad	Dorosoma cepedianum	140-199	3,744	288
275	Threadfin shad	Dorosoma petenense	60-79	18,720	1,104
026	Alewife	Alosa pseudoharengus	100-119	96	0
027	Blueback herring	Alosa aestivalis	60-79,80-99	5,760	96
037	Atlantic menhaden	Brevoortia tyrannus	80-99	10,272	240
103	Bay anchovy	Anchoa mitchilli	60-79	11,616	1,056
149	Tidewater silverside	Menidia beryllina	60-79	96	0
150	Atlantic silverside	Menidia menidia	100-119	2,160	0
135	Pumpkinseed	Lepomis gibbosus	100-119	144	0
032	White perch	Morone americana	100-119,120-139	240	0
033	Spot	Leiostomus xanthurus	100-119,120-139	288	0
005	Atlantic croaker	Micropogon undulatus	40-59	12,720	1,536
151	Hogchoker	Trinectes maculatus			
030	American shad	Alosa sapidissima	100-119	336	0
			TOTAL	67,728	4,320

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 8.6-10.5
SALINITY MIN.-MAX. : 0.0-0.5
Survival Percentage 95 %

Week Of March 16 Through March 22, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	1,440	0
039	White catfish	Ictalurus catus	80-99,140-199	1,728	0
116	Brown bullhead	Ictalurus nebulosus	140-199	4,176	0
108	Golden shiner	Notemigonus crysoleucas	140-199	1,872	0
110	Spottail shiner	Notropis hudsonius	80-99,100-119	2,016	0
060	American eel	Anguilla rostrata	200-299,400-499	1,872	0
051	Gizzard shad	Dorosoma cepedianum	140-199	15,840	0
275	Threadfin shad	Dorosoma petenense	80-99	97,200	4,464
026	Alewife	Alosa pseudoharengus	80-99,120-139	432	0
027	Blueback herring	Alosa aestivalis	80-99	13,968	1,296
037	Atlantic menhaden	Brevoortia tyrannus	80-99	10,224	864
103	Bay anchovy	Anchoa mitchilli	40-59,60-79	1,728	432
149	Tidewater silverside	Menidia beryllina	40-59	144	0
150	Atlantic silverside	Menidia menidia	80-99	288	0
135	Pumpkinseed	Lepomis gibbosus	140-199	720	0
032	White perch	Morone americana	100-119	1,296	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40-59	4,320	864
151	Hogchoker	Trinectes maculatus	120-139,140-199	432	0
269	Bowfin	Amia calva	500-599,600-699	576	0
030	American shad	Alosa sapidissima	140-199	1,872	0
			TOTAL	162,144	7,920

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 10.4-11.7
SALINITY MIN.-MAX. : 0.0-0.0
Survival Percentage 95 %

Week Of March 23 Through March 29, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	7,776	0
039	White catfish	Ictalurus catus	80-99	11,808	0
116	Brown bullhead	Ictalurus nebulosus	140-199	2,448	0
108	Golden shiner	Notemigonus crysoleucas	100-119	576	0
110	Spottail shiner	Notropis hudsonius	80-99	60,192	2,880
060	American eel	Anguilla rostrata	200-299	3,312	432
051	Gizzard shad	Dorosoma cepedianum	120-139,140-199	13,968	576
275	Threadfin shad	Dorosoma petenense	80-99	69,552	4,320
026	Alewife	Alosa pseudoharengus	80-99,200-299	1,584	0
027	Blueback herring	Alosa aestivalis	80-99	40,752	3,600
037	Atlantic menhaden	Brevoortia tyrannus	80-99	864	0
103	Bay anchovy	Anchoa mitchilli			
149	Tidewater silverside	Menidia beryllina	60-79	864	0
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus	140-199	4,464	0
032	White perch	Morone americana	100-119	4,608	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40-59	288	0
151	Hogchoker	Trinectes maculatus	120-139	1,728	0
100	Sea lamprey	Petromyzon marinus	400-499	144	0
269	Bowfin	Amia calva	400-499,500-599	576	0
030	American shad	Alosa sapidissima	100-119,120-139	1,440	0
142	Yellow perch	Perca flavescens	200-299	144	0
			TOTAL	227,088	11,808

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 9.9-13.8
SALINITY MIN.-MAX. : 0.0-0.0
Survival Percentage 98 %

Week Of March 30 Through April 5, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	140-199	864	0
039	White catfish	Ictalurus catus	80-99	34,128	0
116	Brown bullhead	Ictalurus nebulosus	140-199	5,472	0
108	Golden shiner	Notemigonus crysoleucas	140-199	432	0
110	Spottail shiner	Notropis hudsonius	80-99	41,184	1,152
060	American eel	Anguilla rostrata	200-299	3,600	0
051	Gizzard shad	Dorosoma cepedianum	120-139	14,256	288
275	Threadfin shad	Dorosoma petenense	80-99	41,760	0
026	Alewife	Alosa pseudoharengus	100-119,200-299	1,728	0
027	Blueback herring	Alosa aestivalis	80-99	29,664	1,872
037	Atlantic menhaden	Brevoortia tyrannus	80-99	432	0
103	Bay anchovy	Anchoa mitchilli	80-99	288	0
149	Tidewater silverside	Menidia beryllina	40-59,60-79	432	0
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus	120-139	4,320	0
032	White perch	Morone americana	100-119	4,320	0
033	Spot	Leiostomus xanthurus			
005	Atlantic croaker	Micropogon undulatus	40-59	3,888	144
151	Hogchoker	Trinectes maculatus	120-139	2,736	0
269	Bowfin	Amia calva	400-499	864	0
030	American shad	Alosa sapidissima	120-139	1,440	0
136	Bluegill	Lepomis macrochirus	120-139,140-199	432	0
100	Lamprey	Petromyzon marinus	500-599	144	0
107	Silvery minnow	Hybognathus nuchalis	100-119	288	0
122	Mummichog	Fundulus heteroclitus	40-59	144	0
231	Striped mullet	Mugil cephalus	120-139	288	0
089	Tessellated darter	Etheostoma olmstedi	60-79	144	0
			TOTAL	193,248	3,456

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 7.2-9.5
SALINITY MIN.-MAX. : 0.9-4.7
Survival Percentage 96 %

Week Of April 6 Through April 12, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	120-139	288	0
039	White catfish	Ictalurus catus	60-79,80-99	3,888	0
116	Brown bullhead	Ictalurus nebulosus	200-299	288	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	80-99,100-119	13,392	576
060	American eel	Anguilla rostrata	200-299	864	0
051	Gizzard shad	Dorosoma cepedianum	140-199	3,168	144
275	Threadfin shad	Dorosoma petenense	80-99	4,320	0
026	Alewife	Alosa pseudoharengus	100-119	864	0
027	Blueback herring	Alosa aestivalis	80-99	14,688	288
037	Atlantic menhaden	Brevoortia tyrannus	80-99	13,248	0
103	Bay anchovy	Anchoa mitchilli	80-99	19,584	1,440
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	100-119	432	0
135	Pumpkinseed	Lepomis gibbosus	140-199	1,440	0
032	White perch	Morone americana	80-99,100-119	1,008	0
033	Spot	Leiostomus xanthurus	120-139	2,880	0
005	Atlantic croaker	Micropogon undulatus	40-59	15,264	1,728
151	Hogchoker	Trinectes maculatus			
269	Bowfin	Amia calva	300-399	288	0
030	American shad	Alosa sapidissima	140-199	432	0
122	Mummichog	Fundulus heteroclitus	60-79,80-99	432	0
128	Threespine stickleback	Gasterosteus aculeatus	40-59	144	0
136	Bluegill	Lepomis macrochirus	120-139	288	0
003	Summer flounder	Paralichthys dentatus	100-119	144	0
	Sunfish hybrid	Lepomis sp. x Lepomis sp.	80-99	144	0
152	Blackcheek tonguefish	Symphurus plagiusa	100-119	288	0
			TOTAL	97,776	4,176

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 9.6-11.5
SALINITY MIN.-MAX. : 1.0-3.1
Survival Percentage 91 %

Week Of April 13 Through April 19, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	40-59,80-99	288	288
039	White catfish	Ictalurus catus	60-79,80-99	720	0
116	Brown bullhead	Ictalurus nebulosus	200-299	144	0
108	Golden shiner	Notemigonus crysoleucas	140-199	864	0
110	Spottail shiner	Notropis hudsonius	80-99	6,048	288
060	American eel	Anguilla rostrata	200-299	1,008	0
051	Gizzard shad	Dorosoma cepedianum	120-139	8,208	864
275	Threadfin shad	Dorosoma petenense	80-99	5,472	288
026	Alewife	Alosa pseudoharengus	100-119	1,008	0
027	Blueback herring	Alosa aestivalis	80-99,200-299	15,840	576
037	Atlantic menhaden	Brevoortia tyrannus	80-99	42,192	576
103	Bay anchovy	Anchoa mitchilli	80-99	39,888	8,352
149	Tidewater silverside	Menidia beryllina	40-59	144	0
150	Atlantic silverside	Menidia menidia	100-119	720	0
135	Pumpkinseed	Lepomis gibbosus	100-119	720	0
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	120-139	2,304	0
005	Atlantic croaker	Micropogon undulatus	60-79	25,632	4,032
151	Hogchoker	Trinectes maculatus	120-139,140-199	576	0
269	Bowfin	Amia calva	500-599	144	0
			TOTAL	151,920	15,264

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 13.7-18.1
SALINITY MIN.-MAX. : 1.5-2.1
Survival Percentage 92 %

Week Of April 20 Through April 26, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	1,296	0
039	White catfish	Ictalurus catus	140-199	5,760	0
116	Brown bullhead	Ictalurus nebulosus	140-199	1,152	0
108	Golden shiner	Notemigonus crysoleucas	140-199	576	0
110	Spottail shiner	Notropis hudsonius	60-79	17,568	432
060	American eel	Anguilla rostrata	200-299	1,872	0
051	Gizzard shad	Dorosoma cepedianum	300-399	6,480	576
275	Threadfin shad	Dorosoma petenense	80-99	13,968	144
026	Alewife	Alosa pseudoharengus	300-399	720	0
027	Blueback herring	Alosa aestivalis	200-299	9,648	1,008
037	Atlantic menhaden	Brevoortia tyrannus	80-99,100-119	15,408	1,584
103	Bay anchovy	Anchoa mitchilli	80-99	13,824	2,592
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	80-99,100-119	720	0
135	Pumpkinseed	Lepomis gibbosus	140-199	2,160	0
032	White perch	Morone americana	100-119,140-199	1,440	0
033	Spot	Leiostomus xanthurus	100-119,120-139	10,944	864
005	Atlantic croaker	Micropogon undulatus	40-59,60-79	21,600	3,456
151	Hogchoker	Trinectes maculatus	100-119	1,728	0
100	Sea lamprey	Petromyzon marinus	500-599	144	0
030	American shad	Alosa sapidissima	140-199	144	0
120	Sheepshead minnow	Cyprinodon variegatus	20-39	144	0
009	Bluefish	Pomatomus saltatrix	300-399	288	0
007	Weakfish	Cynoscion regalis	140-199	0	288
152	Blackcheek tonguefish	Symphurus plagiusa	60-79	0	144
			TOTAL	127,584	11,088

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 6
TEMPERATURE MIN.-MAX. : 14.9-16.6
SALINITY MIN.-MAX. : 1.7-2.3
Survival Percentage 94 %

Week Of April 27 Through May 3, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	140-199,200-299	576	0
039	White catfish	Ictalurus catus	140-199	432	288
116	Brown bullhead	Ictalurus nebulosus	140-199	576	0
108	Golden shiner	Notemigonus crysoleucas	120-139	144	0
110	Spottail shiner	Notropis hudsonius	80-99	1,584	0
060	American eel	Anguilla rostrata	200-299	1,584	0
051	Gizzard shad	Dorosoma cepedianum	120-139	3,024	0
275	Threadfin shad	Dorosoma petenense	80-99	1,008	0
026	Alewife	Alosa pseudoharengus	100-119,200-299	288	0
027	Blueback herring	Alosa aestivalis	200-299	3,888	288
037	Atlantic menhaden	Brevoortia tyrannus	100-119	20,880	0
103	Bay anchovy	Anchoa mitchilli	60-79	9,360	1,008
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	80-99	864	0
135	Pumpkinseed	Lepomis gibbosus	120-139	1,728	0
032	White perch	Morone americana	140-199	864	0
033	Spot	Leiostomus xanthurus	100-119,120-139	8,352	288
005	Atlantic croaker	Micropogon undulatus	60-79	14,256	2,592
151	Hogchoker	Trinectes maculatus	100-119,120-139	1,728	0
100	Sea Lamprey	Petromyzon marinus	500-599	432	0
120	Sheepshead minnow	Cyprinodon variegatus	40-59	432	0
148	Rough silverside	Membras martinica	80-99	144	0
			TOTAL	72,144	4,464

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 6
TEMPERATURE MIN.-MAX. : 16.4-19.5
SALINITY MIN.-MAX. : 0.6-1.8

Week Of May 4 Through May 10, 1975 Survival Percentage 96 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	140-199	720	0
039	White catfish	Ictalurus catus	200-299	0	144
116	Brown bullhead	Ictalurus nebulosus	80-99	144	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	80-99,100-119	432	0
060	American eel	Anguilla rostrata	200-299	1,008	0
051	Gizzard shad	Dorosoma cepedianum	120-139,140-199	1,008	0
275	Threadfin shad	Dorosoma petenense	140-199	432	0
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis	200-299	720	0
037	Atlantic menhaden	Brevoortia tyrannus	80-99	7,344	432
103	Bay anchovy	Anchoa mitchilli	80-99	1,728	0
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	80-99	144	0
135	Pumpkinseed	Lepomis gibbosus	120-139,140-199	864	0
032	White perch	Morone americana	120-139	288	0
033	Spot	Leiostomus xanthurus	120-139	7,056	0
005	Atlantic croaker	Micropogon undulatus	40-59,60-79	6,192	720
151	Hogchoker	Trinectes maculatus			
052	Carp	Cyprinus carpio	400-499	144	0
120	Sheepshead minnow	Cyprinodon variegatus	20-39	144	0
148	Rough silverside	Membras martinica	80-99	576	0
274	Bluespotted sunfish	Enneacanthus gloriosus	80-99	288	0
			TOTAL	29,232	1,296

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 20.2-22.1
SALINITY MIN.-MAX. : 0.5-0.6

Week Of May 11 Through May 17, 1975 Survival Percentage 95 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	3,600	0
039	White catfish	Ictalurus catus	200-299	1,008	288
116	Brown bullhead	Ictalurus nebulosus	140-199	576	0
108	Golden shiner	Notemigonus crysoleucas	120-139	144	0
110	Spottail shiner	Notropis hudsonius	60-79	1,152	0
060	American eel	Anguilla rostrata	200-299	2,736	0
051	Gizzard shad	Dorosoma cepedianum	300-399	288	144
275	Threadfin shad	Dorosoma petenense			
026	Alewife	Alosa pseudoharengus	100-119	144	0
027	Blueback herring	Alosa aestivalis	200-299	432	0
037	Atlantic menhaden	Brevoortia tyrannus	100-119	7,056	288
103	Bay anchovy	Anchoa mitchilli	40-59,60-79	1,008	0
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus	140-199	2,160	0
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	120-139	8,784	576
005	Atlantic croaker	Micropogon undulatus	60-79	7,920	864
151	Hogchoker	Trinectes maculatus			
100	Sea lamprey	Petromyzon marinus	500+	144	0
148	Rough silverside	Membras martinica	60-79	144	0
144	Naked goby	Gobiosoma bosci	40-59	144	0
003	Summer flounder	Paralichthys dentatus	300-399	288	0
			TOTAL	37,728	2,160

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 5
TEMPERATURE MIN.-MAX. : 21.0-25.7
SALINITY MIN.-MAX. : 0.4-0.6
Survival Percentage 99 %

Week Of May 18 Through May 24, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	2,160	0
039	White catfish	Ictalurus catus	120-139	288	0
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100-119	2,016	0
060	American eel	Anguilla rostrata	200-299	720	0
051	Gizzard shad	Dorosoma cepedianum			
275	Threadfin shad	Dorosoma petenense			
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis	300-399	144	0
037	Atlantic menhaden	Brevoortia tyrannus	100-119	7,632	0
103	Bay anchovy	Anchoa mitchilli	60-79	576	0
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus	100-119	1,008	0
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	40-59	3,024	144
005	Atlantic croaker	Micropogon undulatus	80-99	1,728	0
151	Hogchoker	Trinectes maculatus	40-59	576	0
100	Sea lamprey	Petromyzon marinus	500-599	144	0
52	Carp	Cyprinus carpio	200-299	144	0
144	Naked goby	Gobiosoma bosci	40-59	576	0
188	Redbreast sunfish	Lepomis auritus	120-139	144	0
			TOTAL	20,880	144

NOTE: This report may reflect the effects of a "fish kill" currently in progress downstream from this station (started May 13, 1975). According to the State Water Control Board the "fish kill" is caused by toxic levels of chlorine attributed to the Hampton Roads Sanitation District.

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 5
TEMPERATURE MIN.-MAX. : 23.8-25.3
SALINITY MIN.-MAX. : 0.6-1.0
Survival Percentage 94 %

Week Of May 25 Through May 31, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	140-199	2,592	0
039	White catfish	Ictalurus catus	140-199	3,888	0
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	80-99	2,160	0
060	American eel	Anguilla rostrata	200-299	576	0
051	Gizzard shad	Dorosoma cepedianum			
275	Threadfin shad	Dorosoma petenense			
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis			
037	Atlantic menhaden	Brevoortia tyrannus	40-59	11,952	720
103	Bay anchovy	Anchoa mitchilli	60-79	288	288
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus	140-199	1,008	0
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	40-59	15,840	1,440
005	Atlantic croaker	Micropogon undulatus	40-59	2,880	144
151	Hogchoker	Trinectes maculatus			
120	Sheepshead minnow	Cyprinodon variegatus	40-59	432	0
009	Bluefish	Pomatomus saltatrix	40-59	288	0
144	Naked goby	Gobiosoma bosci	40-59	576	0
003	Summer flounder	Paralichthys dentatus	40-59	144	0
			TOTAL	42,624	2,592

NOTE: This report may reflect the effects of a "fish kill" currently in progress downstream from this station (started May 13, 1975). According to the State Water Control Board the "fish kill" is caused by toxic levels of chlorine attributed to the Hampton Roads Sanitation District.

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 5
TEMPERATURE MIN.-MAX. : 24.3-27.0
SALINITY MIN.-MAX. : 0.7-3.3

Week Of June 1 Through June 7, 1975 Survival Percentage 92 %

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	720	0
039	White catfish	Ictalurus catus	100-119,120-139	432	0
116	Brown bullhead	Ictalurus nebulosus	100-119	288	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	100-119	720	288
060	American eel	Anguilla rostrata	200-299	144	0
051	Gizzard shad	Dorosoma cepedianum			
275	Threadfin shad	Dorosoma petenense			
026	Alewife	Alosa pseudoharengus	200-299	288	0
027	Blueback herring	Alosa aestivalis			
037	Atlantic menhaden	Brevoortia tyrannus	40-59	4,320	288
103	Bay anchovy	Anchoa mitchilli			
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	40-59	14,112	1,152
005	Atlantic croaker	Micropogon undulatus	140-199	2,304	432
151	Hogchoker	Trinectes maculatus	60-79	288	0
274	Bluespotted sunfish	Enneacanthus gloriosus	40-59	288	0
007	Weakfish	Cynoscion regalis	140-199	288	0
			TOTAL	24,192	2,160

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 6
TEMPERATURE MIN.-MAX. : 22.6-24.0
SALINITY MIN.-MAX. : 4.0-5.5
Survival Percentage 92 %

Week Of June 8 Through June 14, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	120-139, 140-199	432	0
039	White catfish	Ictalurus catus	140-199	576	0
116	Brown bullhead	Ictalurus nebulosus	200-299	144	0
108	Golden shiner	Notemigonus crysoleucas	80-99,140-199	432	0
110	Spottail shiner	Notropis hudsonius	100-119	864	0
060	American eel	Anguilla rostrata	200-299	1,008	0
051	Gizzard shad	Dorosoma cepedianum			
275	Threadfin shad	Dorosoma petenense			
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis			
037	Atlantic menhaden	Brevoortia tyrannus	40-59	152,352	13,104
103	Bay anchovy	Anchoa mitchilli	60-79	3,456	0
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	100-119	144	0
135	Pumpkinseed	Lepomis gibbosus	120-139	144	0
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	40-59	51,408	4,032
005	Atlantic croaker	Micropogon undulatus	140-199,200-299	1,440	0
151	Hogchoker	Trinectes maculatus	40-59	144	0
219	Atlantic cutlassfish	Trichiurus lepturus	300-399	0	288
204	Crevalle jack	Caranx hippos	20-39	144	0
031	Striped bass	Morone saxatilis	20-39	288	0
			TOTAL	212,976	17,424

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 7
TEMPERATURE MIN.-MAX. : 24.8-28.0
SALINITY MIN.-MAX, : 3.8-4.7
Survival Percentage 97 %

Week Of June 15 Through June 21, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	140-199	432	0
039	White catfish	Ictalurus catus	140-199	1,008	0
116	Brown bullhead	Ictalurus nebulosus			
108	Golden shiner	Notemigonus crysoleucas	140-199	144	0
110	Spottail shiner	Notropis hudsonius	80-99	576	0
060	American eel	Anguilla rostrata	200-299	720	0
051	Gizzard shad	Dorosoma cepedianum	200-299	0	144
275	Threadfin shad	Dorosoma petenense			
026	Alewife	Alosa pseudoharengus			
027	Blueback herring	Alosa aestivalis			
037	Atlantic menhaden	Brevoortia tyrannus	40-59	9,504	432
103	Bay anchovy	Anchoa mitchilli	60-79	432	0
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia			
135	Pumpkinseed	Lepomis gibbosus			
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	60-79,120-139	39,168	576
005	Atlantic croaker	Micropogon undulatus	140-199	2,304	288
151	Hogchoker	Trinectes maculatus	100-119	288	0
009	Bluefish	Pomatomus saltatrix	60-79	720	144
121	Banded killifish	Fundulus diaphanus	60-79	432	0
274	Bluespotted sunfish	Enneacanthus gloriosus	40-59	288	0
007	Weakfish	Cynoscion regalis	140-199	288	0
144	Naked goby	Gobiosoma bosci	40-59	288	0
			TOTAL	56,592	1,584

SURRY POWER STATION
LOW LEVEL WEEKLY REPORT

AVE. NO. CIRC. PUMPS : 8
TEMPERATURE MIN.-MAX. : 26.0-28.1
SALINITY MIN.-MAX. : 3.3-4.1
Survival Percentage 97 %

Week Of June 22 Through June 28, 1975

VIMS CODE	COMMON NAME	SCIENTIFIC NAME	MODAL SIZE (mm)	ALIVE	DEAD
040	Channel catfish	Ictalurus punctatus	200-299	576	0
039	White catfish	Ictalurus catus	140-199	1,008	0
116	Brown bullhead	Ictalurus nebulosus	100-119	720	0
108	Golden shiner	Notemigonus crysoleucas			
110	Spottail shiner	Notropis hudsonius	80-99	144	0
060	American eel	Anguilla rostrata	200-299	1,152	0
051	Gizzard shad	Dorosoma cepedianum			
275	Threadfin shad	Dorosoma petenense	80-99,100-119	432	0
026	Alewife	Alosa pseudoharengus	40-59	1,584	288
027	Blueback herring	Alosa aestivalis			
037	Atlantic menhaden	Brevoortia tyrannus	60-79	56,592	2,736
103	Bay anchovy	Anchoa mitchilli	60-79	1,440	288
149	Tidewater silverside	Menidia beryllina			
150	Atlantic silverside	Menidia menidia	100-119	144	0
135	Pumpkinseed	Lepomis gibbosus	120-139	144	0
032	White perch	Morone americana			
033	Spot	Leiostomus xanthurus	40-59,60-79	53,136	432
005	Atlantic croaker	Micropogon undulatus	140-199	5,328	288
151	Hogchoker	Trinectes maculatus	40-59	288	0
204	Crevalle jack	Caranx hippos	40-59	0	288
052	Carp	Cyprinus carpio	140-199	144	0
121	Banded killifish	Fundulus diaphanus	60-79	144	0
009	Bluefish	Pomatomus saltatrix	80-99	288	0
007	Weakfish	Cynoscion regalis	140-199	288	0
144	Naked goby	Gobiosoma bosci	40-59	432	0
			TOTAL	123,984	4,320

VEPCO Surry Power Plant Study

River Biota and Phytoplankton Entrainment Sections

Progress Report July 1975

by

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Introduction

This report summarizes the biological data collected from January through June 1975 in the river and phytoplankton entrainment portions of the VEPCO Surry Power Plant Study. The sampling program conducted during this period in the Hog Island area of the James River consisted of an expanded version of a study initiated in May 1969 to monitor certain aquatic communities that could be affected by the operation of the power plant. The river phytoplankton, zooplankton, benthos and fouling organism communities have been included in the past and present study designs. The phytoplankton entrainment substudy was begun in April 1975 with the objective of providing a direct assessment of the impact of passage through the power plant condensers on the abundance and species composition of the entrained algal community.

Methods

Station Locations

Table 1 and Figure 1 show the locations of the twelve phytoplankton and zooplankton sampling stations used in the river monitoring study. The same intake and discharge stations were employed in the phytoplankton entrainment study. The benthos and fouling plate stations are shown in Table 2 and Figure 2.

Sampling and Sample Analysis Methods

Phytoplankton samples were accompanied by samples for determination of chlorophyll a concentration, salinity and dissolved oxygen concentration. Temperature was recorded for each sampling depth, and Secchi Disk transparency was measured at each station sampled during daylight. Primary productivity samples were supplemented with samples for inorganic and organic carbon

Table 1

Plankton Sampling Station Locations

Station	Depth (m)	Location
DWS	2	Adjacent to tower (QK Fl Lt "A")
Intake	1 8	Outside intake forebay - zooplankton sampling; within intake forebay - phytoplankton sampling
HPE 1	5	Adjacent to black and white buoy "J29"
HPE 2	4	Between black and white buoys "J29" and "J35"
HPS	5	Adjacent to tower (QK Fl Lt "C")
HPN	2	Between tower (QK Fl Lt "B") and north bank of river
HPW 1	1	Off west shore of Hog Point, midway between HPS and discharge
HPW 2	3	Tower (QK Fl Lt "E")
Discharge	3 2.5	Outside discharge canal mouth - zooplankton sampling; in discharge canal mouth - phytoplankton sampling
CBE	1	Off west shore of Gravel Neck, south of discharge
CBC	3	Midway between discharge and range markers near Cobham Wharf
JI	8	Tower (QK Fl Lt "G")

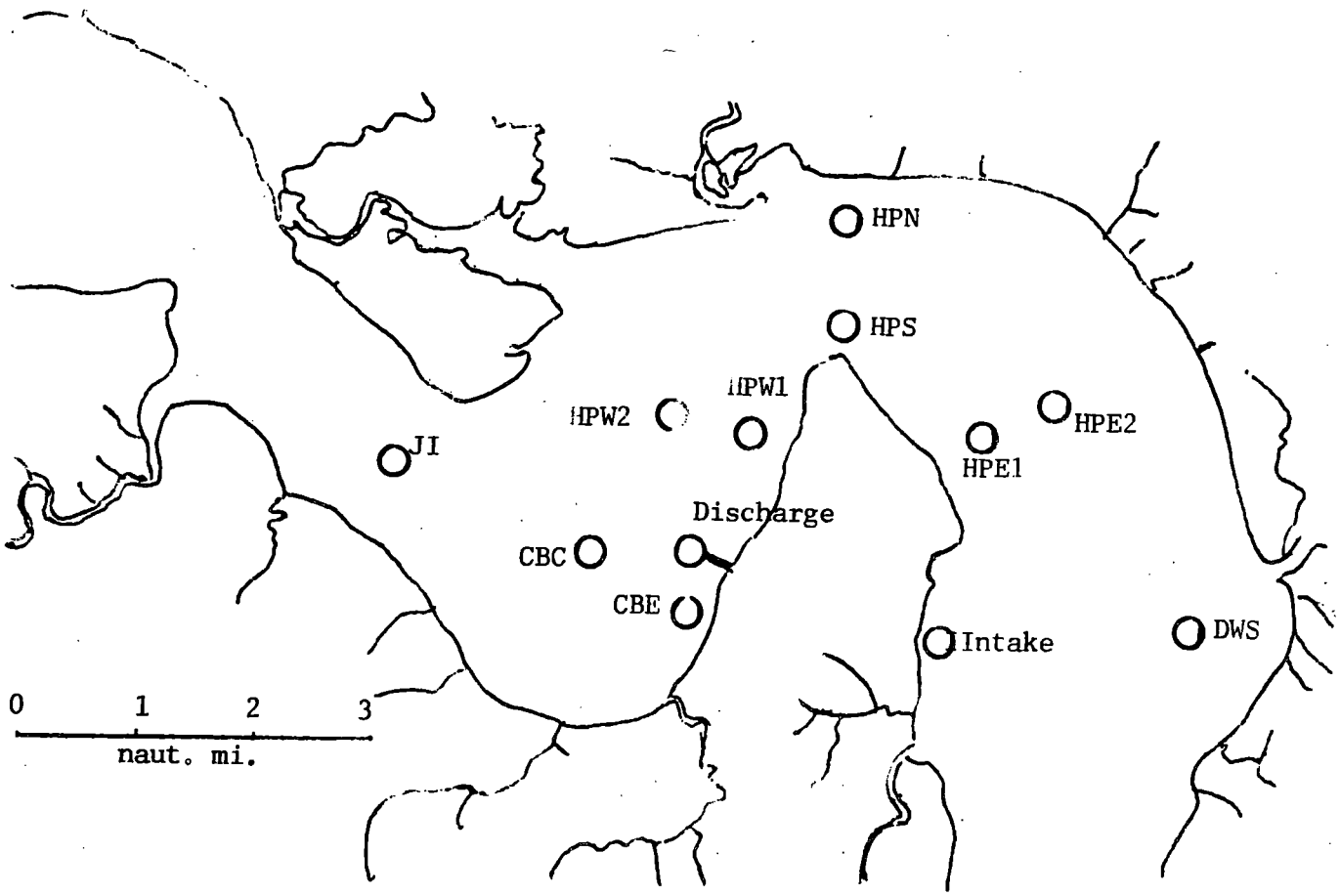

Figure 1. Plankton sampling stations.

Table 2

Benthos and Fouling Plate Station Locations

Station	Depth (m)	Location
1	1.5	Off tower (QK Fl 38 ft.) near Cobham Wharf
2	2.5	Cobham Bay, off Chestnut Bluffs
3	1	Cobham Bay, between mouths of College Run and lower Chippokes Creek
4	3	Center of Cobham Bay
5	3	Tower (QK Fl Lt "E")
6	1	In thorofare off marker tower R "4"
7	1	Cobham Bay, off Gravel Neck
8	4	Tower (QK Fl Lt "F")
9	1	West of Hog Point
10	4	Between station 9 and black buoy "45"
11	5	Tower (QK Fl Lt "C")
12	.5	Off mouth of College Creek
13	1	East of Hog Point, on line with black and white buoy "J29"
14	6	Black and white buoy "J35"
15	1	Off power plant intake
16	2	Tower (QK Fl Lt "A")
DWS	2	Tower (QK Fl Lt "A")
CBN	2.5	Tower (QK Fl Lt "D")
CBS	3	Tower (QK Fl Lt "F")

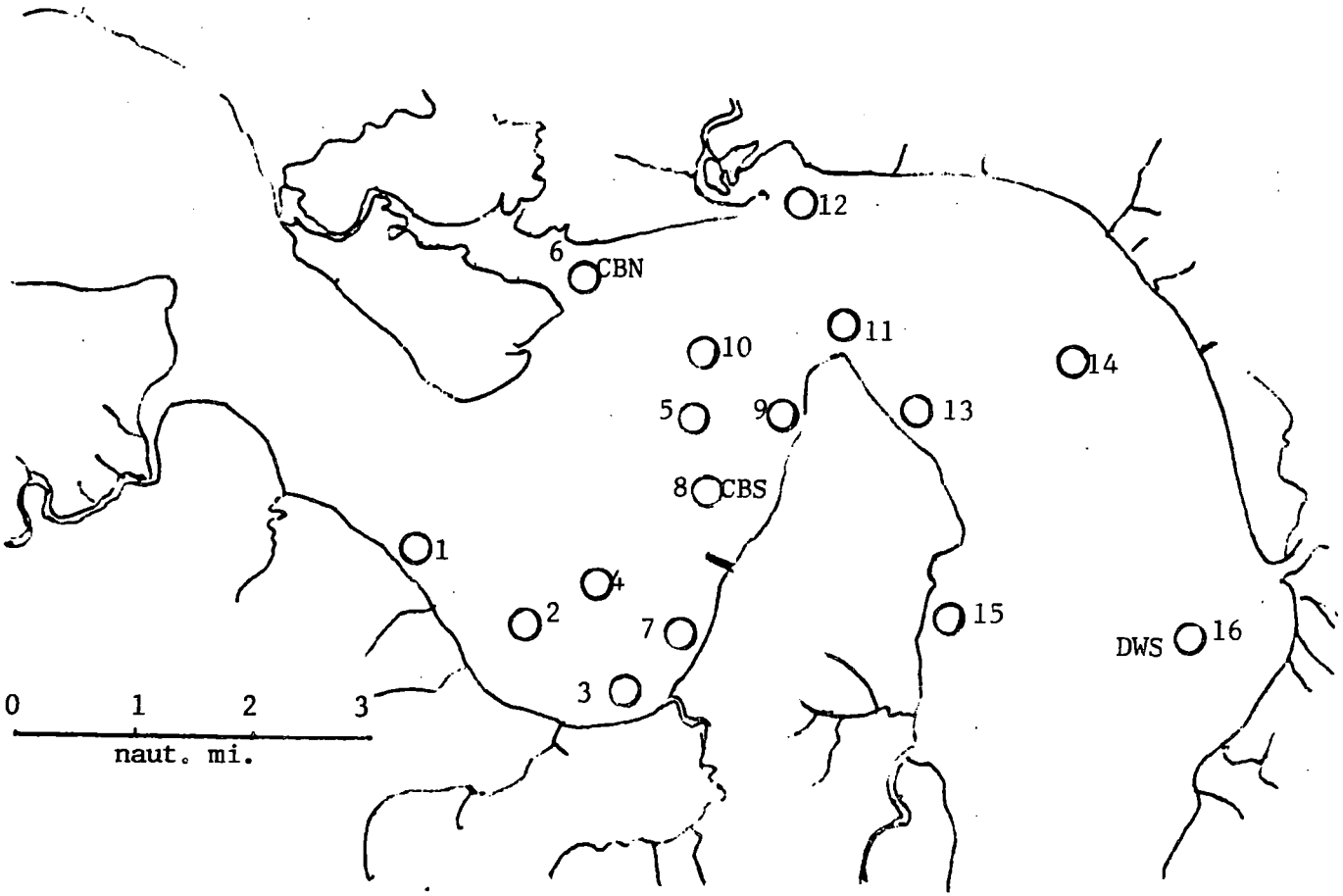

Figure 2. Benthos and fouling plate stations.

determinations.

A non-metallic 2-liter Van Dorn bottle was used for sampling of phytoplankton and related parameters. Phytoplankton samples were preserved with Lugol's iodine solution, and cell counts and identifications were performed using the inverted microscope method. Chlorophyll a samples were preserved with mercuric chloride (40 mg/l), and stored in opaque bottles on ice until return to the laboratory. They were then filtered through glass fiber filters, which were subsequently ground in 90% acetone to extract the chlorophyll a. The chlorophyll concentration in the extract was determined using a Turner Fluorometer, model 111.

Primary productivity samples of 106.6 ml volume were dispensed into acid clean 125 ml glass stoppered Pyrex® bottles, two light and two dark bottles per station. Each sample received 1.0 micro-Curie of carbon -14 in a solution of sodium carbonate, and was incubated in the James River at a depth of 5 cm for a minimum of two hours. Following incubation the samples were filtered through .45μ pore size membrane filters, which were then placed in scintillation vials, dissolved in a dioxane scintillation cocktail, and counted on a Beckman LS-150 liquid scintillation counter. Standardization of the stock carbon-14 solution and determination of counting efficiency of the samples were accomplished by adding an internal standard of known activity and recounting the samples.

Zooplankton samples were taken with a 12.5 cm diameter Clarke-Bumpus quantitative sampler, equipped with a No. 20 (76μ pore size) net. Tow duration ranged from one minute to five minutes, depending on the turbidity conditions encountered. Samples were preserved with 5% buffered formalin, and counts and identifications were made using an American Optical

dissecting microscope. Measurements of water temperature, salinity, dissolved oxygen, Secchi Disk transparency, and water depth accompanied each zooplankton tow.

Benthos was sampled with a .05 m^2 Ponar grab. The samples were seived through a 1.0 mm mesh screen, and the organisms were preserved in a formalin solution containing the stain phloxine B. Counts and identifications were made under a dissecting microscope.

Fouling organisms were collected on 125 x 75 mm asbestos boards suspended in the river. Two pairs of horizontal and vertical fouling plates were suspended at each station, one pair being replaced bimonthly, the other pair yearly. The attached organisms were preserved in formalin and counted and identified under a dissecting microscope.

Temperature measurements were performed using a Hydrolab model RT-125 research thermometer equipped with a model L5 A50 thermistor probe. Salinity was measured on a Beckman model RS-7B salinometer. Dissolved oxygen concentrations were determined by the azide modification of the Winkler technique. Carbon analyses were performed on a Beckman model 915 carbon analyzer.

Sampling Design

The sampling dates and biological parameters sampled in the first half of 1975 are shown in Table 3. Sampling for phytoplankton and primary productivity was begun in January and has included two surface phytoplankton samples and two pairs of light and dark bottle productivity samples per station per month. In January stations DWS and J.I. were not sampled because it was believed at that time that they had been dropped from the study. It was subsequently determined that they could not be dropped, and

Table 3

Summary of Biological Sampling Effort: Sampling Dates, Stations Sampled, and Types of Samples Taken (Ph=Phytoplankton, Pr=Productivity, C=Chlorophyll a, Z=Zooplankton, B=Benthos, F=Fouling Organisms)

Date 1975

River Plankton Stations	1-23	1-30	2-14	2-27	3-21	3-27	4-17	4-22	5-5,5-6	5-15	5-20	6-16	6-18
DWS			Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
Intake	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
HPE 1	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
HPE 2	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
HPS	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
HPN	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
HPW 2	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C	Z,Ph,C	Z	Ph,Pr,C	Ph,Pr,C	Z
HPW 1	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
Discharge	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
CBE	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
CBC	Ph,Pr	Z	Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z
JI			Z	Ph,Pr,C	Z	Ph,Pr,C	Z,Ph,C	Ph,Pr,C		Z	Ph,Pr,C	Ph,Pr,C	Z

Date (1975)

River Benthos Stations	2-20	4-25	6-13
1	B	B	B
2	B	B	B
3	B	B	B
4	B	B	B
5	B	B	B
6	B	B	B
7	B	B	B
8	B	B	B
9	B	B	B
10	B	B	B
11	B	B	B
12	B	B	B
13	B	B	B
14	B	B	B
15	B	B	B
16	B	B	B

Table 3 (cont'd.)

Fouling Plate Stations	Date (1975) 2-20	4-8	4-17	6-13
DWS	F		F	F
CBN	F	F		F
CBS	F		F	F

Phytoplankton Entrainment Stations	Date (1975) 4-7,4-8	5-8,5-9	6-2,6-3
Intake	Ph,C	Ph,C	Ph,C
Discharge	Ph,C	Ph,C	Ph,C

they have been sampled in all months since. Also, after the January sampling chlorophyll a was added to the parameter list, and starting in February a chlorophyll sample has accompanied every phytoplankton sample. Therefore five complete phytoplankton runs, including replicated sampling of surface phytoplankton, primary productivity, and chlorophyll a, were performed in the February through June period.

Two surface zooplankton samples were taken per station per month except in January, when stations DWS and J.I. were omitted. Benthos sampling was performed quarterly during the winter and spring, and monthly during the period June-August. Two samples have been taken per station per sampling run. Fouling plates were recovered in February, April, and June. In June the annual as well as the bimonthly plates were taken.

Entrainment sampling has been accomplished monthly since April. In each run, sampling was performed on four slack tides during a 24 hour period. Two phytoplankton and two chlorophyll a samples were taken at each of three depths (surface, mid-depth, bottom) in the intake forebay and at the discharge canal mouth on each slack tide. Sampling at the discharge was done one hour after sampling at the intake so that approximately the same water mass would be encountered at both stations.

In addition to the monthly plankton sampling runs described above, two intensive studies of plankton distribution were performed during the report period. Sampling to determine the vertical distribution of phytoplankton at each of the twelve stations was performed in conjunction with the monthly zooplankton run on April 17. Two phytoplankton and two chlorophyll a samples were taken at each of 3 depths at each station. On May 15 a

similar sampling run for zooplankton was performed, with the exception that at several of the shallower stations only one or two depths could be sampled. For example, at the intake station phytoplankton was sampled in the forebay, immediately in front of the trash racks in water with a depth of 8 m. The zooplankton sampling, performed by towing the net, however, was done outside the forebay in water 1 m deep. An attempted bottom tow encountered obstacles that damaged the net. Consequently only surface zooplankton samples were obtained at this station.

The other intensive study, performed on May 5-6, was intended to determine the diel and vertical distributions of phytoplankton and zooplankton at a selected river station. Two replicate phytoplankton, chlorophyll a and zooplankton samples were taken at each of three depths at three hour intervals during a 24 hour period (eight sample sets altogether).

Sample Processing Schedule

In the benthos and fouling plate substudies it has been possible for sample analysis to keep up with sample generation. In the phytoplankton and zooplankton substudies sample backlogs have accumulated. For processing, first priority has been assigned to the surface samples collected monthly at the twelve river stations, and analysis of these samples has been completed within one month of their acquisition. Analysis of the samples from the vertical and diel distribution surveys and from the phytoplankton entrainment runs is in progress, and none of these sample sets have yet been completed.

Results and Discussion

Phytoplankton River Study

The phytoplankton cell counts, expressed as total cells per milliliter, are presented in Table 4. For most stations the counts varied little during the period January-April, and rose sharply in May. Station HPN had the highest counts of all stations on three of the six sampling dates. This station is near the mouth of College Creek, and the abundance of phytoplankton is probably a consequence of the nutrients contributed to the James River by this tributary. No other station showed such consistently high, or low, counts and as counts in general increased, so did the variability among stations. As shown in Table 5, the dominant phytoplankton organisms present were diatoms, and flagellates of the divisions Cryptophyta, Chlorophyta, and Pyrrophyta. There was little change in community composition from month to month in the winter and early spring. In May *Coscinodiscus lacustris* appeared in large numbers, and in June the flagellates were distinctly more abundant than the diatoms. Bluegreen algae appeared in samples in all six months, but were never abundant. Genera encountered have included *Anabaena*, *Oscillatoria*, *Merismopedia* and a minute colonial coccoid form not yet identified.

The chlorophyll *a* and primary productivity data (Tables 6 and 7) showed the same general patterns as the cell count data, with elevated levels at HPN in January, April and May, distinct seasonal increases in May, and increased variability among stations in May and June.

Zooplankton River Study

The river zooplankton data for January-June appear in Tables 8-13. Copepod nauplii were the most abundant zooplankters on all dates at all

Table 4

James River Phytoplankton Cell Counts, January - June 1975

(Total cells per ml, surface samples, two samples per station)

Station	Date: Jan. 23		Feb. 27		Mar. 27		Apr. 22		May 20		June 16	
DWS	*		200	100	150	100	1900	1400	900	700	1200	1000
Intake	200	250	150	150	400	150	550	450	3000	3300	800	2850
HPE 1	150	150	200	200	250	200	450	250	1500	2000	1700	1850
HPE 2	150	150	150	200	100	150	350	200	950	650	1550	1250
HPS	250	200	200	200	250	200	350	350	1600	1800	1900	1750
HPN	1900	1800	200	200	150	100	5900	6500	6400	5900	3950	3300
HPW 2	200	200	200	150	200	150	350	300	1000	850	950	850
HPW 1	250	350	150	250	300	150	400	300	1500	1350	1800	1750
Discharge	450	350	150	150	150	150	400	350	1000	1450	750	700
CBE	100	150	200	200	250	150	250	350	1100	1700	4650	4200
CBC	150	300	200	200	200	200	350	150	1450	900	1900	1900
J.I.	*		250	200	200	200	250	350	1050	1000	3650	3600

* Not sampled

Table 5

James River Dominant Phytoplankton Organisms, January - June 1975

Date	Organism	DWS*	Intake	HPE 1	HPE 2	HPS	HPN	HPW 2	HPW 1	Discharge	CBE	CBC	JI*
1-23	Melosira sp.		x	x	x	x	x	x	x	x	x	x	
	Nitzschia kützingiana		x	x	x	x	x	x	x	x	x	x	
	Chroomonas sp.		x	x	x	x	x	x	x	x	x	x	
	Pyramimonas sp.		x			x	x	x	x	x			
	Katodinium rotundatum		x	x	x	x	x		x	x	x		
2-27	Melosira sp.	x	x	x	x	x	x	x	x	x	x	x	x
	Nitzschia kützingiana	x	x	x	x	x	x	x	x	x	x	x	x
	Chroomonas sp.	x	x	x	x	x	x	x	x	x	x	x	x
	Pyramimonas sp.				x	x		x	x			x	x
3-27	Melosira sp.	x	x	x	x	x	x	x	x	x	x	x	x
	Nitzschia kützingiana				x	x		x	x	x	x	x	x
4-22	Melosira sp.	x	x	x	x	x	x	x	x	x	x	x	x
	Nitzschia kützingiana	x	x	x	x	x	x	x	x	x	x	x	x
	Chroomonas sp.	x	x	x	x	x	x	x	x	x		x	x
	Katodinium rotundatum	x		x						x		x	
5-20	Melosira sp.	x	x	x	x	x	x	x	x	x	x	x	x
	Nitzschia kützingiana	x	x	x	x	x	x	x	x	x	x	x	x
	Cyclotella meneghiniana	x	x	x	x	x	x	x	x	x	x	x	x
	Coscinodiscus lacustris	x	x	x	x	x	x	x	x	x	x	x	x
	Chroomonas sp.	x	x	x	x	x	x	x	x	x	x	x	x
	Katodinium rotundatum	x			x		x						
	Cryptomonas sp.		x				x		x		x	x	x
	Scenedesmus quadricauda						x						
	Crucigenia sp.						x						
6-16	Chroomonas sp.	x	x	x	x	x	x	x	x	x	x	x	x
	3μ Flagellate	x	x	x	x	x	x	x	x	x	x	x	x
	Pyramimonas sp.	x	x	x	x	x	x	x	x	x	x	x	x
	15μ chrysophyte		x	x	x	x	x	x	x	x	x	x	x
	Nitzschia kützingiana		x	x	x	x			x	x	x	x	x
	Cryptomonas sp.											x	x

* Not sampled in January

Table 6

James River Chlorophyll Concentrations, January - June 1975
(µg Chl a per liter, surface samples, two samples per station)

Station	Jan. 23*	Feb. 27		Mar. 27		Apr. 22		May 20		June 16	
DWS		4.4	2.5	2.6	3.0	2.2	1.5	4.8	4.1	2.0	1.9
Intake		4.4	3.3	4.0	4.3	3.3	3.8	7.3	6.8	3.1	8.1
HPE 1		5.1	5.8	3.6	3.2	1.9	1.9	5.4	6.1	3.5	4.2
HPE 2		2.8	4.1	2.9	3.3	1.5	1.5	6.3	5.1	3.8	4.4
HPS		4.0	4.9	4.0	3.2	2.7	2.7	4.9	4.5	3.1	3.3
HPN		2.4	1.9	2.2	2.3	4.1	4.0	12.9	15.8	5.2	4.4
HPW 2		5.9	3.8	3.9	4.9	1.8	1.3	8.1	4.9	3.2	3.6
HPW 1		2.0	3.1	2.7	2.7	1.3	1.5	5.6	5.8	4.2	5.4
Discharge		2.2	3.6	4.0	3.0	3.0	3.0	3.8	4.4	2.1	2.5
CBE		4.2	5.7	2.2	2.4	2.0	2.2	3.5	4.1	4.6	5.1
CBC		2.9	2.9	3.0	3.2	1.9	1.5	3.0	3.4	2.7	3.5
JI		3.5	4.2	3.0	3.0	2.3	2.7	3.7	3.7	3.6	6.0

* Not sampled

Table 7

James River Phytoplankton Primary Productivity, January - June 1975

(mg C · m^{-3} · hr^{-1}, surface samples, two samples per station)

Station	Jan. 23		Feb. 27		Mar. 27		Apr. 22		May 20		June 16	
DWS	*		.382	.429	.889	.908	6.79	3.59	4.63	4.88	2.59	7.20
Intake	1.13	1.03	.632	.683	1.14	1.29	2.86	2.72	9.60	9.78	13.1	24.0
HPE 1	.601	.848	.643	.484	.921	.792	2.66	2.67	5.43	6.07	13.5	18.2
HPE 2	1.79	.763	.740	+	.792	.760	2.46	2.34	4.70	4.24	10.0	13.5
HPS	.883	.764	.535	+	1.13	1.46	2.49	2.33	8.09	7.34	16.7	18.8
HPN	2.99	3.42	.157	.159	.495	.499	13.4	13.7	21.4	18.6	21.9	25.1
HPW 2	.761	.886	.433	.506	.747	.857	1.53	1.49	6.30	4.35	7.11	6.06
HPW 1	1.14	.725	.360	.354	1.15	1.42	2.58	2.47	6.64	8.69	16.2	17.9
Discharge	1.34	1.74	.784	.603	1.09	1.04	2.94	2.78	4.76	5.80	8.13	9.15
CBE	.581	.535	.780	.702	1.22	1.01	2.35	2.39	8.11	7.74	29.5	29.2
CBC	.904	1.08	.392	.382	.915	1.30	1.63	1.68	4.26	4.03	10.0	13.0
JI	*		.564	.537	1.02	1.13	2.27	1.97	4.50	4.73	20.2	18.2

* Not sampled

\+ Sample lost

Table 8

James River Zooplankton; January 30, 1975
(Numbers of organisms per 100 liters, surface samples, two samples per station)

Organism		DWS*	Intake	HPE 1	HPE 2	HPS	HPN
			Station				
Copepod nauplii	1		92.86	129.76	233.06	108.77	298.36
	2		111.20	119.12	142.77	129.52	256.78
	$\bar{x}$		102.03	124.44	187.92	119.14	277.57
	s		12.97	7.52	63.84	14.67	29.40
	$s_{\bar{x}}$		9.17	5.32	45.14	10.38	20.79
Harpacticoid copepods	1		92.86	79.75	141.41	55.71	74.34
	2		89.25	40.58	135.01	69.66	84.94
	$\bar{x}$		91.06	60.16	138.21	62.68	79.64
	s		2.55	27.70	4.52	9.86	7.50
	$s_{\bar{x}}$		1.80	19.58	3.20	6.98	5.30
Bosmina sp.	1		8.90	27.03	49.75	11.94	47.86
	2		4.39	19.64	15.52	15.24	44.91
	$\bar{x}$		6.64	23.34	32.64	13.59	46.38
	s		3.19	5.22	24.20	2.33	2.08
	$s_{\bar{x}}$		2.26	3.70	17.12	1.65	1.48
Eurytemora sp.	1		6.36	20.27	15.71	15.92	79.43
	2		4.39	7.85	24.83	17.41	66.39
	$\bar{x}$		5.38	14.06	20.27	16.66	72.91
	s		1.39	8.78	6.45	1.05	9.22
	$s_{\bar{x}}$		0.98	6.21	4.56	0.74	6.52
Acartia sp.	1		3.82	4.05	---	1.33	5.09
	2		4.39	3.93	9.31	4.35	9.76
	$\bar{x}$		4.10	3.99		2.84	7.42
	s		0.40	0.08		2.14	3.30
	$s_{\bar{x}}$		0.28	0.06		1.51	2.34
Pelecypod larvae	1				2.62	1.33	2.04
	2				---	---	0.98
	$\bar{x}$						1.51
	s						0.75
	$s_{\bar{x}}$						0.53
Ostracods	1		--	--	--	10.61	
	2		2.93	6.54	3.10	--	
Polychaete larvae	1					--	
	2					1.09	
Fish larvae	1			2.70			
	2			1.31			
	$\bar{x}$			2.00			
	s			0.98			
	$s_{\bar{x}}$			0.70			

* Not sampled

Table 8 (cont'd.)

Organism		DWS*	Intake	HPE 1	HPE 2	HPS	HPN
			Station				
Barnacle nauplii	1		--				
	2		1.46				
Rotifers	1			5.41			
	2			--			
Gastropod larvae	1						1.02
	2						--

* Not sampled

Table 8 (cont'd.)

Organism		Station HPW 1	HPW 2	Discharge	CBE	CBS	J.I*
Copepod nauplii	1	198.17	115.26	83.32	112.15	69.39	
	2	184.35	85.61	82.29	95.97	104.84	
	$\bar{x}$	191.26	100.44	82.80	104.06	87.12	
	s	9.77	20.96	0.73	11.44	25.07	
	$s_{\bar{x}}$	6.91	14.82	0.52	8.09	17.72	
Harpacticoid copepods	1	60.66	63.06	154.08	48.81	26.89	
	2	67.47	54.18	143.49	41.99	68.34	
	$\bar{x}$	64.06	58.62	154.08	45.40	47.62	
	s	4.82	6.28	14.97	4.82	29.31	
	$s_{\bar{x}}$	3.40	4.44	10.58	3.41	20.72	
Bosmina sp.	1	47.52	34.79	18.85	11.42	11.28	
	2	37.06	10.84	17.94	5.14	22.52	
	$\bar{x}$	42.29	22.82	18.40	8.28	16.90	
	s	7.39	16.94	0.64	4.44	7.95	
	$s_{\bar{x}}$	5.23	11.98	0.46	3.14	5.62	
Eurytemora sp.	1	11.12	1.09	1.98	3.12	0.87	
	2	7.60	4.33	5.28	0.86	2.33	
	$\bar{x}$	9.36	2.71	3.63	1.99	1.60	
	s	2.49	2.29	2.33	1.60	1.03	
	$s_{\bar{x}}$	1.76	1.62	1.65	1.13	0.73	
Acartia sp.	1	6.07	8.70	1.98	2.08	0.87	
	2	2.85	2.17	7.38	0.86	3.11	
	$\bar{x}$	4.46	5.44	4.68	1.47	1.99	
	s	2.28	4.62	3.82	0.86	1.58	
	$s_{\bar{x}}$	1.61	3.26	2.70	0.61	1.12	
Pelecypod larvae	1	1.01					
	2	0.95					
	$\bar{x}$	0.98					
	s	0.04					
	$s_{\bar{x}}$	0.03					
Ostracods	1		10.87				
	2		--				
Polychaete larvae	1			--	1.04		
	2			1.06	--		
Fish larvae	1						
	2						
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						

* Not sampled

Table 8 (cont'd.)

Organism		Station HPW 1	HPW 2	Discharge	CBE	CBS	J.I. *
Barnacle nauplii	1						
	2						
	x						
	s						
	s_x						
Rotifers	1					1.73	
	2					--	
Gastropod larvae	1			1.06			
	2			--			

* Not sampled

Table 9

James River Zooplankton; February 14, 1975
(Numbers of organisms per 100 liters, surface samples, two samples per station)

Organisms		Station DWS	Intake	HPE 1	HPE 2	HPS	HPN
Copepod nauplii	1	85.38	117.30	87.94	77.64	87.69	165.61
	2	98.25	81.04	87.51	80.39	78.58	155.69
	$\bar{x}$	91.82	99.17	87.72	79.02	83.14	160.65
	s	9.10	25.64	0.30	1.94	6.44	7.01
	$s_{\bar{x}}$	6.44	18.13	0.22	1.38	4.56	4.96
Harpacticoid copepods	1	18.56	45.70	24.59	23.29	43.84	38.03
	2	24.56	32.89	24.18	21.35	41.10	39.24
	$\bar{x}$	21.56	39.30	24.38	22.32	42.47	38.64
	s	4.24	9.06	0.29	1.37	1.94	0.86
	$s_{\bar{x}}$	3.00	6.40	0.20	0.97	1.37	0.60
Bosmina sp.	1	2.47	16.76	10.40	9.98	6.74	7.36
	2	3.68	9.40	13.82	10.05	6.04	7.59
	$\bar{x}$	3.08	13.08	12.11	10.02	6.39	7.48
	s	0.86	5.20	2.41	0.05	0.49	0.16
	$s_{\bar{x}}$	0.60	3.68	1.71	0.04	0.35	0.12
Eurytemora sp.	1	2.47	18.28	1.89	5.54	3.37	13.49
	2	6.14	9.40	2.30	6.28	2.42	21.52
	$\bar{x}$	4.30	13.84	2.10	5.91	2.90	17.50
	s	2.60	6.28	0.29	0.52	0.67	5.68
	$s_{\bar{x}}$	1.84	4.44	0.20	0.37	0.48	4.02
Acartia sp.	1	--	1.52	1.89	1.11	1.12	3.68
	2	2.46	2.35	2.30	3.77	1.21	2.53
	$\bar{x}$		1.94	2.10	2.44	1.16	3.10
	s		0.59	0.29	1.88	0.06	0.81
	$s_{\bar{x}}$		0.42	0.20	1.33	0.04	0.58
Ostracods	1		4.57	1.89	3.33	2.25	--
	2		1.17	--	2.51	2.42	3.80
	$\bar{x}$		2.87		2.92	2.34	
	s		2.40		0.58	0.12	
	$s_{\bar{x}}$		1.70		0.41	0.08	
Polychaete larvae	1						
	2						
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Cyclopoid copepods	1		1.52				
	2		--				
Barnacle nauplii	1						
	2						

Table 9 (cont'd.)

Organism		Station HPW 1	HPW 2	Discharge	CBE	CBC	J.I.
Copepod nauplii	1	66.41	100.03	47.85	83.17	110.17	161.36
	2	65.76	93.46	45.02	102.43	119.14	136.74
	$\bar{x}$	66.08	96.74	46.44	92.80	114.66	149.05
	s	0.46	4.64	2.00	13.62	6.34	17.41
	$s_{\bar{x}}$	0.32	3.28	1.42	9.63	4.48	12.31
Harpacticoid copepods	1	20.16	42.40	27.91	30.64	22.72	34.31
	2	15.91	28.39	20.86	22.37	14.26	16.53
	$\bar{x}$	18.04	35.40	24.38	26.50	18.49	25.42
	s	3.00	9.90	4.98	5.85	5.98	12.57
	$s_{\bar{x}}$	2.12	7.00	3.52	4.14	4.23	8.89
Bosmina sp.	1	3.56	1.09	5.98	5.47	19.31	15.25
	2	2.12	3.55	3.29	5.89	22.40	18.03
	$\bar{x}$	2.84	2.32	4.64	5.68	20.86	16.64
	s	1.02	1.74	1.90	0.30	2.18	1.96
	$s_{\bar{x}}$	0.72	1.23	1.34	0.21	1.54	1.39
Eurytemora sp.	1	2.37	9.78	1.99	3.28	9.09	8.89
	2	1.06	3.55	2.90	5.89	5.09	4.51
	$\bar{x}$	1.72	6.66	2.44	4.58	7.09	6.70
	s	0.93	4.40	0.64	1.84	2.83	3.10
	$s_{\bar{x}}$	0.66	3.12	0.46	1.30	2.00	2.19
Acartia sp.	1	1.18	--	--	--	1.14	3.81
	2	--	1.18	2.90	1.18	--	1.50
	$\bar{x}$						2.66
	s						1.63
	$s_{\bar{x}}$						1.16
Ostracods	1		4.35				--
	2		3.55				1.50
	$\bar{x}$		3.95				
	s		0.57				
	$s_{\bar{x}}$		0.40				
Polychaete larvae	1		1.09	1.00			
	2		1.18	--			
	$\bar{x}$		1.14				
	s		0.06				
	$s_{\bar{x}}$		0.04				
Cyclopoid copepods	1						
	2						
Barnacle nauplii	1	1.18					
		--					

Table 10

James River Zooplankton; March 21, 1975
(Numbers of organisms per 100 liters, surface samples, two samples per station)

Organism		DWS	Intake	HPE 1	HPE 2	HPS	HPN
Copepod nauplii	1	98.82	167.67	101.62	88.48	70.11	326.37
	2	135.90	150.29	84.26	111.09	61.48	527.06
	$\bar{x}$	117.36	158.98	92.94	99.79	65.80	426.72
	s	26.22	12.29	12.28	15.99	6.10	141.91
	$s_{\bar{x}}$	18.54	8.69	8.68	11.31	4.32	100.35
Harpacticoid copepods	1	63.29	84.45	50.81	42.90	56.75	71.58
	2	70.91	41.23	43.02	57.96	30.74	88.11
	$\bar{x}$	67.10	62.84	46.92	50.43	43.75	79.85
	s	5.39	30.56	5.51	10.65	18.39	11.69
	$s_{\bar{x}}$	3.81	21.61	3.90	7.53	13.01	8.27
Bosmina sp.	1	7.77	14.90	12.70	24.13	13.35	23.05
	2	9.20	14.63	19.72	19.32	6.99	22.43
	$\bar{x}$	8.49	14.77	16.21	21.73	10.17	22.74
	s	1.01	0.19	4.96	3.40	4.50	0.44
	$s_{\bar{x}}$	0.72	0.14	3.51	2.41	3.18	0.31
Acartia sp.	1	--	2.48	2.12	8.04	1.67	1.21
	2	3.06	3.99	--	2.41	--	6.41
	$\bar{x}$		3.24		5.23		3.81
	s		1.07		3.98		3.68
	$s_{\bar{x}}$		0.76		2.82		2.60
Eurytemora sp.	1	5.55	2.48	2.12	--	3.34	134.67
	2	3.06	2.66	5.38	--	1.40	233.89
	$\bar{x}$	4.31	2.57	3.75		2.37	184.28
	s	1.76	0.13	2.31		1.37	70.16
	$s_{\bar{x}}$	1.25	0.09	1.63		0.97	49.61
Polychaete larvae	1	1.11	--	--	2.68	3.34	1.21
	2	--	--	--	2.41	--	1.60
	$\bar{x}$				2.55		1.41
	s				0.19		0.28
	$s_{\bar{x}}$				0.14		0.20
Rotifers	1	--	--	8.47	50.94	--	3.64
	2	5.11	--	23.30	38.64	2.79	--
	$\bar{x}$			15.89	44.79		
	s			10.49	8.70		
	$s_{\bar{x}}$			7.42	6.15		
Ostracods	1	--	--	2.12	--	--	--
	2	--	--	3.58	--	--	--
	$\bar{x}$			2.85			
	s			1.03			
	$s_{\bar{x}}$			0.73			
Cyclopoid copepods	1	--	--	--	--	--	--
	2	--	--	--	--	--	--
Decapod larvae	1	--	--	--	--	--	--
	2	--	--	--	--	--	--

Table 10 (cont'd.)

Organism		HPW 1	HPW 2	Discharge	CBE	CBC	J.I.
Copepod nauplii	1	83.58	121.93	93.95	72.67	86.40	86.22
	2	66.73	111.93	106.05	69.12	98.99	87.26
	$\bar{x}$	75.16	116.93	100.00	70.90	92.70	86.74
	s	11.91	7.07	8.56	2.51	8.90	0.74
	$s_{\bar{x}}$	8.43	5.00	6.05	1.78	6.30	0.52
Harpacticoid copepods	1	33.75	24.15	46.33	12.92	22.25	34.82
	2	36.40	17.41	35.75	13.60	22.84	24.43
	$\bar{x}$	35.08	20.78	41.04	13.26	22.55	29.63
	s	1.87	4.77	7.48	0.48	0.42	7.35
	$s_{\bar{x}}$	1.33	3.37	5.29	0.34	0.30	5.20
Bosmina sp.	1	8.04	39.11	12.87	27.45	31.42	29.84
	2	18.20	78.35	11.91	21.53	33.00	15.71
	$\bar{x}$	13.12	58.73	12.39	24.49	32.21	22.78
	s	7.18	27.75	0.68	4.19	1.12	9.99
	$s_{\bar{x}}$	5.08	19.62	0.48	2.96	0.79	7.07
Acartia sp.	1	3.21	3.45	5.15	1.61	5.24	3.32
	2	1.21	3.73	1.19	7.93	2.54	1.74
	$\bar{x}$	2.21	3.59	3.17	4.77	3.89	2.53
	s	1.41	0.20	2.80	4.47	1.91	1.12
	$s_{\bar{x}}$	1.00	0.14	1.98	3.16	1.35	0.79
Eurytemora sp.	1	4.82	5.75	32.17	--	5.24	1.66
	2	8.49	2.49	44.09	2.27	6.34	3.49
	$\bar{x}$	6.66	4.12	38.13		5.79	2.58
	s	2.60	2.31	8.43		0.78	1.29
	$s_{\bar{x}}$	1.84	1.63	5.96		0.55	0.92
Polychaete larvae	1	1.61	2.30	--	--	2.62	--
	2	--	--	--	1.13	--	--
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Rotifers	1	1.61	9.20	--	1.61	11.78	14.92
	2	--	3.73	--	--	12.69	3.49
	$\bar{x}$		6.47			12.24	9.21
	s		3.87			0.64	8.08
	$s_{\bar{x}}$		2.74			0.46	5.72
Ostracods	1	--	1.15	--	1.61	--	--
	2	--	--	--	--	2.54	1.74
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Cyclopoid copepods	1	1.61	--	--	--	--	--
	2	--	--	--	--	--	--
Decapod larvae	1	--	--	--	--	--	--
	2	--	--	1.19	--	--	--

Table 11

James River Zooplankton; April 17, 1975

(Numbers of organisms per 100 liters, surface samples, two samples per station)

Organism		Station DWS	Intake	HPE 1	HPE 2	HPS	HPN
Copepod nauplii	1	810.23	377.02	446.28	280.37	175.11	219.11
	2	522.35	237.35	754.13	280.90	366.72	262.09
	$\bar{x}$	666.29	307.19	600.21	280.63	270.91	240.60
	s	203.56	98.76	217.68	0.37	135.49	30.39
	$s_{\bar{x}}$	143.94	69.83	153.93	0.27	95.81	21.49
Harpacticoid copepods	1	67.30	69.30	85.28	75.77	48.04	48.85
	2	42.74	70.70	74.07	139.56	100.45	58.07
	$\bar{x}$	55.02	70.00	79.67	107.67	74.25	53.46
	s	17.37	0.99	7.93	45.11	37.05	6.52
	$s_{\bar{x}}$	12.28	0.70	5.61	31.89	26.21	4.61
Bosmina sp.	1	2.64	1.17	7.11	7.58	6.20	8.88
	2	--	3.37	8.42	10.73	1.59	4.71
	$\bar{x}$		2.27	7.77	9.15	3.89	6.79
	s		1.56	0.93	2.23	3.26	2.95
	$s_{\bar{x}}$		1.10	0.65	1.57	2.31	2.09
Acartia sp.	1	--	1.17	2.84	1.51	1.55	1.48
	2	--	3.37	--	--	1.59	1.57
	$\bar{x}$		2.27			1.57	1.53
	s		1.56			0.03	0.06
	$s_{\bar{x}}$		1.10			0.02	0.05
Eurytemora sp.	1	15.83	75.17	5.68	12.12	6.20	1.29
	2	7.12	3.37	3.37	10.73	9.57	7.85
	$\bar{x}$	11.47	39.27	4.53	11.43	7.89	4.57
	s	6.16	50.77	1.63	0.98	2.38	4.64
	$s_{\bar{x}}$	4.35	35.90	1.15	0.69	1.69	3.28
Cyclopoid copepods	1	2.64	2.35	4.26	1.51	--	--
	2	7.12	1.68	5.05	8.95	1.59	7.85
	$\bar{x}$	4.88	2.01	4.65	5.23		
	s	3.17	0.47	0.56	5.26		
	$s_{\bar{x}}$	2.24	0.33	0.39	3.72		
Polychaete larvae	1	--	1.17	--	--	--	--
	2	1.19	--	--	--	--	--
Barnacle nauplii	1	--	1.17	--	--	--	--
	2	--	--	--	--	--	--
Gastropod larvae	1	--	--	--	--	--	--
	2	--	--	--	--	4.78	--
Fish larvae	1	--	--	--	--	--	--
	2	0.02	--	--	--	--	--

Table 11 (cont'd.)

Organism		Station HPW 2	HPW 1	Discharge	CBE	CBC	J.I.
Copepod nauplii	1	198.67	278.71	435.31	353.67	350.44	298.74
	2	307.32	167.58 *	402.82	126.44	270.59	385.49
	$\bar{x}$	252.99	223.15	419.07	240.05	310.51	342.11
	s	76.83	78.58	22.97	160.68	56.46	61.43
	$s_{\bar{x}}$	54.33	55.57	16.25	113.61	39.93	43.37
Harpacticoid copepods	1	48.56	30.97	30.02	69.66	121.76	97.26
	2	105.23	10.66 *	13.89	28.10	86.10	73.23
	$\bar{x}$	76.89	20.81	21.95	48.88	103.93	85.25
	s	40.07	14.36	11.41	29.39	25.21	16.99
	$s_{\bar{x}}$	28.33	10.15	8.07	20.78	17.83	12.01
Bosmina sp.	1	4.41	2.58	2.73	--	4.45	11.11
	2	5.98	1.52 *	5.21	2.55	2.73	16.58
	$\bar{x}$	5.19	2.05	3.97		3.59	13.85
	s	1.11	0.75	1.75		1.22	3.87
	$s_{\bar{x}}$	0.79	0.53	1.24		0.86	2.73
Acartia sp.	1	2.94	--	--	--	--	1.39
	2	2.39	-- *	1.74	--	--	5.53
	$\bar{x}$	2.67					3.46
	s	0.39					2.93
	$s_{\bar{x}}$	0.27					2.07
Eurytemora sp.	1	8.83	5.16	8.19	10.72	16.33	23.62
	2	15.54	1.52 *	8.69	2.55	16.40	38.69
	$\bar{x}$	12.19	3.34	8.43	6.63	16.37	31.15
	s	4.75	2.57	0.35	5.78	0.05	10.66
	$s_{\bar{x}}$	3.35	1.82	0.25	4.09	0.03	7.53
Cyclopoid copepods	1	2.94	1.29	1.36	12.50	8.91	6.95
	2	13.15	1.52 *	1.74	1.28	13.67	4.14
	$\bar{x}$	8.05	1.41	1.55	6.89	11.29	5.55
	s	7.22	0.16	0.27	7.93	3.37	1.99
	$s_{\bar{x}}$	5.11	0.11	0.19	5.61	2.38	1.41
Polychaete larvae	1	--	--	--	--	--	--
	2	--	-- *	--	1.28	--	--
Barnacle nauplii	1	--	--	--	--	--	--
	2	--	3.05 *	1.74	--	--	--
Gastropod larvae	1	--	--	--	--	2.97	--
	2	--	-- *	--	--	--	--
Fish larvae	1	--	--	--	--	--	--
	2	--	-- *	--	--	--	0.04

* Small portion of sample was lost

Table 12

James River Zooplankton; May 15, 1975
(Numbers of organisms per 100 liters, surface samples, two samples per station)

Organism		DWS	Intake	HPE 1	HPE 2	HPN	HPS
Copepod nauplii	1	1811.54	95.10	301.50	380.71	277.88	331.62
	2	1753.60	66.14	206.11	202.05	554.76	350.64
	$\bar{x}$	1782.57	80.62	253.81	291.38	416.32	341.13
	s	40.97	20.48	67.45	126.33	195.78	13.45
	$s_{\bar{x}}$	28.97	14.48	47.69	89.33	138.44	9.51
Harpacticoid copepods	1	132.88	32.92	10.20	20.37	6.20	55.67
	2	82.08	12.66	25.10	11.28	16.77	31.59
	$\bar{x}$	107.48	22.79	17.65	15.83	11.49	43.63
	s	35.92	14.33	10.54	6.43	7.47	17.03
	$s_{\bar{x}}$	25.40	10.13	7.45	4.55	5.29	12.04
Bosmina sp.	1	48.84	8.53	2.91	--	23.57	4.84
	2	36.07	1.41	1.32	--	20.96	18.95
	$\bar{x}$	42.45	4.97	2.11		22.27	11.89
	s	9.03	5.03	1.12		1.85	9.98
	$s_{\bar{x}}$	6.39	3.56	0.79		1.31	7.05
Acartia sp.	1	1.14	--	--	--	--	--
	2	--	2.81	--	--	6.99	3.16
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Eurytemora sp.	1	39.75	9.75	2.91	3.13	16.13	26.63
	2	37.31	--	1.32	3.08	15.37	28.43
	$\bar{x}$	38.53		2.11	3.11	15.75	27.53
	s	1.73		1.12	0.03	0.54	1.27
	$s_{\bar{x}}$	1.22		0.79	0.03	0.38	0.90
Cyclopoid copepods	1	1.14	2.44	4.37	--	3.26	1.29
	2	12.44	1.41	1.32	1.03	11.18	6.32
	$\bar{x}$	6.79	1.93	2.85		7.22	3.81
	s	7.99	0.73	2.16		5.60	3.56
	$s_{\bar{x}}$	5.65	0.51	1.53		3.96	2.51
Rotifers	1	--	--	--	--	818.76	4.84
	2	--	2.81	--	--	983.76	3.16
	$\bar{x}$					901.26	4.00
	s					116.67	1.19
	$s_{\bar{x}}$					82.50	0.84
Ostracods	1	--	--	--	--	8.68	--
	2	--	--	--	--	5.59	--
	$\bar{x}$					7.13	
	s					2.19	
	$s_{\bar{x}}$					1.55	
Polychaete larvae	1	1.14	--	--	--	--	--
	2	--	--	--	--	--	--
Barnacle nauplii	1	--	--	--	--	--	--
	2	1.24	--	--	--	--	--
Gastropod larvae	1	--	--	--	--	--	--
	2	--	--	--	--	--	--

Table 12 (cont'd.)

Organism		Station HPW 2	HPW 1	Discharge	CBE	CBC	J.I.
Copepod nauplii	1	794.01	188.38	437.99	245.66	530.22	920.28
	2	806.13	408.79	345.53	675.59	861.10	562.00
	$\bar{x}$	800.07	298.59	391.76	460.63	695.66	741.14
	s	8.57	155.85	65.38	304.01	233.97	253.34
	$s_{\bar{x}}$	6.06	110.21	46.23	214.97	165.44	179.14
Harpacticoid copepods	1	206.74	10.05	8.94	3.19	7.01	100.10
	2	151.91	18.23	5.16	--	93.78	30.91
	$\bar{x}$	179.33	14.14	7.05		50.39	65.51
	s	38.77	5.78	2.67		61.36	48.93
	$s_{\bar{x}}$	27.41	4.09	1.89		43.39	34.59
Bosmina sp.	1	20.97	15.07	14.90	9.57	25.69	113.02
	2	34.30	62.49	7.74	13.90	31.26	61.42
	$\bar{x}$	27.63	38.78	11.32	11.73	28.48	87.22
	s	9.43	33.53	5.06	3.06	3.94	36.49
	$s_{\bar{x}}$	6.67	23.71	3.58	2.17	2.79	25.80
Acartia sp.	1	3.00	--	--	--	2.34	--
	2	2.45	--	--	--	5.68	3.07
	$\bar{x}$	2.73				4.01	
	s	0.39				2.36	
	$s_{\bar{x}}$	0.28				1.67	
Eurytemora sp.	1	44.94	15.07	--	--	63.07	48.44
	2	51.45	10.41	2.58	2.78	54.00	42.99
	$\bar{x}$	48.19	12.74			58.53	45.71
	s	4.60	3.29			6.41	3.85
	$s_{\bar{x}}$	3.25	2.33			4.53	2.73
Cyclopoid copepods	1	41.95	2.51	--	--	7.01	22.60
	2	24.50	--	--	2.78	28.42	3.07
	$\bar{x}$	33.23				17.71	12.83
	s	12.34				15.14	13.81
	$s_{\bar{x}}$	8.73				10.71	9.77
Rotifers	1	41.95	2.51	32.77	--	350.36	477.90
	2	9.80	15.62	--	19.46	36.94	562.00
	$\bar{x}$	25.87	9.07			193.65	519.95
	s	22.73	9.27			221.62	59.47
	$s_{\bar{x}}$	16.07	6.55			156.71	42.05
Ostracods	1	--	--	--	--	--	--
	2	4.90	--	--	--	--	--
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Polychaete larvae	1	--	--	--	--	--	--
	2	--	23.43	--	--	--	--
Barnacle nauplii	1	--	--	2.98	--	--	--
	2	--	--	--	--	--	--
Gastropod larvae	1	3.00	--	--	--	--	--
	2	--	--	--	--	--	--

Table 13

James River Zooplankton; June 18, 1975
(Numbers of organisms per 100 liters, surface samples, two samples per station)

Organism		DWS	Intake	HPE 1	HPE 2	HPN	HPS
Copepod nauplii	1	152.38	1003.35	361.18	968.83	929.51	787.76
	2	224.77	649.40	246.07	580.11	400.46	495.31
	$\bar{x}$	188.57	826.37	303.63	774.47	664.99	641.53
	s	51.19	250.28	81.39	274.87	374.09	206.79
	$s_{\bar{x}}$	36.19	176.97	57.55	194.36	265.53	146.23
Harpacticoid copepods	1	6.63	18.09	1.04	11.12	9.17	18.21
	2	7.59	18.59	1.06	3.31	5.24	36.10
	$\bar{x}$	7.11	18.34	1.05	7.21	7.21	27.15
	s	0.68	0.35	0.01	5.52	2.78	12.65
	$s_{\bar{x}}$	0.48	0.25	0.01	3.91	1.97	8.95
Acartia sp.	1	15.46	280.99	11.48	149.53	26.36	31.87
	2	22.78	182.58	23.33	90.43	53.46	163.18
	$\bar{x}$	19.12	231.79	17.41	119.98	39.91	97.53
	s	5.18	69.59	8.38	41.79	19.16	92.85
	$s_{\bar{x}}$	3.66	49.21	5.93	29.55	13.55	65.65
Eurytemora sp.	1	6.63	21.71	11.48	32.13	76.79	4.55
	2	7.59	2.19	23.33	7.72	2.10	--
	$\bar{x}$	7.11	11.95	17.41	19.93	39.45	
	s	0.68	13.80	8.38	17.26	52.81	
	$s_{\bar{x}}$	0.48	9.76	5.93	12.21	37.35	
Barnacle nauplii	1	15.46	160.39	36.53	22.24	136.39	27.32
	2	13.67	51.38	22.27	7.72	110.07	8.66
	$\bar{x}$	14.57	105.89	29.40	14.98	123.23	17.99
	s	1.27	77.08	10.08	10.27	18.61	13.19
	$s_{\bar{x}}$	0.89	54.51	7.13	7.26	13.16	9.33
Polychaete larvae	1	5.52	194.16	9.39	9.89	3.44	5.69
	2	13.67	9.84	4.24	--	1.05	1.44
	$\bar{x}$	9.59	102.00	6.81		2.25	3.57
	s	5.76	130.33	3.64		1.69	3.01
	$s_{\bar{x}}$	4.07	92.16	2.57		1.19	2.13
Gastropod larvae	1	33.16	15.68	1.04	11.12	1.15	--
	2	1.52	--	33.94	--	--	1.44
	$\bar{x}$	17.34		17.49			
	s	22.37		23.26			
	$s_{\bar{x}}$	15.89		16.45			
Pelecypod larvae	1	5.52	41.00	--	14.83	4.58	--
	2	--	--	3.18	11.03	--	--
	$\bar{x}$				12.93		
	s				2.69		
	$s_{\bar{x}}$				1.90		
Rotifers	1	15.46	--	19.83	3.71	--	9.11
	2	--	24.05	--	11.03	--	2.89
	$\bar{x}$				7.37		6.00
	s				5.18		4.40
	$s_{\bar{x}}$				3.66		3.11

Table 13 (cont'd.)

Organism		DWS	Intake	HPE 1	HPE 2	HPN	HPS
Bosmina sp.	1	--	--	--	--	--	1.14
	2	--	--	--	--	1.05	--
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Decapod larvae	1	--	8.44	--	--	1.15	--
	2	1.52	1.09	--	--	--	--
	$\bar{x}$		4.77				
	s		5.20				
	$s_{\bar{x}}$		3.67				
Cyclopoid copepods	1	--	7.23		--	--	--
	2	--	--		--	--	8.66
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Barnacle cyprids	1	--	--	--	--	--	--
	2	--	--	--	--	--	--
Calanoid copepods	1	--	--	--	--	--	--
	2	--	--	--	--	--	--
Ostracods	1	--	--	--	--	--	--
	2	--	--	--	--	--	--
Amphipods	1	--	--	--	--	--	--
	2	--	--	--	--	--	--

Table 13 (cont'd.)

Organism		Station HPW 2	HPW 1	Discharge	CBE	CBC	J.I.
Copepod nauplii	1	775.23	805.49	130.43	352.73	300.46	162.48
	2	984.35	378.43	552.70	487.54	313.19	96.87
	$\bar{x}$	879.79	591.96	341.57	420.13	256.83	129.67
	s	147.87	301.98	298.59	95.33	61.71	46.39
	$s_{\bar{x}}$	104.56	213.53	211.13	67.41	43.63	32.81
Harpactiooid copepods	1	34.45	25.09	2.02	3.51	23.11	15.58
	2	157.63	16.66	13.53	2.48	13.12	28.49
	$\bar{x}$	96.04	20.87	7.77	2.99	18.11	22.03
	s	87.10	5.96	8.14	0.73	7.06	9.13
	$s_{\bar{x}}$	61.59	4.21	5.75	0.51	4.99	6.45
Acartia sp.	1	344.55	56.46	16.18	--	34.13	21.14
	2	70.06	70.21	25.94	1.24	5.47	2.28
	$\bar{x}$	207.31	63.33	21.06		19.80	11.71
	s	194.09	9.72	6.90		20.27	13.34
	$s_{\bar{x}}$	137.25	6.87	4.88		14.33	9.43
Eurytemora sp.	1	--	214.55	1.01	5.26	7.70	33.39
	2	353.80	40.46	13.53	6.20	21.87	6.84
	$\bar{x}$		127.51	7.27	5.73	14.79	20.11
	s		123.10	8.85	0.67	10.02	18.77
	$s_{\bar{x}}$		87.05	6.26	0.47	7.09	13.27
Barnacle nauplii	1	4.31	110.41	38.42	63.17	5.50	6.69
	2	7.01	52.36	129.71	23.57	--	1.14
	$\bar{x}$	5.66	81.39	84.07	43.37		3.91
	s	1.91	41.05	64.55	28.00		3.92
	$s_{\bar{x}}$	1.35	29.03	46.65	19.80		2.77
Polychaete larvae	1	8.61	7.53	1.01	--	--	1.11
	2	--	7.14	2.25	1.24	--	--
	$\bar{x}$		7.33	1.63			
	s		0.28	0.88			
	$s_{\bar{x}}$		0.19	0.62			
Gastropod larvae	1	--	23.84	1.01	3.51	--	--
	2	7.01	4.76	12.41	--	2.19	--
	$\bar{x}$		14.30	6.71			
	s		13.49	8.06			
	$s_{\bar{x}}$		9.54	5.70			
Pelecypod larvae	1	4.31	22.58	--	5.26	--	--
	2	45.54	--	9.02	3.72	1.09	--
	$\bar{x}$	24.93			4.49		
	s	29.15			1.09		
	$s_{\bar{x}}$	20.61			0.77		
Rotifers	1	47.37	--	--	3.51	1.10	148.01
	2	10.51	14.28	--	--	28.43	177.78
	$\bar{x}$	28.94				14.77	162.89
	s	26.06				19.33	21.05
	$s_{\bar{x}}$	18.43				13.67	14.89
Bosmina sp.	1	--	--	--	--	1.10	13.35
	2	3.50	--	--	--	3.28	9.12
	$\bar{x}$					2.19	11.23
	s					1.54	2.99
	$s_{\bar{x}}$					1.09	2.11

Table 13 (cont'd.)

Organism		Station HPW 2	HPW 1	Discharge	CBE	CBC	J.I.
Decapod larvae	1	--	--	--	--	--	--
	2	--	2.38	--	--	1.09	--
	$\bar{x}$						
	s						
	$s_{\bar{x}}$						
Cyclopoid copepods	1	--	3.76	--	--	--	4.45
	2	3.50	--	2.25	--	6.56	3.42
	$\bar{x}$						3.93
	s						0.73
	$s_{\bar{x}}$						0.51
Barnacle cyprids	1	--	--	--	1.75	--	--
	2	3.50	--	--	--	--	--
Calanoid copepods	1	--	--	--	--	--	--
	2	3.50	--	--	--	--	--
Ostracods	1	--	--	--	--	--	--
	2	7.01	--	--	--	--	--
Amphipods	1	--	--	--	--	--	--
	2	--	--	2.25	--	--	--

stations except on January 30, when harpacticoid copepods were more numerous at the discharge, and on May 15 and June 18 when large populations of rotifers were encountered at HPN and J.I., respectively. In January, February and March the largest numbers of nauplii and of Eurytemora sp. were collected at HPN, suggesting an influence of College Creek on the zooplankton as well as the phytoplankton community. The spring increase in overall zooplankton abundance generally paralleled the seasonal increase in phytoplankton.

Benthos

The benthos data appear in Tables 14-16. The most abundant mollusks were Rangia cuneata, Congeria leucophaeta, and Hydrobia sp. (June 13). The polychaete Scolecolepides viridis and unidentified oligochaetes dominated the annelid population, while the most abundant amphipods were Gammarus sp., Corophium lacustre and Leptocheirus plumulosus.

Fouling Plates

The fouling plate results are shown in Tables 17-19. Very few organisms were found on any of the plates examined prior to June 13. The annual plates, recovered along with the bimonthly plates on this date, exhibited the densest colonization, especially at DWS. Microscopic examination of material scraped from the June plates revealed the presence of scattered pennate diatoms, but no bluegreen algae, at all three stations.

Phytoplankton Entrainment

The data obtained, to date, in the phytoplankton entrainment substudy, are presented in Tables 20-22. All chlorophyll samples have been analyzed, but the phytoplankton samples are still in progress. The chlorophyll data have shown little or no indication of vertical stratification at

Table 14

James River Benthos; February 20, 1975

Species, Number of Individuals and Total Wet Weight
(Without Clam Shell) in Grams per 0.1 m^2 at Each Station

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mollusks																
Rangia cuneata	5	10		35	8	13	5	6		2	1		4	15	1	19
Congeria leucophaeta	1			40	1		1	28			19					
Macoma mitchelli															1	4
Macoma balthica																
Corbicula manilensis																
Hydrobia sp.																
Mya arenaria																
Brachidontes recurvus				1							2		1			
Annelids																
Polychaetes																
Scolecolepides virdis		2		1	3	1		1								
Nereis succinea	4		1	1									1		2	2
Lysipiddes grayi				1		1		1		2						
Polydora ligni																
Laeonereis culveri																
Heteromastus filiformis																
Oligochaetes	21	33	8	5	6	25	1	1	3	78				31	7	
Amphipods																
Gammarus sp.			1	2	1	1					1	1				
Corophium lacustre	1			1	1						12					
Lepidactylus dytiscus		1	3				7		8			3				
Leptocheirus plumulosus		1			1									1	3	48
Monoculodes edwardsi	2						3		16							
Caprella sp.																

Table 14 (cont'd.)

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Isopods																
Cyathura polita																2
Edotea triloba																
Chiridotea almyra																
Dipteran larvae	6		1	1		4	1	1	1	3		1			1	
Nemerteans					2									3	1	
Hydroids	x			x	x	x	x	x		x				x	x	x
Balanus sp.				1				4			16					1
Nematodes	1					1										
Biomass (grams)	2.1	1.5	0.2	5.8	0.7	4.3	2.6	1.3	0.2	0.4	0.3	0.2	0.8	1.8	0.2	0.8

Table 15

James River Benthos; April 25, 1975
Species, Number of Individuals and Total Wet Weight
(Without Clam Shell) in Grams per 0.1 m^2 at Each Station

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mollusks																
Rangia cuneata	9	25	6	10	2	39	5	8	2	2			2	7	2	10
Congeria leucophaeta		2				2		24								
Macoma mitchelli														1		1
Macoma balthica																
Corbicula manilensis			1				1		1	1		6				
Hydrobia sp.																
Mya arenaria																
Brachidontes recurvus																
Annelids																
Polychaetes																
Scolecolepides viridis		6	2	1	10	6		8	2	14	8			2	3	3
Nereis succinea	7		2							1	2		1		8	
Lysipiddes grayi								2								
Polydora ligni																
Laeonereis culveri																
Heteromastus filiformis																
Oligochaetes	4	26	4	21	1	20				9	1		8	1		1
Amphipods																
Gammarus sp.																
Corophium lacustre													1			
Lepidactylus dytiscus							3		4			3				
Leptocheirus plumulosus		3	2													18
Monoculodes edwardsi						1										
Caprella sp.																

Table 15 (cont'd.)

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Isopods																
Cyathura polita																1
Edotea triloba																
Chiridotea almyra																
Dipteran larvae	2				1	1				1	3		2	1		
Nemerteans				1		1					2				1	2
Hydroids		x		x	x	x		x		x	x		x	x	x	x
Balanus sp.								3		3						
Nematodes				1												
Biomass (grams)	2.8	4.9	1.8	1.6	0.6	7.9	1.7	1.4	0.4	0.2	0.2	0.1	1.1	0.5	1.4	0.5

Table 16

James River Benthos; June 13, 1975

Species, Number of Individuals and Total Wet Weight (Without Clam Shell) in Grams per 0.1 m^2 at Each Station

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mollusks																
Rangia cuneata	4	18	1	26	6	13	2	15	4	3	43	2	6	7		10
Congeria leucophaeta				1	3			23			2					1
Macoma mitchelli														6		3
Macoma balthica																
Corbicula manilensis			1		1				3			1				
Hydrobia sp.	91		87				32					17	4	2	1	
Mya arenaria																
Brachidontes recurvus								2		1						
Annelids																
Polychaetes																
Scolecolepides viridis		6		1	10			23	2		4		1	3	4	1
Nereis succinea					1											
Lysipiddes grayi				1	1						1					
Polydora ligni																
Laeonereis culveri																
Heteromastus filiformis																
Oligochaetes	2	20	8	4	1	2	3			5	1	1	8	7	1	
Amphipods																
Gammarus sp.				3	12	8	3	9	6	2	1		1		1	2
Corophium lacustre		2		3	2	20		11		2		2	3	1	1	
Lepidactylus dytiscus			6						1			6				
Leptocheirus plumulosus			7	1	16									12	25	27
Monoculodes edwardsi																
Caprella sp.																

Table 16 (cont'd.)

Species	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Isopods																
Cyathura polita		1						1								
Edotea triloba																
Chiridotea almyra																
Dipteran larvae	1		4			3	2					3		1		
Nemerteans											1			1		
Hydroids	x				x	x		x	x	x	x	x	x	x	x	
Balanus sp.								3		1						
Nematodes																
Biomass (grams)	1.4	4.0	0.8	7.6	0.9	2.1	0.3	2.1	0.8	0.2	8.1	0.3	1.5	1.1	0.3	1.2

Table 17

Fouling Organisms
1975
Station DWS

		No. Organisms /dm^2			
Horizontal Plate		Jan-Feb	Mar-Apr	May-Jun	Annual
Barnacles	Balanus sp.			203	38
Bivalves	Brachidontes recurvus				
	Congeria leucophaeta				2
Amphipods	Corophium lacustre			173	547
	Gammarus sp.			25	52
Polychaetes	Nereis succinea				
	Scolecolepides viridis				
Flatworms	Stylochus ellipticus				
Crabs	Rhithopanopeus horrisii			1	1
Ectoprocts	Bowerbankia sp.				
Bryozoans	Membranipora tenuis	x			
Hydroids		x	x	x	x
Dipteran Larvae				2	1
Total No. of Genera (not including Hydroids and Dipteran Larvae)				5	6
Total No. of Organisms (not including Bryozoans and Hydroids)				404	641
Vertical Plate					
Barnacles	Balanus sp.			5	47
Bivalves	Brachidontes recurvus				
	Congeria leucophaeta				3
Amphipods	Corophium lacustre			155	354
	Gammarus sp.	3		83	58
Polychaetes	Nereis succinea				
	Scolecolepides viridis				
Flatworms	Stylochus ellipticus				
Crabs	Rhithopanopeus horrisii				
Ectoprocts	Bowerbankia sp.				
Bryozoans	Membranipora tenuis				
Hydroids		x	x	x	x
Dipteran larvae				4	
Total No. of Genera (not including Hydroids and Dipteran Larvae)		1		4	4
Total No. of Organisms (not including Bryozoans and Hydroids)		3		247	462

Table 18

Fouling Organisms

1975

Station CBN

		No. organisms/dm^2			
Horizontal Plate		Jan-Feb	Mar-Apr	May-Jun	Annual
Barnacles	*Balanus* sp.				75
Bivlaves	*Brachidontes recurvus*				
	Congeria leucophaeta				1
Amphipods	*Corophium lacustre*			6	255
	Gammarus sp.		3	4	298
Polychaetes	*Nereis succinea*				
	Scolecolepides viridis				
Flatworms	*Stylochus ellipticus*				
Crabs	*Rhithopanopeus horrisii*				
Ectoprocts	*Bowerbankia* sp.				
Bryozoans	*Membranipora tenuis*				
Hydroids		x	x	x	x
Dipteran larvae					7
Total No. of Genera (not including Hydroids and Dipteran Larvae)			1	2	5
Total No. of Organisms (not including Bryzoans and Hydroids)			3	10	636
Vertical Plate					
Barnacles	*Balanus* sp.				4
Bivalves	*Brachidontes recurvus*				
	Congeria leucophaeta				7
Amphipods	*Corophium lacustre*			6	52
	Gammarus sp.	2		2	81
Polychaetes	*Nereis succinea*				
	Scolecolepides viridis				
Flatworms	*Stylochus ellipticus*				
Crabs	*Rhithopanopeus horrisii*				
Ectoprocts	*Bowerbankia* sp.				
Bryozoans	*Membranipora tenuis*		x		
Hydroids		x	x	x	x
Dipteran larvae				1	1
Total No. of Genera (not including Hydroids and Dipteran larvae)		1		3	5
Total No. of Organisms (not including Bryozoans and Hydroids)		2		9	145

Table 19

Fouling Organisms
1975
Station CBS

Horizontal Plate		No. of Organisms /dm^2 Jan-Feb	Mar-Apr	May-Jun	Annual
Barnacles	*Balanus* sp.				
Bivalves	*Brachidontes recurvus*				
	Congeria leucophaeta				5
Amphipods	*Corophium lacustre*			15	171
	Gammarus sp.			7	138
Polychaetes	*Nereis succinea*				
	Scolecolepides viridis				
Flatworms	*Stylochus ellipticus*				
Crabs	*Rhithopanopeus horrisii*				
Ectoprocts	*Bowerbankia* sp.				
Bryozoans	*Membranipora tenuis*	x			
Hydroids		x	x	x	x
Dipteran Larvae				1	5
Total No. of Genera (not including Hydroids and Dipteran Larvae)				3	4
Total No. of Organisms (not including Bryozoans and Hydroids)				23	319
Vertical Plate					
Barnacles	*Balanus* sp.				16
Bivalves	*Brachidontes recurvus*				
	Congeria leucophaeta			1	7
Amphipods	*Corophium lacustre*			10	206
	Gammarus sp.	2	2	2	76
Polychaetes	*Nereis succinea*				
	Scolecolepides viridis				
Flatworms	*Stylochus ellipticus*				
Crabs	*Rhithopanopeus horrisii*				
Ectoprocts	*Bowerbankia* sp.				
Bryozoans	*Membranipora tenuis*	x	x		
Hydroids		x	x	x	x
Dipteran larvae					1
Total No. of Genera (not including Hydroids and Dipteran Larvae)		1	1	3	5
Total No. of Organisms (not including Bryozoans and Hydroids)		2	2	13	306

Table 20

Phytoplankton Entrainment Data; April 7-8, 1975

Date (1975)	Tide	Time (EDT)	Station	Depth (m)	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)	Chl a (µg/l)		Total cells per ml	
4-7	HWS	1135	Intake	0	8.70	4.06	9.89	3.0	2.4	400	250
				4	8.70	4.51	10.15	2.6	2.5	500	400
				8	8.55	4.65	10.09	2.8	2.8	450	450
4-7		1235	Discharge	0	16.80	4.32	9.89	3.1	3.3	500	500
				1	16.70	4.32	9.43	3.5	3.0	250	600
				2	16.70	4.32	9.83	3.2	3.1	450	450
4-7	LWS	1759	Intake	0	10.20	3.45	10.41	2.5	2.2	600	400
				3.75	9.90	3.62	10.09	3.0	2.9	450	550
				7.5	9.80	3.82	10.31	2.6	2.7	500	400
4-7		1900	Discharge	0	18.40	3.75	9.93	2.5	2.5	450	550
				1	18.20	3.72	9.97	2.2	2.1	300	450
				2	18.00	3.71	10.03	2.1	2.3	250	400
4-7	HWS	2308	Intake	0	9.20	4.35	10.25	2.0	2.5	400	550
				4	9.30	4.53	10.41	2.7	2.9	550	450
				8	9.20	4.58	10.45	3.5	2.8	650	700
4-8		0009	Discharge	0	17.40	4.48	10.03	2.5	2.8	500	
				1	17.10	4.47	10.09	2.6	2.4	400	
				2	17.10	4.45	10.13	2.8	2.8	250	
4-8	LWS	0620	Intake	0	8.60	4.53	10.43	3.9	3.2		
				4	8.95	5.06	10.03	3.3	3.7		
				8	8.80	5.09	10.33	3.6	3.2		
4-8		0721	Discharge	0	17.20	4.52	9.81	2.2	2.4		
				1	17.10	4.51	10.11	3.5	2.5		
				2	17.10	4.48	9.89	2.5	2.7		

Table 21

Phytoplankton Entrainment Data; May 8-9, 1975

Date	Tide	Time	Station	Depth (m)	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)	Chl a (µg/l)		Total cells per ml
5-8	HWS	1124	Intake	0	19.00	.910	8.15	3.8	3.5	
				4.25	19.60	.924	8.03	3.5	3.5	
				8.5	18.40	1.07	8.27	3.5	3.5	
5-8		1222	Discharge	0	23.60	.818	8.33	3.5	3.8	
				1.5	23.60	.812	8.17	3.3	3.5	
				3	23.60	.812	7.97	4.0	4.1	
5-8	LWS	1830	Intake	0	21.65	1.10	8.48	4.9	4.8	
				4.25	21.45	1.09	8.60	5.7	4.9	
				8.5	20.80	.981	8.78	4.3	4.8	
5-8		1931	Discharge	0	25.20	.684	8.21	4.7	5.9	
				1.5	25.20	.684	8.35	5.0	4.0	
				3	25.20	.662	8.17	5.4	5.2	
5-9	HWS	0010	Intake	0	19.45	1.28	8.21	5.0	4.4	
				4.25	19.40	1.20	8.56	4.7	3.6	
				8.5	19.20	1.31	8.46	3.8	4.8	
5-9		0110	Discharge	0	24.20	1.04	8.29	3.8	4.4	
				1.5	24.00	1.02	8.13	3.4	4.2	
				3	23.80	1.01	8.01	4.4	4.7	
5-9	LWS	0705	Intake	0	18.15	.737	8.07	4.5	3.5	
				4.25	18.20	.745	--	4.2	3.8	
				8.5	18.25	.762	7.65	4.0	4.6	
5-9		0807	Discharge	0	23.40	.734	8.01	3.2	4.5	
				1.25	23.30	.751	7.71	4.6	4.5	
				2.5	23.20	.745	7.91	4.2	5.1	

Table 22

Phytoplankton Entrainment Data; June 2-3, 1975

Date (1975)	Tide	Time (EDT)	Station	Depth (m)	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)	Chl a (µg/l)		Total cells per ml
6-2	LWS	1456	Intake	0	28.70	.792	10.18	4.8	6.1	
				4	27.40	.621	8.33	7.6	7.0	
				8.25	27.30	.591	7.88	3.8	4.3	
6-2		1556	Discharge	0	32.50	.693	8.41	4.8	7.2	
				1.25	32.40	.704	8.43	4.2	6.4	
				2.5	32.40	.709	8.39	3.8	4.6	
6-2	HWS	1949	Intake	0	26.40	.599	8.43	4.3	4.7	
				4.25	26.25	.629	7.82	4.6	4.1	
				8.5	26.20	.629	7.96	4.6	4.8	
6-2		2047	Discharge	0	32.50	.624	8.27	5.0	3.8	
				1.25	32.40	.621	7.84	4.9	4.6	
				2.5	32.15	.621	7.86	5.4	4.7	
6-3	LWS	0310	Intake	0	24.80	.657	7.88	4.8	4.8	
				4	24.55	.643	7.66	4.0	4.3	
				8	24.00	.748	8.43	5.2	5.3	
6-3		0412	Discharge	0	30.90	.679	7.74	4.4	4.1	
				1.25	30.80	.657	8.11	4.4	3.8	
				2.5	30.40	.657	7.80	4.4	4.4	
6-3	HWS	2013	Intake	0	24.85	.874	7.86	4.3	3.5	
				4.25	24.90	.941	8.04	3.5	2.7	
				8.5	24.90	.961	7.44	3.4	4.0	
6-3		2114	Discharge	0	30.70	.876	7.74	2.5	2.5	
				1.25	30.65	.876	7.50	3.0	3.8	
				2.5	30.65	.882	7.34	4.4	3.1	

either the intake or the discharge station. Therefore in testing for significant differences between the two stations, six observations per station per sampling time have been used. Using the t test, three significant differences, all in the April run, have been detected. The mean discharge chlorophyll concentration was higher than the mean intake concentration in the first sampling period (.01 level), and lower in the second period (.05 level) and fourth period (.01 level). Analysis of the cell count data for this date showed no significant differences in either the first or second sampling period.

Vertical and Diel Distribution Studies

Tables 23 and 24 present the hydrographic and chlorophyll a data for the two intensive phytoplankton distribution surveys. At only two stations sampled for vertical distribution, CBC and JI, was there apparent vertical stratification of chlorophyll a. At both of these stations concentrations increased with increasing depth. During the diel distribution study differences in chlorophyll a concentrations among the sampling times related more to tidal current differences than to time of day. Elevated concentrations at the bottom sampling depth at 1830 occurred 1.25 hours before the time of maximum flood tide current velocity at Hog Point, while the higher concentrations throughout the water column at 0353 occurred 1.5 hours after the time of maximum ebb current. During the 0353 sampling, waves of suspended sediment could be seen being swept along by the current.

Table 23

Vertical Phytoplankton Distribution Data; April 17, 1975

Station	Time (EDT)	Depth (m)	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)	Secchi Depth (cm)	Chl a (µg/l)		Total cells per ml	
DWS	1046	0	11.10	2.85	9.7	50	1.5	1.6	300	300
		1	11.20	2.89	9.8		1.9	1.9	300	400
		2	11.40	2.98	10.0		1.6	1.7	400	250
Intake	1123	0	11.95	2.23	9.8	30	2.4	2.3	300	400
		4	12.00	2.32	9.7		2.6	2.7	300	450
		8	12.10	2.46	9.9		2.8	2.6	550	350
HPE 1	1154	0	12.15	1.06	9.9	25	2.2	2.4	150	200
		2.5	12.15	1.07	9.9		2.2	2.3	150	200
		5	12.35	1.09	10.0		2.4	2.7	100	250
HPE 2	1253	0	11.85	.86	10.0	25	2.0	2.0	250	150
		2	11.70	.90	9.9		1.9	2.1	200	250
		4	11.90	.92	9.8		2.1	2.0	150	150
HPS	1321	0	13.35	1.11	9.8	28	2.0	1.6		
		2.5	13.00	1.10	10.0		3.2	2.8		
		5	13.05	1.10	9.9		3.0	2.3		
HPN	1349	0	11.95	.61	9.9	26	1.6	1.8		
		1	11.85	.61	10.0		1.6	2.6		
		2	11.50	.65	9.9		1.9	1.9		
HPW 2	1418	0	12.60	.49	10.0	25	2.2	2.1		
		1.75	12.40	.50	9.8		1.8	2.4		
		3.5	12.20	.50	9.7		2.7	3.0		
HPW 1	1445	0	15.40	1.40	10.1	33	1.8	2.0		
		0.5	15.25	1.40	9.7		1.7	2.3		
		1	15.30	1.41	9.7		2.0	2.2		
Discharge	1525	0	21.40	2.72	9.8	32	2.3	2.2		
		1.25	21.40	2.72	9.8		2.3	2.4		
		2.5	21.40	2.71	9.7		2.2	2.3		

Table 23 (cont'd.)

Station	Time (EDT)	Depth (m)	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)	Secchi Depth (cm)	Chl a (µg/l)		Total cells per ml
CBE	1550	0	13.90	.59	9.5	29	1.6	1.4	
		0.5	13.40	.55	9.9		1.5	2.0	
		1	13.25	.53	9.7		1.6	1.4	
CBC	1618	0	11.60	.48	9.8	29	2.2	2.3	
		2	12.45	.47	9.8		3.0	2.7	
		4	12.40	.46	10.0		5.6	4.4	
JI	1649	0	11.85	.19	9.8	23	1.1	2.4	
		4	11.70	.19	9.8		3.7	3.7	
		8	11.70	.19	9.9		5.8	6.2	

Table 24

Diel Phytoplankton Data, HPW 2; May 5-6, 1975

Date (1975)	Tide	Time (EDT)	Depth (m)	Temp. (°C)	Sal. (°/oo)	D.O. (mg/l)	Secchi Depth (cm)	Chl a (µg/l)	Total cells per ml
5-5	ebb	1249	0	17.55	.474	8.45	32	2.4	4.3
			1.5	17.60	.474	8.33		5.1	2.5
			3	17.60	.480	8.43		4.8	3.7
5-5	ebb	1549	0	17.20	.101	8.17	38	3.3	2.0
			1.5	17.25	.101	8.03		1.9	1.8
			3	17.35	.104	8.03		3.0	3.0
5-5	flood	1830	0	18.85	.690	8.45	32	2.7	3.8
			1.75	18.75	.665	8.33		2.3	3.1
			3.5	18.80	.629	8.23		5.6	6.8
5-5	flood	2145	0	17.40	.632	8.43	--	2.1	2.4
			1.75	17.35	.627	8.53		2.5	2.5
			3.5	17.30	.635	8.45		1.9	2.3
5-6	ebb	0032	0	17.25	.464	8.35	--	3.0	3.2
			1.75	17.20	.469	8.41		3.1	4.0
			3.5	17.10	.477	8.37		2.3	3.5
5-6	ebb	0353	0	17.00	.118	8.03	--	3.9	3.6
			1.75	16.90	.116	7.84		3.8	5.6
			3.5	16.80	.116	8.01		5.7	3.8
5-6	LWS	0635	0	17.00	.108	7.94	37	1.9	3.7
			1.75	16.90	.106	8.07		2.9	2.2
			3.5	16.75	.106	7.88		2.6	1.8
5-6	flood	0933	0	18.35	.657	8.25	34	2.8	1.9
			1.75	17.95	.640	8.43		3.6	2.5
			3.5	17.95	.649	8.23		4.0	2.4

Conclusions

The results presented in this report are in a preliminary form, since many samples have not yet been processed and statistical analysis of the data from the processed samples is not yet complete. It is planned to perform variance analyses on the monthly plankton monitoring data to detect significant differences among stations, correlation analyses among the chlorophyll, cell count, and productivity data to evaluate their interrelationships, and community structure parameter calculations on the benthos data. Results of these analyses will be presented in future reports.

ZOOPLANKTON ENTRAINMENT
Quarterly Report
April - June 1975

George C. Grant

INTRODUCTION

The diverse zooplankton found in marine and estuarine waters serves an important role in food chains, converting phytoplankton and detrital material into protein-rich animal tissues necessary in the nutrition of higher life forms, such as the young stages of decapod crustaceans and fishes. Generally free-floating or only weak swimmers, zooplankters are readily entrained in cooling waters pumped into power plants.

Mortality of entrained organisms can be caused by mechanical abrasion, the length of time and amplitude of temperature increases during plant passage, and from chlorination of the system for fouling control. Estimates of the percent of mortality due to plant passage are difficult to obtain, however, because of the many variables that need to be taken into account.

This project was designed to examine several of these variables as they apply to entrained zooplankton at the VEPCO Surry plant. These variables include seasonal changes in populations, diurnal variation in composition and abundance, and a comparison of techniques for estimating

mortality. This report presents preliminary results for the period April - June 1975.

METHODS AND MATERIALS

Only two stations are sampled in this subproject, one at the intake forebay and one in the discharge canal. Initial sampling on 7 April 1975 indicated a low current speed and some stratification of the water column at the intake, compared with a turbulent, fast-moving stream in the discharge canal. To offset this difference, we increased the time of tows to 15 minutes in the intake, thereby providing a volume of sampled water roughly equal to that from a 5-min. tow in the discharge canal.

Zooplankton collections are made with an eight-inch bongo sampler (18.5 cm inside diameter), equipped with 202 Nitex nets and a General Oceanics flowmeter. The sampler is lowered from a fixed position to just off the bottom, then raised at set intervals in one or two meter steps to the surface (stepped oblique technique). The sampler provides paired net collections that lend themselves to comparative treatments. Our sampling schedule and sample treatment during April through June, 1975 is given in Table 1.

Live samples were initially stained with neutral red, a vital stain, using the dosage recommended by Dressel

Table 1. Schedule of completed sampling for zooplankton entrainment at the VEPCO Surry Plant, April-June 1975.

Date	Purpose	Treatment of Collections	
		Net 1	Net 2
7IV75	Establishment of sampling locations; comparison of catches with 202 and 569 micron mesh nets; vertical stratification	Preserved, 202 mesh	Preserved, 571 mesh
22-23IV75	Regular monthly sampling, 24 hour stations	Preserved	Stained, then preserved
30IV75	Trial of live examination	Stained, then preserved	Dead organisms counted prior to preservation
14-15V75	Regular monthly sampling, 24 hour stations	Stained at double dose and time, then preserved	Dead organisms counted prior to preservation, or preserved
4VI75	Replicate sampling at intake and discharge for statistical estimate of catch variability	Preserved	Not collected
17-18VI75	Regular monthly sampling, 24 hour stations	Stained, then preserved	Dead organisms counted prior to preservation, or preserved

et al. (1972). The concentration of stain was doubled beginning with the 24-hour station in May. Live samples were returned to the VEPCO biological laboratory in gallon jars kept at ambient temperatures, and counted within an hour of collection.

Counts of zooplankters were obtained from either whole samples or from aliquots in the case of smaller, more numerous taxa. Splitting of samples was accomplished by use of the device described by Burrell et al. (1974). Counts were reduced to numbers per cubic meter, after calibration of flowmeters in a flume (VIMS Physical Oceanography Dept.). Identification to species, where possible, has been carried out after the initial sorting into major taxonomic groups.

Estimates of mortality due to entrainment were obtained by three methods: 1) staining, 2) the method of Marcy (1971) and 3) that of Davies and Jensen (1974). The last two methods are based on examination of live samples.

PRELIMINARY RESULTS

Hydrography during sampling

Entrained waters during the three regular monthly sampling dates fell into the salinity classifications of fresh water to oligohaline (Table 2). Discharge waters at the point of sampling were consistently 3-4C higher than at

Table 2. Range of temperature and salinity observed at intake and discharge stations during regular monthly samples, April - June 1975.

Date	Station	Temperature (C)	Salinity (‰)
22-23IV	Intake	14.2 - 16.5	1.43 - 2.05
	Discharge	16.9 - 20.5	1.53 - 2.00
14-15V	Intake	19.5 - 23.1	0.36 - 0.78
	Discharge	22.8 - 26.0	0.40 - 0.73
17-18VI	Intake	26.0 - 29.5	3.34 - 3.99
	Discharge	30.2 - 32.2	3.40 - 3.87

the intake. Observed ranges of both temperature and salinity, measured at surface, midwater and bottom every four hours for 24 hours, were consistently narrower in the discharge than in the intake. This difference is due to mixing during plant passage of waters that, in the intake forebay, had been vertically stratified. No significant reduction in dissolved oxygen was noted in discharge waters at any time during the three-month period.

Vertical stratification and net comparisons

Samples were collected at both stations from surface, midwater and near-bottom waters with paired 202 and 571 Nitex nets on 7 April 1975. Copepods and cladocerans appeared to be most abundant at middepths at both the intake and discharge stations (Table 3), although most counts of a given taxon were in the same order of magnitude at all depths. Considering the inherent variability of plankton catches, these counts were quite close. In any event, a stepped oblique technique of sampling (used subsequently to this preliminary work) integrates populations and densities throughout the water column.

The 571 Nitex net (equivalent to a #0 mesh) was much too coarse for quantitative sampling of zooplankton, especially the typically small estuarine and freshwater forms found at the Surry location, and was tested primarily for its efficiency in catching fish larvae (cf. Ichthyoplankton

section of this report).. The 202 Nitex net has been recommended by Ahlstrom et al. (1969) as one that provides a separation between microzooplankton and mesozooplankton. It is efficient for cladocerans and all but the smallest of adult estuarine copepods (e.g. Oithona), but does not quantitatively retain smaller copepodites or copepod nauplii. Catches of fish larvae were influenced more by sampler size than mesh size. None were caught in intake sampling; the few caught in the discharge canal were unevenly distributed between nets (Table 4). A net with an opening larger than 8 inches was indicated for efficient sampling of fish larvae in the slow currents of the intake forebay.

Smaller holoplanktonic organisms such as copepods and cladocerans exhibit little net avoidance and are efficiently caught in an 8" bongo net constructed of 202 Nitex (Table 4). These organisms, together with polychaete larvae, readily pass through the meshes of a 571 Nitex net. Catch ratios of the two nets are closer to 1:1 for the larger, more active organisms such as amphipods, mysids and fish larvae.

Live staining - interference and specific variation

Vital staining of freshly-caught zooplankton was included in the design of this research as the primary means of estimating mortality due to plant passage. Earlier

Table 3. Vertical stratification of dominant major groups of zooplankton, 7 April 1975, as sampled with 202 Nitex nets. Numbers per cubic meter.

Taxon	Intake Surface	Intake Midwater	Intake Bottom	Discharge Surface	Discharge Midwater	Discharge Bottom
Copepoda	1,044	1,975	1,093	262	451	381
Cladocera	156	262	180	67	82	26
Polychaeta	67	37	28	3.2	3.2	12
Amphipoda	8.3	9.4	10	0	22	17
Mysidacea	0	11	10	1.6	6.4	0.5

Table 4. Catch ratio of major zooplankton components from paired tows of 202 and 571 Nitex nets (202:571). Based on log (x+1) transform of catch per cubic meter.

Taxon	Intake Surface	Intake Midwater	Intake Bottom	Discharge Surface	Discharge Midwater	Discharge Bottom
Copepoda	98:1	190:1	161:1	146:1	107:1	66:1
Cladocera	65:1	263:1	181:1	57:1	83:1	22:1
Polychaeta	29:1	38:1	38:1	4.2:1	3.5:1	11:1
Amphipoda	5.5:1	1:1	2.1:1	1.7:1	4.6:1	4.9:1
Mysidacea	----	1.7:1	1.4:1	1:1.4	1.5:1	1:1.1
Fish larvae	----	-----	-----	1:1.2	1:1.6	1.3:1

testing of staining with a 1:200,000 concentration of neutral red (Dressel et al. 1972) had indicated good results could be expected with copepods and ctenophores (York River, April 1974), providing that organisms were stained for at least 30 minutes. Poor results in our initial staining during the regular April sampling at the Surry plant were, therefore, unexpected.

During our initial 24-hour sampling on 22-23 April 1975, complete failure of staining was experienced at 3 of 11 stations, once at the intake and twice at the discharge. In the remaining collections, the percentage of organisms stained varied widely from 19.3% to 71.4% of the total. Sorters had difficulty in classifying many of the organisms as stained or unstained. Examination of samples revealed large amounts of detrital particles to which an evident adsorption of stain had occurred. A heavy detrital load may, thereby, interfere with staining of zooplankton. Sorting of stained and unstained organisms also showed a specific difference in stain uptake (Table 5A). Only Eurytemora affinis, the dominant calanoid copepod at this time (see below), stained consistently. Other calanoids were few in number, and only occasionally were stained; cyclopoid copepods never stained. Crippen and Perrier (1974) successfully stained calanoid copepods, polychaete eggs and larvae, gastropod eggs, hydrozoan larvae, rotifers and chaetognaths with this concentration of neutral red and

Table 5. Relative success in staining of zooplankton with neutral red at a concentration of A) 1:200,000 for 1/2 hour, Surry plant, 22-23 April 1975, B) 1:100,000 for 1 hour, Surry plant, 14-15 May 1975.

	Consistently stained	Occasionally stained	Not stained
A.	*Eurytemora affinis*	*Acartia tonsa* *Diaptomus birgei* polychaete larvae	cyclopoid copepods amphipods gastropods fish larvae
B.	*Eurytemora affinis* *Diaptomus birgei* *Acartia tonsa* harpacticoids brachyuran zoea polychaete larvae	cladocerans hydroids amphipods gastropods	cyclopoid copepods hydrachnids

a staining time of one hour. By doubling the stain concentration and increasing the staining time (1-6 hours), they were able to increase the effectiveness of staining. Calanoid copepods and polychaete larvae required the shortest staining period, barnacle larvae and decapod zoea the longest.

A staining time in excess of one hour is undesirable in our research for two reasons: 1) the schedule of sampling each of two stations every four hours and 2) the liklihood of mortality due to holding for lengthy periods. We therefore increased staining time in subsequent sampling to only one hour, and doubled stain concentration to 1:100,000. This change resulted in vividly stained organisms from our regular monthly May sampling. Preserved samples were still stained one month after collection (in 5% formalin). Results in May (Table 5B) were improved considerably, with no indecision on the part of sorters, good stain retention for up to one month after collection, and an expansion of the list of those taxa that are consistently stained. Cyclopoid copepods were the only abundant organisms that largely failed to stain. Amphipods and gastropods rarely stained and results with cladocerans and hydroids were mixed. The list of organisms consistently staining was extended from E. affinis to all calanoids, harpacticoids, polychaete larvae, and the few brachyuran larvae.

Staining results in June, with a changing fauna, were similar, with the exceptions of the now more abundant decapod larvae, which did not stain and the barnacle nauplii which consistently stained. Obviously, staining alone cannot be relied upon as an estimate of plant mortality unless a distinction is made between those organisms that consistently stain well and those that either rarely stain or stain unevenly. Examination of freshly caught collections for dead specimens was incorporated into our regular sampling in May 1975 as an alternative and comparative method.

Faunal composition and abundance of entrained zooplankton

Sorting of all collected samples into major taxonomic categories, such as copepods, cladocerans, barnacle nauplii, etc., has been completed for the April - June period. Counts from either whole samples or aliquots have been converted to numbers per cubic meter. Species identifications are nearly complete for calanoid copepods, decapod larvae and fish larvae; a good start has been made on cladocerans and amphipods. These constitute the most important components of zooplankton at the Surry location. The cyclopoid copepods, freshwater forms abundant in April and May, have not yet been identified. Presently available identifications and estimates of abundance are given in Table 6.

Zooplankton throughout the sampling period was numerically dominated by the Copepoda, as expected. The

Table 6. Identity and abundance of zooplankters at the Surry nuclear power plant (VEPCO) April - June 1975. Numbers per cubic meter based on stepped oblique tows with an 8" bongo sampler using 202 Nitex nets.

	April 22-23											
Time:	1000		1400		1800		2200		0200		0600	
Taxon / Intake (I) Discharge (D)	I	D	I	D	I	D	I	D	I	D	I	D
Cnidaria												
medusae												
hydroids	1.6	1.6		1.0	0.4	1.4		0.6	1.7		pr.	
Mollusca												
gastropods	0.8	11	0.5		1.3	8.4	90	1.2	3.1		pr.	
bivalve larvae												
Annelida												
polychaete larvae					0.2					1.6		
leeches									0.3			
Crustacea												
Cladocera	0.8	0.2			0.2							
Cirripedia												
barnacle nauplii												
barnacle cyprids												
Copepoda	70	61	50	55	63	26	227	71	160	222	pr.	
Eurytemora affinis	43	44	22	38	41	20	137	53	97	161	pr.	
Acartia tonsa	3.2	1.6			0.9		3.9	0.6	2.0		pr.	
A. clausi				0.8								
Diaptomus birgei	0.8	0.8	1.0	0.5	1.7	0.3	4.8		4.0		pr.	
Centropages hamatus												
Pseudodiaptomus coronatus												
Paracalanus crassirostris												

Table 6 (Continued)

Taxon	Time: Intake (I) Discharge (D)	April 22-23 1000 I	1000 D	1400 I	1400 D	1800 I	1800 D	2200 I	2200 D	0200 I	0200 D	0600 I	0600 D
Crustacea (cont.)													
Non-calanoids		24	14	26	15	20	5.9	81	18	57	61	pr.	
cyclopoids							4.5						
harpacticoids							1.4						
Amphipoda		0.2	4.3	2.1	6.3	8.5	36	21	20	25	18	pr.	
Isopoda													
Mysidacea													
Neomysis americana			0.2			0.2				1.4	0.2	pr.	
Decapoda (larvae)													
Crangon septemspinosa													
Palaemonetes sp.													
Rhithropanopeus harrisii													
Uca sp.													
Insecta and Hydrachnida					3.1				1.8	2.3		pr.	
Pisces													
fish eggs													
fish larvae						0.2					0.4		

Table 6 (Continued)

May 14-15

Taxon	Time: Intake (I) Discharge (D)	1000 I	1000 D	1400 I	1400 D	1800 I	1800 D	2200 I	2200 D	0200 I	0200 D	0600 I	0600 D
Cnidaria													
medusae													
hydroids			5.5										
Mollusca													
gastropods		3.1	0.5	0.2	2.8		1.2			71	27		
bivalve larvae										1.2	0.8		
Annelida													
polychaete larvae								6.9		0.9	0.4		
leeches		0.8											
Crustacea													
Cladocera		11	2.8	1.7	1.7	21	12	50		68	28	2.0	
Cirripedia													
barnacle nauplii										1.2	0.8	0.2	
barnacle cyprids													
Copepoda		458	114	111	44	382	121	2,472		492	193	133	
Eurytemora affinis		327	94	40	30	268	104	1,236					
Acartia tonsa			0.5										
A. clausi													
Diaptomus birgei				3.3		2.3	1.2	11					
Centropages hamatus			0.5	0.8									
Pseudodiaptomus coronatus													
Paracalanus crassirostris													
Non-calanoids		128	20	67	14	112	15	1,225					
cyclopoids			18	67				1,037					
harpacticoids			1.4					188					

Table 6 (Continued)

May 14-15

Taxon	Time: Intake (I) Discharge (D)	1000		1400		1800		2200		0200		0600	
		I	D	I	D	I	D	I	D	I	D	I	D
Crustacea (cont.)													
Amphipoda		5.5	6.9	4.5	19	1.6	29	243		96	70	17	
Isopoda													
Mysidacea													
Neomysis americana													
Decapoda (larvae)				0.6	0.2	1.2							
Crangon septemspinosa				0.2									
Palaemonetes sp.													
Rhithropanopeus harrisii				0.4	0.2	1.2							
Uca sp.													
Insecta and Hydrachnida		0.8		0.2		0.1				7.0	3.3		
Pisces													
fish eggs													
fish larvae		0.2			0.2	0.3							

Table 6 (Continued)

June 17-18

Taxon	Time: Intake (I) Discharge (D)	1000 I	1000 D	1400 I	1400 D	1800 I	1800 D	2200 I	2200 D	0200 I	0200 D	0600 I	0600 D
Cnidaria													
medusae		0.9				1.9						1.0	
hydroids													
Mollusca													
gastropods		1.2	1.1			41	16	30			0.5	109	44
bivalve larvae		1.7	1.1					0.7				5.2	1.8
Annelida													
polychaete larvae							0.5					1.0	
leeches													
Crustacea													
Cladocera							1.1				5.3	1.0	
Cirripedia													
barnacle nauplii		651	71	1,040	82	112	43	258	0.4	932	121	526	88
barnacle cyprids													1.8
Copepoda		3,377	567	7,048	327	383	262	3,039	394	8,778	1,093	11,996	2,002
Eurytemora affinis		93	61		2.2	9.5		44		735	157	34	80
Acartia tonsa		3,284	506	7,048	325	373	262	2,972		8,004	936	11,946	1,900
A. clausi													
Diaptomus birgei													
Centropages hamatus													
Pseudodiaptomus coronatus						0.9		5.6		7.9			
Paracalanus crassirostris												17	
Non-calanoids						1.9		17		32			22
cyclopoids						1.9				32			22
harpacticoids								17					

Table 6 (Continued)

June 17-18

Taxon	Time: Intake (I) Discharge (D)	1000		1400		1800		2200		0200		0600	
		I	D	I	D	I	D	I	D	I	D	I	D
Crustacea (cont.)													
Amphipoda			91	4.8	97	8.5	141	53	143	15	194	12	75
Isopoda							0.5				1.1		0.9
Mysidacea													
Neomysis americana						0.5	0.5	8.7	4.6	18	3.7		
Decapoda (larvae)		20	22	37	15	5.7	3.7	29	8.2	45	20	69	25
Crangon septemspinosa								0.3					
Palaemonetes sp.		5.2	9.8	1.2		2.8	0.5	8.0		12	4.2	8.4	3.7
Rhithropanopeus harrisii		12	11	36	15	0.9	2.6	14		33	15	59	21
Uca sp.		2.9	1.1			1.9	0.5	6.9			0.5	2.1	
Insecta and Hydrachnida			2.1	1.2	2.2		2.6	1.4		1.0	22		
Pisces													
fish eggs		7.0		2.4		2.4				1.0			
fish larvae		3.2	1.1		1.1		1.1	2.8	1.0	5.0	1.6	8.9	5.4

dominant copepod in April and May was Eurytemora affinis, an important upper estuarine East Coast species. Acartia tonsa was present in low numbers in April, along with the cold-water A. clausi, decreased in the freshened conditions of May, and dramatically increased to dominance in June. Diaptomus birgei, apparently a new record for the James River, if correctly identified, was common in April and May. Other calanoid copepods were quite rare, occurring mostly at the intake station in June. Non-calanoids, associated with the low salinity E. affinis, were most abundant in April and May and consisted mostly of cyclopoid copepods (Mesocyclops edax and possibly Cyclops vernalis). Only one as yet unidentified species of harpacticoid copepod was present.

Amphipods were abundant throughout the period, more so in the discharge station and at night. This distribution may be related to net avoidance in daylight or slow currents, to diurnal migration, or some combination of these factors.

Decapod larvae first appeared in May (Crangon septemspinosa and Rhithropanopeus harrisii), then increased in diversity and abundance in June. R. harrisii larvae were most abundant, followed by those of Palaemonetes sp., Uca sp. and Crangon septemspinosa. Barnacle nauplii also became abundant in June, reaching densities of 1000 per cubic meter, second only to Acartia tonsa. Cladocerans were numerous in May, in the lowest salinities sampled, and consisted of several freshwater species.

Hydroids, a small gastropod, polychaete larvae, Neomysis americana, water mites and fish larvae occurred frequently but in low numbers. Less frequent were hydromedusae, bivalve larvae, leeches, isopods and fish eggs.

Early occurrences of fish larvae consisted of Atlantic menhaden (Brevoortia tyrannus) and spot (Leiostomus xanthurus). Increased numbers in June were due to appearances of bay anchovy (Anchoa mitchilli) and the naked goby (Gobiosoma bosci), primarily.

Intake - discharge differences

Distinctions between the composition and abundance of species before and after plant passage are necessarily tentative at this point, but certain features of Table 6 merit mention. Among the more abundant organisms, a fairly consistent reduction in density from intake to discharge is evident for all copepods, cladocerans, decapod larvae and fish eggs. The opposite relationship of intake to discharge densities was found in catches of amphipods. These differences are important in that estimates of mortality based on percent motility (or percent stained) do not take into account elimination of individuals (possibly through maceration beyond recognition) or early mortality and decomposition in the intake canal. However, the possibility that observed differences may be an artifact of sampling cannot yet be ruled out. Complete absence in

the discharge canal of forms taken in the intake occurred only in June with fish eggs (Anchoa mitchilli) and the copepod Pseudodiaptomus coronatus.

Variation in replicate tows

A series of replicate tows (5 discharge, 4 intake) was taken on 4 June 1975 in an initial assessment of catch variation. This will be repeated seasonally. The number of replicates was insufficient for a good estimate of variation. Data for total copepods per cubic meter were as follows:

Tow No.	Discharge	Intake
1	3437	2033
2	2490	3145
3	3856	1775
4	1719	718
5	2710	
$\bar{x}$:	2842	1918
$s_{\bar{x}}$:	373.2	507.8
st.dev.:	834.4	1,015.6

With such wide variation, especially at the intake, a minimum of 10 replicates will be needed to estimate sampling error. In order to minimize time and tide variation in catches, tows at the intake will be reduced to five minutes.

Mortality estimates

Preliminary estimates of mortality due to entrainment have been calculated by three methods: 1) differentiation of stained and unstained organisms, using the vital stain neutral red, 2) the technique of Marcy (1971) where the number of living organisms per cubic meter are determined, and those in the discharge are divided by those in the intake to give percent survival and 3) the method of Davies and Jensen (1974), also based on live counts, that corrects for dead organisms in the intake in calculating a corrected percent motility. Problems in staining stemming from interference by detritus and specific differences in uptake have been treated earlier in this report. Calculation of percent survival, following Marcy (1971), seems to assume that total dead plus live organisms in the intake are equal in density, theoretically not an unreasonable assumption, but in practice not one that we have been able to demonstrate. With estimates of abundance consistently higher in the intake, our calculations of percent survival are usually quite low, even though visual examination of discharge collections show few dead (intact) zooplankton. The final method (Davies and Jensen 1974) yields much higher percent survival estimates, but does so by ignoring absolute numbers per cubic meter.

The various estimates are compared in Table 7. The correction applied by Davies and Jensen (1974) to their percent motility data to account for dead organisms at the

Table 7. Preliminary estimates of zooplankton survival after plant passage at the Surry plant, James River, Virginia, April - June 1975. Based on paired collections at the intake forebay and discharge canal.

	Staining		Method of Marcy (1971)	Method of Davies and Jensen (1974)
	Corrected % stained		% survival	Corrected % motility
Month	Total zoopl.	Calanoid copepods	Total zoopl.	Total zoopl.
April	86.7	112.8	---- no estimates	----
	stain failure	stain failure	----	----
	0	0	----	----
	216.5	140.0	----	----
	102.4	92.6	----	----
May	122.2	106.7	27.7	97.3
	122.7	94.1	57.6	94.8
	80.5	91.4	41.5	100.9
	142.0	127.1	----	----
	99.6	102.0	----	----
	140.0	98.2	----	----
June	95.1	n.a.	17.3	92.1
	20.3	19.6	6.1	93.2
	59.4	87.8	84.8	99.4
	76.6	n.a.	----	----
	69.8	76.3	----	----

intake has been utilized in our estimates for staining. The percent stained in discharge samples was divided by the percent stained in intake samples and multiplied by 100. Percentages less than 100 should indicate entrainment mortality; the lower the corrected percent stained, the greater the entrainment effect. Corrected percentages greater than 100 (6 of 15 estimates for total zooplankton, 5 of 13 for calanoid copepods) probably result from changes in composition and abundance between intake and discharge paired samples. Their occurrence seriously questions the reliability of the method.

Estimates of percent survival by the Marcy (1971) method, based on numbers per cubic meter of live organisms, were generally quite low and appeared to be at variance with other estimates, even in a general sense. Corrected percent motility estimates (Davies and Jensen 1974) appeared reasonable for this time of year, based on observation of living samples and in view of the temperature at the discharge canal. The single estimate above 100 could be explained by sampling error, especially where all estimates were above 92%. Similar estimates during summer conditions when mortality might be expected to increase should prove or disprove the method.

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Ichthyoplankton Entrainment Study
VEPCO Surry Nuclear Power Station
Progress Report - July 1975

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Introduction

Ichthyoplankton entrainment studies at the Surry Nuclear Power Station in Surry, Virginia were started in April 1975 by the Ichthyology Department of the Virginia Institute of Marine Science. These studies are designed to assess the magnitude and kinds of ichthyoplankton passing through the facility.

Numerous resident fish species and several anadromous fishes spawn in the vicinity of Hog Island, James River, Virginia. Larvae and small juveniles of several marine fishes are also expected in the river near Hog Island, i.e. sciaenids and menhaden. Pelagic and demersal fish eggs as well as larval fishes which are unable to overcome the intake water velocities would be passed through the facility. The species lists and abundance of fish eggs, larvae, and juveniles obtained during the preliminary tests and first two 24 hour stations of our entrainment monitoring program are presented in this progress report.

Materials and Methods

Preliminary ichthyoplankton entrainment studies were conducted between April 7th and 30th, 1975 to evaluate gear type, mesh size, length of tow and vertical stratification before establishment of a standard sampling program to be implemented on 24 hour stations. Sampling sites were the intake forebay immediately in front of the trash screens and the discharge canal at the roadway bridge. Sampling gear included 1) 8 inch bongo net (see zooplankton section for test results), 2) D-Net

sled (Fig. 1), 3) single 0.63 meter diameter net, 4) single 1.0 meter diameter net, and 5) paired 0.5 meter diameter nets (=Bongo net) (Fig. 1). Mesh sizes of netting included 1) 202 micron nitex, 2) 505 micron nitex, and 3) rectangular mesh 375 x 750 micron nitex. Tows ranged from 5 to 20 minutes duration and were taken at the surface, mid-depth, and near bottom at both sites.

Gear comparison tests were made in the following combinations:

1) D-Net vs 0.63 m for bottom samples and tow duration
2) 0.63 m for vertical stratification and tow duration
3) 0.5 m bongo for 505 u vs 202 u
4) 8 inch bongo vs .5 m vs 0.63 m vs 1.0 m for net avoidance

Mesh size in the various nets were :
0.63 m, and D-Net = 375 x 750 micron; 8 inch bongo = 202 micron; 0.5 m bongo = 202 and 505 micron; and 1.0 m = 505 micron

All preliminary sampling was conducted during daylight hours. Vessels and operators were furnished by VEPCO. Usually, two project personnel were required to conduct each ichthyoplankton preliminary gear test.

The standard sampling program includes 0.5 m bongo nets (505 micron) equipped with GSI flowmeters, tows made at surface, mid-depth and bottom in the intake forebay in front of the trash screen and mid-channel at the roadway bridge in the discharge canal; and sample times of 0200, 0600, 1000, 1400,

1800, 2200 hrs. EDT. Tow time at the intake is 10 minutes per depth and at the discharge is 5 minutes per depth. Temperature, dissolved oxygen, and salinity data are recorded for each sample depth at each site on each sample interval.

The bongo provides 2 replicate samples for each tow. Different tow times at the intake and discharge stations reflect our compromise between sampling equivalent water volumes and being able to sample approximately the same water mass at the intake and discharge sites for each time interval (time of water passage through the plant is approximately 1 hour; J. C. White, personal communication). Travel time for personnel between the sampling sites requires approximately 20 minutes and short delays for various reasons often cause discharge samples to be taken slightly later than one hour after beginning the intake samples.

Vessels and an operator are furnished by VEPCO and two project personnel on each 12 hour shift are required to conduct a standard 24 hour sampling program.

All samples are preserved in glass jars with approximately 5% formalin, labelled, and returned to the laboratory for sorting, enumeration and identification. Data are stored in log sheet form and are being prepared as punch cards for ADP. Specimens are stored in vials with 5% formalin for future reference or further study.

The first 24-hour station was occupied on April 22 - 23, 1975 using 0.63 m bongo arrangement due to a delay in shipment of the 0.5 m (505 u) nets. Sampling was continued on a weekly

schedule through June 1975.

Results and Discussion

Primarily postlarval and juvenile fishes with very few fish eggs or larvae were captured during preliminary gear tests. D-Net and 0.63 m net samples at the intake yielded very few fishes and often contained no fish at all (Tables 1, 2, and 3). Discharge canal samples consistently yielded young fishes in both nets.

Turbidity of the water, variation in water velocity horizontally and vertically in front of the forebay, and gear avoidance by the larger fishes were considered prime factors contributing to catch variability during the preliminary tests. Spot (*Leiostomus xanthurus*), Atlantic menhaden (*Brevoortia tyrannus*) and bay anchovy (*Anchoa mitchilli*) in postlarval, juvenile and adult life stages dominated the samples. Larvae of two species (yellow perch, *Perca flavescens* and Atlantic silversides, *Menidia menidia*) were found. The only eggs found were carp, *Cyprinus carpio*. Catch variability between replicates was greater at the intake site at each depth than at the discharge site for any depth.

The D-Net was eliminated from consideration as a standard sampling device for ichthyoplankton entrainment at the Surry Power station. This net fished directly on the bottom yet samples with the 0.63 meter net which fished slightly above bottom yielded similar catches. In fact, catches with the 0.63

meter net were slightly higher and contained more fish species (Table 3). The D-Net retained a greater quantity of detritus than the 0.63 m net. Detritus hampers sorting and processing efficiency in direct proportion to its abundance.

The 202 u mesh nitex nets were eliminated as sampling devices for the ichthyoplankton entrainment study at Surry. Though slightly more individuals (82 vs 77) and species (1.25 per tow vs 1.17 per tow) were caught in 202 u mesh nets than the 505 u mesh net (Table 4), catch variability ruled out any significant differences. A much greater quantity of detritus was present in the 202 u net samples at all fishing depths relative to that in the 505 u net samples. Loss of net filtration efficiency and increased time in processing samples were factors against the use of 202 u mesh nets.

The 1.0 meter diameter nitex net was rejected as a standard sampling device at the intake forebay. Area at the net mouth for the 1.0 meter net is 4 times that of the .5 meter net, thus at low water velocity, as at the intake 1) larvae and postlarvae might more effectively avoid the smaller net and 2) sample volume filtered would be increased 4X per unit time with the 1.0 m net. Yet, comparison of catches (Tables 4 and 5) revealed the 1.0 meter net to be no more effective than the .5 meter net. Therefore tow time could be reduced at the intake by use of a 1.0 meter net but data reliability would not be improved since gear escapement by the fishes was not evident when 0.5 and 1.0 m data were compared. Physical size and cumbersomeness of the

larger net in the sampling vessel also weighed against selection of a 1.0 m net as standard gear in our program.

Standard gear selected for 24 hour stations was the 0.5 meter "bongo" equipped with 505 u nitex nets. Apparent advantages of this gear and disadvantages of other gear types outlined in previous paragraphs led to this selection.

Hydrographic data for preliminary studies are listed in Table 6.

The 24 hour stations processed to date (2 stations, Tables 7-10) yielded catches similar to those obtained in the preliminary studies, i.e. postlarval, juvenile, and adult fishes were the dominant developmental stages. Bay anchovy, menhaden and spot again dominated the samples. Numbers of fish and number of species caught increased slightly, presumably as a function of sampling intensity on the 24 hour stations and the seasonal trend in species availability in the vicinity of the power station. Several species of fish larvae were taken (spottail shiner, Notropis hudsonius, carp and one unidentified species). Carp eggs were again the only fish eggs taken.

Total number of fishes and number of species caught increased at night. Less net avoidance through reduced visibility and diurnal habits of the fishes may account for the higher catches at night. Some species, i.e. spot, were taken in all tows but increased in abundance during the night.

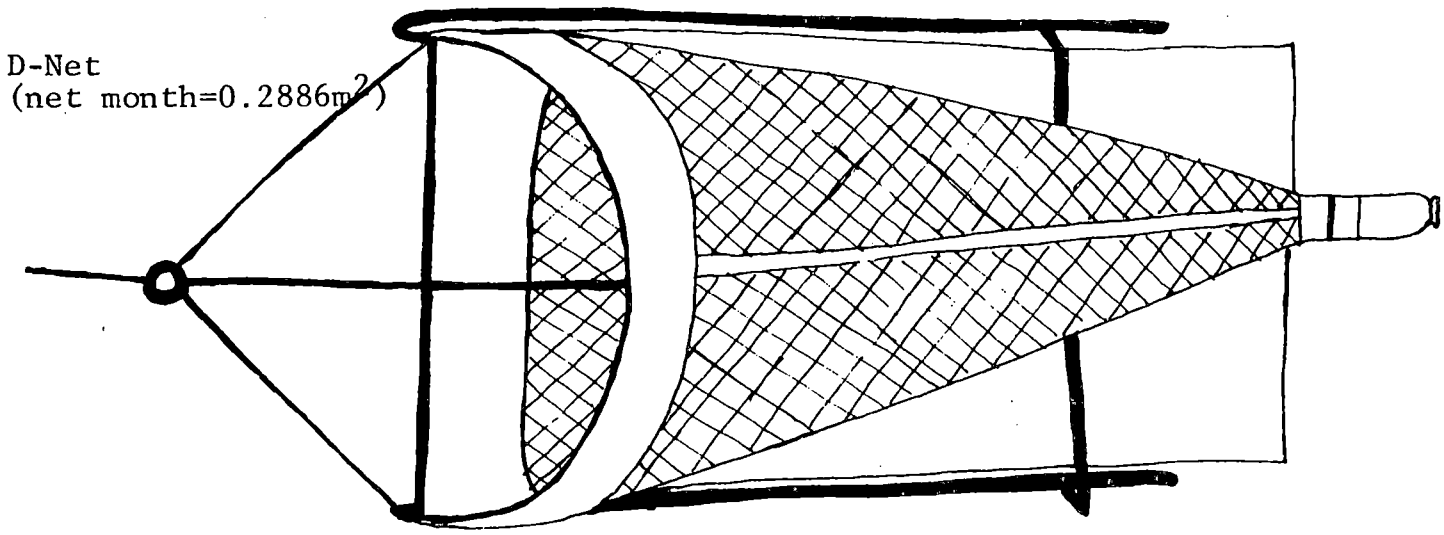
Rarely did any species increase in abundance during daylight hours. One pair of daylight surface samples, 1400 hours

on April 22, contained high numbers of menhaden and bay anchovy.

Hydrographic data for the 24 hour stations are listed in Tables 11 and 12.

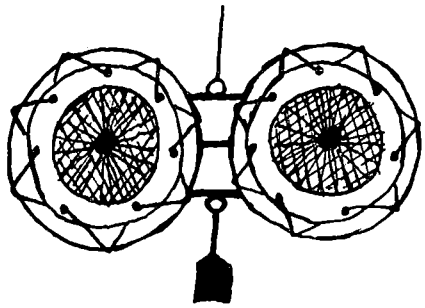
The data presented in this report were deemed insufficient to perform statistical analysis. Numbers were quite low and variability high. As sampling progresses into the height of the spawning period, numbers are expected to increase and statistical analysis can be performed. More complete analysis will be presented in later reports.

Fig. 1: D-Net Sled & Bongo Net Used in Sampling

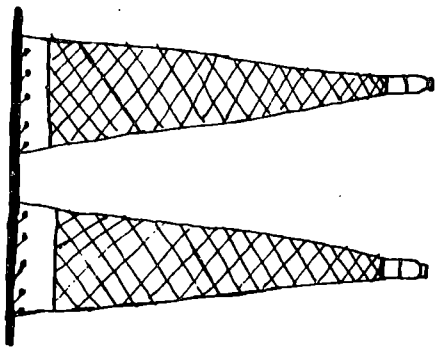


Front Angle View

Bongo Net



Front View



Top View

Table 1. Species, number of individuals, and calculated number of individuals per $100m^3$ caught in the D-Net during preliminary studies

			Tow 1		Tow 2		Tow 3		Tow 4	
Location	Date/Time	Species	Total #	#/$100m^3$	Total #	#/$100m^3$	Total #	#/$100m^3$	Total #	#/$100m^3$
Intake*	7 Apr./1330	Spot	1	29	1	12	4	61		
		Menhaden			8	92	4	61		
Discharge*	7 Apr./1448	Spot	3	6	2	25	6	14		
		Menhaden	16	32			14	32		
Intake*	11 Apr./1000		0	0	0	0	0	0	0	
Discharge*	11 Apr./1305	Menhaden	4	11	3	9	1	2		
		Spot	1	3						
Discharge*	16 Apr./1508	Menhaden	1	3	4	12	3	8		
		Spot			1	3	2	6		
	Bay	Anchovy	1	3	2	6	1	3		
Intake**	16 Apr./1002		0		0		0			

* Duration of tows = 5 minutes
** Tow 1 = 5 minutes, Tow 2 = 15 minutes, and Tow 3 = 20 minutes

Table 2. Species, number of individuals, and calculated number of individuals per $100m^3$ caught in the 0.63 meter net during preliminary studies

Location	Date/Time (EDT)	Species	Tow 1		Tow 2		Tow 3		Tow 4		Tow 5	
			Total #	#/$100m^3$	Total #	#/$100m^3$	Total #	#/$100m^3$	Total #	#/$100m^3$	Total #	#/$100m^3$
Intake												
Bottom*	11 Apr./1040		0		0		0		0			
Midwater*	11 Apr./1119		0		0		0					
Surface*	11 Apr./1141		0		0		0					
Discharge												
Bottom*	11 Apr./1305	Bay Anchovy	1	2	1	2	1	2				
		Atlantic Menhaden	3	7	2	5	2	5				
		Spot			3	7						
Midwater*	11 Apr./1338	Atlantic Menhaden	0		1	2	1	2				
Surface*	11 Apr./1405		0		0		0					
Intake												
Midwater**	16 Apr./1037	Spot			1	1					1	2
		Bay Anchovy			3	3					1	2
		Yellow Perch					1	2	1	2		
		Atlantic Menhaden					2	4				
		Croaker							1	2		
		American Eel									1	2
Bottom***	16 Apr./1230	Spot	1	2	1	2	7	11				
		Atlantic Menhaden					2	3				
		Bay Anchovy					1	2				
		American Eel					2	3				
Surface***	16 Apr./1325	Atlantic Menhaden	2	9	1	3	3	10				
		Unidentified	1	4								
		Spot			4	12						
Discharge												
Bottom*	16 Apr./1450	Spot	4	9	7	15	2	5				
		Atlantic Menhaden	5	11	10	21	1	2				
		American Eel	1	2								
		Bay Anchovy			1	2	3	7				
Midwater*	16 Apr./1523	Spot	5	9	3	6	4	8				
		Atlantic Menhaden	4	7	2	4	5	10				
		Bay Anchovy			1	2						
		American Eel			1	2						
		Croaker					1	2				
Surface*	16 Apr./1549	Spot	1	2	0		0					

* Duration of tows = 5 minutes
** Duration of tow 2 = 20 minutes, all others = 15 minutes
*** Duration of tows = 15 minutes

Table 3. Comparison of catches by the D-Net and the .63 meter conical net (bottom) during preliminary work.

			D-Net		2/3 Meter		
Location	Date	Species	Total #	#/100m^3	Total #	#/100m^3	Tow Number
Intake	11 April		0		0		1
			0		0		2
			0		0		3
			0		0		4
Discharge	11 April	Atl. Menhaden	4	10	3	7	1
		Spot	1	3			
		Bay Anchovy			1	2	
		Atl. Menhaden	3	8	2	5	2
		Spot			3	7	
		Bay Anchovy			1	2	
		Atl. Menhaden	1	2	2	5	3
		Bay Anchovy			1	2	
Intake	16 April	Spot			1	2	1
Discharge	16 April	Atl. Menhaden	1	3	5	11	1
		Bay Anchovy	1	3			
		Spot			4	9	
		American Eel			1	2	
		Spot	1	3	7	15	2
		Atl. Menhaden	4	12	10	21	
		Bay Anchovy	2	6	1	2	
		Atl. Menhaden	3	8	1	2	3
		Spot	2	6	2	5	
		Bay Anchovy	1	3	3	7	

Table 4. Catches by 202 u and 505 u mesh nets during preliminary studies (sampling on 30 April)

Location	Depth	# Replicate	Species	Left 202 u Total #	Left 202 u #/100m^3	Right 505 u Total #	Right 505 u #/100m^3
Intake	Surface	1	Am. Eel	1	6	0	
		2	Atl. Menhaden	0		2	13
			Atl. Silverside			1	7
	Mid H_2O	1	Spot	2	12		
			Croaker			1	6
		2		0		0	
	Bottom	1		0		0	
		2		0		0	
Discharge	Bottom	1	Atl. Menhaden	2	10	3	16
			Carp (eggs)	33	168	25	132
		2	Atl. Menhaden	1	9	1	4
			Spot	1	9	1	4
			Am. Eel	1	9		
			Carp (eggs)	5	45	9	40
	Mid H_2O	1	Bay Anchovy	2	9	1	4
			Spot	1	4		
			Carp (eggs)	7	31	9	39
		2	Carp (eggs)	21	93	20	87
			Atl. Menhaden			1	4
	Surface	1	Carp (eggs)	3	13	0	
			Atl. Menhaden	1	4	0	
		2	Atl. Menhaden	1	4	1	4
			Carp (eggs)			2	9

Table 5. Species, number of individuals and calculated number of individuals per $100m^3$ caught in a 1 meter net during preliminary studies (Sampling on 30 April)

			Tow 1		Tow 2	
Location	Depth	Species	Total #	#/$100m^3$	Total #	#/$100m^3$
Intake	Surface	Spot	1	2		
		Atl. Menhaden	1	2	10	18
		Tidewater Silver-side	1	2		
	Midwater	Atl. Menhaden	1	4	1	2
		Bay Anchovy			1	2
	Bottom	Bay Anchovy			2	4

Table 6. Temperature, salinity and dissolved oxygen readings from preliminary studies.

Date	Intake Surface	Intake Midwater	Intake Bottom	Discharge Surface	Discharge Midwater	Discharge Bottom
			Temperature			
11 April	10.6	*	*	18.3	*	*
16 April	10.4	10.5	11.5	19.5	19.7	19.1
30 April	--	--	--	--	--	--
	(No thermometer)					
			Salinity			
11 April	4.6	*	*	4.3	*	*
16 April	2.2	2.2	2.4	--	2.6	2.6
30 April	1.9	2.0	2.0	2.1	2.0	2.0
			Dissolved Oxygen			
11 April	9.9	*	*	9.8	*	*
16 April	10.1	10.3	10.5	10.3	10.1	9.9
30 April	8.9	8.9	9.0	8.6	8.6	8.4

* Kemmerer bottle broken when dropped in boat.

TABLE 7. Species and number of individuals per tow during the 24 hr. station on 22 - 23 April 1975

Species	Station Time	Intake						Discharge					
		Surface		Midwater		Bottom		Surface		Midwater		Bottom	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Anchoa mitchilli	1000	1	2							1	1		
Brevoortia tyrannus		7	17	9	9	1			3	9	8	3	6
Leiostomus xanthurus				1									
Menidia beryllina												1	
Unidentified									1				
Anguilla rostrata													1
Micropogon undulatus													
Brevoortia tyrannus	1800	12	6	2	7	4		4	1	8	6	12	14
Leiostomus xanthurus				6	2	1	2			5	5		1
Micropogon undulatus					1		1						
Anchoa mitchilli						1			1		1	2	5
Anguilla rostrata						1							
Menidia beryllina									1				
Unidentified											1		
Anchoa mitchilli	0200	15	9	6	2		1	1		1	4		
Brevoortia tyrannus		1	3	5	3	2	1	2	2	4	7	1	8
Leiostomus xanthurus		1	1		1		2			3	1	1	1
Anguilla rostrata			1					2	3			1	
Micropogon undulatus						1							
Menidia beryllina								2	3				
Notropis hudsonius													
Unidentified													

Species	Station Time	Intake						Discharge					
		Surface		Midwater		Bottom		Surface		Midwater		Bottom	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Anchoa mitchilli	1400	150	130	15	3	2	3		1	1	2	1	
Brevoortia tyrannus		16	34	5	7	1		2	4	6	5	8	6
Leiostomus xanthurus					1	2				1	2	1	
Menidia beryllina				1									
Unidentified		1											
Anguilla rostrata													
Micropogon undulatus				1	1								
Brevoortia tyrannus	2200	3	4	5	2	2	1	2		8	5	1	3
Leiostomus xanthurus		5	1	2	2	1	1			9	3	2	3
Micropogon undulatus				1	3						1		
Anchoa mitchilli				1	1			2		5	6	3	4
Anguilla rostrata		4	2					1	3	2			1
Menidia beryllina								1	2				1
Unidentified													
Anchoa mitchilli	0600	1											
Brevoortia tyrannus				3	2								
Leiostomus xanthurus				3	3	1	1						
Anguilla rostrata				1	1								
Micropogon undulatus							1						
Menidia beryllina													
Notropis hudsonius					2								
Unidentified				1									

* No sample taken due to boat failure between intake and discharge sites.

TABLE 8. Species and number of individuals per 100 cubic meters during the 24 hour station on 22 - 23 April 1975

Species	Station Time	Intake						Discharge						Station Time	Intake						Discharge					
		Surface		Midwater		Bottom		Surface		Midwater		Bottom			Surface		Midwater		Bottom		Surface		Midwater		Bottom	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Anchoa mitchilli	1000	9	17							2	2			1400	435	374	34	5	6	10		2	3	4		3
Brevoortia tyrannus		61	145	27	22	7			7	21	17	9	14		46	98	11	11	3		5	8	15	11	27	17
Leiostomus xanthurus				3														2	6				3	4		3
Menidia beryllina												3					2									
Unidentified									2						3											
Anguilla rostrata													2													
Micropogon undulatus																	2	2								
Brevoortia tyrannus	1800	84	34	8	25	14	26	11	2	22	15	33	32	2200	21	20	21	7	13	5	5		13	10	3	7
Leiostomus xanthurus				24	7	4	6			14	12		2		35	5	8	7	6	5			15	6	6	7
Micropogon undulatus					4		3										4	10						2		
Anchoa mitchilli						4			2		2	6	11				4	3			5		8	12	9	9
Anguilla rostrata						4									28	10					2	7	3			2
Menidia beryllina									2												2	5				2
Unidentified											2															
Anchoa mitchilli	0200	79	41	18	5		3	2		2	9			0600	5											
Brevoortia tyrannus		5	14	15	8	8	3	5	5	9	15	3	20				11	7								
Leiostomus xanthurus		5	5		3		7			7	2	3	3				11	11	4	4						
Anguilla rostrata			5					5	7			3					4	4								
Micropogon undulatus						4														4						
Menidia beryllina								5	7																	
Notropis hudsonius																		7								
Unidentified																	4									

*No sample taken due to boat failure between intake and discharge sites.

TABLE 9. Species and number of individuals per tow during the 24 hour station on 1 - 2 May 1975

Species	Station Time	Intake						Discharge						Station Time	Intake						Discharge					
		Surface		Midwater		Bottom		Surface		Midwater		Bottom			Surface		Midwater		Bottom		Surface		Midwater		Bottom	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Brevoortia tyrannus	1000		1		1						1		1	1400				1				1	2	1	2	2
Menidia menidia			1																							
Anchoa mitchilli												1	1											1		1
Cyprinus carpio												1													1 (egg)	
Unidentified																		1								
Menidia menidia	1800		2											2200												
Notropis hudsonius			1																							
Brevoortia tyrannus						6	2			1		5	2				5	1		3				1		1
Cyprinus carpio												1											1		1 (egg)	
Anchoa mitchilli													1						1	2				1	1	1
Leiostomus xanthurus													1				4	3	4	5			6	6		3
Micropogon undulatus																		1							1	
Leiostomus xanthurus	0200	1		16	5	2	2			4	13	1	3	0600										2	4	3
Brevoortia tyrannus				2						3	4	1						1	2	1					3	1
Micropogon undulatus					1	1					1															
Unidentified								1		1								1								
Anchoa mitchilli										1																
Anguilla rostrata											1															
Cyprinus carpio																										1 (egg)

TABLE 10. Species and number of individuals per 100 cubic meters during the 24 hour station on 1 - 2 May 1975

Species	Station Time	Intake						Discharge						Station Time	Intake						Discharge					
		Surface		Midwater		Bottom		Surface		Midwater		Bottom			Surface		Midwater		Bottom		Surface		Midwater		Bottom	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Brevoortia tyrannus	1000		5		4						4		3	1400				12				4	8	4	7	8
Menidia menidia			5																							
Anchoa mitchilli												3	3											4		4
Cyprinus carpio												3													4 (eggs)	
Unidentified																		12								
Menidia menidia	1800	33												2200												
Notropis hudsonius		16																								
Brevoortia tyrannus						16	6			3		17	7				17	3		10				4		4
Cyprinus carpio												3											3		3 (eggs)	
Anchoa mitchilli													3						3	7				3	3	4
Leiostomus xanthurus													3				14	6	12	17			18	19		11
Micropogon undulatus																		3							3	
Leiostomus xanthurus	0200	9		99	80	54	141			15	47	3	11	0600										7	19	11
Brevoortia tyrannus				12						11	15	3						6	13	12					14	4
Micropogon undulatus					16	27					4															
Unidentified								4		4								6								
Anchoa mitchilli										4																
Anguilla rostrata											4															
Cyprinus carpio																										4(eggs)

TABLE 11. Temperature, salinity, and dissolved oxygen readings during 24 hour station April 22-23, 1975.

Time	Intake			Discharge		
	Surface	Midwater	Bottom	Surface	Midwater	Bottom
			Temperature			
1000	15.2	15.2	15.1	19.2	19.3	19.1
1400	16.5	16.3	16.2	20.5	19.7	19.8
1800	15.8	15.3	15.3	20.0	18.7	18.7
2200	14.7	14.2	14.8	19.2	18.2	18.0
0200	14.5	broken thermometer		18.5	17.0	16.9
0600	14.4	14.2	14.2	*--	--	--
			Salinity			
1000	1.8	--	1.9	--	1.8	--
1400	1.6	1.6	1.6	1.6	1.5	1.5
1800	1.4	1.7	1.7	1.5	1.6	1.5
2200	1.9	2.0	2.0	1.9	1.9	2.0
0200	1.5	1.5	1.7	1.6	1.6	*--
0600	1.8	1.4	2.0	+--	--	--
			Dissolved Oxygen			
1000	--	--	--	--	--	--
1400	8.6	--	--	--	--	--
1800	9.5	9.3	9.2	9.3	9.2	9.2
2200	9.2	9.1	9.2	9.5	9.2	9.2
0200	9.2	9.2	9.4	9.7	9.1	*--
0600	9.4	9.6	9.5	+--	--	--

* No analysis by lab
+ Station cancelled, vessel failure

TABLE 12. Temperature, salinity, and dissolved oxygen readings during 24 hour station May 1-2, 1975.

Time	Intake			Discharge		
	Surface	Midwater	Bottom	Surface	Midwater	Bottom
			Temperature			
1000	14.8	--	--	15.6	15.9	15.6
1400	16.4	16.5	16.5	16.6	16.7	16.7
1800	17.0	16.8	16.8	17.0	17.3	17.1
2200	16.5	17.5	17.0	18.0	--	--
0200	16.5	16.7	16.7	17.8	17.7	17.4
0600	16.0	16.0	16.0	19.5	19.1	19.1
			Salinity			
1000	1.7	1.7	1.7	1.8	1.8	1.8
1400	1.7	1.8	1.8	1.7	1.7	1.7
1800	1.7	2.0	2.1	2.0	2.0	2.0
2200	2.0	1.5	2.1	1.5	1.5	1.5
0200	1.6	0.6	1.6	1.7	1.7	1.7
0600	1.7	2.0	2.1	1.8	1.8	1.8
			Dissolved Oxygen			
1000	8.1	8.0	7.8	8.5	8.6	8.8
1400	8.9	8.9	8.6	8.6	8.8	8.7
1800	8.6	8.5	8.6	8.6	8.6	8.5
2200	7.8	8.5	8.3	8.6	8.5	8.9
0200	8.2	8.2	8.2	8.5	8.6	8.8
0600	8.3	8.1	8.4	6.9	8.4	8.2

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The Surry Station of the Virginia Electric and Power Company is located on a peninsula in the James River, 25 miles upstream of the junction of the river with the Chesapeake Bay. The site is on the west bank of the river in Surry County, Virginia. Two (2) pressurized water reactors are located at the site with a design output of 824.3 MWe (gross) per unit. Cooling water for the condensers is taken in downstream of the site and discharged 5.7 miles upstream of the intake. The flow of the river at the site is complex, influenced by the amount of fresh water run-off, the back-and-forth flow of the tide, upstream flow of more saline water near the bottom, and downstream flow of less saline water near the top.

During plant operation, low levels of radioactivity are released with the cooling water to the James River and with ventilation air to the atmosphere. These releases are limited to the "lowest practicable level" and are measured to assure compliance with NRC Regulations and the Surry Power Station Technical Specifications. The environmental monitoring program provides confirmatory surveillance.

The low levels of radionuclides released to the air and water from Surry Station contribute to the radiation background through both external and internal exposure. The primary modes of external exposure include immersion in a cloud of radioactive gaseous effluent, submersion in water containing radioactive effluent, and exposure from contaminated land surface. The primary modes of internal deposition include inhalation of air and ingestion of milk, fish, and shellfish. Dose via the

ingestion pathway is limited by the following site related considerations. The vicinity represents a very limited milk shed. During the year, milk was analyzed by gamma spectrometry with a conservative detection limit of 10 pCi/ℓ. In order to completely document this potential path, the 1975 program includes radiochemical analyses of milk samples for I-131 content with a sensitivity of 0.25 pCi/ℓ. The saline river is unusable for drinking purposes. Fish and shellfish consumption could become an important pathway in the future when sewage pollution (from cities upstream) is reduced.

The following shows the manner in which the elements of the Surry Surveillance Program fit together to monitor any radiological impact as a result of operations:

Relationship of Sampling and Measurements to Elements of the Radiation Dose Paths

Radiation Dose Path	Sample and Measurements (Supportive Data)
Air Immersion	Thermoluminescent Dosimetry (Air Sampling)
Inhalation	Air Sampling (Precipitation, Crop, Soil, and Milk Sampling)
Land Surface	Thermoluminescent Dosimetry, Crop and Soil Sampling (Air and Milk Sampling)
Ingestion	
Fish and Shellfish	Fish, Oysters, Clam and Crab Sampling (Water and Silt Sampling)
Water	Well, Surface Water, and Precipitation Sampling (River Water and Silt Sampling)
Milk	Milk Sampling (Air, Water, Soil and Crop Sampling)
Water Submersion	Water Sampling (Silt Sampling)

This report contains data resulting form a radioassy of various samples obtained from the environs of the station. Figure 1 indicates the land based sampling stations while Figure 2 indicates James River stations.

Data obtained by Eberline Instrument Corporation (EIC), a consulting service, is presented for the first and second quarters of this year.

The 1975 program when compared to that presented in the Technical Specifications is redundant in order to maintain the sampling and analytical requirements.

SURRY POWER STATION
ENVIRONMENTAL SAMPLING PROGRAM
1975

LAND BASED SAMPLING STATIONS
STATION NUMBER (See Figure 1)

Sample Medium	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Air Particulate	X	X	X	-	X	X	-	-	X	X	X	-	-	-	-	-	-
Radiogas	X	X	X	-	X	X	-	X	X	X	X	X	X	X	X	X	X
Precipitation	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Milk	-	-	X(2)	-	-	X	-	-	X	-	-	X	-	-	-	-	-
Well Water	X	X	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Crop	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface Water	-	-	-	X	-	-	X	-	-	-	X	X	-	-	-	-	-
Fowl	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil	X	-	X	-	X	X	-	-	X	X	-	-	-	-	-	-	-

No. 1 - Surry Station
No. 2 - Hog Island Reserve
No. 3 - Bacon's Castle
No. 4 - Chippokes Creek
No. 5 - Alliance
No. 6 - Colonial Parkway
No. 7 - Williamsburg
No. 8 - Jamestown
No. 9 - Dow
No. 10 - Fort Eustis
No. 11 - Newport News
No. 12 - Smithfield
No. 13 - Scotland Wharf
No. 14 - Lee Hall
No. 15 - Rt. 10 and 676
No. 16 - Kingsmill
No. 17 - Budweiser

JAMES RIVER SAMPLING STATIONS
STATION NUMBER (See Figure 2)

Sample Medium	1	2	3	4	5	6	7	8	9	10
James River Water	X	-	X	-	X	X	-	-	-	X
Silt	X	-	X	-	X	X	-	-	X	X
Oyster	-	-	-	-	-	-	-	X	X	X
Clam	X	X	-	X	X	-	X	-	-	-
Crab*	-	-	-	-	-	-	-	-	-	-
Fish*	-	-	-	-	-	-	-	-	-	-

No. 1 - Chickahominy
No. 2 - Cobham Bay
No. 3 - Station Discharge
No. 4 - Jamestown
No. 5 - Hog Island Point
No. 6 - Station Intake
No. 7 - Lawnes Creek
No. 8 - Deep Water Shoals
No. 9 - Point of Shoals
No. 10 - Newport News

* Sampled in vicinity of station - usually at intake canal.

SAMPLE TYPE	FREQUENCY		TYPE OF ANALYSIS
II. AIR			
A. Particulates	Bi-Weekly (Vepco)		Gross Beta
	Monthly (Vepco)		Gross Alpha
	Monthly (EIC)		Gross Beta (Gamma Isotopic if over 10pCi/m^3)
	Quarterly (EIC)***		Gamma Isotopic
Surry Station Hog Island Reserve Bacon's Castle Alliance Colonial Parkway Dow Fort Eustis Newport News			
B. Radiogas	Quarterly (EIC)	TLD	mrem exposure
Surry Station Hog Island Reserve Bacon's Castle Alliance Colonial Parkway Dow Fort Eustis Newport News Smithfield Jamestown Scotland Wharf Lee Hall Rt. 10 & 676 Kingsmill Budweiser			

*** Composits (by Eberline) of Bi-Weekly samples. Stations 1 and 2 analyzed as one sample, Stations 3, 5, 6, 9 and 10 analyzed as one sample. Station II analyzed as one sample.

SURRY POWER STATION
ENVIRONMENTAL SAMPLING PROGRAM

SAMPLE TYPE	FREQUENCY	TYPE OF ANALYSIS
1. WATERS		
A. James River	Bi-Monthly (Vepco) Bi-Monthly (Vepco) Tri-Annually (EIC) Semi-Annual	Gross Beta Tritium (Chickahominy & Newport News) Gamma Isotopic Enriched Tritium*
Chickahominy Hog Island Point Station Intake Newport News Station Discharge		
B. Wells	Semi-Annual (Vepco & EIC)	Gross Alpha, Gross Beta, & Tritium (Enriched Tritium by Eberline)
Surry Station (Deep) Hog Island Reserve (Deep) Bacon's Castle (Shallow) Jamestown (Shallow)		
C. Surface Water	Semi-Annual (Vepco & EIC)	Gross Alpha, Gross Beta, & Tritium
Chippokes Creek Williamsburg Reservoir Newport News Reservoir Smithfield		
D. Precipitation	Monthly (Vepco) Quarterly (EIC)**	Gross Beta & Tritium Gross Beta (Gamma Isotopic if over 15nCl/m^2) Enriched Tritium
Surry Station Newport News		

* Composites (by Eberline) of Bi-Monthly samples from Chickahominy & Newport News Stations.

** Composites (by Vepco) of monthly samples.

SAMPLE TYPE	FREQUENCY	TYPE OF ANALYSIS
III. BIOTA		
A. Crops	Annual (EIC) Corn, Peanuts and Soybean	Gamma Isotopic and Sr-89 & Sr-90
Bacon's Castle		
B. Fowl	Semi-Annual (EIC)	Gamma Isotopic
Hog Island Reserve		
C. Oyster	Bi-Monthly (EIC) Tissue	Gamma Isotopic
Deep Water Shoals Point of Shoals Newport News		
D. Clam	Bi-Monthly (EIC) Tissue	Gamma Isotopic
Chickahominy Hog Island Point Lawnes Creek Station Discharge Jamestown		
E. Crab	Three per season (EIC) Tissue (July, Aug. & Sept.)	Gamma Isotopic
In Vicinity of Station		
F. Fish (Catfish and White Perch or Eel)	Semi-Annual (EIC)	Gamma Isotopic
Vicinity of Station		

SAMPLE TYPE	FREQUENCY	TYPE OF ANALYSIS
IV. SILT	Semi-Annual (EIC)	Gamma Isotopic
Chickahominy Station Discharge Hog Island Point Station Intake Point of Shoals Newport News		
V. MILK	Monthly (EIC) Bi-Monthly (EIC)	Iodine 131 Gamma Scan (NaI) for CS-137; SR-89, Sr-90, and Calcium
Bacon's Castle (Epps) Bacon's Castle (Judkins) Lee Hall (Ross) Smithfield (Gwaltney) Colonial Parkway (Smith)		
VL. SOIL	Annual (EIC)	Gamma Isotopic
Alliance Bacon's Castle Colonial Parkway Dow Fort Eustis Surry Station		

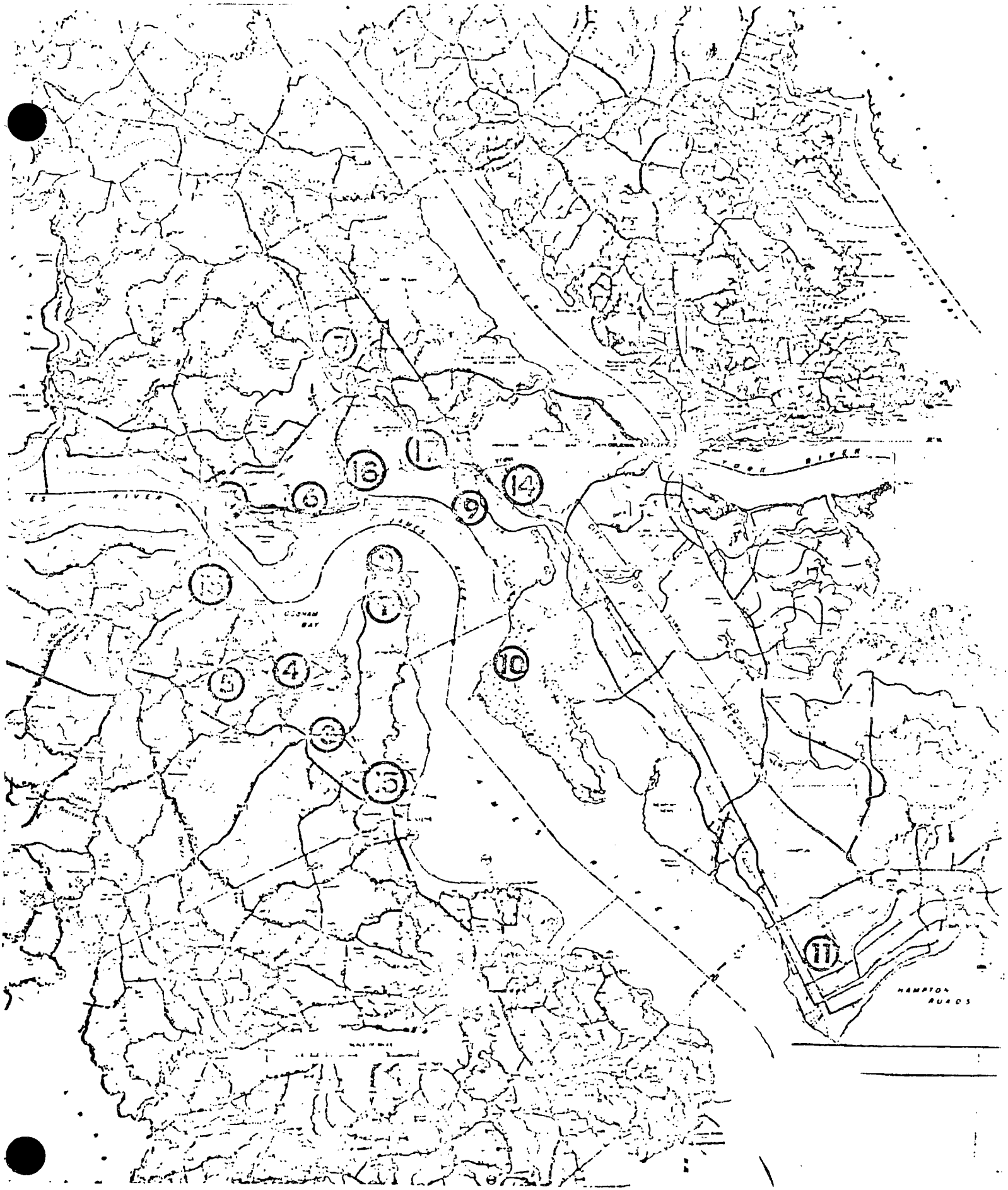


FIGURE 1

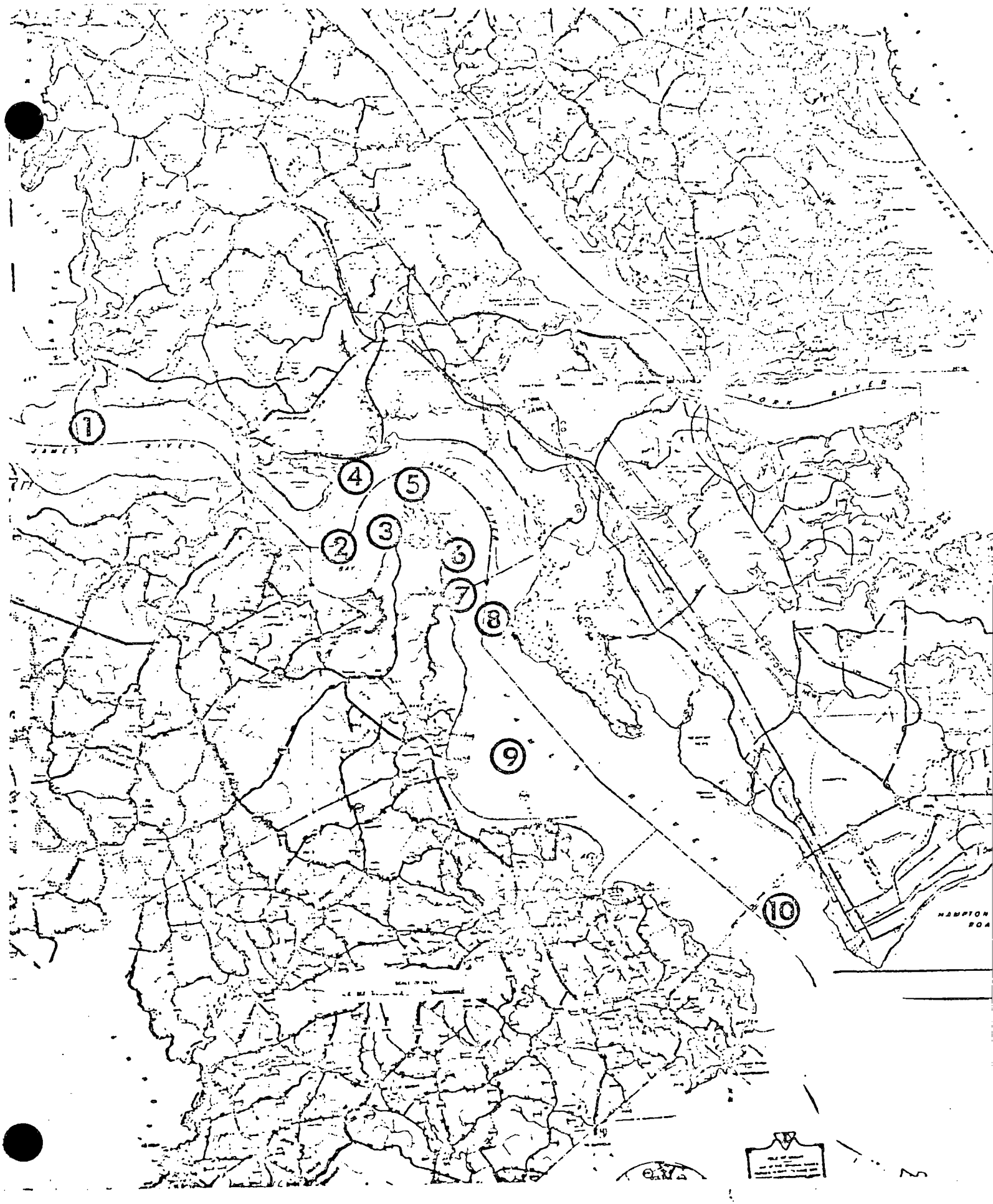


FIGURE 2

SUMMARY

Air Particulate Samples

During late winter and early spring of 1974, air particulate gross beta concentrations increased due to the arrival of fission products not related to Surry Station. A number of conditions indicated the activity was received from an upper atmosphere inventory injected by the Peoples Republic of China surface weapons test conducted in June, 1973. From February through April of 1975, the same type of apparent increase was observed through a rise and fall of the gross beta air particulate concentrations. It would appear that the relatively increased activity observed during the first half of 1975 experienced an additional amount due to the 1974 surface weapons test. The relative persistance of fission product concentrations, in spite of the relatively short half-lived isotopes, concludes additional contribution. During the late spring and eary summer of this year, gross beta concentrations returned to early 1974 levels. Gross beta concentrations returned to early 1974 levels. Gross beta concentrations for the past 18 months, started with chronological averages at 5.3 and 8.5 E-02 pCi/M^3 (Jan. '74) and increased to 3.5 and 3.2 E-01 pCi/M^3 (May, '74). The concentrations gradually declined and remained in the range of from 6.7 to 9.0 E-02 pCi/M^3 throughout the last quarter of 1974 and January 1975. By the February 11, 1975 collection, activity was noted to increase and reached a maximum of 1.5 E-01 pCi/M^3 for the April 22nd collection. The subsequent month showed averages to be 8.9 E-02 pCi/M^3 and the following three sampling periods showed steady declines from 7.9 to 6.9 and to 5.7 E-02 pCi/M^3.

The overall average gross beta concentration for the first six months of 1975 was 9.7 E-02 pCi/M^3 with the average maximum station at 1.8 E-01 pCi/M^3 and the average minimum concentration at 3.3 E-02 pCi/M^3.

Gamma spectrometry of quarterly composite samples showed expected concentrations of naturally occurring radio-isotopes. Four fission products have been consistently observed: zirconium and niobium-95, cesium-137, and cerium-144. A summary of these data and a comparison with the same period in 1974 are given in Table IV. The concentrations in the Table show that samples from Newport News showed higher concentrations of at least three of the four fission products relative to other stations during that quarter and also compared to the average at Newport News during the first half of 1974. This judgement must be tempered by the fact that the composited samples for Newport News represent less sample size than the other multi-station composites. The relative error terms are therefore, significantly greater than for the other determinations. If any plant contribution to this activity had occurred, the composited samples from Surry Station and Hog Island Reserve would have shown the highest concentration of the three. During the first and second quarters of 1975, that composite indicated either the lowest or similar concentrations of the fission products relative to the other two composites. These data, with effluent documentation, plus those from other monitoring programs at nuclear power plants in this region of the United States, deny Surry Station as a source of the four fission products. The five sample composite showed cobalt-60, during the first quarter, with 4.0 ± 1.5 E-03 pCi/M^3. The second quarter composite showed potential concentrations of manganese-54 at 1.2 ± 1.0 E-03 pCi/M^3, and ruthenium-106 at 1.4 ± 1.2 E-02 pCi/M^3. The composite of these five stations allows most sensitive determination due to the large air volume represented on the filters. Presuming these three isotopes were from Surry Station, the following comparison can be made with Table II of Appendix B of 10 CFR 20 which is based upon continuous exposure:

TABLE IV. SUMMARY OF FISSION PRODUCT CONCENTRATIONS IN AIRBORNE PARTICULATE COMPOSITE SAMPLES (picocuries per cubic meter)

	Zirconium-95	Niobium-95	Cesium-137	Cerium-144
First Quarter, 1975				
Surry Station & Hog Island Reserve	2.9 ± 2.2 E-03	4.5 ± 2.5 E-03	4.7 ± 1.8 E-03	1.5 ± 1.1 E-02
Bacon's Castle, Alliance, Colonial Pkwy., Dow., Ft. Eustis	6.2 ± 1.8 E-03	1.0 ± 0.3 E-02	4.1 ± 1.6 E-03	4.6 ± 1.5 E-03
Newport News	2.1 ± 1.0 E-02	2.8 ± 1.0 E-02	6.2 ± 6.2 E-03	1.8 ± 0.8 E-01
Second Quarter, 1975				
Surry Station & Hog Island Reserve	5.1 ± 2.8 E-03	3.2 ± 2.5 E-03	3.1 ± 1.7 E-03	3.3 ± 1.1 E-02
Bacon's Castle, Alliance, Colonial Pkwy., Dow., Ft. Eustis	3.9 ± 1.8 E-03	9.3 ± 2.0 E-03	3.0 ± 1.6 E-03	9.2 ± 1.6 E-02
Newport News	Less than 8.6 E-03	4.4 ± 4.2 E-03	Less than 5.7 E-03	2.9 ± 2.4 E-02
Average of First and Second Quarters, 1975				
Surry Station & Hog Island Reserve	1.0 E-02	1.7 E-02	Less than 4.8 E-03	8.1 E-02
Bacon's Castle, Alliance, Colonial Pkwy., Dow., Ft. Eustis	7.3 E-03	1.8 E-02	3.8 E-02	7.1 E-02
Newport News	Less than 7.7 E-03	1.9 E-02	4.8 E-03	7.1 E-02

	Observed Concentrations	10CFR20 Concentration	Fraction
Mn-54	1.2 ± 1.0 E-03 pCi/M^3	3 E+02 pCi/M^3	4.0 E-06
Ru-106	1.4 ± 1.2 E-02	1 E+03	1.4 E-05
Co-60	4.0 ± 1.5 E-03	2 E+02	2.0 E-05

Ambient Thermoluminescent Dosimetry

The average dose rate for all stations during the first quarter of 1975 was 1.5 mrem/wk. The second quarter yielded an average of 0.8 mrem/wk. The average dose rate for the second half of 1974 was 1.6 mrem/wk.

The difference is not due to altered dose rates in the field. All the factors of in-transit dose, including shipping, handling, and storage before and after field placement, bear directly on the gross dose measurements. In the way of example, the control dosimeters used to quantify in-transit dose, frequently show dose rates in excess of that measured in the field due to the very slightly elevated dose rate it receives during storage relative to the field dosimeters. This difference is roughly 13 uR/hr compared to 9 uR/hr in the field. The best way to review the data is to use the lowest field measurement as the "control" and compare those dose rates during the two quarterly monitoring periods. This presentation gives:

	First Quarter 1975	Second Quarter 1975
Surry Station	1.6 (± 19%) mrem/wk	0.3 (± 47%) mrem/wk
Hog Island Reserve	0.2 (± 64%)	0.3 (± 27%)
Bacon's Castle	0.1 (± 150%)	0
Alliance	0	0.1 (± 120%)
Colonial Pkwy	0	0.1 (± 120%)
Dow	0	0.1 (± 80%)
Fort Eustis	0.2 (± 49%)	0.2 (± 90%)
Newport News	0.3 (± 80%)	0.3 (± 60%)

	First Quarter 1975	Second Quarter 1975
Smithfield	0.3 (± 50%)	0.4 (± 17%)
Scotland Warf	0.1 (± 98%)	0.4 (± 30%)
Jamestown	0.1 (± 100%)	0.3 (± 20%)
Lee Hall	0.3 (± 37%)	0.5 (± 20%)
Rts. 10 & 676	0	0

The percentage errors are an estimate of the 95 percent confidence level by using the dose measurement error relative to the net dose above the lowest dose stations.

Precipitation Samples

Gross beta and tritium levels in precipation remained relatively low in comparison to expected levels and historically observed levels. Gross beta averaged 7.6 nNi/M^2 at Surry Station and 5.7 nCi/M^2 at Newport News during the first half of 1975. Tritium levels averaged were 36 ± 25 nCi/M^2 and 42 ± 28 nCi/M^2 at Surry and Newport News during the first quarter. Second quarter samples were below analytical sensitivity. These can be compared to the 1974 data:

1974

	Average Gross Beta	Average Tritium
Newport News	4.9 nCi/ M^2	43 nCi/M^2
Surry Station	8.5	70

A single higher value for tritium of 114 nCi/M^2 was noted for the second quarter of 1974; without that value the above tabulated average could have been 56 nCi/M^2.

Milk Samples

An unusual feature of the milk sampling program was the incidence of iodine-131 in three of the 26 samples analyzed during the first half of 1975. The three were:

Colonial Parkway	5-20-75	0.69 ± 0.22 pCi/l
	6-04-75	0.61 ± 0.20

Lee Hall	5-20-75	1.9 ± 0.2

Every effort was made to investigate the analytical environment to assure no potential cross contamination was possible. All samples were re-counted to insure the data was accurate. The Colonial Parkway samples were not statistically distinct from background upon recount. The Lee Hall sample was re-counted four times during the following two weeks and apparently the half life of iodine-131 was possible; the half life was between five and thirteen days at 95 percent confidence. The Colonial Parkway samples would indicate an extended contribution since the expected five day effective half life on the pasture was not indicated. The potential for cross contamination following collection cannot be discounted however, a potential dose estimate can be made for these data.

For Colonial Parkway, the following assumptions are made:

1. The concentration in milk gradually decreased from 0.69 pCi/l to 0.61 pCi/l during the period 5-20-75 to 6-04-75.
2. After 6-04-75, the concentration in milk decreased with the five day effective pasture half life expected. (1)
3. The dose to the thyroid due to ingestion by an adult is 1.86 E-03 mrem/pCi. (2)

The resultant dose to the adult thyroid would be approximately 0.026 mrem and, by presuming a factor of ten difference in the infant thyroid mass, 0.26 mrem to the potential infant. A dose estimate for Lee Hall can be made by applying the five day effective pasture half life following 5-20-75. Using the other assumptions above, the potential dose to the adult thyroid is 0.028 mrem and the infant thyroid is 0.28 mrem. It must be noted that neither effluent documentation nor any other environmental sample analyses support the possibility that the observed

(1) J.K. Soldat, "Environmental Evaluation of an Acute Release of I-131 to the Atmosphere," Health Physics, pp. 1009-1015, Vol. 11, October, 1965

(2) Attachment to - Numerical Guides - To Meet the Criterion "As Low as Practicable - In Light Water Cooled Nuclear Power Reactors, Docket, No. RM-50-2, p. A-17, U.S. Atomic Energy Commission, February 20, 1974.

iodine-131 levels are attributable to Surry Plant operation.

Radiostrontium analysis of the milk samples showed finite probability of strontium-89 in a single sample: 2.3 ± 2.3 pCi/l at Colonial Parkway on 1-27-75. Strontium-90 concentrations averaged 5.7 p Ci/l for all stations during the six month period and ranged from 1.6 to 20 pCi/l. The levels are typical for strontium-90 present from old weapons test fallout. During the last half of 1974, strontium-90 averaged 6.9 pCi/l with a ranged of form 1.6 to 15 pCi/l.

Gamma spectrometry showed expected concentrations of naturally occurring radionuclides and cesium-137 was measurable in nine of the 24 samples. The latter is expected from old fallout and an average of the nine yields 17 pCi/l wihtin a range of from 13 ± 11 pCi/l to 26 ± 13 pCi/l. For comparison, the six measurable concentrations from the second half of 1974 averaged 20 pCi/l with a range of from 12 ± 12 pCi/l to 32 ± 16 pCi/l. While probably a statistical artifact, cobalt-57 could have been present in the 7-1-75 collection from Judkins; the calculated concentration was 17 ± 17 pCi/l.

Well Water

Four samples were collected on May 6, 1975 and analyzed for gross alpha and beta concentrations and low levels of tritium. A single sample showed measurable alpha activity with 5.8 ± 3.7 pCi/l. This same sample, from Bacon's Castle also showed the highest beta concentration, with 16 ± 5 pCi/l, and also the highest tritium concentration with 410 ± 100 pCi/l. The only other sample showing measurable beta activity was collected at Jamestown and showed 5.6 ± 5.1 pCi/l.

Tritium concentrations other than Bacon's Castle sample discussed above, showed levels near detection limits. Hog Island Reserve measured 100 ± 90 pCi/l, Surry Station had less than 90 pCi/l, and Jamestown indicated 90 ± 90 pCi/l.

The previous experience has shown the Bacon's Castle sample to indicate measurable gross activity. During 1973 and 1974 Bacon's Castle showed gross alpha activity in a single sample with 3.2 ± 1.3 pCi/l. The sample collected during the second half of 1974 indicated a gross beta concentration of 17 ± 5 pCi/l and the first half sampling showed 11 ± 5 pCi/l. Two analyses during 1973 gave 5.9 ± 4.4 and 8.6 ± 4.5 pCi/l. In April of 1973, the Jamestown sample showed a high of 19.1 ± 6.5 pCi/l.

Tritium was observed in the Bacon's Castle well during the second half of 1974 with 200 ± 160 pCi/l. Jamestown had previously indicated tritium including 380 ± 80 pCi/l during the first half of 1974 and 370 ± 160 during the second half. These data have indicated potential surface water intrusion.

None of the activity observed can be expected due to Surry operation. Other sample data plus the lack of elevated activity in the two closest locations (Surry and Hog Island Reserve) support this point.

Surface Water Samples

Of the four samples analyzed for gross alpha activity, only the Smithfield reservoir showed activity above analytical sensitivity with 4.1 ± 3.7 pCi/l. Gross beta concentrations averaged 8.4 pCi/l and ranged from 5.6 ± 4.6 to 16 ± 6 pCi/l. Tritium levels were all below 380 pCi/l.

The gross alpha activity can be expected due to the presence of naturally existing radionuclides however this is the first time any measurable alpha activity was found in a surface water sample. It must be noted that at the 96 percent condifence level, the result becomes non-distinct from background. The gross beta concentration, at Smithfield, at 16 ± 6 pCi/l appears elevated however, during the second half of 1974 a sample from Smithfield showed 12 ± 5 pCi/l. These levels are within the 2 to 31 pCi/l reported by the Environmental Protection Agency (1970) at the Kerr Dam in Va.

James River Water

Gamma spectrometry of James River Water samples collected during January, March, and May, 1975, yielded data for naturally occurring radionuclides, cesium-134, and possibly cesium-137. The March 13th collection at the Station Discharge may have had cesium-137 with 4.1 ± 4.1 pCi/l. A low concentration of cesium-134 was observed at Newport News with the May 15th collection at 4.3 ± 3.4 pCi/l. It is doubtful that the cesium-134 came from Surry since none of the James River Water samples, including Station Discharge, showed the isotope. Non-uniform distribution of the very dilute cesium-134 could have occurred. Possibilities could include another source, or even a statistical artifact in the gamma spectrum since 4.3 pCi/l is slightly below the normal analytical sensitivity.

Silt Samples

The semi-annual collection was effected during March. Gamma spectrometry indicated the presence of nine naturally occurring radionuclides and also ten fission and activation products. The following tabulation summarizes the latter group.

Station Discharge (3-18-75)

MN-54	4.9 ± 1.6 E-01 pCi/g	Cs-134	1.1 ± 0.1 E+00
Co-58	4.9 ± 1.7 E-01	Cs-137	3.0 ± 0.3 E+00
Co-60	1.3 ± 0.2 E+00		

Point of Shoals (3-27-75)

Co-58	7.6 ± 6.9 E-02 pCi/g	Cs-137	6.7 ± 1.7 E-01
Cs-134	1.5 ± 1.1 E-01		

Station Intake (3-13-75)

Mn-54	4.1 ± 1.2 E-01 pCi/g	Cs-134	1.5 ± 0.2 E+00
Co-58	5.3 ± 1.8 E-01	Cs-137	3.6 ± 0.4 E+00
Co-60	8.1 ± 1.9 E-01	Ce-144	2.0 ± 1.4 E+00

Newport News (3-27-75)

Cs-137	7.6 ± 1.7 E-01 pCi/g

Chickahominy (3-24-75)

Cs-137	8.4 ± 2.0 E-01 pCi/g

Hog Island Point (3-18-75)

Mn-54	4.4 ± 1.5 E-01 pCi/g	Cs	1.3 ± 0.2 E+00
Co-58	6.5 ± 1.7 E-01	Cs-137	2.9 ± 0.3 E+00
Co-60	1.1 ± 0.2 E+00		

One can historically relate the accumulated fission and activation products. Cesium-137 has been observed consistently over the past two and one-half years:

		Average	Range
1973 First Half	(4/6 samples)	8.6 E-01 pCi/g	3.6 ± 1.6 E-01
			1.5 ± 0.2 E+00
Second Half	(6/6 samples)	7.1 E-01	4.0 ± 3.1 E-01
			1.1 ± 0.3 E+00
1974 First Half	(6/6 samples)	7.6 E-01	5.0 ± 1.8 E-01
			1.2 ± 0.9 E+00
Second Half	(6/6 samples)	6.0 E-01 pCi/g	1.9 ± 1.4 E-01
			1.1 ± 0.2 E+00
1975 First Half	(6/6 samples	2.0 E+00	6.7 ± 1.7 E-01
			3.6 ± 0.4 E+00

The ranking, by concentration and from high to low is:

Station Intake

Station Discharge

Hog Island Point

Chickahominy

Newport News

Point of Shoals

Statistically the results represent two distinct distributions: The three highest locations range from 2.9 to 3.6 pCi/g (± 10%) and the three lowest stations range from 0.67 to 0.84 (± 25%). It would appear that something on the order of 2 pCi/g was distributed about Hog Island Point and between the discharge and intake points. This picture can be complicated by the rate of sedimentation from surface water runoff into the James River and also subsequent scrubbing of the sediments due to higher than usual river flow and/or tides. The relatively non-uniform distribution of the cesium-137 is historically demonstrated in that no sampling location, including Station Discharge, had exhibited consistently high or low results.

The presence of activation product concentrations also show the trend. The September, 1974 collection showed several isotopes not previously detected and can be compared to the March, 1975 concentrations:

	Station Discharge (pCi/g)	
	September, 1974	March, 1975
Mn-54		4.9 ± 1.6 E-01
Co-58	3.1 ± 1.1 E-01	4.9 ± 1.7 E-01
Co-60	4.0 ± 1.7 E-01	1.3 ± 0.2 E+00
Cs-134	2.4 ± 1.5 E-01	1.1 ± 0.1 E+00
Hg-203	1.9 + 1.7 E-01	

	Hog Island Point (pCi/g)	
	September, 1974	March, 1975
Mn-54		4.4 ± 1.5 E-01
Co-58		6.5 ± 1.7 E-01
Co-60		1.1 ± 0.2 E+00
Cs-134		1.3 ± 0.2 E+00

	Station Intake (pCi/g)	
	September, 1974	March, 1975
Mn-54	1.6 ± 1.2 E-01	4.1 ± 1.2 E-01
Co-58		5.3 ± 1.8 E-01
Co-60		8.1 ± 1.9 E-01
Cs-134		1.5 ± 0.2 E+00
	Point of Shoals (pCi/g)	
	September, 1974	March, 1975
Co-58		7.6 ± 6.9 E-02
Cs-134		1.5 ± 1.1 E-01

The impact of the bottom sediment concentrations, in the path to man, will depend upon many conditions. While estimates could be made, better judgement is permitted through review of shellfish and fish concentrations.

Oyster Samples

The three sets of samples, collected during the first half of 1975, showed relatively low level concentrations of fission and activation products. Cesium-137 was measurable in all samples except the March collection at Newport News and the May sampling from Point of Shoals. No build up of the cesium-137 concentrations is indicated and, relative to previous data, they may even be decreasing. This could mean that most of the cesium-137 taken in by oysters originated with old weapons surface tests. Point of Shoals and Deep Water shoals are relatively close to Surry Station and would show plant influence while Newport News is sufficiently down river to act as a comparative control. A comparison shows:

Cesium-137 in Oysters (pCi/g wet)

	Point of Shoals	Deep Water Shoals	Newport News
1-24-75	2.5 ± 1.7 E-02	3.0 ± 1.0 E-02	1.3 ± 0.3 E-01
3-27-75	2.7 ± 1.6 E-02	3.1 ± 1.5 E-02	Less than 3.8 E-02
5-15-75	Less than 2.7 E-02	3.0 ± 2.2 E-02	2.4 ± 2.1 E-02
5-08-75		(Extra sample)	2.7 ± 1.4 E-02

During the second half of 1974, only a single sample from Deep Water Shoals (9-13-74) showed cesium-137 at 4.1 ± 2.0 E-02 pCi/g. Similarly Point of Shoals had two of three samples with calculable cesium-137 at 5.8 ± 2.1 E-02 pCi/g (7-2-74) and 7.4 ± 4.6 E-02 pCi/g (11-22-74).

There is some evidence to support a hypothesis that the January 24, 1975 collection of Newport News received activity from some other source. In addition to the relatively elevated cesium-137, three other artifically produced isotopes were observed:

Zn-65	3.3 ± 2.2 E-02 pCi/g
Ru-103	2.2 ± 1.4 E-02
Cs-134	6.6 ± 2.2 E-02

One other sample had a finite probability of containing cesium-134; the 1-24-75 sampling at Deep Water Shoals indicated 1.5 ± 1.3 E-02 pCi/g. Through the entire history of the environmental monitoring program, cesium-134 had been observed in a single sample from Newport News: 4.3 ± 2.8 E-02 pCi/g collected on 11-22-74. Zinc-65 had not been previously documented in shellfish and the only previous indication of this activation product in any sample was in James River Water collected at Newport News on January 24, 1974 (15 + 10 pCi/l).

One activation product not previously observed in oysters, was manganese-54. Although very near the analytical sensitivity the May 15th Point of Shoals collection indicated 1.7 ± 1.2 E-02 pCi/g. Two additional activation products, cobalt-58 and 60, were observed. Cobalt-58 showed 1.2 ± 1.0 E-02 pCk/g in the January 24th sample from Deep Water Shoals. Cobalt-60 indicated 1.4 ± 1.3 E-02 pCi/g at Newport News on May 15th; a supplemental sample collected on May 8, 1975 only indicated less than 2.7 E-02 pCi/g with 99.7 percent confidence.

Deep Water Shoals oysters previously had cobalt-58 in a sample collected on July 2, 1975: 4.8 ± 3.0 E-02 pCi/g. Cobalt-60 had been measured in a Deep Water Shoals sample at 3.0 ± 2.1 E-02 pCi/g on March 26, 1974.

The manganese-54 at Point of Shoals and the cobalt-58 and cesium-134 at Deep Water Shoals appear to be the only isotopes that are present in the oysters as a result of Surry Station operations. Since they are single and isolated instances, a dose estimate can be made on the basis of a single intake using guidance published by the AEC(1) and presuming one adult consumed the total three samples. The resultant infinite dose committments would be:

	mrem
Mn-54	1.2 ± 0.8 E-04 (GI-LLI)
Co-58	1.2 ± 2.0 E-05 (GI-LLI)
Cs-134	6.7 ± 4.5 E-04 (Body)

Presuming continuous consumption and an annual intake of 9 kg, the committment of the above would be

	mrem/yr.
Mn-54	2.1 ± 1.5 E-03 (GI-LLI)
Co-58	4.8 ± 4.0 E-04 (GI-LLI)
Cs-134	1.4 ± 0.9 E-02 (Body)

Clam Samples

Clam samples were collected at five locations during January, March and May of 1975. Gamma spectrometry showed 11 of 15 samples with cesium-137. The average concentration was 4.6 E-02 pCi/g and the observed range was from 2.0 ± 1.7 E-02 to 8.3 ± 2.7 E-02 pCi/g. Any significant accumulation could be revealed by reviewing the historical data. A summary of the positive indications of cesium-137 by sampling location and chronological sequence shows:

	Station Discharge (pCi/g)
9-13-74	1.3 ± 0.4 E-01
11-22-74	6.8 ± 2.6 E-02
1-07-75	2.5 ± 2.4 E-02
3-24-75	3.4 ± 2.1 E-02
5-13-75	3.5 ± 7.0 E-02

(1) Attachment - Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as Practicable..." Docket No. RM-50-S, U.S. Atomic Energy Comm., February 20, 1974, p A-16ff.

	Jamestown (pCi/g)
3-19-74	4.1 ± 4.0 E-02
7-02-74	2.4 ± 2.4 E-02
11-22-74	3.8 ± 1.7 E-02
1-07-75	8.0 ± 2.4 E-02
3-24-75	5.4 ± 2.3 E-02
5-13-75	5.5 ± 1.7 E-02
	Hog Island Point (pCi/g)
5-20-75	7.4 ± 6.0 E-02
7-02-74	6.0 ± 2.8 E-02
9-13-74	7.0 ± 4.4 E-02
11-22-74	5.0 ± 2.8 E-02
3-24-75	2.6 ± 2.5 E-02
5-13-75	4.7 ± 2.4 E-02
	Chickahominy (pCi/g)
1-16-74	4.1 ± 3.0 E-02
9-13-74	5.4 ± 3.6 E-02
11-25-74	4.8 ± 2.5 E-02
3-24-75	2.0 ± 1.7 E-02
5-13-75	4.8 ± 2.3 E-02
	Lawnes Creek (pCi/g)
5-13-75	8.3 ± 2.7 E-02

The cesium-137 concentrations are remaining relatively constant; the overall average concentration for the past 18 months has been 5.2 E-02 pCi/g compared to 4.6 E-02 pCi/g for the first half of 1975.

Cobalt-58 continues to be detectable in clams although none of the samples collected during March, 1975 showed measurable concentrations. A chronological summary of the three most consistent stations shows the variation in concentrations:

	Station Discharge	Hog Island Point	Jamestown
3-19-74	4.9 ± 3.2 E-02 pCi/g		1.3 ± 0.5 E-01 pCi/g
7-02-74	9.9 ± 4.7 E-02	2.3 ± 0.4 E-01 pCi/g	
9-13-74	4.8 ± 0.8 E-01	6.2 ± 2.5 E-02	1.4 ± 1.4 E-02
11-22-74	6.1 ± 3.8 E-02	4.4 ± 2.6 E-02	
1-07-75	5.3 ± 2.9 E-02	2.7 ± 1.3 E-02	2.4 ± 1.9 E-02
5-13-75	1.9 ± 0.3 E-01	2.8 ± 2.4 E-02	

Lawnes Creek had cobalt-58 in measurable concentrations for the first time in May, 1975 with 4.2 ± 0.6 E-01 pCi/g, as well as manganese-54 at 5.7 ± 2.9 E-02 pCi/g and cobalt-60 with 3.2 ± 0.5 E-01 pCi/g.

Cobalt-60 was also observed in the May, 1975 sampling at Chickahominy with 5.8 ± 2.4 E-02 pCi/g and off Hog Island Point with 5.5 ± 2.3 E-02 pCi/g.

An historical comparison for both cobalt-60 and cesium-134 can be made for the Station Discharge and Jamestown collection.

Station Discharge (pCi/g)

	Co-60	Cs-134
7-02-74	1.3 ± 0.8 E-01	
9-13-74	2.4 ± 0.5 E-01	6.1 ± 4.1 E-02
1-07-75	4.8 ± 2.9 E-02	2.3 ± 2.0 E-02
3-24-75	4.4 ± 2.7 E-02	3.0 ± 2.1 E-02
5-13-75	1.2 ± 0.3 E-01	

Jamestown (pCi/g)

	Co-60	Cs-134
3-19-74	6.1 ± 5.7 E-02	
11-22-74		1.9 ± 1.7 E-02
1-07-75	4.5 ± 2.0 E-02	2.5 ± 1.7 E-02
3-24-75	2.8 ± 2.5 E-02	
5-13-75	3.3 ± 2.0 E-02	

The May sample from Station Discharge yielded manganese-54 at 2.8 ± 1.7 E-02 pCi/g and potentially iodine-131 at 2.0 ± 1.9 E-02 pCi/g at time of count which was nine days post-collection.

Given the consistent and uniform distribution of cesium-137 one can conclude that the isotope has been present due to old fallout; only th 9-13-74 collection at Station Discharge is significantly different than the other concentrations noted. Similarly the air sample data can be used to conclude that the single sample showing cerium-144 at Chickahominy is indicative of a source other than Surry. For a conservative dose estimate, one can synthesize a "maximum credible clam" byusing the highest concentration of each of the balance of fission and activations

products at any location. Such a clam yields the following concentrations.

Mn-54	5.7 ± 2.9 E-02 pCi/g
Co-58	4.2 ± 0.6 E-01
Co-60	3.2 ± 0.5 E-01
Ru-103	2.8 ± 1.7 E-02
Cs-134	3.0 ± 2.1 E-02

Using the same reference and assumptions used for a dose estimate with the oyster data, the dose committment due to consumption of 9 kg in one year, of the above concentrations, becomes

Isotope	mrem/yr.
Mn-54	3.4 ± 1.7 E-04
Co-58	1.7 ± 0.2 E-02
Co-60	4.3 ± 0.7 E-02
Ru-103	5.3 ± 3.2 E-03
Cs-134	2.7 ± 1.9 E-02
	(∿ 9.3 E-02 mrem)

Fish Samples

On February 25, 1975, an eel sample was caught near the Station Intake and a catfish near Station Discharge. Gamma spectrometry of the muscle showed expected naturally occurring radionuclides and barely detectable levels of cesium-137 and chromium-51. The former was quantitated in the catfish with 1.6 ± 1.6 E-01 pCi/g and the latter in the eel with 3.8 ± 3.6 pCi/g. The data are similar to previous collections; chronium-51 was previously seen in a white perch collected on February 28, 1974 (2.0 ± 1.4 pCi/g).

ANALYTICAL PROCEDURES

Air Particulate

Gross alpha and gross beta radioactivity measurements are made utilizing a Beckman Widebeta II low background (anti-coincidence proportional) counter. The minimum detectable levels (99.7% confidence) are approximately 0.24 cPi per sample for alpha particles and 0.80 pCi per sample for beta particles.

Air particle samples are mounted in two inch planchets and counted directly.

Gamma spectrum analysis utilizes a lithium-drifted germanium detector with a sensitive volume of 55 cm^3 and a thin aluminum window. The detector is housed in a graded lead shield with an internal volume of eight $ft.^3$, six inches of lead are at the bottom with four inches of lead on all sides and on top. The analyzer system is a Nuclear Data 4420 and ND812 computer housing of 20K memory for acquisition, storage, and manipulation of spectra and computer programs. The overall system has a resolution of 2.2 kev for the 1170 kev peak of cobalt-60 with a peak to compton ratio of 32:1.

Air particulate composites are fitted into a Petri dish and analyzed directly.

Ambient Radiation

Thermoluminescent dosimeters of lithium fluoride (TLD-100) are used to indicate ambient background radiation as well as noble gases such as xenon. The chips are preselected by laboratory irradiation and measurement with criterion of $\pm$ 4%. At low dose levels subsequent response can vary with $\pm$ 6% typical and with a range of less than $\pm$ 10%. A standard annealing cycle is

used including one hour at 400%C and a subsequent 16 hours at 80%C. Calibration of the overall system includes use of ionization chambers as directly received from calibration by the National Bureau of Standards. Each annealing batch includes a packet for quality control comparison. The dose reported is that received between annealing and reading unless otherwise directed.

Well Water and Surface Water

These water samples are treated identically as the precipitation samples. The major factor influencing the data is the fraction of the total sample analyzed.

Fowl

The single coot sample analyzed semi-annually is analyzed by high resolution gamma spectrometry on the Ge-Li system. Following separation of the flesh from feathers, bone and other organs, the sample is ground and dried. The minimum detectable activities are essentially equal to those of other dried organic materials.

Soil and Silt Samples

Soil and silt samples are analyzed in an identical manner. Samples are dried and sieved through a number 11 U.S.A. Standard Testing Sieve to remove pebbles and other foreign matter. The samples are tumbled to provide uniform mixing and aliquots of approximately 100g are analyzed by high resolution gamma spectrometry. Representative sensitivities for various isotopes are:

Zr-95	0.1 pCi/g
Nb-95	0.1 pCi/g
Cs-137	0.1 pCi/g
Pb-214	1.0 pCi/g
Bi-214	1.0 pCi/g
Ra-226	9.0 pCi/g

James River Water

Samples from the James River are directly counted by Vepco for tritium. Samples are analyzed by Eberline by high resolution gamma spectrometry and also by an enrichment procedure for tritium. The gamma spectrometry is performed by slowly dying a one liter aliquot and counting the residue. The tritium aliquot is electrolytically enriched before liquid scintillation counting and has a sensitivity of 90 pCi/L. This sensitivity is more than adequate to document equilibrium concentration due to world-wide environmental inventories.

Aquatic and Marine Organisms

Oysters and clams are analyzed by high resolution gamma spectrometry following grinding and drying. Only the edible portion of the mollusks are analyzed. Fish entrails are removed and the remainder submitted to pressurized steam to allow segregation of bone and flesh. The resultant sample weights are on the order of 10-20 grams. Typical resultant sensitivities are:

Zr-95	0.8 pCi/g
Nb-95	0.8 pCi/g
Sb-125	1.1 pCi/g
Cs-137	0.4 pCi/g
Ce-144	5.0 pCi/g
Ra-226	10.0 pCi/g

Precipitation

An aliquot of the composite is counted directly for tritium activity via liquid scintillation. The minimum detectable activity is 1.0 pCi/ml. Gross beta analysis is performed by drying an aliquot, in a planchet. The dried planchet is counted directly in the Widebeta II with a minimum detectable activity of 0.58 pCi per planchet.

The fractions of the samples analyzed are then related to the total precipitation collected and the area of the sample collector with units reported as pCi/M^2.

Milk Samples

Milk samples are analyzed for gamma emitters by sodium iodide spectrometry. Minimum detectable activities include 10 pCi/L for I-131 and 10 pCi/L for Cs-137. Samples are also analyzed for Sr-90 and calcium.

The strontium procedure includes separation by ion exchange with subsequent dried elute counted on the Widebeta II system. An initial count with an additional count several days later, identified the Y-90 in-growth. The sensitivity for Sr-90 is approximately 2 pCi/L. Stable calcium is measured by a standard titration with a sensitivity of 1 mg/L. For dosimetric techniques, the ratio of pCi/L Sr-90 to gm/L Ca is also reported for each sample.

Mile samples are analyzed for low concentrations of I-131 through radiochemical analysis; sensitivity is approximately 0.25 pCi/L. Iodide carrier is added to the raw milk and ion exchange is used for the first step of purification. Sodium hypochlorite leached solution is treated with nitric acid and hydroxylamine. An organic extraction is effected and AgI is precipitated. The precipitate is washed, dried, and the tared filter is counted on a low background proportional beta particle counter. Recovery is based upon iodide carrier recovery.

EQUIPMENT

Gross alpha, gross beta, Sr-89 and Sr-90 measurements are made using a low background Beckman Widebeta II equipped with shielding and anti-coincidence electronic to obtain very low background counting rates. Automatic absorber measurements are also available.

Tritium enrichment analysis has a minimum detectable concentration of tritium in water on the order of 0.10 pCi/ml. Tritium is determined using a Bechman Model LS-200 liquid scintillation counter with 5 ml of water in Insta-Gel scintillator. The MDA for this system without enrichment is 0.6 pCi/ml based on a 100-minutes counting time, but the practical reporting level is 1 pCi/ml. When values below 1 pCi/ml are required, the sample is electrolytically enriched (HASL procedure) prior to liquid scintillation counting.

The gamma spectrometry system utilizes a high resolution detection with efficiency and resolution suitable for counting environmental samples. The analyzer system is a Nuclear Data 4420 with ND 812 Computer with 20 K memory for acquisition, storage, manipulation of spectra and programs. The Ge-Li detector is a right circular cylinder with a 40 mm diameter, drifted coaxially with an open end. The "P" core diameter is 6 mm and "N" layer thickness of 0.5 mm. An active area of 12.3 cm^2 faces the thin aluminum window which permits analysis of photon energies as low as 35 kev. The resolution is 2.2 kev for the 1170 kev peak of Co-60 and the peak-to-compton ratio is 32:1 for Co-60 gamma. The minimum detectable activities (MDA), based upon typical samples for the type indicated are listed in Table IV. The reporting level is a function of spectrum complexity, detector resolution, and peak-to-compton ratio. One reason this particular system was selected for environmental samples was the excellent resolution and peak-to-compton ratio. The detector resides in a graded shield with

eight ft.^{3} interior and with four inches of lead on top and sides and six inches on the bottom.

Several sodium-iodide gamma spectrometry systems are also employed to quantify gamma emmiters. Table V shows typical minimum detectable activities based upon 99.7% confidence above background.

TABLE IV

TYPICAL MINIMUM DETECTABLE CONCENTRATIONS
GE-LI GAMMA SPECTROMETRY

Air Samples

Cs-134	1.6×10^{-2} pCi/M^3
Cs-137	1.6×10^{-2} pCi/M^3
Ba-140	5.2×10^{-2} pCi/M^3
La-140	3.2×10^{-2} pCi/M^3
Other Expected Gamma Emitters	1.2×10^{-2} to 1.2×10^{-1} pCi/M^3

Water Samples

Cr-51	80 pCi/l
Co-58	8 pCi/l
Co-60	8 pCi/l
Mn-54	8 pCi/l
Cs-134	9 pCi/l
Cs-137	9 pCi/l
Ba-140	30 pCi/l
La-140	20 pCi/l
Other Expected Gamma Emitters	8 to 80 pCi/l

Soil and Bottom Sediments

Cs-134	35 pCi/kg (dry)
Cs-137	35 pCi/kg (dry)
Cr-51	280 pCi/kg (dry)
Co-58	30 pCi/kg (dry)
Co-60	30 pCi/kg (dry)
Mn-54	30 pCi/kg (dry)
Other Expected Gamma Emitters	30 to 300 pCi/kg (dry)

Fish, Benthus, and Aquatic Vegetation

I-131	13 pCi/kg (wet)
Cs-134	14 pCi/kg (wet)
Cs-137	14 pCi/kg (wet)
Cr-51	110 pCi/kg (wet)
Co-58	12 pCi/kg (wet)
Co-60	13 pCi/kg (wet)
Mn-54	12 pCi/kg (wet)
Other Expected Gamma Emitters	1 to 120 pCi/kg (wet)

TABLE V

MINIMUM DETECTABLE ACTIVITY
IN SAMPLES ANALYZED BY
SODIUM IODIDE GAMMA SPECTROMETRY

Isotope	Peak Used To Quantity (KEV)	MDA for 4" x 4" (NaI-Tl) Detector (pCi/Sample)	
		Sm. Sample	2.5 Liters
CO-57	122	10	33
Ce-144	134	18	60
Hg-203	279	15	50
Cr-51	320	125	420
I-131	364	13	14
Ru-103	497	15	50
Na-22	511	8	26
Cs-134	605	11	37
Cs-137	662	12	40
Zr-Nb-95	724,756,765	6	20
Mn-54	835	13	43
Co-58	865	13	43
Zn-65	1115	21	70
Co-60	1173	11	75
K-40	1460	200	660
Ba-140	537	20	60
Ce-141	145	18	18

KEY INFORMATION FOR TABLES

1. Where data can range over several orders of magnitude, concentrations are expressed as powers of ten using E notation. For example E-03 is 10^{-3}.
2. Error terms are expressed as two standard deviations (95% confidence) for EIC data; zero values have three standard deviation error terms (99.7% confidence.)
3. Where shown, averages are based upon measurable data, that is where two standard deviations are smaller than the calculated value. These averages should be used only as presented; averages among different sampling locations only present a basis for relative variability. The sequence in time is also an important factor.
4. The exact minimum detectable concentrations are variable dependent upon many factors such as complexity of a spectrum, quantity of the sample, etc. In order to maximize the value of the analysis, certain concentrations are reported as less than a given value. These data are reported through two methods.
   a. Frequently the analyses present information, such as a gamma spectrum peak, where the calculated error term at 95% confidence is larger than the calculated value. One can discern a very finite probability for the presence of that isotope. In these cases, the error term is increased to permit 99.7% confidence and the result is divided by sample size to yield concentration.
   b. One can expect certain isotopes to be present in a sample due to the nature of that sample. This is especially true when a member of a class of samples has definite data, but other members of the class do not

exhibit the same information. Likewise, one can observe a small concentration of one member of a parent-daughter pair without observing the other member which is obviously present. In these cases (always represented by the lowest "less than" concentrations) the value reported is based upon three standard deviations (99.7% confidence) of the instrument background with a blank sample in the counting geometry.

AIR PARTICULATE SAMPLES
GROSS BETA CONCENTRATIONS
(picocuries per cubic meter)

Station	January 8, 1975	January 27, 1975
Surry Station	4.0 ± 0.4 E-02	1.2 ± 0.2 E-02
Hog Island Reserve	5.5 ± 0.4 E-02	1.2 ± 0.2 E-02
Bacon's Castle	7.2 ± 0.5 E-02	3.0 ± 0.3 E-02
Alliance	1.5 ± 0.1 E-01	1.9 ± 0.1 E-01
Colonial Parkway	0.0 ± 1.3 E+00/sample*	No sample collected
Dow	9.5 ± 0.7 E-02	1.1 ± 0.1 E-01
Fort Eustis	6.5 ± 0.5 E-02	7.0 ± 0.4 E-02
Newport News	9.8 ± 0.6 E-02	1.6 ± 0.1 E-01
Average	8.2 E-02	8.3 E-02
Maximum	1.5 ± 0.1 E-01	1.9 ± 0.1 E-01
Minimum	4.0 ± 0.4 E-02	1.2 ± 0.2 E-02

*malfunction; volume unknown

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

Date Collected	Feb. 11, 1975	Feb. 25, 1975
Surry Station	2.1 ± 0.4 E-02	1.2 ± 0.1 E-01
Hog Island Reserve	1.2 ± 0.4 E-02	8.2 ± 0.6 E-02
Bacon's Castle	3.1 ± 0.5 E-02	4.1 ± 0.5 E-02
Alliance	1.9 ± 0.1 E-01	2.2 ± 0.1 E-01
Colonial Parkway	9.0 ± 1.1 E-02	1.0 ± 0.8 E-02
Dow	1.1 ± 0.1 E-01	1.5 ± 0.1 E-01
Fort Eustis	7.7 ± 0.6 E-02	8.1 ± 0.6 E-02
Newport News	3.1 ± 0.2 E-01	1.7 ± 0.1 E-01
Average	1.0 E-01	1.1 E-01
Maximum	3.1 ± 0.2 E-01	2.2 ± 0.1 E-01
Minimum	1.2 ± 0.4 E-02	1.0 ± 0.8 E-02

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

	March 12, 1975	March 25, 1975
Surry Station	1.7 ± 0.1 E-01	6.7 ± 4.0 E-03**
Hog Island Reserve	6.1 ± 0.6 E-02	7.6 ± 0.7 E-02
Bacon's Castle	3.4 ± 0.5 E-02	1.7 ± 0.1 E-01
Alliance	No sample collected	1.7 ± 0.1 E-01
Colonial Parkway	No sample collected	0.0 ± 1.0 E+00*
Dow	1.2 ± 0.1 E-01	1.5 ± 0.1 E-01
Fort Eustis	1.3 ± 0.1 E-01	3.6 ± 0.5 E-02
Newport News	1.3 ± 0.1 E-01	1.6 ± 0.1 E-01

*Air sampler out-of-commission; total activity reported.
**Omitted from average; suspected leak in sampling trains.

Average	1.1 E-01	1.3 E-01
Maximum	1.7 ± 0.1 E-01	1.7 ± 0.1 E-01
Minimum	3.4 ± 0.5 E-02	3.6 ± 0.5 E-02

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

	April 8, 1975	April 22, 1975
Surry Station	5.4 ± 3.1 E-03	8.6 ± 0.6 E-02
Hog Island Reserve	5.3 ± 0.5 E-02	1.4 ± 0.1 E-01
Bacon's Castle	1.1 ± 0.1 E-01	1.3 ± 0.1 E-01
Alliance	2.2 ± 0.1 E-01	2.5 ± 0.1 E-01
Colonial Pkwy.	1.3 ± 0.1 E-01	1.9 ± 0.1 E-01
Dow	9.8 ± 0.7 E-02	1.2 ± 0.1 E-01
Newport News	1.3 ± 0.1 E-01	1.1 ± 0.1 E-01
Average	1.1 E-01	1.5 E-01
Maximum	2.2 ± 0.1 E-01	2.5 ± 0.1 E-01
Minimum	5.4 ± 3.1 E-03	8.6 ± 0.6 E-02

Fort Eustis sampler being repaired

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

	May 6, 1975	May 20, 1975
Surry Station	1.4 ± 0.4 E-02	No sample; out-of-commission
Hog Island Reserve	6.6 ± 0.6 E-02	9.1 ± 0.7 E-02
Bacon's Castle	9.9 ± 0.7 E-02	4.3 ± 0.6 E-02
Alliance	1.9 ± 0.1 E-01	1.2 ± 0.1 E-01
Colonial Pkwy.	5.7 ± 0.6 E-02	1.0 ± 0.1 E-01
Dow	1.4 ± 0.1 E-01	1.1 ± 0.1 E-01
Fort Eustis		1.0 ± 0.1 E-01
Newport News	5.9 ± 0.8 E-02	6.0 ± 0.6 E-02
Average	8.9 E-02	8.9 E-02
Maximum	1.9 ± 0.1 E-01	1.2 ± 0.1 E-01
Minimum	1.4 ± 0.4 E-02	6.0 ± 0.6 E-02

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

	June 3, 1975	June 17, 1975
Surry Station	0.0 ± 6.4 E-03	7.7 ± 0.8 E-02
Hog Island Reserve	7.8 ± 0.6 E-02	4.4 ± 0.5 E-02
Bacon's Castle		4.4 ± 0.4 E-02
Alliance	1.3 ± 0.1 E-01	6.4 ± 0.6 E-02
Colonial Pkwy.	7.8 ± 0.6 E-02	3.5 ± 2.8 E-03 *
Dow	1.1 ± 0.1 E-01	9.8 ± 0.7 E-02
Fort Eustis	2.2 ± 0.5 E-02	7.9 ± 0.7 E-02
Newport News	5.4 ± 0.7 E-02	7.8 ± 0.7 E-02
Average	7.9 E-02	6.9 E-02
Maximum	1.3 ± 0.1 E-01	9.8 ± 0.7 E-02
Minimum	5.4 ± 0.7 E-02	4.4 ± 0.5 E-02

*Leaky air sampler, head replaced.

AIR PARTICULATE SAMPLES
GROSS BETA ANALYSIS
(picocuries per cubic meter)

	Volume*	July 1, 1975
Hog Island Reserve	252	2.1 ± 0.5 E-02
Bacon's Castle	323	5.2 ± 0.6 E-02
Alliance	282	0.0 ± 4.1 E-03**
Colonial Pkwy.	302	5.4 ± 0.6 E-02
Dow	208	1.0 ± 0.1 E-01
Fort Eustis	202	8.5 ± 0.9 E-02
Newport News	202	5.3 ± 0.8 E-02
Surry Station	222	3.2 ± 0.6 E-02
Average		5.7 E-02
Maximum		1.0 ± 0.1 E-01
Minimum		2.1 ± 0.5 E-02

*volumes reported in cubic meters
**Apparent leak in sampling trains.

OVERALL AVERAGES
FOR FIRST HALF OF 1975

Average	9.7 E-02
Average Maximum	1.8 E-01
Average Minimum	3.3 E-02

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

FIRST QUARTER, 1974 COMPOSITES

	Surry Station and Hog Island Reserve	Bacon's Castle, Alliance Colonial Pkwy., Dow, Fort Eustis
Volume	3598 M^3	7949 M^3
Gamma Spectrometry		
Be-7	2.0 ± 1.5 E-02	3.9 ± 1.5 E-02
K-40	Less than 3.7 E-02	2.0 ± 1.5 E-02
Co-60	Less than 2.7 E-03	4.0 ± 1.5 E-03
Nb-95	4.5 ± 2.5 E-03	1.0 ± 0.3 E-02
Zr-95	2.9 ± 2.2 E-03	6.2 ± 1.8 E-03
Sb-125	Less than 1.5 E-02	Less than 7.0 E-03
Cs-137	4.7 ± 1.8 E-03	4.1 ± 1.6 E-03
Ce-144	1.5 ± 1.1 E-02	4.6 ± 1.5 E-03
Tl-208	Less than 2.7 E-03	Less than 1.2 E-03
Pb-212	Less than 6.5 E-03	Less than 6.5 E-03

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

FIRST QUARTER, 1975 COMPOSITES

Newport News

Volume	1346 M^3
Gamma Spectrometry	
Be-7	1.2 ± 0.6 E-01
K-40	Less than 1.4 E-01
Co-60	Less than 7.2 E-03
Nb-95	2.8 ± 1.0 E-02
Zr-95	2.1 ± 1.0 E-02
Sb-125	Less than 4.1 E-02
Cs-137	6.2 ± 6.2 E-03
Ce-144	1.8 ± 0.8 E-01
Tl-208	Less than 7.2 E-03
Pb-212	Less than 3.8 E-02
Pb-214	Less than 3.7 E-02
Bi-214	Less than 3.1 E-02

AIR PARTICULATE SAMPLES
(picocuries per cubic meters)

SECOND QUARTER, 1975 COMPOSITES

	Hog Island Reserve Surry Station	Bacon's Castle, Alliance Colonial Parkway, Dow Fort Eustis
Volume	3485 M^3	7978 M^3
Gamma Spectrometry		
Be-7	4.0 ± 1.6 E-02	8.8 ± 1.7 E-02
K-40	Less than 2.6 E-02	Less than 1.1 E-02
Mn-54	Less than 2.3 E-03	1.2 ± 1.0 E-03
Nb-95	3.2 ± 2.5 E-03	9.3 ± 2.0 E-03
Zr-95	5.1 ± 2.8 E-03	3.9 ± 1.8 E-03
Ru-106	Less than 2.7 E-02	1.4 ± 1.2 E-02
Sb-125	Less than 8.8 E-03	Less than 7.6 E-03
Cs-137	3.1 ± 1.7 E-03	3.0 ± 1.6 E-03
Ce-144	3.3 ± 1.1 E-02	9.2 ± 1.6 E-02
Tl-208	Less than 4.6 E-03	Less than 2.0 E-03
Pb-212	Less than 6.7 E-03	Less than 6.2 E-03
Pb-214	Less than 1.5 E-02	Less than 6.6 E-03
Bi-214	Less than 1.1 E-01	Less than 5.0 E-02
Ra-226	Less than 6.8 E-02	Less than 3.0 E-02

AIR PARTICULATE SAMPLES
(picocuries per cubic meter)

SECOND QUARTER, 1975 COMPSOITES

Newport News

Volume	1580 M^3
Gamma Spectrometry	
Be-7	6.6 ± 2.8 E-02
K-40	Less than 7.1 E-02
Mn-54	Less than 5.0 E-03
Nb-95	4.4 ± 4.2 E-03
Zr-95	Less than 8.6 E-03
Ru-106	Less than 6.1 E-02
Sb-125	Less than 1.9 E-02
Cs-137	Less than 5.7 E-03
Ce-144	2.9 ± 2.4 E-02
Tl-208	Less than 5.9 E-03
Pb-212	Less than 1.5 E-02
Pb-214	Less than 3.3 E-02
Bi-214	Less than 2.5 E-01
Ra-226	Less than 1.5 E-01

AMBIENT THERMOLUMINESCENT DOSIMETRY

FIRST QUARTER, 1975

Date Annealed: 12-14-74 Date Returned: 4-14-75
Date Issued: 12-17-74 Date Read: 4-15-75

	Net mrem						
	1st	2nd	3rd	4th	5th	Average ± 2 Sigma	mrem/wk
Control	35	36	41	38	*	37.5 ± 5.2	2.2
Surry Station	45	51	47	49	*	48.0 ± 5.2	2.8
Hog Island Reserve	29	27	28	26	22	26.4 ± 5.4	1.5
Bacon's Castle	21	21	20	18	21	20.2 ± 2.6	1.2
Alliance	22	24	23	21	23	22.6 ± 2.2	1.3
Colonial Pkwy.	25	21	24	22	23	22.8 ± 3.2	1.3
Dow	24	25	21	22	23	23.0 ± 3.2	1.3
Ft. Eustis	24	24	25	26	25	24.8 ± 1.7	1.4
Newport News	26	25	26	25	30	26.4 ± 4.2	1.5
Smithfield	28	27	*	30	29	28.5 ± 2.6	1.6
Scotland Warf	25	24	23	23	24	23.8 ± 1.7	1.6
Jamestown	24	23	25	23	23	23.6 ± 1.8	1.4
Lee Hall	28	30	28	29	30	29.0 ± 2.0	1.7
Routes 10-676	21	21	24	21	21	21.6 ± 2.6	1.2
				Average			1.5

*Dosimeter damaged.

AMBIENT THERMOLUMINESCENT DOSIMETRY

SECOND QUARTER, 1975

Date Annealed: 3-24-75 Date Returned: 7-24-75
Date Issued: 3-25-75 Date Read: 7-28-75**

	Net mrem						
	1st	2nd	3rd	4th	5th	Average ± 2 Sigma	mrem/wk
Control	22	20	*	21	20	20.8 ± 1.9	1.1
Surry Station	18	20	17	17	19	18.2 ± 2.6	1.0
Hog Island Reserve	17	18	18	17	16	17.2 ± 1.6	0.9
Bacon's Castle	14	14	13	14	*	13.8 ± 1.0	0.8
Alliance	12	14	14	12	14	13.2 ± 2.2	0.8
Colonial Pkwy.	14	12	11	13	12	12.4 ± 2.2	0.7
Dow	14	12	13	13	13	13.0 ± 1.4	0.7
Ft. Eustis	*	*	16	16	19	17.0 ± 3.4	0.9
Newport News	17	17	18	21	17	18.0 ± 3.4	1.0
Smithfield	*	*	17	18	18	17.7 ± 1.2	1.0
Scotland Warf	13	15	16	15	15	14.8 ± 2.2	0.8
Jamestown	14	13	14	14	13	13.6 ± 1.1	0.8
Lee Hall	19	18	19	19	17	18.4 ± 1.8	1.1
Routes 10-676	14	12	11	10	13	12.0 ± 3.2	0.7
			Averages			15.3	0.8

*Dosimeter damaged.
**Control and Surry Station dosimeters did not accompany the first shipment. They were received and read on August 1, 1975.

PRECIPITATION COMPOSITES
FIRST QUARTER, 1975
(nanocuries per square meter)

	Gross Beta	Tritium
Surry Station	8.6 ± 1.5 E+00	3.6 ± 2.5 E+01
Newport News	6.8 ± 1.4 E+00	4.2 ± 2.8 E+01

Surry Station Collector Area = 0.0729 square meter

Newport News Collector Area = 0.0856 square meter

SECOND QUARTER, 1975
(nanocuries per square meter)

	Gross Beta	Tritium
Surry Station	6.6 ± 1.9 E+00	Less than 3.5 E+01
Newport News	4.6 ± 1.4 E+00	Less than 2.7 E+01

Surry Station Collector Area = 0.0729 square meter

Newport News Collector Area = 0.0856 square meter

MILK SAMPLES
(picocuries per liter)

	Lee Hall	Colonial Parkway
Date Collected	1-28-75	1-27-75
Radiochemistry		
I-131	0.0 ± 5.2 E-02	0.0 ± 5.2 E-02
Ca (g/l)	1.5	1.7
Sr-89	0.0 ± 2.5 E+00	2.3 ± 2.3 E+00
Sr-90	4.5 ± 1.0 E+00	1.6 ± 0.7 E+00
Gamma Spectrometry		
K-40	1.4 ± 0.4 E+03	6.5 ± 2.3 E+02
Co-58	Less than 5.0 E+00	Less than 6.0 E+00
Sb-125	Less than 4.7 E+01	Less than 4.7 E+01
I-131	Less than 2.7 E+01	Less than 2.7 E+01
Cs-137	Less than 1.9 E+01	Less than 1.1 E+01
La-140	Less than 3.5 E+01	Less than 3.5 E+01
Tl-208	Less than 1.9 E+01	Less than 1.9 E+01
Pb-212	Less than 6.3 E+01	Less than 6.3 E+01
Pb-214	Less than 6.4 E+01	Less than 6.1 E+01
Bi-214	Less than 5.7 E+01	Less than 5.7 E+01
Ra-226	Less than 7.5 E+02	Less than 7.5 E+02

MILK SAMPLES
(picocuries per liter)

	Epps	Judkins
Date Collected	2-12-75	2-12-75
Radiochemistry		
I-131	0.0 ± 7.5 E-02	0.0 ± 1.1 E-01
Ca (g/l)	1.0	1.1
Sr-89	0.0 ± 2.9 E+00	0.0 ± 3.4 E+00
Sr-90	5.0 ± 1.4 E+00	5.8 ± 1.2 E+00
Gamma Spectrometry		
K-40	2.1 ± 0.5 E+03	1.6 ± 0.4 E+03
Co-58	Less than 5.0 E+00	Less than 5.0 E+00
Sb-125	Less than 4.7 E+01	Less than 6.5 E+01
I-131	Less than 2.7 E+01	Less than 2.7 E+01
Cs-137	Less than 2.1 E+01	Less than 1.4 E+01
La-140	Less than 3.5 E+01	Less than 3.5 E+01
Tl-208	Less than 1.9 E+01	Less than 1.9 E+01
Pb-212	Less than 6.3 E+01	Less than 6.6 E+01
Pb-214	Less than 6.1 E+01	Less than 6.7 E+01
Bi-214	Less than 5.7 E+01	5.4 ± 3.9 E+01
Ra-226	Less than 7.5 E+02	Less than 7.5 E+02

MILK SAMPLES
(picocuries per liter)

	Epps	Judkins
Date Collected	3-12-75	3-12-75
Radiochemistry		
I-131	0.0 ± 2.5 E-01	0.0 ± 2.3 E-01
Ca (g/l)	1.44	1.38
Sr-89	0.0 ± 2.4 E+00	0.0 ± 3.4 E+00
Sr-90	5.3 ± 1.4 E+00	6.3 ± 1.7 E+00
Gamma Spectrometry		
K-40	1.4 ± 0.4 E+03	1.4 ± 0.4 E+03
Co-58	Less than 5.0 E+00	Less than 5.0 E+00
Sb-125	Less than 6.9 E+01	Less than 7.6 E+01
I-131	Less than 2.7 E+01	Less than 2.7 E+01
Cs-137	Less than 2.1 E+01	Less than 1.8 E+01
La-140	Less than 3.5 E+01	Less than 3.5 E+01
Tl-208	Less than 2.1 E+01	Less than 1.9 E+01
Pb-212	Less than 6.9 E+01	Less than 6.3 E+01
Pb-214	Less than 6.4 E+01	Less than 6.9 E+01
Bi-214	Less than 5.7 E+01	Less than 6.1 E+01
Ra-226	Less than 8.0 E+02	Less than 7.8 E+02

MILK SAMPLES
(picocuries per liter)

	Epps	Lee Hall
Date Collected	3-17-75	3-17-75
Radiochemistry		
Sr-89	0.0 ± 2.8 E+00	0.0 ± 2.3 E+00
Sr-90	4.5 ± 1.3 E+00	1.7 ± 1.0 E+00
I-131	0.0 ± 1.2 E-01	0.0 ± 2.9 E-01
Ca (g/l)	1.38	.97
Gamma Spectrometry		
K-40	1.2 ± 0.3 E+03	1.8 ± 0.4 E+03
Co-58	Less than 5.0 E+00	Less than 5.0 E+00
Sb-125	Less than 4.7 E+01	Less than 4.7 E+01
I-131	Less than 2.7 E+01	Less than 2.7 E+01
Cs-137	1.3 ± 1.1 E+01	1.3 ± 1.0 E+01
La-140	Less than 3.5 E+01	Less than 3.5 E+01
Tl-208	Less than 1.9 E+01	Less than 2.1 E+01
Pb-212	Less than 7.0 E+01	Less than 6.3 E+01
Pb-214	Less than 6.1 E+01	Less than 6.1 E+01
Bi-214	Less than 5.7 E+01	Less than 5.7 E+01
Ra-226	Less than 7.5 E+02	Less than 7.5 E+02

MILK SAMPLES
(picocuries per liter)

	Lee Hall	Colonial Parkway
Date Collected	3-25-75	3-25-75
Radiochemistry		
Sr-89	0.0 ± 5.7 E+00*	0.0 ± 4.2 E+00
Sr-90	0.0 ± 4.4 E+00*	7.8 ± 2.0 E+00
I-131	0.0 ± 8.2 E-02	0.0 ± 7.9 E-02
Ca (g/L)	1.39	1.17
Gamma Spectrometry		
K-40	1.4 ± 0.4 E+03	1.5 ± 0.4 E+03
Co-58	Less than 5.0 E+00	Less than 5.0 E+00
Sb-125	Less than 4.7 E+01	Less than 4.7 E+01
I-131	Less than 2.7 E+01	Less than 2.7 E+01
Cs-137	Less than 1.5 E+01	Less than 2.0 E+01
La-140	Less than 3.5 E+01	Less than 3.5 E+01
Tl-208	Less than 1.9 E+01	Less than 1.9 E+01
Pb-212	Less than 6.6 E+01	Less than 6.3 E+01
Pb-214	Less than 6.1 E+01	Less than 6.1 E+01
Bi-214	Less than 5.7 E+01	Less than 5.7 E+01
Ra-226	Less than 7.5 E+02	Less than 7.5 E+02

*Low radiochemical recovery.

MILK SAMPLES
(picocuries per liter)

	Epps	Judkins
Date Collected	4-9-75	4-9-75
Radiochemistry		
Sr-89	0.0 ± 1.8 E+00	0.0 ± 4.2 E+00
Sr-90	5.0 ± 1.2 E+00	5.4 ± 2.3 E+00
I-131	0.0 ± 7.3 E-02	0.0 ± 7.0 E-02
Ca (g/l)	1.2	1.3
Gamma Spectrometry		
K-40	1.4 ± 0.4 E+03	1.2 ± 0.3 E+03
Cs-137	1.7 ± 1.0 E+01	1.3 ± 1.0 E+01
Ce-141	Less than 7.5 E+01	Less than 6.3 E+01
Pb-212	Less than 7.1 E+01	Less than 6.7 E+01
Pb-214	Less than 7.3 E+01	Less than 7.0 E+01
Bi-214	Less than 5.9 E+01	Less than 5.0 E+01

MILK SAMPLES
(picocuries per liter)

	Lee Hall
Date Collected	April 22, 1975

Radiochemistry

I-131	0.0 ± 1.6 E-01
Ca (g/l)	1.2
Sr-89	0.0 ± 6.1 E+00
Sr-90	2.0 ± 0.3 E+01

Gamma Spectrometry

K-40	1.9 ± 0.4 E+03
Cs-137	Less than 1.4 E+01
Ce-141	Less than 7.7 E+01
Pb-212	Less than 7.9 E+01
Bi-214	Less than 6.7 E+01

Sample received 4-25-75

MILK SAMPLES
(picocuries per liter)

	Judkins	Lee Hall
Date Collected	5-7-75	5-7-75
Radiochemistry		
Sr-89	0.0 ± 3.2 E+00	0.0 ± 2.1 E+00
Sr-90	5.7 ± 1.8 E+00	2.3 ± 1.2 E+00
I-131	0.0 ± 8.1 E-02	0.0 ± 8.7 E-02
Ca (g/l)	1.4	1.3
Gamma Spectrometry		
K-40	1.6 ± 0.4 E+03	1.0 ± 0.4 E+03
Sb-125	Less than 7.5 E+01	Less than 7.5 E+01
Cs-137	1.9 ± 1.2 E+01	Less than 2.1 E+01
Pb-212	Less than 8.0 E+01	Less than 6.0 E+01
Bi-214	Less than 6.6 E+01	Less than 8.8 E+01
Ra-226	Less than 7.5 E+02	Less than 9.0 E+02

MILK SAMPLES
(picocuries per liter)

	Epps
Date Collected	5-6-75
Radiochemistry	
Sr-89	0.0 ± 3.2 E+00
Sr-90	2.2 ± 1.7 E+00
I-131	0.0 ± 8.3 E-02
Ca (g/l)	1.3
Gamma Spectrometry	
K-40	1.0 ± 0.4 E+03
Sb-125	Less than 8.7 E+01
Cs-137	Less than 1.0 E+01
Pb-212	Less than 6.0 E+01
Bi-214	Less than 5.0 E+01
Ra-226	Less than 9.1 E+02

MILK SAMPLES
(picocuries per liter)

	Colonial Parkway	Lee Hall
Date Collected	5-20-75	5-20-75
Radiochemistry		
Sr-89	0.0 ± 5.7 E+00	0.0 ± 4.2 E+00
Sr-90	7.2 ± 3.2 E+00	4.8 ± 2.5 E+00
I-131	6.9 ± 2.2 E-01	1.9 ± 0.2 E+00
Ca (g/l)	1.3	1.4
Gamma Spectrometry		
K-40	1.4 ± 0.4 E+03	1.2 ± 0.4 E+02
Cs-137	1.9 ± 1.4 E+01	Less than 2.2 E+01
Pb-212	Less than 7.4 E+01	Less than 7.8 E+01
Pb-214	Less than 7.7 E+01	Less than 7.8 E+01
Bi-214	Less than 5.0 E+01	6.0 ± 4.7 E+01
Ra-226	Less than 8.3 E+02	Less than 8.8 E+02

I-131 results corrected to 20 May 75 - 1200

MILK SAMPLES
(picocuries per liter)

	Colonial Parkway	Lee Hall
Date Collected	6-4-75	6-4-75
Radiochemistry		
Sr-89	0.0 ± 2.8 E+00	0.0 ± 2.9 E+00
Sr-90	5.1 ± 1.6 E+00	1.8 ± 1.4 E+00
I-131	6.1 ± 2.0 E-01	0.0 ± 7.3 E-02
Ca (g/l)	1.3	1.2
Gamma Spectrometry		
K-40	1.5 ± 0.5 E+03	1.3 ± 0.4 E+03
Nb-95	Less than 2.3 E+01	Less than 2.0 E+01
Cs-137	2.6 ± 1.3 E+01	Less than 1.9 E+01
Tl-208	Less than 2.0 E+01	Less than 2.5 E+01
Pb-212	Less than 6.0 E+01	Less than 8.1 E+01
Pb-214	Less than 8.2 E+01	Less than 7.0 E+01
Bi-214	Less than 5.0 E+01	6.4 ± 4.8 E+01
Ra-226	Less than 7.5 E+02	Less than 7.5 E+02

MILK SAMPLES
(picocuries per liter)

	Judkins	Epps
Date Collected	6-3-75	6-3-75
Radiochemistry		
Sr-89	0.0 ± 3.0 E+00	0.0 ± 7.0 E+00*
Sr-90	3.7 ± 1.6 E+00	1.3 ± 0.3 E+01
I-131	0.0 ± 6.8 E-02	0.0 ± 7.3 E-02
Ca (g/l)	1.2	1.4
Gamma Spectrometry		
K-40	1.6 ± 0.4 E+03	1.4 ± 0.1 E+03
Nb-95	Less than 2.0 E+01	Less than 2.0 E+01
Cs-137	2.2 ± 1.3 E+01	1.6 ± 1.4 E+01
Tl-208	Less than 2.0 E+01	Less than 2.0 E+01
Pb-212	Less than 8.1 E+01	Less than 7.9 E+01
Pb-214	Less than 7.0 E+01	Less than 7.0 E+01
Bi-214	Less than 7.9 E+01	Less than 5.0 E+01
Ra-226	Less than 7.5 E+02	Less than 9.2 E+02

*Low chemical recovery

MILK SAMPLES
(picocuries per liter)

	Lee Hall
Date Collected	6-17-75
Radiochemistry	
Sr-89	0.0 ± 2.3 E+00
Sr-90	2.5 ∓ 1.3 E+00
I-131	0.0 ∓ 3.0 E-01
Ca (g/l)	1.3
Gamma Spectrometry	
K-40	1.5 ± 0.4 E+03
Cs-137	Less than 1.6 E+01
Pb-212	Less than 7.8 E+01
Bi-214	Less than 6.9 E+01

MILK SAMPLES
(picocuries per liter)

	Colonial Parkway
Date Collected	6-26-75
Radiochemistry	
Sr-89	0.0 ± 3.4 E+00
Sr-90	4.9 ± 2.3 E+00
I-131	0.0 ± 2.9 E-01
Ca (g/l)	1.3
Gamma Spectrometry*	

*Sample aliquot lost in handling

MILK SAMPLES
(picocuries per liter)

	Judkins	Epps
Date Collected	7-1-75	7-1-75
Volume	1 Liter	1 Liter
Radiochemistry		
Sr-89	0.0 ± 4.7 E+00	0.0 ± 4.2 E+00
Sr-90	5.8 ± 2.5 E+00	1.2 ± 0.2 E+01
I-131	0.0 ± 8.6 E-02	0.0 ± 8.7 E-02
Ca (g/l)	1.4	1.4
Gamma Spectrometry		
K-40	1.6 ± 0.4 E+03	1.3 ± 0.4 E+03
Co-57	Less than 1.5 E+01	1.7 ± 1.7 E+01
Cs-137	Less than 2.2 E+01	Less than 1.8 E+01
Tl-208	Less than 2.0 E+01	Less than 3.3 E+01
Pb-212	Less than 7.1 E+01	Less than 7.4 E+01
Bi-212	Less than 2.0 E+01	Less than 2.2 E+02
Bi-214	Less than 6.0 E+01	Less than 5.4 E+01
Ra-226	Less than 8.5 E+02	Less than 7.5 E+02

WELL WATER SAMPLES
(picocuries per liter)

	Gross Alpha	Gross Beta	Tritium
Hog Island Reserve	0.0 ± 3.2 E+00	0.0 ± 5.1 E+00	100 ± 90
Surry Station	0.0 ± 2.7 E+00	0.0 ± 4.7 E+00	Less than 90
Jamestown	0.0 ± 2.9 E+00	5.6 ± 5.1 E+00	90 ± 90
Bacon's Castle	5.8 ± 3.7 E+00	1.6 ± 0.5 E+01	410 ± 100

Date Collected - 5-6-75

SURFACE WATER SAMPLES
(picocuries per liter)

	Newport News	Smithfield
Date Collected	5-6-75	5-6-75
Radiochemistry		
Gross Alpha	0.0 ± 2.4 E+00	4.1 ± 3.7 E+00
Gross Beta	5.6 ± 4.6 E+00	1.6 ± 0.6 E+01
Tritium	Less than 3.8 E+02	Less than 3.8 E+02

	Chippokes Creek	Williamsburg
Date Collected	5-6-75	5-6-75
Radiochemistry		
Gross Alpha	0.0 ± 2.7 E+00	0.0 ± 2.4 E+00
Gross Beta	5.8 ± 4.9 E+00	6.1 ± 4.7 E+00
Tritium	Less than 3.8 E+02	Less than 3.8 E+02

JAMES RIVER WATER SAMPLES
(picocuries per liter)

	Hog Island Point	Chickahominy
Date Collected	1-7-75	1-7-75
Gamma Spectrometry		
K-40	Less than 1.1 E+02	Less than 1.1 E+02
Na-22	Less than 3.8 E+00	Less than 3.8 E+00
Co-58	Less than 4.8 E+00	Less than 4.8 E+00
Co-60	Less than 8.7 E+00	Less than 8.7 E+00
Sb-125	Less than 2.9 E+01	Less than 2.9 E+01
I-131	Less than 1.1 E+01	Less than 1.1 E+01
Cs-137	Less than 5.8 E+00	Less than 5.8 E+00
Tl-208	Less than 8.9 E+00	Less than 8.8 E+00
Bi-212	Less than 8.4 E+01	Less than 8.4 E+01
Pb-212	Less than 2.3 E+01	Less than 2.3 E+01
Pb-214	Less than 2.7 E+01	Less than 2.7 E+01
Bi-214	Less than 6.4 E+01	1.9 ± 1.7 E+01
Ra-226	Less than 2.5 E+02	Less than 2.4 E+02

JAMES RIVER WATER SAMPLES
(picocuries per liter)

	Station Intake	Station Discharge
Date Collected	1-7-75	1-7-75
Gamma Spectrometry		
K-40	Less than 1.1 E+02	9.9 ± 7.7 E+01
Na-22	Less than 3.8 E+00	Less than 3.8 E+00
Co-58	Less than 4.8 E+00	Less than 4.8 E+00
Co-60	Less than 8.7 E+00	Less than 8.7 E+00
Sb-125	Less than 2.9 E+01	Less than 2.9 E+01
I-131	Less than 1.1 E+01	Less than 1.1 E+01
Cs-137	Less than 7.0 E+00	Less than 6.6 E+00
Tl-208	Less than 8.8 E+00	Less than 9.3 E+00
Bi-212	Less than 8.4 E+01	Less than 8.4 E+01
Pb-212	Less than 2.4 E+01	Less than 2.3 E+01
Pb-214	Less than 2.7 E+01	Less than 2.7 E+01
Bi-214	Less than 3.2 E+01	Less than 2.4 E+01
Ra-226	Less than 2.4 E+02	Less than 2.4 E+02

JAMES RIVER WATER
(picocuries per liter)

	Station Discharge
Date Collected	3-13-75
Gamma Spectrometry	
K-40	Less than 1.1 E+02
Na-22	Less than 3.8 E+00
Co-58	Less than 4.8 E+00
Co-60	Less than 8.7 E+00
Sb-125	Less than 2.9 E+01
I-131	Less than 1.1 E+01
Cs-137	4.1 ± 4.1 E+00
Tl-208	Less than 8.8 E+00
Bi-212	Less than 8.4 E+01
Pb-212	Less than 2.3 E+01
Pb-214	Less than 2.7 E+01
Bi-214	Less than 2.8 E+01
Ra-226	Less than 2.4 E+02

JAMES RIVER WATER
(picocuries per liter)

	Station Intake	Chickahominy
Date Collected	3-13-75	3-24-75
Gamma Spectrometry		
K-40	Less than 1.1 E+02	Less than 1.2 E+02
Na-22	Less than 3.8 E+00	Less than 3.8 E+00
Co-58	Less than 4.8 E+00	Less than 4.8 E+00
Co-60	Less than 9.1 E+00	Less than 8.7 E+00
Sb-125	Less than 2.9 E+01	Less than 2.9 E+01
I-131	Less than 1.1 E+01	Less than 1.1 E+01
Cs-137	Less than 6.6 E+00	Less than 7.0 E+00
Tl-208	Less than 9.2 E+00	Less than 9.8 E+00
Bi-212	Less than 8.4 E+01	6.8 ± 5.1 E+01
Pb-212	Less than 2.3 E+01	Less than 2.3 E+01
Pb-214	Less than 2.7 E+01	Less than 2.7 E+01
Bi-214	Less than 2.4 E+01	Less than 2.4 E+01
Ra-226	Less than 2.4 E+02	Less than 2.4 E+02

JAMES RIVER WATER
(picocuries per liter)

	Hog Island Point	Newport News
Date Collected	3-18-75	3-27-75
Gamma Spectrometry		
K-40	Less than 9.1 E+01	Less than 1.1 E+02
Na-22	Less than 3.8 E+00	Less than 3.8 E+00
Co-58	Less than 4.8 E+00	Less than 4.8 E+00
Co-60	Less than 8.7 E+00	Less than 8.7 E+00
Sb-125	Less than 2.9 E+01	Less than 2.9 E+01
I-131	Less than 1.1 E+01	Less than 1.1 E+01
Cs-137	Less than 6.3 E+00	Less than 7.8 E+00
Tl-208	Less than 8.8 E+00	Less than 8.8 E+00
Bi-212	Less than 8.4 E+01	Less than 8.4 E+01
Pb-212	Less than 2.3 E+01	Less than 2.4 E+01
Pb-214	Less than 2.7 E+01	Less than 2.7 E+01
Bi-214	Less than 2.4 E+01	Less than 2.5 E+01
Ra-226	Less than 2.4 E+02	Less than 2.4 E+02

JAMES RIVER WATER
(picocuries per liter)

	Newport News	Hog Island Point
Date Collected	5-15-75	5-13-75
Gamma Spectrometry		
K-40	Less than 1.3 E+02	Less than 1.1 E+02
Sb-125	Less than 2.6 E+01	Less than 2.5 E+01
Cs-134	4.3 ± 3.4 E+00	Less than 5.0 E+00
Cs-137	Less than 4.4 E+00	Less than 6.6 E+00
Tl-208	Less than 8.8 E+00	Less than 9.1 E+00
Pb-212	Less than 2.2 E+01	Less than 2.2 E+01
Pb-214	Less than 2.5 E+01	Less than 2.5 E+01
Ra-226	Less than 2.4 E+02	Less than 2.4 E+02

JAMES RIVER WATER
(picocuries per liter)

	Chickahominy	Station Discharge
Date Collected	5-14-75	5-13-75
Gamma Spectrometry		
K-40	Less than 1.1 E+02	Less than 1.1 E+02
Sb-125	Less than 2.5 E+01	Less than 2.5 E+01
Cs-134	Less than 5.0 E+00	Less than 5.0 E+00
Cs-137	Less than 6.6 E+00	Less than 6.6 E+00
Tl-208	Less than 8.8 E+00	Less than 8.8 E+00
Pb-212	Less than 2.3 E+02	Less than 2.2 E+01
Pb-214	Less than 2.5 E+01	Less than 2.7 E+01
Ra-226	Less than 2.5 E+02	Less than 2.4 E+02

SILT SAMPLES
(picocuries per gram dry)

	Station Intake	Newport News
Date Collected	3-13-75	3-27-75
Sample Weight Dry	103.0 gm	113.0 gm
Gamma Spectrometry		
Be-7	1.7 ± 1.5 E+00	1.3 ± 0.3 E+01
K-40	1.5 ± 0.3 E+01	Less than 1.0 E+01
Mn-54	4.1 ± 1.2 E-01	Less than 3.7 E-01
Co-58	5.3 ± 1.8 E-01	Less than 5.0 E-02
Co-60	8.1 ± 1.9 E-01	Less than 1.1 E-01
Zn-65	Less than 3.6 E-01	Less than 3.3 E-01
Ru-103	Less than 2.0 E-01	Less than 1.1 E-01
Sb-125	Less than 8.1 E-01	Less than 5.6 E-01
Cs-134	1.5 ± 0.2 E+00	Less than 1.1 E-01
Cs-137	3.6 ± 0.4 E+00	7.6 ± 1.7 E-01
Ce-141	Less than 4.6 E-01	Less than 4.2 E-01
Ce-144	2.0 ± 1.4 E+00	Less than 1.8 E+00
Tl-208	5.0 ± 2.1 E-01	4.3 ± 1.6 E-01
Bi-212	Less than 1.8 E+00	2.0 ± 1.3 E+00
Pb-212	1.1 ± 0.4 E+00	1.3 ± 0.4 E+00
Pb-214	7.5 ± 4.5 E-01	7.0 ± 3.5 E-01
Bi-214	Less than 1.5 E-01	6.9 ± 4.0 E-01
Ra-226	4.9 ± 4.4 E+00	Less than 5.4 E+00
Ac-228	1.8 ± 0.9 E+00	Less than 1.0 E+00

SILT SAMPLES
(picocuries per gram dry)

	Station Discharge	Point of Shoals
Date Collected	3-18-75	3-27-75
Sample Weight Dry	115.0 gm	106.0 gm
Gamma Spectrometry		
Be-7	Less than 1.3 E+00	Less than 1.4 E+00
K-40	1.3 ± 0.2 E+01	1.4 ± 0.3 E+01
Mn-54	4.9 ± 1.6 E-01	Less than 4.0 E-01
Co-58	4.9 ± 1.7 E-01	7.6 ± 6.9 E-02
Co-60	1.3 ± 0.2 E+00	Less than 9.0 E-02
Zn-65	Less than 3.2 E-01	Less than 3.5 E-01
Ru-103	Less than 1.8 E-01	Less than 1.9 E-01
Sb-125	Less than 5.5 E-01	Less than 6.0 E-01
Cs-134	1.1 ± 0.1 E+00	1.5 ± 1.1 E-01
Cs-137	3.0 ± 0.3 E+00	6.7 ± 1.7 E-01
Ce-141	Less than 4.7 E-01	Less than 4.5 E-01
Ce-144	Less than 1.8 E+00	Less than 1.9 E+00
Tl-208	4.7 ± 1.8 E-01	2.5 ± 1.7 E-01
Bi-212	Less than 1.6 E+00	Less than 1.8 E+00
Pb-212	1.6 ± 0.4 E+00	1.3 ± 0.4 E+00
Pb-214	5.0 ± 4.5 E-01	5.4 ± 3.8 E-01
Bi-214	Less than 1.4 E-01	9.1 ± 3.6 E-01
Ra-226	Less than 6.1 E+00	Less than 5.9 E+00
Ac-228	8.8 ± 8.3 E-01	8.9 ± 7.6 E-01

SILT SAMPLES
(picocuries per gram dry)

	Chickahominy	Hog Island Point
Date Collected	3-24-75	3-18-75
Sample Weight Dry	106.0 gm	112.0 gm
Gamma Spectrometry		
Be-7	Less than 1.4 E+00	Less than 1.3 E+00
K-40	1.1 ± 0.3 E+01	1.3 ± 0.3 E+01
Mn-54	Less than 4.0 E-01	4.4 ± 1.5 E-01
Co-58	Less than 5.3 E-02	6.5 ± 1.7 E-01
Co-60	Less than 1.2 E-01	1.1 ± 0.2 E+00
Zn-65	Less than 3.5 E-01	Less than 1.1 E-01
Ru-103	Less than 1.9 E-01	Less than 1.8 E-01
Sb-125	Less than 6.0 E-01	Less than 5.7 E-01
Cs-134	Less than 1.1 E-01	1.3 ± 0.2 E+00
Cs-137	8.4 ± 2.0 E-01	2.9 ± 0.3 E+00
Ce-141	Less than 4.5 E-01	Less than 4.2 E-01
Ce-144	Less than 1.9 E+00	Less than 1.0 E+00
Tl-208	3.7 ± 1.8 E-01	3.5 ± 2.0 E-01
Bi-212	1.8 ± 1.5 E+00	Less than 1.7 E+00
Pb-212	1.6 ± 0.4 E+00	1.6 ± 0.4 E+00
Pb-214	7.7 ± 4.2 E-01	1.1 ± 0.4 E+00
Bi-214	1.5 ± 0.4 E+00	Less than 1.4 E-01
Ra-226	Less than 6.0 E+00	Less than 6.4 E+00
Ac-228	1.2 ± 0.8 E+00	1.5 ± 0.9 E+00

OYSTER SAMPLES
(picocuries per gram wet)

	Deep Water Shoals	Newport News
Date Collected	1-24-75	1-24-75
Sample Weight Dry/Wet	21.5/448.0 g	19.5/352.0 g
Gamma Spectrometry		
K-40	5.4 ± 2.3 E-01	5.6 ± 3.0 E-01
Co-58	1.2 ± 1.0 E-02	Less than 1.3 E-02
Co-60	Less than 2.1 E-02	Less than 2.4 E-02
Zn-65	Less than 3.0 E-02	3.3 ± 2.2 E-02
Nb-95	Less than 1.9 E-02	Less than 2.1 E-02
Ru-103	Less than 2.0 E-02	2.2 ± 1.4 E-02
Sb-125	Less than 1.3 E-01	Less than 1.0 E-01
Cs-134	1.5 ± 1.3 E-02	6.6 ± 2.2 E-02
Cs-137	3.0 ± 1.0 E-02	1.3 ± 0.3 E-01
Tl-208	Less than 3.2 E-02	Less than 3.5 E-02
Pb-212	Less than 5.2 E-02	Less than 6.0 E-01
Bi-214	Less than 1.5 E-01	Less than 1.6 E-01
Pb-214	Less than 1.1 E-01	Less than 8.0 E-02
Ra-226	Less than 5.5 E-01	Less than 5.0 E-01

OYSTER SAMPLES
(picocuries per gram wet)

	Point of Shoals
Date Collected	1-24-75
Sample Weight Dry/Wet	18.5/382.0 g

Gamma Spectrometry

K-40	Less than 3.8 E-01
Co-58	Less than 1.4 E-02
Co-60	Less than 2.5 E-02
Zn-65	Less than 3.5 E-02
Nb-95	Less than 2.2 E-02
Ru-103	Less than 2.3 E-02
Sb-125	Less than 1.0 E-01
Cs-134	Less than 1.7 E-02
Cs-137	2.5 ± 1.7 E-02
Tl-208	Less than 3.7 E-02
Pb-212	Less than 6.0 E-02
Pb-214	Less than 7.5 E-02
Bi-214	Less than 1.7 E-01
Ra-226	Less than 6.2 E-01

OYSTER SAMPLES
(picocuries per gram wet)

	Deep Water Shoals	Point of Shoals
Date Collected	3-27-75	3-27-75
Sample Weight Dry/Wet	16.0/337.0 g	18.0/252.6 g
Gamma Spectrometry		
K-40	Less than 4.5 E-01	5.8 ± 4.3 E-01
Co-58	Less than 1.6 E-02	Less than 1.4 E-02
Co-60	Less than 2.9 E-02	Less than 2.6 E-02
Zn-65	Less than 4.0 E-02	Less than 3.6 E-02
Nb-95	Less than 2.6 E-02	Less than 2.3 E-02
Ru-103	Less than 2.7 E-02	Less than 2.4 E-02
Sb-125	Less than 1.2 E-01	Less than 1.1 E-01
Cs-134	Less than 1.0 E-02	Less than 1.8 E-02
Cs-137	3.1 ± 1.5 E-02	2.7 ± 1.6 E-02
Tl-208	Less than 4.2 E-02	Less than 3.8 E-02
Pb-212	Less than 7.0 E-03	5.6 ± 0.6 E-01
Pb-214	Less than 2.0 E-01	Less than 2.7 E-01
Pb-214	Less than 1.0 E-01	Less than 7.0 E-02
Ra-226	Less than 7.4 E-01	Less than 5.6 E-01

OYSTER SAMPLES
(picocuries per gram wet)

	Newport News
Date Collected	3-31-75
Sample Weight Dry/Wet	15.0/251.3 g

Gamma Spectrometry

K-40	8.9 ± 4.0 E-01
Co-58	Less than 1.7 E-02
Co-60	Less than 1.7 E-02
Zn-65	Less than 4.3 E-02
Nb-95	Less than 2.7 E-02
Ru-103	Less than 2.9 E-02
Sb-125	Less than 1.3 E-01
Cs-134	Less than 2.1 E-02
Cs-137	Less than 3.8 E-02
Tl-208	Less than 4.5 E-02
Pb-212	Less than 9.3 E-02
Bi-214	Less than 2.1 E-01
Pb-214	Less than 1.1 E-01
Ra-226	Less than 7.9 E-01

OYSTER SAMPLES
(picocuries per gram wet)

	Deep Water Shoals	Newport News
Date Collected	5-15-75	5-15-75
Sample Weight Dry/Wet	22.5/403.5 gm	35.0/486.0 gm
Radiochemistry		
K-40	Less than 6.0 E-01	5.9 ± 3.4 E-01
Mn-54	Less than 2.2 E-02	Less than 1.8 E-02
Co-60	Less than 7.5 E-02	1.4 ± 1.3 E-02
Ru-103	Less than 3.8 E-01	Less than 3.2 E-01
Cs-137	3.0 ± 2.2 E-02	2.4 ± 2.1 E-02
Ce-141	Less than 1.5 E-01	Less than 1.3 E-01
Tl-208	Less than 4.7 E-01	Less than 3.9 E-01
Pb-212	Less than 1.2 E-01	Less than 9.7 E-02
Pb-214	Less than 1.3 E-01	Less than 1.4 E-01
Bi-214	Less than 1.0 E-01	6.5 ± 5.5 E-02
Ra-226	Less than 1.4 E+00	Less than 1.2 E+00
Ac-228	Less than 2.8 E-01	Less than 2.3 E-01

OYSTER SAMPLES
(picocuries per gram wet)

	Point of Shoals	Newport News
Date Collected	5-15-75	5-8-75
Sample Weight Dry/Wet	29.0/502.0 gm	92.5/863.5 gm
Gamma Spectrometry		
K-40	3.8 ± 3.7 E-01	8.0 ± 2.4 E-01
Mn-54	1.7 ± 1.2 E-02	Less than 1.0 E-02
Co-60	Less than 2.0 E-02	Less than 2.7 E-02
Ru-103	Less than 3.1 E-01	Less than 1.8 E-01
Cs-137	Less than 2.7 E-02	2.7 ± 1.4 E-02
Ce-141	Less than 1.2 E-01	Less than 7.1 E-02
Tl-208	Less than 3.8 E-01	Less than 2.2 E-01
Pb-212	Less than 9.8 E-02	Less than 7.7 E-02
Pb-214	Less than 1.4 E-01	Less than 8.0 E-02
Bi-214	Less than 8.0 E-02	Less than 4.7 E-02
Ra-226	Less than 1.1 E+00	Less than 6.5 E-01
Ac-228	Less than 2.7 E-01	Less than 1.3 E-01

CLAM SAMPLES
(picocuries per gram wet)

	Hog Island Point	Jamestown
Date Collected	1-7-75	1-7-75
Sample Weight Dry/Wet	12.5/371.0 g	21.0/392.0 g
Gamma Spectrometry		
K-40	Less than 8.4 E-01	Less than 3.7 E-01
Mn-54	Less than 2.6 E-02	Less than 1.5 E-02
Co-58	2.7 ± 1.3 E-02	2.4 ± 1.9 E-02
Co-60	Less than 1.6 E-02	4.5 ± 2.0 E-02
Zr-95	Less than 2.1 E-02	Less than 3.8 E-02
Nb-95	Less than 3.0 E-02	Less than 1.8 E-02
Ru-103	Less than 1.5 E-02	Less than 9.0 E-03
Ru-106	Less than 2.7 E-01	Less than 1.6 E-01
Ag-110m	Less than 1.2 E-02	Less than 7.0 E-03
Sb-125	Less than 1.0 E-01	Less than 6.2 E-02
I-131	Less than 5.2 E-02	Less than 3.1 E-02
Cs-134	Less than 1.6 E-02	2.5 ± 1.7 E-02
Cs-137	Less than 2.6 E-02	8.0 ± 2.4 E-02
La-140	Less than 5.2 E-02	Less than 1.7 E-02
Ce-144	Less than 1.5 E-01	Less than 9.0 E-02
Tl-208	Less than 2.7 E-02	Less than 3.0 E-02
Pb-212	Less than 6.3 E-02	Less than 6.1 E-02
Pb-214	Less than 2.1 E-01	Less than 1.2 E-01
Bi-214	Less than 8.5 E-02	Less than 8.0 E-02
Ra-226	Less than 6.6 E-01	Less than 6.4 E-01
Ac-228	Less than 1.0 E-01	Less than 6.0 E-02

CLAM SAMPLES
(picocuries per gram wet)

	Station Discharge
Date Collected	1-7-75
Sample Weight Dry/Wet	8.5/289.0 g
Gamma Spectrometry	
K-40	Less than 4.4 E-01
Mn-54	Less than 3.8 E-02
Co-58	5.3 ± 2.9 E-02
Co-60	4.8 ± 2.9 E-02
Zr-95	Less than 3.0 E-02
Nb-95	Less than 4.4 E-02
Ru-103	2.8 ± 1.7 E-02
Ru-106	Less than 3.9 E-01
Ag-110m	Less than 1.7 E-02
Sb-125	Less than 1.5 E-01
I-131	Less than 7.6 E-02
Cs-134	2.3 ± 2.0 E-02
Cs-137	2.5 ± 2.4 E-02
La-140	Less than 7.7 E-02
Ce-144	Less than 2.2 E-01
Tl-208	Less than 7.3 E-02
Pb-212	Less than 8.4 E-02
Pb-214	Less than 3.1 E-01
Bi-214	Less than 2.1 E-01
Ra-226	Less than 8.5 E-01
Ac-228	1.5 ± 1.4 E-01

CLAM SAMPLES
(picocuries per gram wet)

	Lawnes Creek	Chickahominy
Date Collected	1-24-75	1-7-75
Sample Weight Dry/Wet	12.5/205.0 g	17.0/364.0 g
Gamma Spectrometry		
K-40	Less than 5.8 E-01	Less than 6.2 E-01
Mn-54	2.6 ± 2.2 E-02	Less than 1.9 E-02
Co-58	Less than 4.0 E-02	Less than 3.0 E-02
Co-60	Less than 1.6 E-02	Less than 1.1 E-02
Zr-95	Less than 2.1 E-02	Less than 1.5 E-02
Nb-95	Less than 3.0 E-02	Less than 2.2 E-02
Ru-103	Less than 1.5 E-02	Less than 1.1 E-02
Ru-106	Less than 2.7 E-02	Less than 2.0 E-01
Ag-110m	Less than 1.2 E-02	Less than 9.0 E-03
Sb-125	Less than 1.0 E-01	Less than 7.6 E-02
I-131	Less than 5.2 E-02	Less than 3.8 E-02
Cs-134	Less than 1.6 E-02	Less than 1.2 E-02
Cs-137	Less than 4.2 E-02	Less than 2.4 E-02
La-140	Less than 5.2 E-02	Less than 3.8 E-02
Ce-144	Less than 1.5 E-01	Less than 1.1 E-01
Tl-208	Less than 5.0 E-02	Less than 3.7 E-02
Pb-212	Less than 1.3 E-02	Less than 6.4 E-02
Pb-214	Less than 2.1 E-01	Less than 1.5 E-01
Bi-214	1.3 ± 1.2 E-01	Less than 1.0 E-01
Ra-226	Less than 1.2 E+00	Less than 6.9 E-01
Ac-228	Less than 1.0 E-01	Less than 8.0 E-02

CLAM SAMPLES
(picocuries per gram wet)

	Station Discharge	Lawnes Creek
Date Collected	3-24-75	3-27-75
Sample Weight Dry/Wet	24.0/393.2 gm	26.0/426.0 gm
Gamma Spectrometry		
K-40	4.2 ± 3.1 E-01	4.3 ± 2.3 E-01
Mn-54	Less than 1.4 E-02	Less than 1.1 E-02
Co-58	Less than 2.1 E-02	Less than 1.9 E-02
Co-60	4.4 ± 2.7 E-02	Less than 2.9 E-02
Zr-95	Less than 1.1 E-02	Less than 1.0 E-02
Nb-95	Less than 1.5 E-02	Less than 1.4 E-02
Ru-103	Less than 8.0 E-03	Less than 7.0 E-03
Ru-106	Less than 2.7 E-01	Less than 1.3 E-01
Ag-110m	Less than 6.0 E-03	Less than 6.0 E-03
Sb-125	Less than 5.4 E-02	Less than 5.0 E-02
I-131	Less than 2.7 E-02	Less than 2.5 E-02
Cs-134	3.0 ± 2.1 E-02	Less than 8.0 E-03
Cs-137	3.4 ± 2.1 E-02	Less than 2.4 E-02
La-140	Less than 2.7 E-02	Less than 2.5 E-02
Ce-144	Less than 8.0 E-02	Less than 7.0 E-02
Tl-208	Less than 2.6 E-02	Less than 2.4 E-02
Pb-212	Less than 9.3 E-02	Less than 6.1 E-02
Pb-214	Less than 1.1 E-01	Less than 1.0 E-01
Bi-214	Less than 7.2 E-02	Less than 6.6 E-02
Ra-226	Less than 6.0 E-01	Less than 6.0 E-01
Ac-228	Less than 2.5 E-01	Less than 5.0 E-02

CLAM SAMPLES
(picocuries per gram wet)

	Jamestown	Hog Island Point
Date Collected	3-24-75	3-24-75
Sample Weight Dry/Wet	7.0/255 gm	12.0/243.8 gm
Gamma Spectrometry		
K-40	Less than 5.4 E-01	3.9 ± 3.0 E-01
Mn-54	Less than 4.6 E-02	Less than 1.7 E-02
Co-58	Less than 7.2 E-02	Less than 4.2 E-02
Co-60	2.8 ± 2.5 E-02	Less than 1.6 E-02
Nb-95	Less than 5.3 E-02	Less than 3.1 E-02
Zr-95	3.7 ± 3.7 E-02	Less than 2.1 E-02
Ru-103	Less than 2.7 E-02	Less than 3.1 E-02
Ru-106	Less than 4.8 E-01	Less than 2.8 E-01
Ag-110m	Less than 2.1 E-02	Less than 1.2 E-02
Sb-125	Less than 1.8 E-01	Less than 1.1 E-01
I-131	Less than 9.2 E-02	Less than 5.4 E-02
Cs-134	Less than 2.8 E-02	Less than 1.6 E-02
Cs-137	5.4 ± 2.3 E-02	2.6 ± 2.5 E-02
La-140	Less than 9.3 E-02	Less than 5.5 E-02
Ce-144	Less than 2.7 E-01	Less than 1.6 E-01
Tl-208	Less than 8.9 E-02	Less than 3.5 E-02
Pb-212	Less than 9.7 E-02	Less than 9.3 E-02
Pb-214	Less than 1.1 E-01	Less than 1.1 E-01
Bi-214	1.4 ± 1.2 E-01	Less than 1.3 E-01
Ra-226	Less than 2.1 E-01	Less than 1.2 E-01
Ac-228	Less than 1.8 E-01	Less than 2.4 E-01

CLAM SAMPLES
(picocuries per gram wet)

	Chickahominy
Date Collected	3-24-75
Sample Weight Dry/Wet	16.0/356.8 gm

Gamma Spectrometry

K-40	Less than 3.3 E-01
Mn-54	Less than 2.0 E-02
Co-58	Less than 3.2 E-02
Co-60	Less than 1.2 E-02
Zr-95	Less than 1.6 E-02
Nb-95	Less than 2.3 E-02
Ru-103	Less than 1.2 E-02
Ru-106	Less than 2.1 E-01
Ag-110m	Less than 9.0 E-03
Sb-125	Less than 8.0 E-02
I-131	Less than 4.1 E-02
Cs-134	Less than 1.2 E-02
Cs-137	2.0 ± 1.7 E-02
La-140	4.1 ± 3.0 E-02
Ce-144	1.2 ± 0.9 E-01
Tl-208	Less than 2.5 E-02
Pb-212	Less than 6.6 E-02
Pb-214	Less than 1.6 E-01
Bi-214	Less than 1.0 E-01
Ra-226	Less than 6.9 E-01
Ac-228	Less than 8.0 E-02

CLAM SAMPLES
(picocuries per gram wet)

	Chickahominy	Hog Island Reserve
Date Collected	5-13-75	5-13-75
Sample Weight Dry/Wet	29.0/445.0 gm	23.0/437.0 gm
Gamma Spectrometry		
K-40	Less than 5.4 E-01	Less than 5.7 E-01
Mn-54	Less than 1.7 E-02	Less than 1.8 E-02
Co-58	Less than 3.5 E-02	2.8 ± 2.4 E-02
Co-60	5.8 ± 2.4 E-02	5.5 ± 2.3 E-02
Zn-65	Less than 5.0 E-02	Less than 5.1 E-02
Sb-125	Less than 1.2 E-01	Less than 1.2 E-01
I-131	Less than 1.9 E-02	Less than 1.9 E-02
Cs-137	4.8 ± 2.3 E-02	4.7 ± 2.4 E-02
Tl-208	Less than 3.6 E-02	Less than 3.7 E-02
Pb-212	Less than 1.1 E-01	Less than 1.1 E-01
Pb-214	Less than 1.2 E-01	Less than 1.2 E-01
Bi-214	Less than 1.0 E-01	Less than 1.0 E-01

CLAM SAMPLES
(picocuries per gram wet)

	Lawnes Creek	Jamestown
Date Collected	5-13-75	5-13-75
Sample Weight Dry/Wet	34.0/432.0 gm	17.5/356.0 gm
Gamma Spectrometry		
K-40	6.4 ± 3.8 E-01	3.9 ± 2.4 E-01
Mn-54	5.7 ± 2.9 E-02	Less than 2.1 E-02
Co-58	4.2 ± 0.6 E-01	Less than 4.4 E-02
Co-60	3.2 ± 0.5 E-01	3.3 ± 2.0 E-02
Zn-65	Less than 5.1 E-02	Less than 6.2 E-02
Sb-125	Less than 1.2 E-01	Less than 1.5 E-01
I-131	Less than 2.0 E-02	Less than 2.4 E-02
Cs-137	8.3 ± 2.7 E-02	5.5 ± 1.7 E-02
Tl-208	Less than 3.7 E-02	Less than 4.5 E-02
Pb-212	Less than 5.6 E-02	Less than 6.8 E-02
Pb-214	Less than 1.2 E-01	Less than 1.5 E-01
Bi-214	Less than 1.0 E-01	Less than 1.2 E-01

CLAM SAMPLES
(picocuries per gram wet)

	Station Discharge
Date Collected	5-13-75
Sample Weight Dry/Wet	19.9/449.9 gm
<u>Gamma Spectrometry</u>	
K-40	4.3 ± 2.1 E-01
Mn-54	2.8 ± 1.7 E-02
Co-58	1.9 ± 0.3 E-01
Co-60	1.2 ± 0.3 E-01
Zn-65	Less than 4.9 E-02
Sb-125	Less than 1.2 E-01
I-131	2.0 ± 1.9 E-02*
Cs-134	Less than 2.5 E-02
Cs-137	3.5 ± 2.0 E-02
Tl-208	Less than 3.5 E-02
Pb-212	Less than 5.6 E-02
Pb-214	Less than 1.1 E-01
Bi-214	Less than 9.9 E-02

*1350-24 May 75

FISH SAMPLES
(picocuries per gram wet)

	Eel from Station Intake	Catfish from Station Discharge
Date Collected	2-25-75	2-25-75
Sample Weight Dry/Wet	11.5/14.0	21.0/30.0
<u>Gamma Spectrometry</u>		
K-40	Less than 8.9 E+00	2.5 ± 2.4 E+00
Cr-51	3.8 ± 3.6 E+00	Less than 2.0 E+00
Co-60	Less than 4.6 E-01	Less than 2.5 E-01
Cs-137	Less than 4.5 E-01	1.6 ± 1.6 E-01
Tl-208	Less than 7.1 E-01	Less than 3.9 E-01
Pb-212	Less than 1.7 E+00	Less than 7.7 E-01
Pb-214	Less than 2.0 E+00	Less than 1.1 E+00
Bi-214	Less than 1.9 E+00	Less than 8.6 E-01
Ra-226	Less than 1.5 E+01	Less than 8.1 E+00

CONCLUSION

Conduct of the environmental monitoring program at Surry Power Station during the first half of 1975 provided information concerning diluted effluent in the environment as well as levels of radionuclides from other sources.

Air particulate samples primarily showed activity due to injection from upper atmosphere which apparently increased due to surface weapons tests by the Peiples Republic of China during the summers of 1973 and 1974. The typical spring mixing of upper and lower atmospheres was demonstrated by the trend of gross beta concentrations. The period started with relatively low gross beta concentrations averaging 8.2 E-02 pCi/M^3 among all stations and an increase was observed in samples collected during February, 1975. Concentrations proceeded to decline and the six month period ended with an average concentration of 5.7 E-02 pCi/M^3. Gamma spectrometry of composited air particulate filters continued to document concentrations of zirconium and niobium-95, cesium-137 and cerium-144 with good evidence that the presence of these radionuclides was not due to Surry effluent. The five station composite of air particulate filters showed cobalt-60 during the first quarter with 4.0 ± pCi/M^3; the same composite showed traces of ruthenium-106 and manganese-54 during the second quarter.

Environmental dosimetry yielded historically typical data during the first quarter of 1975 while the second quarter was markedly lower. The difference is most likely due to lower intransit and storage dose. A conservative dose estimate, using the lowest dose stations as controls and by adding the 95 percent confidence error term, shows Newport News (0.5 mrem/wk), Smithfield (0.4 mrem/wk), and Hog Island Reserve (0.3 mrem/wk) as the highest among the first quarter measurements. A similar conservative estimate for second quarter dosimetry provides Lee Hall (0.6 mrem/wk), Scotland Wharf(0.5 mrem/wk), Smithfield (0.5 mrem/wk), and Hog Island Reserve (0.4 mrem/wk). These net dose rates, because of the mehtod of comparison, do not necessarily reflect dose due to Surry effluent, but

do provide a comparison with the lowest ambient rates within the dosimetry array.

Precipitation, surface water, well water and James River water, yielded results which were typical of the previous history. Ground water showed some sporadic elevations of the tritium concentration however, they are comparable to surface water levels and not unlike previous experience. James River water showed a single low level indication of cesium-137 at the Station Discharge and cesium-134 was at analytical sensitivity in a sample from Newport News.

Silt and shellfish concentrations continue to demonstrate their relationship. to liquid effluent from Surry. Synthesizing the "maximum credible" oyster yielded a total estimate of 0.17 mrem/yr and the same clam comparison gave .093 mrem/yr (sum of whole body and gastronintestinal - lower large intestine).

5.0 STATION RADIOACTIVE EFFLUENT RELEASES AND SOLID RADIOACTIVE WASTE

Date on radioactive effluents for the first six (6) months of 1975 are herewith reported in the form given in Appendix A of U.S.A.E.C. Safety Guide 21, dated December 29, 1971.

Liquid concentrations were measured at their source prior to discharge to determine total activities released. Percent of technical specification limit for activity released is based on the limits specified in 10CFR20, Appendix B, for unrestricted areas and takes into account the nuclides present, excluding tritium, and are calculated using data averaged over the actual time of discharge only and hence do not take credit for dilution water flow available at those times when releases were not being made.

Halogen and particulate concentrations were measured by continuous samples of all discharges near their points of release. Gaseous concentrations were measured at the source prior to discharge to determine total activities released.

Percent of applicable limit for airborne releases are based on the limits specified in 10CFR20, Appendix B.

REPORT OF RADIOACTIVE EFFLUENTS

Facility: Surry Power Station Docket: 50-280 and 50-281 Year: 1975

I. LIQUID RELEASES	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL	± ERROR
		MONTHS							
1. Gross Radioactivity (B.Y.)									
a) Total release	Curies	7.76E-1	1.66E-0	5.35E-1	3.03E-1	isotopic	2.23E-1		
b) Average concentration released	µCi/ml	5.32E-9	8.14E-9	2.41E-9	1.36E-9	analysis	1.03E-9		
c) Maximum concentration released	µCi/ml	isot. analysis	isot. analysis	isot. analysis	isot. analysis		isotopic analysis		
2. Tritium									
a) Total released	Curies	1.86E+1	2.04E+1	6.25E+1	5.12E+1	3.25E+1	4.38E+1	2.29E+2	1.95E+1
b) Average concentration released	µCi/ml	1.27E-7	1.00E-7	2.82E-7	2.30E-7	1.67E-7	2.02E-7		
3. Dissolved Noble Gases									
a) Total release	Curies	7.75E-1	3.84E-0	1.83E-0	1.12E+1	5.39E-0	2.71E-1	2.33E+1	1.98E-0
b) Average concentration released	µCi/ml	5.31E-9	1.88E-8	8.25E-9	5.06E-8	2.78E-8	1.25E-9		
4. Gross Alpha Radioactivity									
a) Total release	Curies	9.39E-6	1.58E-5	7.08E-6	9.56E-7	2.30E-6	2.70E-6	3.82E-5	3.82E-5
b) Average Concentration released	µCi/ml	6.43E-14	7.75E-14	3.19E-14	4.31E-15	1.19E-14	1.24E-14		
5. Volume Of Liquid To Discharge Canal	Liters	4.93E+6	1.49E+7	5.16E+6	3.56E+6	4.47E+6	3.90E+6	3.69E+7	1.29E+6
6. Volume of Dilution Water	Liters	1.46E+11	2.04E+11	2.22E+11	2.22E+11	1.94E+11	2.17E+11	1.21E+12	4.24E+10
7. Isotopes Released MPC µCi/ml	Curies								
Ba + La - 140 2×10^{-5}									
Sr-89 3×10^{-6}		6.06E-4	1.22E-3	6.61E-4	7.12E-4	8.94E-4	7.80E-4	4.87E-3	
I-131 3×10^{-7}		1.05E-2	5.96E-2	6.88E-2	4.92E-1	7.58E-1	2.51E-1	1.64E-0	1.39E-1
Xe-133 3×10^{-7}		7.75E-1	3.83E-0	1.82E-0	1.12E+1	5.38E-0	2.52E-1	2.33E+1	1.98E-0
Xe-135 1×10^{-7}		-	4.15E-2	9.75E-3	3.14E-2	8.59E-3	1.87E-2	1.10E-1	9.35E-3
Cs-137 2×10^{-5}		6.09E-1	3.79E-1	4.27E-2	5.92E-2	8.42E-2	1.07E+1	1.19E+1	1.01E-0
Cs-134 9×10^{-6}		3.06E-1	1.84E-1	2.17E-2	3.11E-2	3.31E-2	6.19E-0	6.77E-0	5.75E-1
Co-60 3×10^{-5}		6.86E-2	2.09E-1	1.23E-2	4.08E-2	3.97E-2	5.93E-1	9.63E-1	8.19E-2
Co-58 9×10^{-5}		4.34E-2	1.84E-1	1.07E-2	2.14E-2	1.55E-1	3.97E-2	4.54E-1	3.86E-2
Cr-51 2×10^{-3}		-	-	-	-	9.00E-3	-	9.00E-3	7.65E-4
Mn-54 1×10^{-4}		4.91E-3	3.66E-3	1.36E-3	7.21E-3	3.43E-3	1.10E-1	1.31E-1	1.11E-2
Zn-65 1×10^{-4}									
Sr-90 3×10^{-7}		1.05E-4	1.90E-4	1.16E-4	4.98E-5	6.26E-5	5.46E-5	5.78E-4	
C-14 8×10^{-4}		7.35E-5	1.00E-4	8.15E-5	6.37E-4	8.00E-4	6.98E-4	2.39E-3	
8. Percent Of Technical Specification Limit For Activity Released (10CFR20)	%	7.00E-2	1.21E-1	1.06E-1	7.43E-1	1.32E-0	9.60E-1		

REPORT OF RADIOACTIVE EFFLUENTS

Facility: Surry Power Station Docket: 50-280 and 50-281 Year: 1975

II. AIRBORN RELEASES

	UNITS	MONTHS JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL	± ERROR
1. Total Noble Gases	Curies	7.96E+1	4.23E+1	1.91E+0	1.57E+3	1.52E+3	-	3.21E+3	2.73E+2
2. Total Halogens	Curies	5.31E-4	5.75E-4	7.06E-4	2.19E-3	8.99E-3	8.84E-3	2.18E-2	1.85E-3
3. Total Particulate Gross Radioactivity (B.Y.)	Curies	1.26E-3	5.12E-4	1.69E-4	2.50E-4	1.33E-3	1.22E-3	4.74E-3	4.03E-4
4. Total Tritium	Curies	3.42E-4	-	-	5.91E-1	2.26E-0	-	2.85E-0	2.42E-1
5. Total Particulate Gross Alpha Radioactivity	Curies	3.37E-5	1.15E-5	2.78E-6	1.29E-5	2.11E-5	2.78E-5	1.10E-4	9.35E-6
6. Maximum Noble Gas Release Rate	μCi/sec	2.43E+2	9.28E+2	1.80E+2	6.06E+2	2.73E+3	-		
7. Percent of Applicable Limit For 10CRF20:									
a) Noble gases	%	4.95E-2	2.91E-2	1.19E-3	1.01E-0	9.45E-1	-		
b) Halogens	%	9.91E-4	1.19E-3	1.32E-3	4.22E-3	1.68E-2	1.71E-2		
c) Particulates	%	7.63E-4	2.17E-3	7.37E-5	2.95E-3	1.33E-4	7.85E-4		
8. Isotope Released:	Curies								
a) Particulates									
Co-58	Curies	6.10E-4	1.15E-3	1.43E-5	3.20E-4	2.38E-4	8.73E-5	2.42E-3	2.06E-4
Ba-LA-140									
Sr-90		0	0	0	-	-	-	-	
Co-60	Curies	6.54E-4	1.47E-3	2.32E-5	2.30E-3	2.87E-7	6.26E-4	5.07E-3	4.31E-4
Sr-89		0	0	0	-	-	-	-	
Mn-54	Curies	5.97E-6	8.44E-4	1.14E-5	-	-	-	8.61E-4	7.32E-5
b) Halogens									
I-131	Curies	4.97E-4	4.94E-4	6.82E-4	1.99E-3	8.56E-3	8.49E-3	2.07E-2	1.76E-3
I-133	Curies	3.44E-5	8.10E-5	2.43E-5	1.88E-4	4.15E-4	3.51E-4	1.09E-3	9.27E-5
I-135	Curies	-	-	-	7.36E-6	1.43E-5	-	2.17E-5	1.85E-6
I-132	Curies								
c) Gases									
Kr-85	Curies								
Xe-133	Curies	7.95E+1	3.43E+1	1.91E+0	1.57E+3	1.52E+3	-	3.21E+3	2.73E+2
Kr-88	Curies	3.73E-3	-	-	-	-	-	3.73E-3	3.17E-4
Kr-87	Curies								
Kr-85m	Curies	8.51E-3	-	-	-	-	-	8.51E-3	7.23E-4
Xe-138									
Xe-135m	Curies								

Facility: Surry Power Station Docket: 50-280 and 50-281 Year: 1975

II. AIRBORN RELEASES	UNITS	MONTHS JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL	± ERROR
c) Gases Continued									
Xe-135	Curies	9.66E-2	7.98E+0	-	4.22E+0	-	-	1.23E+1	1.05E-0
Ar-41		1.73E-2	-	-	-	-	-	1.73E-2	1.47E-3
Others As Appropriate (Specify)							-		
Xe-133m		9.51E-3	-	-	-	-	-	9.51E-3	8.08E-4
Na-24		2.05E-4	-	-	-	-	-	2.05E-4	1.74E-5
Cs-134		1.04E-4	6.07E-4	1.96E-6	7.99E-4	2.60E-7	-	1.51E-3	1.28E-4
CS-137		6.30E-4	1.35E-3	1.47E-4	2.73E-3	9.91E-5	5.03E-4	5.46E-3	4.64E-4
Cs-138		1.04E-3	-	-	-	1.18E-2	-	1.28E-2	1.09E-3
III. SOLID RADIOACTIVE WASTE DISPOSAL									
1. a) Total Amount Solid Waste Packaged	FT^3	3.65E+3	1.66E+3	8.29E+2	1.59E+3+	3.07E+5*	2.85E+3	3.18E+5	
b) Estimated Total Activity	Curies	8.26E+0	10.28E+0	6.91E+0	1.83E+2+	2.19E+2	1.46E+2	5.73E+2	
c) Date Of Shipment And Disposition									
		1-02-75* 1-04-75* 1-20-75** 1-21-75** 1-22-75** 1-27-75** 1-28-75** 1-29-75** *Barnwell, S.C. **Moorehead, Ky.	2-04-75* 2-10-75* 2-20-75** 2-21-75** 2-28-75** *Barnwell, S.C. ** Moore-head, KY	3-18-75* 3-27-75* 3-3-75** *Barnwell S.C. **Moore-head, KY.	4-02-75** 4-03-75* 4-09-75* 4-16-75* 4-24-75* 4-26-75* 4-28-75* 4-30-75* *Barnwell S.C. **Moore-head, KY. +4.6E+2FT³ Spent Resin Containing 1.82 Ci	Barnwell, SC 5-03-75 5-05-75 5-06-75 5-07-75 5-09-75 5-10-75 5-11-75 5-12-75 5-12-75 5-13-75 5-14-75 5-14-75 5-15-75 5-16-75 5-18-75 5-19-75 5-27-75 5-28-75 5-31-75 *Includes of water	Barnwell, S.C. 6-03-75 6-07-75 6-10-75 6-11-75 6-12-75 6-16-75 6-23-75 6-23-75 6-30-75 40,600 gal. shipped via tanker.		

6.0 FUEL SHIPMENTS

There were no fuel shipments during this report period.

7.0 SUMMARY OF OCCURRENCES IN WHICH TEMPERATURE LIMITATIONS ON COOLING WATER DISCHARGE WERE EXCEEDED

The licensee is required to report any deviation from cooling water discharge limitations as specified in Technical Specification 4.14. There were no deviations during this reporting period.

8.0 Changes to Station Organization

The following changes were made in the station operating organization involving positions for which minimum qualifications are specified in Technical Specifications:

1. Mr. J.D. Kellams, Ass't. Operating Supervisor, was transferred to North Anna effective January 1, 1975.
2. Mr. W.L. Stewart was promoted to Ass't. Operating Supervisor effective January 1, 1975.
3. Mr. L.A. Wagner was promoted to Shift Supervisor effective January 1, 1975.
4. Mr. J.W. Martin, Jr., Supt. Station Operations was transferred to Richmond effective April 1, 1975.
5. Mr. T.L. Baucom, Operating Supervisor, was promoted to Supt. Station Operations effective April 1, 1975.
6. Mr. W.L. Stewart, Ass't Operating Supervisor, was promoted to Operating Supervisor effective April 1, 1975.
7. Mr. T.J. Kenny was promoted to Ass't. Operating Supervisor effective April 1, 1975.
8. Mr. J.A. Hanson was promoted to Shift Supervisor effective April 1, 1975.

9.0 OCCUPATIONAL PERSONNEL RADIATION EXPOSURE (T.S.6.6.A.10)

9.1 The whole body exposures for this reporting period have been recorded in Table 9.1-1.

9.2 The numbers of personnel receiving more than 500 mrem during this reporting period are listed by duty function in Table 9.2-1.

OCCUPATIONAL PERSONNEL RADIATION EXPOSURE

TECHNICAL SPECIFICATION 6.6.A.10

JANUARY - JUNE, 1975

Dose Range (mrem)	Number of Individuals
No measurable exposure	456
1 - 99	579
100 - 249	153
250 - 499	138
500 - 749	78
750 - 999	51
1000 - 1999	102
2000 - 2999	45
3000 - 3999	5
4000 - 4999	2
Greater than 5000	0
Total Number of Individuals Reported	1,609

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION
LICENSE NO. DPR-32 AND DPR-37
MAN-REM EXPOSURE - JOB FUNCTION
JANUARY - JUNE 1975

Technical Specification 6.6A.10

Dose Range (mrem)	Station Employees			Utility Emoployees			Sub-Contractual Employees		
	Job Function	Number of Individuals	Total Dose Rem	Job Function	Number of Individuals	Total Dose Rem	Job Function	Number of Individuals	Total Dose Rem
500-749	Reactor Operation and Surveillance	4	2.488	Reactor Operation and Surveillance	4	2.552	In-Service Inspection	6	4.081
	In-Service Inspection	2	1.159	Routine Maintenance	14	8.634	Routine Maintenance	15	8.857
	Routine Maintenance	10	6.263	Refueling	1	0.711	Special Maintenance-Eddy Current	6	3.754
	Special Maintenance - Eddy Current	1	0.545				Waste Processing	9	6.046
	Waste Processing	1	0.530				Refueling	3	1.838
	Refueling	2	1.239						
750-999	Reactor Operation and Surveillance	4	3.476	Reactor Operation and Surveillance	2	1.592	In-Service Inspection	2	1.617
	Routine Maintenance	5	4.354	Routine Maintenance	5	4.502	Routine Maintenance	15	13.256
	Refueling	3	2.594				Special Maintenance Eddy Current	8	6.773
							Waste Processing	5	3.924
							Refueling	2	1.746
1000-1999	Reactor Operation and Surveillance	3	4.227	Routine Maintenance	12	16.299	Inservice Inspection	23	36.662
	In-Service Inspection	3	4.004	Special Maintenance Eddy Current	2	2.983	Routine Maintenance	11	14.983
	Routine Maintenance	14	19.862				Special Maintenance Eddy Current	21	31.168
	Special Maintenance Eddy Current	1	1.418				Waste Processing	7	11.684
	Waste Processing	2	2.886				Refueling	2	2.443
	Refueling	1	1.114						
2000-2999	Reactor Operation and Surveillance	3	7.217	Special Maintenance Eddy Current	3	7.308	In-Service Inspection	9	20.540
	Routine Maintenance	8	19.699	Refueling	1	2.540	Routine Maintenance	4	8.431
							Special Maintenance Eddy Current	12	26.035
							Waste Processing	5	11.695
3000-3999	Routine Maintenance	3	10.155		0	0	In-Service Inspection	1	3.023
							Waste Processing	1	3.738
4000-4999	Waste Processing	2	8.203		0	0		0	0
Greater than 5000		0	0		0	0		0	0

TABLE 9.2-1

10.0 UNIT NO. 1 OPERATING SUMMARY

10.1 POWER GENERATION

10.1.1 A summary of power generated during each month of the reporting period, the total for the reporting period, and the accumulative total since commercial operations commenced is tabulated in Table 10.1.1-1.

10.1.2 A histogram of thermal power versus time for the reporting period is given in Figure 10.1.2-1.

10.1.3 Operating statistics during the period from initial criticality until the date Unit No. 1 was declared commercial (July 1, 1972 to December 21, 1972) are tabulated in Table 10.1.3-1.

10.1.4 A summary of the power generated by the combustion turbines is tabulated in Table 10.1.4-1.

10.1.5 The Maximum Dependable Capacity (MDC) and Reserve Shutdown Hours (RSH) for the Surry Power Station Units are contained in Table 10.1.5-1.

POWER GENERATION SUMMARY
SURRY POWER STATION

UNIT NO. 1

DESCRIPTION	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL FOR PERIOD	* CUMULATIVE TOTAL
1. Gross Thermal Power Generated (MWH)	611	1,329,659	1,363,940	1,475,404	1,712,641	1,566,410	7,448,665	29,504.075
2. Gross Electrical Power Generated (MWH)	0	434,615	453,670	486,190	558,495	502,800	2,435,770	9,763,533
3. Station Service (MWH)	0	22,118	21,729	23,675	27,601	25,523	120,646	518,056
4. Net Electrical Power Generated (MWH)	0	412,497	431,941	462,515	530,894	477,277	2,315,124	9,245,477
5. Number of Hours Reactor Critical (HRS)	42.2	665.3	716.1	625	717.7	662.3	3,428.6	14,153
6. Number of Hours Generator On Line (HRS)	0	590.7	569.6	620.4	716.3	660.8	3,157.8	13,575.3

* Since Commercial Operation

Figure 10.1.2-1

POWER GENERATION HISTOGRAM
UNIT NO. 1
SURRY POWER STATION
JANUARY THROUGH JUNE 1975

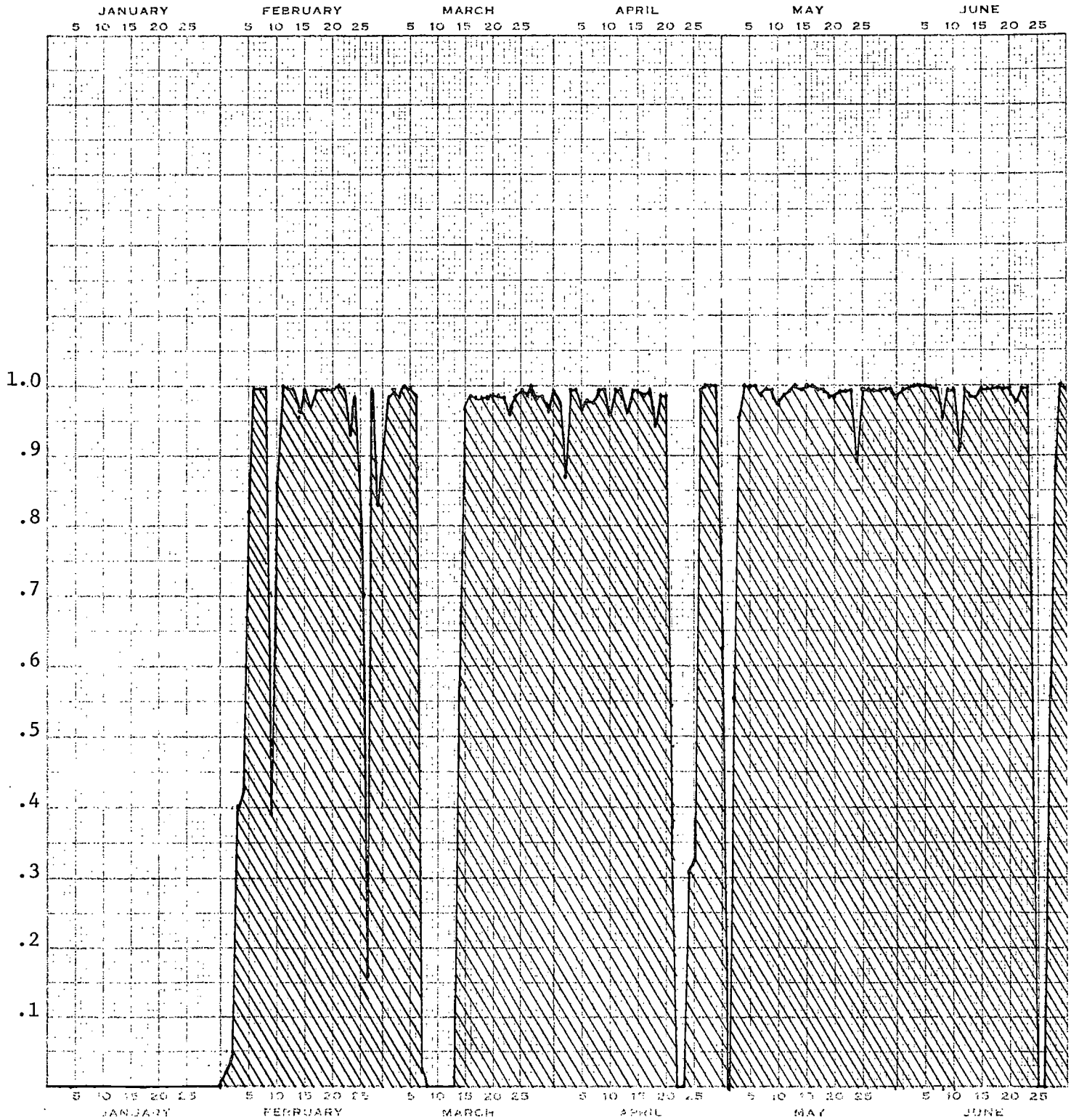


Table 10.1.3-1

PRE-COMMERCIAL OPERATION STATISTICS

SURRY POWER STATION

UNIT NO. 1

Gross Thermal Power Generated (MWH):	851,218
Gross Electrical Power Generated (MWH)	265,435
Net Electrical Power Generated (MWH)	237,457
Hours Reactor Was Critical	1107.4
Hours Generator On-Line	1076.9

POWER GENERATION

COMBUSTION TURBINES

SURRY POWER STATION

UNIT NO.	MONTH						TOTAL FOR PERIOD	CUMMULATIVE TOTAL
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE		
GT 191 (MW)	0	0	7	69	0	0	76	40,886
GT 251 (MW)	0	0	0	0	0	0	0	59,771
Total (MW)	0	0	7	69	0	76	76	100,657

Readings are in Megawatt hours.

Table 10.1.4-1

MAXIMUM DEPENDABLE CAPACITY (MDC)

RESERVE SHUTDOWN HOURS (RSH)

SURRY POWER STATION

	MDC	RSH
Unit No. 1	824.3 MW Gross 788.3 MW Net	0
Unit No. 2	824.3 MW Gross 788.3 MW Net	0

10.2 OUTAGES

The outages occurring during this reporting period for Unit No. 1 are tabulated in Table 10.2-1.

OUTAGE REPORT
UNIT NO. 1
SURRY POWER STATION
JANURAY 1, 1975 THROUGH JUNE 30, 1975

Table 10.2-1

OUT OF SERVICE		RETURN TO SERVICE		NO. HRS. OUT	UNIT	METHOD OF		
TIME	DATE	TIME	DATE	HRS MIN	STATUS	SHUTDOWN	CAUSE	CORRECTIVE ACTION
2004	10-24-74	0750	2-02-75	2711-46	CSD	Rx trip via Turbine trip	Failure of permissive P-7 to interlock. Reactor trip via turbine trip below 10% power (blown fuse).	None required. Reactor scheduled for first refueling.
0824	2-02-75	1130	2-02-75	3 - 6	HSD	Automatic	Feed regulator valve failed open due to error in the control circuit of the feed water regulator valve.	Color coding error - input No. 1 of FC-1-498E - coding corrected.
1138	2-02-75	1443	2-02-75	3 - 5	HSD	Automatic	Feedwater control sensitivity.	N/A
1515	2-02-75	1730	2-02-75	2 -15	HSD	Automatic	Loss of feed water pump occurred during bus shifting with a breaker in the test position.	Racked in breaker 15A2 to preclude future loss of feed pumps.
1855	2-02-75	2220	2-02-75	2 -25	HSD	Automatic	Feed water control sensitivity.	N/A
2305	2-03-75	0252	2-04-75	3 -47	HSD	Automatic	Low steam generator water level spike.	Cycled all feed water reg. valves for proper operation.
0925	2-09-75	2251	2-09-75	13 -26	HDS	Manual	100% load reject test.	N/A

OUTAGE REPORT
UNIT NO. 1
SURRY POWER STATION
JANUARY 1, 1975 THROUGH JUNE 30, 1975

Table 10.2-1

OUT OF SERVICE		RETURN TO SERVICE		NO. HRS. OUT	UNIT STATUS	METHOD OF SHUTDOWN	CAUSE	CORRECTIVE ACTION
TIME	DATE	TIME	DATE	HRS MIN				
2217	2-25-75	1830	2-26-75	20 - 13	HSD	Automatic	Feedwater control sensitivity.	N/A.
0153	3-07-75	0814	3-14-75	174 - 21	HSD	Manual	Turbine bearing repair.	N/A
0815	4-02-75	0943	4-02-75	1 - 30	HSD	Automatic	Faulty relay on loop stop valve while performing PT.	Corrected fault.
1040	4-21-75	1315	4-24-75	74 - 35	CSD	Manual	Repair leaks in MOV-RH-1700, 1701.	N/A
1326	4-24-75	1431	4-24-75	1 - 5	HSD	Automatic	Feedwater control sensitivity.	Spiked signal.
1445	4-24-75	1549	4-24-75	1 - 5	HSD	Automatic	Feedwater control sensitivity.	Spiked signal.
0256	4-25-75	1453	4-25-75	11 - 57	HSD	Automatic	Pressurizer spray valve failed open.	Isolated air to PCV-1455B.
1435	4-30-75	0343	5-02-75	37 - 08	HSD	Automatic	No. 3 Diesel generator failure	Reinstated power to vital busses.
1403	6-24-75	0114	6-27-75	59 - 11	HSD	Manual	Leak of MOV-RH-1700	Repacked MOV-RH-1700

10.3 CHANGES IN FACILITY DESIGN

The following changes were implemented during this reporting period:

Design Change	Unit
1. DC-73-4 - Wire Motor Operated Valve Indicating Lights in Series with Motor Overloads	1,2

Description - This change involved wiring valve position indicating lights in series with the overloads. In this case both lights would extinguish if a motor overload occurs and the operator would have immediate indication of a problem. This change was previously initiated but completed during this report period.

Summary of Safety Evaluation -

a. The probability of an occurrence important to safety is not increased due to the fact that the operator will be aware of a malfunction in the case of a motor overload in an MOV sooner than the present system allows.

b. There is no possibility of a malfunction of a different type occurring due to the change because the basic function of the systems involved remain unchanged.

c. The margin of safety is not decreased since the knowledge of an MOV overload is detected sooner than the present system allows.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
2. DC-73-13 - Subsurface Drainage System Modification	1,2

Description - The purpose of the system is to keep the water pressure around the containment within certain limits. The new system will be easier to maintain and should require less maintenance, while draining the area within the cofferdam through the same tile the old system was intended to use. Two pumps will be used versus three.

Summary of Safety Evaluation

a. The probability of an accident or malfunction of equipment important to safety previously evaluated is not increased. The limits to be placed on the subsurface water level are more conservative than at present.

b. The possibility for an accident or malfunction of a different type than any previously evaluated in the FSAR is not created. The new system will monitor at the same points as at present plus will monitor at the new pump location. The new pumps will keep the buoyant pressure fluctuation to a smaller level than at present.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced. The subsurface drainage system is not the subject of any Technical Specifications.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis for any Technical Specification.

3. DC-73-81 - Residual Heat Removal System Inlet Valve Interlocks	1,2

Description - The residual heat removal system inlet valves

are two series valves. One is interlocked to prevent opening at a pressure greater than 460 psig. The second is administratively controlled. The purpose of the modification was to eliminate the administrative control on the second valve and interlock the same as the first valve.

Summary of Safety Evaluation

a. The probability of occurrence or the consequence of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased since the system design relies on the same circuitry scheme as MOV-700. The modification will decrease the probability by providing a redundant backup to MOV-700.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created since a similar control circuit is used on MOV-700. Both valves will have identical control circuits.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced by this design change since the additional interlocks is specified in the Technical Specifications.

Conclusion - This design change does not constitute an unreviewed safety question and the basis for any Technical Specification is not changed.

Design Change	Unit
4. DC-73-82 - Accumulator Discharge Valves Interlocks	1,2

Description - The purpose of this design change is to provide automatic opening of the accumulator discharge valves at a pressure of 2000 PSIG (Safety Injection Unblock Pressure) to eliminate administrative opening of the valve and de-energizing the motor operators. A bypass is also included to allow manipulation of the valve and periodic testing prior to 2000 PSIG.

Summary of Safety Evaluation

a. The probability of occurrence or the consequence of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report is not increased. Previous evaluations were based on the assumption that the MOV's were open at the time of the accident or malfunction, the design change will only introduce a new method of opening the valve. The valves will fail in the open position if there is a malfunction and the opening signal received upon safety injection initiation will be retained. Thus, the probability of occurrence does not increase and the consequences of an accident or malfunction remain unchanged.

b. The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report is not created. At the present time MOV-865A, B, and C are opened by operator action, upon indication that the valves

are open. The valve motor operators are de-energized to prevent accidental valve closure. The design change would allow the valves to be opened automatically upon reaching a preset reactor coolant pressure, once the valves are open at pressure they cannot be closed unless the manual bypasses are used. The manual bypass would be under administrative control, however, the opening of the MOV's would not. At the present time both the opening and closing of the valves are under strict administrative control while the change would allow only the closure to be controlled.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced. The margin of safety is based upon the assumption that MOV-865A, B and C are open when the reactor coolant system is pressurized above the safety injection unblock pressure. The design change incorporates a new method of opening the affected valves. I.E., automatically instead of manually. The margin is also based upon the assumption that the valves will not be closed inadvertantly, at the present time, this is ensured by de-energizing the valve motor operators, the design change would prevent valve closure unless the manual bypass is used. Thus the margin of safety is not reduced.

Conclusion - This design change does not constitute an unreviewed safety question and the basis for any Technical Specifications is not changed.

Design Change	Unit
5. DC-74-49 - Add Solenoid To Fuel Conveyor Car System	2

Description - The purpose of this change is to prevent inadvertant movement of the fuel conveyor car should an air line on the air motor rupture. If a line should rupture it would be the same as exhausting one side of the air motor even though the control switch is not directing the car to move. The air supply to the motor will be on only when the control switch directs the car to move. If a rupture should occur while the car is in motion, movement of the switch to "OFF" will close the solenoid and thus shut-off the main air supply.

Summary of Safety Evaluation

a. The probability of occurrence of the consequence of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased. The design change will not affect the fuel transfer system operation or characteristics.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created. The additional valve will not change the operation of the system and the fail closed feature of the valve makes any failure in the conservative direction.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced by this design change.

Conclusion - This design does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
6. DC-74-55A, B, C, D, E - Flooding Control of Safety Related Equipment	1,2

Description - The purpose of this design change was to prevent flooding of safety related equipment from a rupture of a service water line and fire protection lines. The changes provide the operator with indications of potential flooding situations and allow sufficient time to take appropriate measures. The modifications covered the following areas:

a. Modifications to protect against a failure in the circulation water system.

Modifications to both units.

(1) Seal the service water valve pits serving the recirculating spray coolers, bearing coolers and component coolers.

(2) Replace one (1) of the four (4) checker plates covering the Amertap equipment pit downstream of the condenser with grating.

(3) Add level alarms at following turbine bldg. pits:

(a) Pit located just south of condenser where circulating water intake lines to condenser are located.

(b) Pit located just north of condenser where circulating water discharge lines from condenser are located.

(c) Amertap equipment pit located north of condenser.

(4) Add three (3) level switches, two (2) on the north side of condenser; one (1) on the south side of condenser.

(5) Partially enclose each circulating water expansion joint with carbon steel plate, allowing ½ inch gap around one end for movement.

Modifications to Unit 1 Only

(1) Construct a two (2) foot dike surrounding the pit which provides entrance to the Aux. Bldg. pipe tunnel and around the entrance to the switch-gear and relay room.

(2) Isolate the four (4) floor drains located at El. 9'-6" (in electrical tunnel and relay rooms 1 & 2) from turbine building sump.

(3) Install two (2) foot dike inside the entrance to mechanical equipment Rm. 3.

(4) Seal (with concrete), the pipe tunnel leaking from mechanical equipment Room #3 into the switch-gear and relay room, at entrance to the tunnel.

b. Modifications to protect against failure in the fire protection system.

(1) Aux. Bldg. - Two (2) foot dikes will be erected at entrances to charging pump pits (EL. 13 ft. -0 in.).

(2) Fuel Bldg. - A normally closed, fail open trip valve shall be installed in the 6 in. supply header to the fuel building.

Summary of Safety Evaluation

a. The probability of occurrence or the consequence of an accident or malfunction of equipment important to safety,

previously evaluated in the safety analysis report, would not be increased. The proposed modifications will protect safety related equipment form possible malfunction due to flood damage. The steel shields will prevent the rapid flow of water from a potential expansion joint break, enabling an operator enough time to take appropriate measures.

b. The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report would not be created. Again the proposed modifications will not affect equipment or operations; rather the modifications will protect safety related equipment to ensure operability in event of the hypothesized rupture of a circulating water expansion joint.

c. The margin of safety as defined in the basis for Technical Specifications would not be reduced. Protection of safety related equipment in the event of a circulating water expansion joint rupture will provide the operator with the ability to take adequate steps to ensure a safe shutdown of the effected unit.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
7. DC-74-71 - Modifications to Main Steam Non-Return Valves	1

Description - This design change involved modification to the piston/disc assembly of the main steam non-return valves to prevent fatigue failures. (Reference AO-S2-74-04). The stem connecting the piston to the valve disc was modified and enlarged. The transition between the stem and disc was changed to include a forged transition piece with a gradual radius instead of direct attachment of the stem to the disc. The stem itself consisting of schedule 100 pipe was enlarged to schedule 160. The modifications were intended to eliminate localized stress at the point of connection of the item to the disc, which had been the point of failure with old piston/disc assemblies.

Summary of Safety Evaluation

a. The probability of occurrence or the consequence of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report is not increased. This design change is a modification of the structure of the Main Steam Non-Return Valve (NRV) disc and piston assembly. This modification improves the fatigue strength of the disc to piston weld joint which would reduce the probability of in-service failure.

b. The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report is not created. No new components have been added to the NRV's, nor has any existing component been functionally modified. Therefore, the NRV's will function exactly as before,

but will be able to withstand more fatigue cycles.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced. The margin of safety for a steam line break between any Main Steam Trip Valve and its NRV should actually be increased since the likelihood for NRV failure is now reduced.

Conclusion - This design change does not constitute an unreviewed safety question and does not change the basis of any Technical Specification.

8. DC-74-100 - Concrete Storage Pad Roofs 1,2

Description - This change involved installing a roof area over each concrete storage pad. One pad is a general non-radioactive storage pad and the other a storage area for drummed radioactive waste. Drains from the radioactive storage pad go to liquid waste. Installing a roof over the radioactive storage pad would direct drains away from the pad and prevent undue processing of rain-water. The roof over the other has no significance except for weather protection.

Summary of Safety Evaluation

a. The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report would not be increased as long As FSAR structural criteria are adhered to.

b. The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report would not be created. The addition of miscellaneous structures on site creates no different type of potential accident or malfunction than already exists with current yard structures.

c. The margin of safety as defined in the basis for Technical Specifications would not be reduced. The margin of safety is not affected by yard structures.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specifications.

9. DC-74-102 - Addition of Instrumentation For All Volatile Treatment 1,2

Description - The purpose of this design change was to add additional instrumentation required when all volatile treatment was implemented. The modification required installation of analyzers and recording equipment for pH monitoring, cation conductivity, and sodium concentration for steam generator blowdown on each steam generator. In addition, a sodium analyzer and recorder was added to the condensate system. Even though this change has been implemented, operational difficulties are being resolved at present.

Summary of Safety Evaluation

a. The probability of an accident or malfunction of equipment important to safety previously evaluated is not increased. The monitoring of the secondary plant chemistry is not

safety related.

b. The possibility for an accident or malfunction of a different type than any previously evaluated in the FSAR is not created. The addition of secondary water chemistry analyzers will not increase the possibility fo an accident.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced. The secondary plant chemistry is not a limiting factor.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

10. DC-74-103 - Replacement of Main Steam Safety Valve Discharge Elbows and Flange Bolts 2

Description - This design change involved changing out the main steam safety valve discharge elbows and flange bolts with higher strength components. This was prompted by re-evaluation by Stone & Webster Engineering Corp. Their analysis indicates that:

a. The safety valve discharge elbow flange bolt stresses are below the elastic limit but are above the maximum bolt service stress of 2/3 yield at temperature. Since there are no rules for maximum service stress in bolts in ANSI B31.1, 1967, the rules for class 1 systems of ASME Section III applied.

Calculations show that the maximum stress valves for the elbow flange bolts do not exceed 90% of their respective

allowable yield strengths at temperature.

b. The supplementary analysis indicates that the safety valve discharge elbow stresses are within the elastic limit at temperature but are stressed beyond the allowable value of 1.2 S_h for occasional loads.

Under normal conditions, the loads are negligible. The conditions of load have a low probability of occurrence.

Summary of Safety Evaluation

a. The probability of occurrence or the consequences of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased. This component is not specifically related to to any safety analysis.

b. The possibility for an accident or malfunciton of a different type than any previously evaluated is not created. No safety system function is changed.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced by this design change.

Conclusion - This design change does not constitute an unreviewed safety question.

11. DC-74-106 - Control Rod Drive Mechanism Interference Modification 2

Description - The NSSS supplier outlines a Control Rod Shaft Interference problem which has been experienced at other power stations. As stated in the letter, the interference occurs

between the top surface of the control rod drive shaft and the bottom surface of the CRDM guide tube. There is a possibility during the reactor vessel head lowering that the interference may occur, possibly causing drive rod bowing. The NSSS supplier contends that this is not a design deficiency which could adversely affect the safety of plant operation since operating plant experience has shown that trip times have been unaffected. Also, rod drop tests would have detected any bow severe enough to compromise plant safety. The modification was to modify all drive rods to enlarge the lead-in chamber on the top end.

Summary of Safety Evaluation

a. The probability is not increased since this modification will not affect the operation of the control rods. The chamfered portion of the drive rod assembly is not part of the acutal latching mechanism. This change will prevent the possibility of bowed rods and increased rod drop times.

b. The possibility is not created since the modification will not affect the performance or operation of the drive rod assembly and the effect of the cutting tool on the operating deck will be minimal.

c. The margin of safety is not reduced since the rod performance and rod drop times will remain within the requirements outlined in Technical Specifications.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
12. DC-74-107 - Manipulator Crane Fuel Gripper Pin Modification	2

Description - The modification consisted of providing more clearance between the gripper guide pin and fuel assembly nozzle. This was accomplished by reducing the length of guidance diameter of the pin to approximately 1.2 inches. The guidance diameter remains at 0.855 inches. Beyond this the diameter has been reduced to 0.750 inches. This will prevent gripper pin interference in a bowed fuel assembly. The bow may be as much as 1.45 inches in the center of the assembly before interference occurs which is more than has been previously experienced. This modification was made at the recommendation of the NSSS vendor.

Summary of Safety Evaluation

a. The probability of occurrence or the consequences of an accident or malfunction of this equipment with regard to safety evalutation given in the safety analysis is not increased since the pin is not a structural member.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created. No new accident situation is created with this change.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced by this design change.

Conclusion - This change does not constitute an unreviewd safety question or change the basis of any Technical Specification.

Design Change	Unit
13. DC-74-108 - Steam Generator Seismic Restraint Modification	1,2

Description - This design change was prompted by cracking of components of the lower support ring swivel end couplings discovered on the outboard coupling "A" Unit 2. Reference AO-S2-74-09 for further detail. The modification consisted replacing the swivel joint couplings with couplings of the crossed dove tail design. Since no angular rotation occurs and thus movement in one plane only the lack of the swivel joint can be justified.

Summary of Safety Evaluation

a. The probability of occurrence or the consequence of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report is decreased.

   The failure of the S/G support lower ring coupling is important to contain the S/G piping and the S/G from damaging other equipment. The new coupling is designed to eliminate the probable modes of failure of the old coupling.

b. The possibility for an accident or malfunction of a different type than any previously evaluated in the safety analysis report is not created. The change of the coupling will permit the same movement of the S/G as the old coupling.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced. This change does not affect the basis for any Technical Specification.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
14. DC-74-111 - Installation of Turbine Trip Circuit From Generator Breaker Opening	1,2

Description - This modification consisted of installing a circuit to trip the turbine directly from both generator output breakers opening. Two auxiliary relays were added to monitor generator output breaker position. Contacts from these relays were put in series with P-2, a 15% power permissive, and connected to the turbine trip solenoid. Therefore at power levels greater than 15% should both generator breakers open, a direct turbine trip would result.

Summary of Safety Evaluation - The proposed design change does not constitute an unreviewed safety question per 10CFR50.59 because:

a. The probability is not increased since an additional turbine trip via the proposed circuitry is "fail safe". The proposed change will not affect the other turbine trips or the reactor trip caused by these trips.

b. The possibility is not created since the present overspeed mechanism will remain in the system and serve as a backup to this design change.

c. The margin of safety is not reduced since the new system will not affect any installed system.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
15. DC-74-116 - Deletion of Automatic CLS Hi-Hi Trip of Reactor Coolant Pumps	1,2

Description - This change consisted of disconnecting the contacts from the CLS relays which tripped the reactor coolant pumps on a CLS-Hi-Hi signal. The NSSS vendor recommended the deletion of the trip since it was inconsistent with their position on flywheel integrity following a large LOCA. If power remains on the motors for approximately 30 seconds following a large LOCA and subsequent blowdown, a braking effect is created preventing overspeed. Therefore, without the trip high pump speeds would not occur from system blowdown.

Summary of Safety Evaluation

a. The probability of occurrence or the consequences of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased. The CLS trip of the reactor coolant pumps was not evaluated in the FSAR.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created. The modification is consistent with NSSS vendor analysis regarding RCP flywheel integrity following a large LOCA.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced by this design change. The trip is not defined in the basis for any Technical Specification.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any technical specification.

Design Change	Unit
16. DC-75-1 - Addition of Delta Flux Alarms to Computer	1,2

Description - This change consisted of adding a program to the unit computer to monitor delta flux in the reactor core and alert the operator when an alarm condition exists. Two alarm states exists which are: 1) Alarm above a preset power level if delta flux has exceeded its allowable limit. 2) Alarm below this power level if allowable limit has been exceeded for a preset cumulative amount of time in the past 24 hours.

Summary of Safety Evaluation

a. The probability of occurrence or the consequence of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased. Functions of computer are not safety related.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created. No safety functions are changed in any system.

c. The margin of safety as defined in the basis for any Technical specification is not reduced by this design change. Computer is not addressed in the Technical Specifications.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

Design Change	Unit
17. DC-75-13 - Turbine Governor Valve Spring Modifications	1,2

Description - Due to failures of spring retainer bolts at other sites, the turbine - generator supplier has proposed a change to prevent such failures. The action of the valve and spring movement causes the retainer bolt to bend which causes failure due to bending fatigue. The change consists of a locking wire, replacing the existing lock washer with a spherical washer, and installing a support column between the top retainer plate and adjacent valve bonnet cover.

Summary of Safety Evaluation

None is required since this design change is not safety related. Reported for information purposes.

Conclusion - No unreviewed safety question exists.

18. DC-75-22 - Steam Generator Mechanical Modification 2

Description - The purpose of these modifications was to redistribute the flow across the tubesheet of the steam generators to reduce sludge buildup. In general, the modification included: 1) feedwater ring modifications, 2) downcomer resistance plate removal, 3) tube lane blocking and redirection of blowdown suction and 4) perforated plate installation on secondary separators. The feedwater ring modification consisted of enlarging some and plugging other holes in the feedring to offset the flow to the hot leg side. The flow ratio was designed to be 80/20 hot leg to cold leg. This results in equalization of temperature across the tube sheet thereby equalizing density and preventing siphoning from the cold leg to the hot leg. The downcomer resistance

plate removal will minimize feedwater mixing and increase the recirculation ratio. Redirecting the blowdown is to increase the effectiveness of the blowdown by having breater suction in the center of the tubesheet. The perforated plates were installed to decrease moisture carryover in view of the increased recirc. ratio.

Summary of Safety Evaluation

a. The probability of occurrence or the consequences of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased since the analysis is not changed.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created since no new accident situation is created.

c. The margin of safety is not reduced since the basis for any Technical Specification is not changed by this design change.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

19. DC-75-26 - Eliminate Fuel Conveyor Car Speed Change 2

Description - This change involved removing the electrical and pneumatic controls in the speed change circuit of the fuel conveyor car. Field experience as indicated by the NSSS vendor has shown the circuit to be unreliable. Single speed conveyor car travel is satisfactory. Single speed which is "fast" speed is not sufficient to exceed the "G" forces imposed by the fuel

supplier when the car contacts the travel steps.

Summary of Safety Evaluation

a. The probability of occurrence or the consequences of an accident or malfunction of this equipment with regard to the safety evaluation given in the safety analysis is not increased. This equipment is not specifically addressed.

b. The possibility for an accident or malfunction of a different type than any previously evaluated is not created. The "G" forces on the fuel are not exceeded when the car contacts the stops so no new accident situation is created.

c. The margin of safety as defined in the basis for any Technical Specification is not reduced by this design change. This equipment is not specifically mentioned.

Conclusion - This design change does not constitute an unreviewed safety question or change the basis of any Technical Specification.

10.4 PERFORMANCE CHARACTERISTICS

10.4.1 Abnormal Occurrences

A tabulation of the Abnormal Occurrences as defined by Technical Specification 1.0.I which occurred during the reporting period is contained in Table 10.4.1-1. These reports have been previously submitted to the U.S. Nuclear Regulatory Commission.

10.4.2 Unusual Safety Related Events

A tabulation of the Unusual Safety Related Events which occurred during the reporting period is contained in Table 10.4.2-1.

10.4.3 Equipment Performance

Section 10.6 of this report summarizes the important maintenance which was performed on unit equipment and is indicative of equipment performance.

Equipment problems experienced in the performance of surveillance tests are summarized in section 10.7.

The abnormal occurrences and unusual safety related events enumerated above also provide information on equipment performance.

ABNORMAL OCCURRENCE REPORTS
UNIT NO. 1
SURRY POWER STATION

JANUARY THROUGH JUNE, 1975

NUMBER	TITLE	OCCURRENCE DATE
1	Dilution of the Primary System Boron Concentration	1-18-75
2	Station Instrument Air Supply to Containment Instrument Air System	1-19-75
3	Process Vent Gaseous Waste Release	1-15-75
4	Failure to Continuously Record and Monitor Steam Generator Blowdown	2-01-75
5	Failure of Pressurizer Pressure Comparator	2-14-75
6	Failure of Overpower ΔT Protection	2-15-75
7	Uncontrolled & Unplanned Release of Low Level Radioactive Material to Discharge Canal from P.G. Tank	3-13-75
8	Fz Surveillance Delay	4-02-75
9	Inadvertant Disabling of Process Vent System Gaseous Radiation Monitor	4-12-75
10	Failure of Valve FCV-GW-260 to Operate Properly	4-12-75
11	Release of Airborne Particulate Activity Due to Charging Line Leak	4-16-75
12	Number Three Emergency Diesel Generator	4-30-75
13	Chemical Addition Tank Discharge Valve	5-16-75

UNUSUAL SAFETY RELATED EVENTS
UNIT NO. 1
SURRY POWER STATION

JANUARY THROUGH JUNE, 1975

NUMBER	TITLE
1	Failure of Pump to Radiation Monitor of SW from Component Cooling Water Heat Exchanger

10.4.4 FUEL PERFORMANCE

A summary of fuel performance is contained in the attached report.

VEP-FRD-14

SURRY UNIT 1
CORE PERFORMANCE REPORT
Cycle 2 - January 30, 1975 to June 30, 1975

by

L. L. Flournoy
S. P. Keck
K. F. McLaughlin

Nuclear Fuel Engineering and
Operation Group
Fuel Resources Department

July, 1975

Approved:

J. T. Rhodes, Director
Nuclear Fuel Engineering and Operation

Virginia Electric and Power Company
Richmond, Virginia

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INTRODUCTION AND SUMMARY

Surry Unit 1 has completed five months of Cycle 2 operation. Since Cycle 2 initial criticality on January 30, 1975, the reactor core has produced some 25 x 10^6 MBTU (4,355 Megawatt days per metric ton of contained uranium) which has resulted in the generation of over 2.3 x 10^9 kwhr of electrical energy. The purpose of this report is to present an analysis of the core performance for routine operation during Cycle 2. Non-routine operation was covered in the Surry 1-Cycle 2 startup physics test report(1) and, therefore, will not be included here.

Routine core follow involves the analysis of four principal performance indicators. These are burnup distribution, reactivity depletion, power distribution, and primary coolant activity. The core burnup distribution is followed to verify both burnup symmetry and proper batch burnup sharing, thereby ensuring that the fuel held over for the next cycle will be compatible with the new fuel inserted. Reactivity depletion is monitored to: detect the existence of any abnormal reactivity behavior, determine if the core is depleting as designed, and indicate at what burnup level refueling will be required. Core power distribution follow includes the monitoring of nuclear hot channel factors to verify that they are within the Technical Specifications limits thereby ensuring that adequate margins to linear power density and critical heat flux thermal limits are maintained. Lastly, as part of normal core follow, the primary coolant activity is monitored to assess the integrity of the fuel.

---

(1) Lippard, D. W., and Keck, S. P., Surry Unit 1 Startup Physics Test Report-Cycle 2, VEP-FRD-11, Richmond, Virginia, July, 1975.

In addition to the above, the effects of fuel densification were monitored. Although not normally part of routine core follow, this phenomenon is treated here because of its impact on core performance.

Each of the four performance indicators, as well as the status of observed fuel densification effects, is discussed in detail for the Surry 1 Cycle 2 core in the body of this report.(2) The results are summarized below:

1. Burnup Follow - The burnup tilt (deviation from quadrant symmetry) on the core is less than $\pm$ 0.3% with the burnup accumulation in each batch deviating from design prediction by less than 3%.
2. Reactivity Depletion Follow - The critical boron concentration, used to monitor reactivity depletion, has consistently been within $\pm$ 0.5% ΔK/K of the design prediction which is well within the $\pm$ 1% ΔK/K margin allowed by Section 4.10 of the Technical Specifications.
3. Power Distribution Follow - Maps taken during each month indicate that the radial power distributions were generally within $\pm$ 5% of the design prediction with all hot channel factors meeting the Technical Specifications limits.
4. Primary Coolant Activity Follow - The iodine-131 activity level in the primary coolant is approximately 0.13 μCi/ml, which indicates that there are approximately fifteen to twenty defects in the fuel. This corresponds to a 99.95% fuel integrity factor.

---

(2) See Appendix A for definition of terms used in this report.

5. Fuel Densification Status - There are five confirmed and three suspected assembly locations with power spikes due to gap formation. However, all power spikes are very small, that is, less than 2% in magnitude.

Section 2

CORE PERFORMANCE ANALYSIS

2.1 Burnup Follow

The burnup history for the Surry Unit 1 core is graphically depicted in Figure 2.1.1. A chronology of the associated operating power level is given in Figure 2.1.2. The core has accumulated a burnup of over 4,300 MWD/MTU, leaving approximately 4,700 MWD/MTU to the normal Cycle 2 reactivity end-of-life. As shown in Figure 2.1.3, the average Surry 1-Cycle 2 load factor has been 85% when referenced to rated thermal power (2441 MW(t)).

Radial (X-Y) burnup maps distribute the core burnup among the various assemblies and thereby allow a detailed burnup distribution analysis. The TOTE computer code (see Appendix B) is used to calculate these assemblywise burnups. Figure 2.1.4 is a radial burnup map in which the core's assemblywise burnup accumulation as of June 30, 1975 is given. For comparison purposes, the predicted values are also given. As can be seen from this figure, the accumulated assembly burnups are generally within $\pm$ 4% to the predicted values. In addition, deviation from quadrant symmetry in the core, as indicated by the burnup tilt factors, is less than $\pm$ 0.3%.

As shown in Figure 2.1.5, the various assemblies are grouped together into batches according to their nuclear characteristics and time spent in the reactor. The burnup sharing on a batch basis is monitored to verify that the core is operating as designed and to enable accurate end-of-cycle batch burnup predictions to be made for use in reload fuel design studies. As seen in Figure 2.1.6, the batch burnup sharing for Surry 1 is following design predictions

very closely with each batch deviating less than 3% from design; this is considered excellent agreement.

Therefore, symmetric burnup in conjunction with good agreement between actual and predicted assemblywise burnups and batch burnup sharing indicate that the Cycle 2 core is depleting as designed.

2.2 Reactivity Depletion Follow

The primary coolant critical boron concentration is monitored for the purposes of following core reactivity and flagging any anomalous reactivity behavior. The FOLLOW computer code (see Appendix C) is used to normalize "actual" critical boron concentration to design conditions taking into consideration off-normal rod positions, xenon and samarium concentrations, moderator temperatures, and power levels. The normalized critical boron concentration versus burnup curve for the Surry 1 Cycle 2 core is shown in Figure 2.2.1. It can be seen that the measured data compare within $\pm$ 35 to 45 ppm of the design prediction. This corresponds to within $\pm$ 0.4 to 0.5% $\Delta K/K$ which is well within the $\pm$ 1% $\Delta K/K$ criteria for reactivity anomalies set forth in Section 4.10 of the Technical Specifications.

In conclusion, the trend indicated by the critical boron concentration verifies that the Cycle 2 core is depleting as expected with no reactivity anomalies.

2.3 Power Distribution Follow

Analysis of core power distribution data on a routine basis is necessary to verify that the hot channel factors are within the Technical Specifications limits and to ensure that the reactor is operating with no abnormal conditions which could cause an "uneven"

burnup distribution. Three-dimensional core power distributions are determined from movable detector flux map measurements using the INCORE computer program (see Appendix D). A summary of all flux maps taken since completion of startup physics testing for Surry 1 Cycle 2 is given in Table 2.3.1. Power distribution maps are generally taken monthly with additional maps taken as needed.

Radial (X-Y) core power distributions for a representative series of maps are given in Figures 2.3.1 through 2.3.3. All of the radial maps shown were taken under equilibrium operating conditions with the Unit operating at approximately full power. In each case, the measured assembly powers are generally within 5% of the predicted values, which is considered good agreement. In addition, as indicated by the INCORE tilt factors, the power distributions are essentially symmetric for all cases.

An important aspect of core power distribution follow is the monitoring of nuclear hot channel factors. Verification that these factors are within Technical Specifications limits ensures that linear power density and critical heat flux limits will not be violated, thereby providing adequate thermal margins and maintaining fuel cladding integrity.

The current Technical Specifications limits on the axial dependent heat flux hot channel factor, $F_Q^T(Z)$, is 2.10 x K(Z), where K(Z) is given in Figure 2.3.4. (Prior to the acceptance of our second revised ECCS analysis on June 16, 1975 this limit was 2.32 x K(Z)). The axial-dependent heat flux hot channel factor for a representative series of maps is given in Figures 2.3.5 through 2.3.7. As shown in these figures the $F_Q^T(Z)$ measured values are at least 10% below the

applicable Technical Specifications limit. A summary of the maximum values of all heat flux hot channel factors measured thus far in Cycle 2 is given in Figure 2.3.8. As shown in this figure, the Surry 1 Cycle 2 core has maintained an F_Q^T of at least 13 % less than the nominal allowable limit.

Peak linear power density, which is determined directly from maximum F_Q^T is fiven in Figure 2.3.9. This is an important parameter from a loss-of-coolant accident-ECCS standpoint since it directly relates to the stored thermal energy in the core. As with F_Q^T, the Surry 1 Cycle 2 core has maintained a peak linear power density of at least 13 % below the nominal allowable limit.

A radial hot channel factor routinely followed is $F_{\Delta H}^N$, the enthalpy rise hot channel factor. The Technical Specifications limit for this parameter is set such that the critical heat flux (DNB) limit will not be violated. Figure 2.3.10 shows that at least a 4% margin to this limit has been maintained.

Another radial hot channel factor routinely monitored is F_{xy}, the horizontal plane peaking factor. This peaking factor is a ratio of the peak to average power in a given horizontal plane. It is related to, but is not identical to, $F_{\Delta H}^N$, which is the ratio of the integral of power along the rod with the highest integrated power to that of the average rod. As shown in Figure 2.3.11, the measured F_{xy} peaking factors, evaluated at core mid-plane, are less than 3% higher than the nominal design prediction, which is well within the design uncertainty of 8%.

The Technical Specifications require that target delta flux (3) values be determined monthly. Operational delta flux limits are then established about this target value, and by maintaining a relatively

---

(3) Delta Flux $= \frac{Pt - Pb}{2441} \times 100$ where Pt = power at top of core (Mw(t))
Pb = power at bottom of core (Mw(t))

Axial Offset $= \frac{Pt - Pb}{Pt + Pb} \times 100$

constant delta flux, adverse axial power shapes are avoided. A plot of delta flux versus burnup and several corresponding core average axial power distriubtions for a representative series of maps are given in Figures 2.3.12 through 2.3.15. As can be seen from these figures, delta flux and the corresponding axial power distributions have remained relatively constant throughout Cycle 2. Consequently as seen in Figure 2.3.16, the core average axial peaking factor ($\overline{F}_z$) has also remained relatively constant at approximately 1.15 throughout this cycle. This is consistent with design predictions which indicate that $\overline{F}_z$ would remain between 1.1 and 1.2 throughout Cycle 2.

In conclusion, the Surry 1 Cycle 2 core performed very satisfactorily with power distribution analyses verifying that design predictions are accurate and that hot channel factors are meeting Technical Specifications limits.

2.4 Primary Coolant Activity Follow

Activity levels of iodine-131 and 133 are important in core performance follow analyses because they are used as indicators of defective fuel. These two isotopes leak into the primary coolant systems through a breach in the cladding. I-131 activity is directly correlatable to the number of cladding defects; the ratio of I-131 to I-133 is used to determine the type of fuel failure which has occurred in the reactor core. Use of the ratio for this determination is feasible because I-133 has a short half-life (approximately 24 hours) compared to that of I-131 (approximately eight days) so that for pinhole defects where the diffusion time through the defect is on the order of days, the I-133 decays out leaving I-131 dominant in activity thereby causing

the ratio to be 0.5 or more. In the case of large leaks, uranium particles in the coolant, and/or "tramp"[4] uranium, where there is no diffusion time, the I-131/I-133 ratio will generally be less than 0.1.

Figure 2.4.1 shows the I-131 activity history for the Surry 1 Cycle 2 core with the FSAR value for various defect levels[5] (one defect is equivalent to one defective rod) delineated and for comparison purposes. The data shows considerable scatter but the trend of the last few months of operation indicates that approximately fifteen to twenty defective fuel rods exist in the core. This is substantially below the Technical Specifications limit of 1% failed fuel which is equivalent to approximately 320 defects. In Figure 2.4.2 of the I-131/I-133 ratio the data points fall well above 0.5, indicating that the defective rods most likely have pinhole defects.

2.5 Fuel Densification Status

Throughout Cycle 1 the majority of the densification induced power spikes were observed in Region 3 fuel which had the lowest UO_2 density (91.9% theoretical density). During the Cycle 1-2 refueling all Region 3 fuel was removed from the core and replaced by high density fuel (94.4% theroretical). Therefore it is anticipated that during Cycle 2 of Surry 1 the effects of fuel densification will be relatively minor.

Table 2.5.1 gives the assembly locations, along with related data, in which densification induced power spikes have been observed. All power spikes are very small with the largest single power spike having a magnitude of approximately 1%.

---

(4) "Tramp" uranium consists of small particles of uranium which adhere to the outside surface of the fuel during the manufacturing process.

(5) This is derived from FSAR Table 9.1-5 where cladding defects in 1% of the fuel rods gives an I-131 primary coolant activity concentration of 1.68 μCi/cc @ 560°F. Samples are analyzed at room temperature; hence, this value is 2.35 μCi/cc when a density correction is made.

Figures 1 through 8 of Appendix E are the latest Surry 1 strip-chart traces for all confirmed[6] and suspected assemblies with densification induced gaps. Note that in nearly all cases the power spike is located above the midplane and usually is in the top one-third of the fuel, which is where gap formation of notable size is most likely to occur.

In conclusion, the observed effects of fuel densification have been relatively minor thus far for Cycle 2 with both the number and magnitude of power spikes being very small.

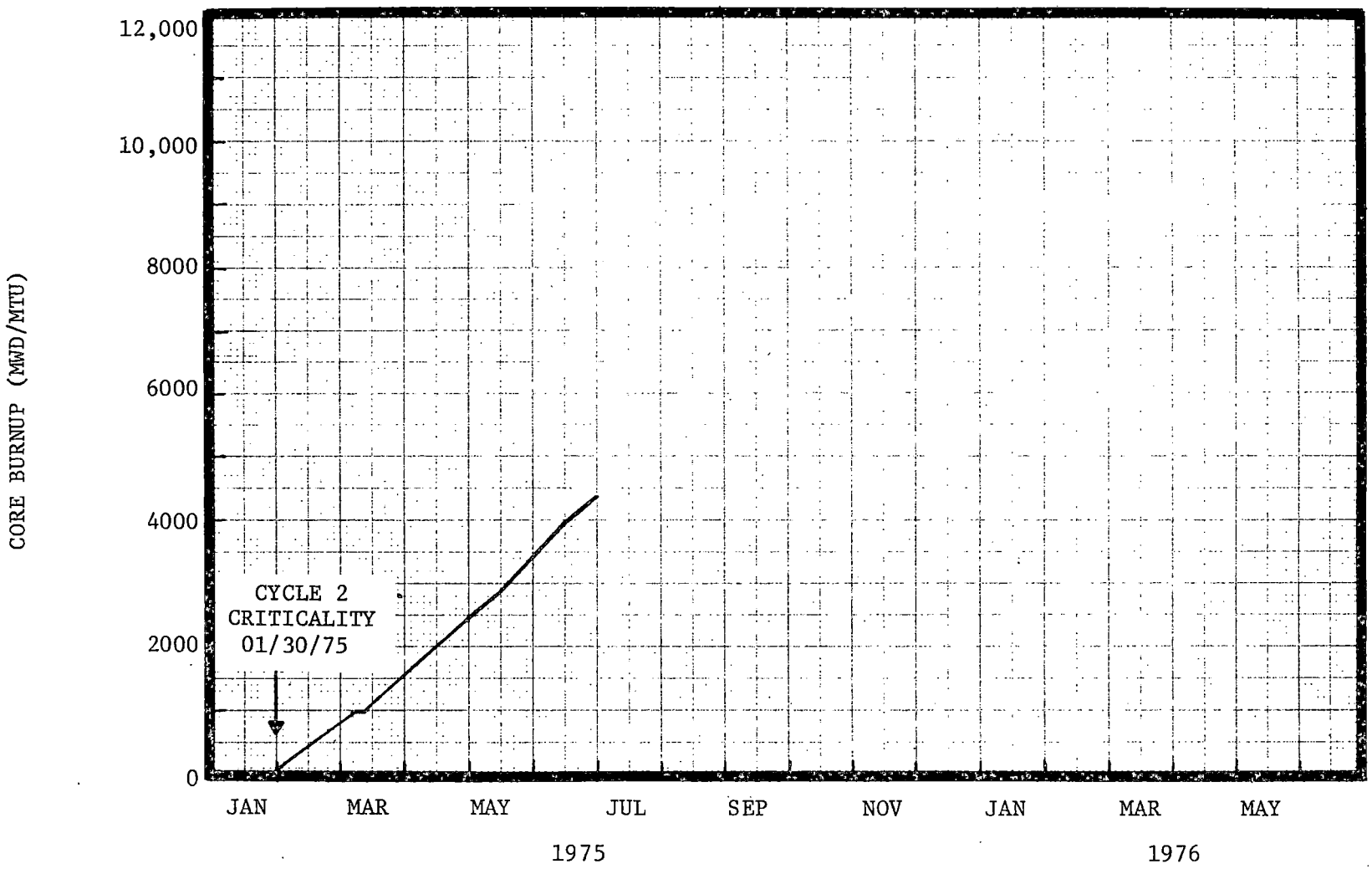
---

(6) A confirmed power spike is one which has been observed in two or more recent maps. A suspected power spike is one which has been observed generally only in the most recent map.

SURRY UNIT 1 - CYCLE 2

FIGURE 2.1.1

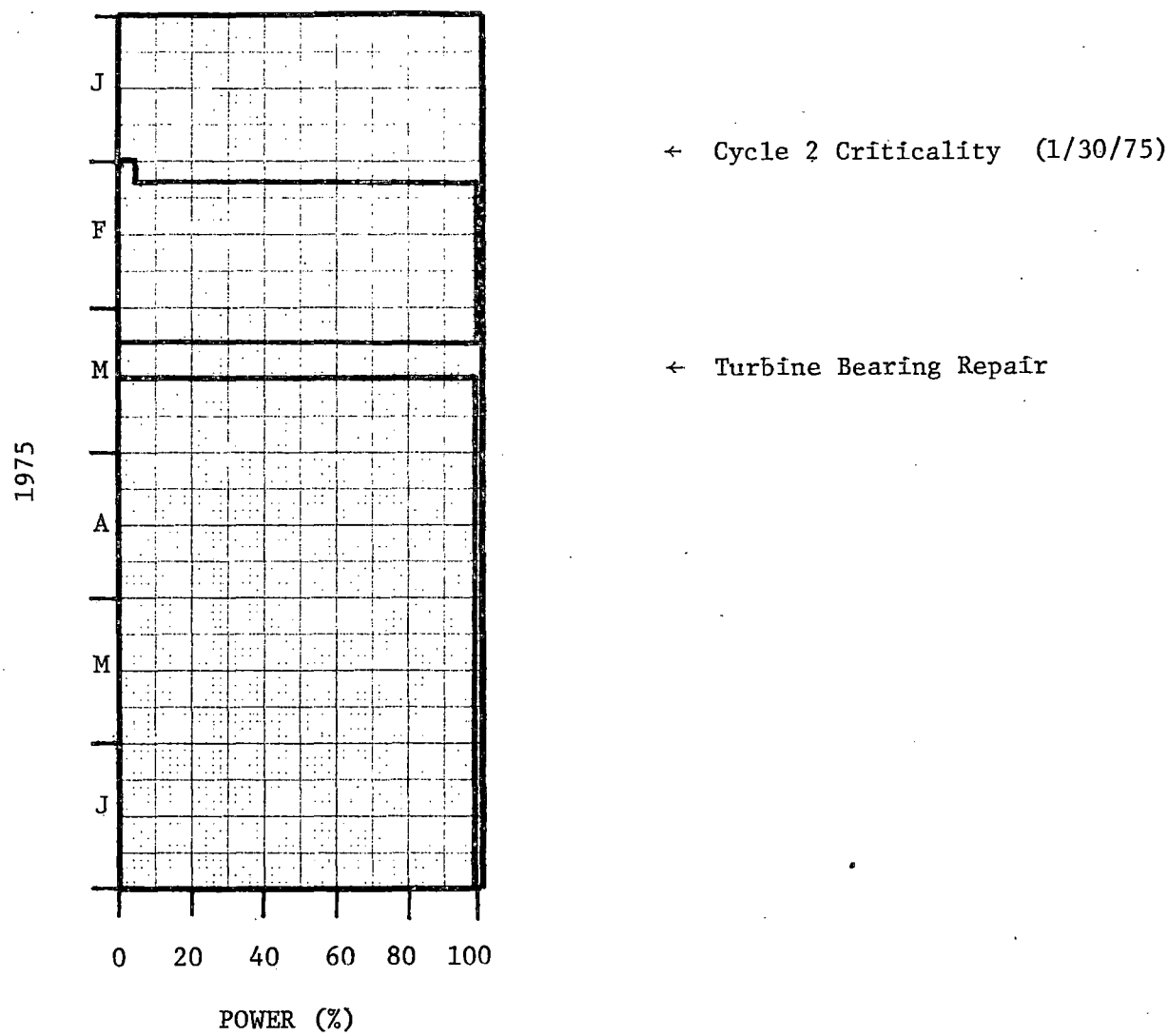
CORE BURNUP HISTORY



SURRY UNIT 1 - CYCLE 2

FIGURE 2.1.2

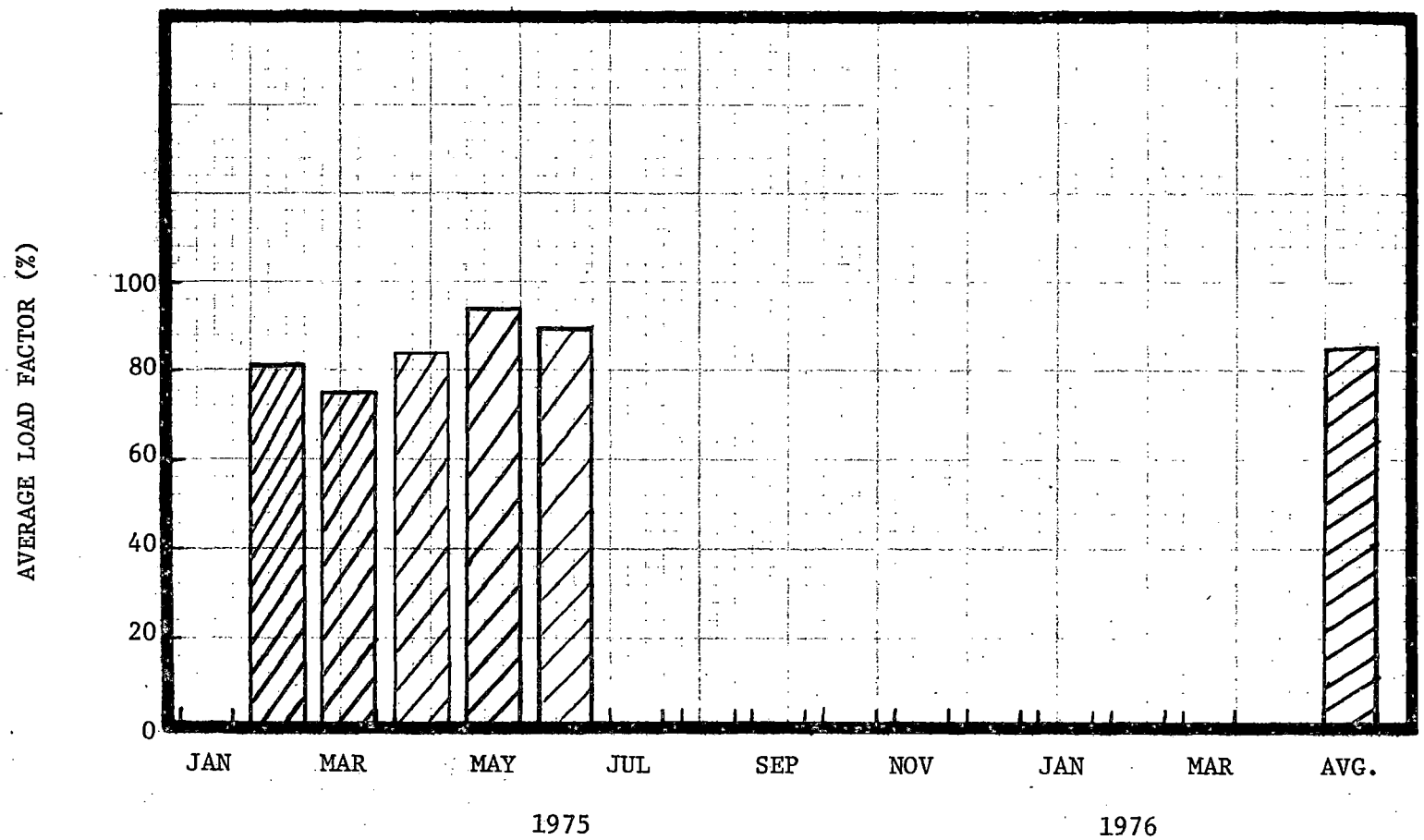
CHRONOLOGY OF OPERATING POWER LEVEL



SURRY UNIT 1 - CYCLE 2

FIGURE 2.1.3

MONTHLY AVERAGE LOAD FACTORS



LOAD FACTOR REFERENCED TO 2441 MW(t)

SURRY UNIT 1 - CYCLE 2

FIGURE 2.1.4

ASSEMBLYWISE ACCUMULATED BURNUP:
COMPARISON OF MEASURED WITH PREDICTED
10^3 MWD/MTU

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							2.96 3.06 +3.4	3.75 3.82 +1.9	2.96 2.99 +1.0						
2					3.36 3.43 +2.1	4.49 4.49 0.0	3.82 3.89 +1.8	18.61 18.10 -2.7	3.82 3.85 +0.8	4.49 4.43 -1.3	3.36 3.37 +0.3				
3				3.73 3.78 +1.3	4.54 4.61 +1.5	18.17 17.98 -1.0	18.40 18.96 +3.0	5.41 5.22 -3.5	18.40 18.84 +2.4	18.17 17.88 -1.6	4.54 4.59 +1.1	3.73 3.79 +1.6			
4			3.73 3.78 +1.3	4.22 4.30 +1.9	20.89 20.62 -1.3	20.14 20.00 -0.7	20.54 20.22 -1.6	19.91 19.66 -1.3	20.54 20.38 -0.8	20.14 20.10 -0.2	20.89 20.64 -1.2	4.22 4.22 0.0	3.73 3.78 +1.3		
5		3.36 3.42 +1.8	4.54 4.62 +1.8	20.89 20.51 -1.8	21.36 21.14 -1.0	4.97 4.83 -2.8	19.01 19.28 +1.4	5.41 5.23 -3.3	19.01 19.15 +0.7	4.97 4.87 -2.0	21.36 20.97 -1.8	20.89 20.52 -1.8	4.54 4.60 +1.3	3.36 3.59 +6.8	
6		4.50 4.48 -0.4	18.17 17.68 -2.7	20.14 20.16 +0.1	4.99 4.84 -3.0	16.04 15.98 -0.4	5.27 5.13 -2.7	17.28 16.85 -2.5	5.27 5.19 -1.5	16.04 15.97 -0.4	4.99 4.83 -3.2	20.14 20.34 +1.0	18.17 17.71 -2.5	4.50 4.72 +4.9	
7	2.96 3.19 +7.8	3.82 3.97 +3.9	18.40 18.68 +1.5	20.54 19.94 -2.9	19.02 19.17 +0.8	5.27 5.19 -1.5	21.49 21.38 -0.5	5.34 5.42 +1.5	21.49 21.45 -0.2	5.27 5.21 -1.1	19.02 19.11 +0.5	20.54 20.34 -1.0	18.40 18.39 -0.1	3.82 4.01 +5.0	2.96 3.10 +4.7
8	3.75 4.01 +6.9	18.61 18.45 -0.9	5.42 5.37 -0.9	19.92 20.34 +2.1	5.41 5.36 -0.9	17.28 17.32 +0.2	5.34 5.46 +2.2	20.29 19.56 -3.6	5.34 5.39 +0.9	17.28 17.12 -0.9	5.41 5.37 -0.7	19.92 20.26 +1.7	5.42 5.43 +0.2	18.61 18.48 -0.7	3.75 3.89 +3.7
9	2.96 3.19 +7.8	3.82 3.98 +4.2	18.40 18.86 +2.5	20.54 20.51 -0.1	19.02 18.94 -0.4	5.27 5.22 -0.9	21.49 21.47 -0.9	5.34 5.39 +0.9	21.49 20.92 -2.7	5.27 5.12 -2.8	19.02 19.17 +0.8	20.54 20.18 -1.8	18.40 18.93 +2.9	3.82 3.98 +4.2	2.96 3.10 +4.7
10		4.50 4.46 -0.9	18.17 17.64 -2.9	20.14 20.12 -0.1	4.99 4.87 -2.4	16.04 16.21 +1.1	5.27 5.19 -1.5	17.28 16.88 -2.3	5.27 5.07 -3.8	16.04 15.98 -0.4	4.99 4.78 -4.2	20.14 20.12 -0.1	18.17 17.80 -2.0	4.50 4.61 +2.4	
11		3.36 3.46 +3.0	4.54 4.67 +2.9	20.89 20.61 -1.3	21.36 21.03 -1.5	4.97 4.88 -1.8	19.01 19.06 +0.3	5.41 5.25 -3.0	19.01 18.99 -0.1	4.97 4.83 -2.8	21.36 20.90 -2.2	20.89 20.39 -2.4	4.54 4.63 +2.0	3.36 3.45 +2.7	
12			3.73 3.94 +5.6	4.22 4.41 +4.5	20.89 20.42 -2.2	20.14 19.85 -1.4	20.54 20.31 -1.1	19.91 19.63 -1.4	20.54 20.22 -1.6	20.14 19.78 -1.8	20.89 20.36 -2.5	4.22 4.36 +3.3	3.73 3.81 +2.1		
13				3.73 3.87 +3.8	4.54 4.62 +1.8	18.17 17.80 -2.0	18.40 19.06 +3.6	5.41 5.27 -2.6	18.40 18.80 +2.2	18.17 17.64 -2.9	4.54 4.60 +1.3	3.73 3.84 +2.9			
14					3.36 3.42 +1.8	4.49 4.63 +3.1	3.82 4.01 +5.0	18.61 17.98 -3.4	3.82 4.09 +7.1	4.49 4.62 +2.9	3.36 3.33 -0.9				
15							2.96 3.19 +7.8	3.75 4.04 +7.7	2.96 3.22 +8.8						

PREDICTED
MEASURED
% DIFFERENCE

DATE June 30, 1975

CORE AVERAGE BURNUP 4355 MWD/MTU

BURNUP TILT

NW - 1.0001
NE - 0.9998
SW - 1.0026
SE - 0.9975

SURRY UNIT 1 - CYCLE 2

FIGURE 2.1.5

BATCH DEFINITION

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							4C	4C	4C						
2					4C	4C	4C	1A2	4C	4C	4C				
3				4C	4C	1A2	2	4B	2	1A2	4C	4C			
4			4C	4A	2	2	2	2	2	2	2	4A	4C		
5		4C	4C	2	2	4A	2	4B	2	4A	2	2	4C	4C	
6		4C	1A2	2	4A	1A2	4A	1A2	4A	1A2	4A	2	1A2	4C	
7	4C	4C	2	2	2	4A	2	4B	2	4A	2	2	2	4C	4C
8	4C	1A2	4B	2	4B	1A2	4B	1A2	4B	1A2	4B	2	4B	1A2	4C
9	4C	4C	2	2	2	4A	2	4B	2	4A	2	2	2	4C	4C
10		4C	1A2	2	4A	1A2	4A	1A2	4A	1A2	4A	2	1A2	4C	
11		4C	4C	2	2	4A	2	4B	2	4A	2	2	4C	4C	
12			4C	4A	2	2	2	2	2	2	2	4A	4C		
13				4C	4C	1A2	2	4B	2	1A2	4C	4C			
14					4C	4C	4C	1A2	4C	4C	4C				
15							4C	4C	4C						

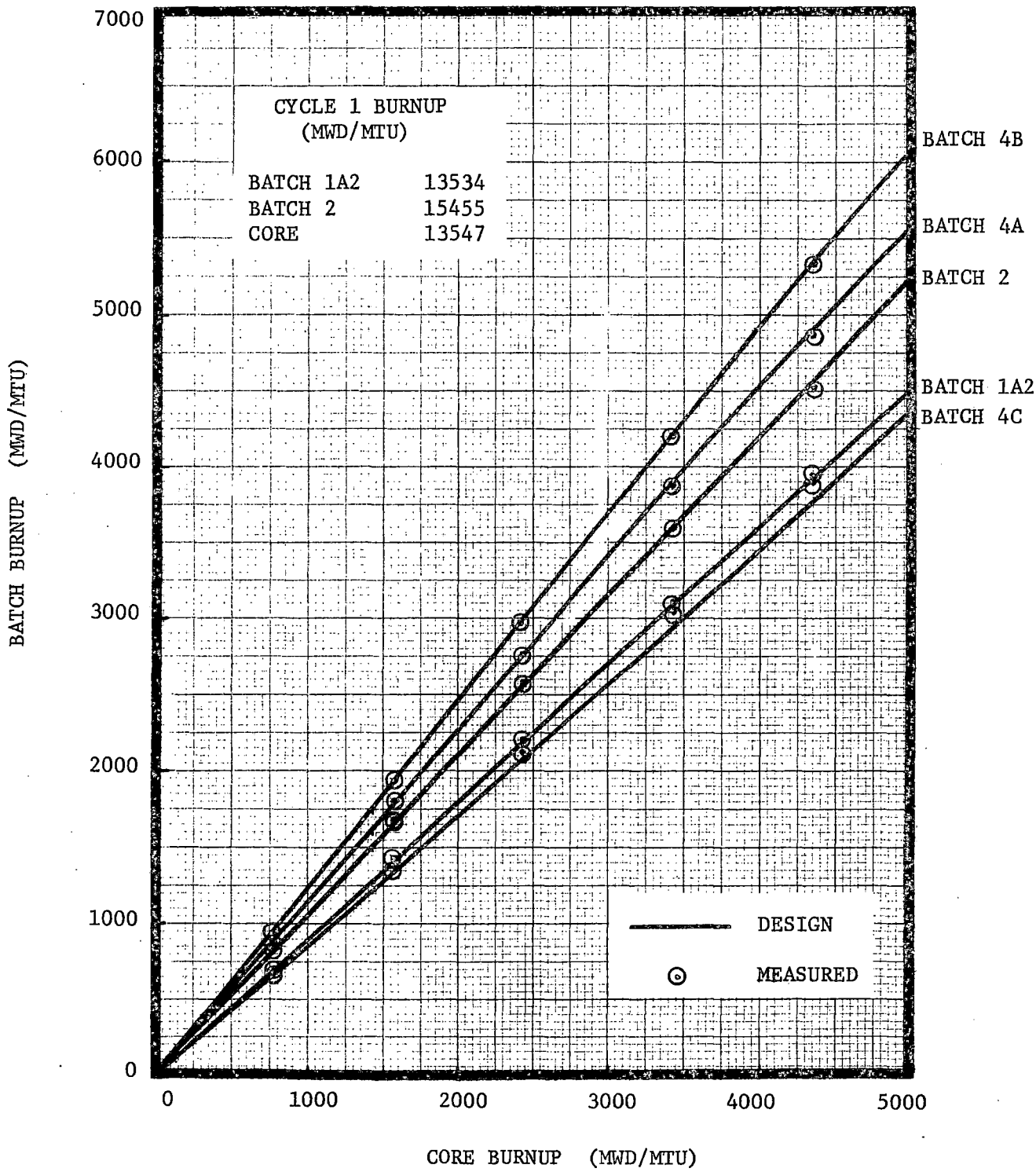
BURNUP SHARING
(10^3 MWD/MTU)

REGION	NO. OF ASSYS.	INITIAL ENRICHMENT	CYCLE 1	CYCLE 2	TOTAL
1A2	21	1.87	13.53	3.94	17.47
2	52	2.57	15.46	4.53	19.99
4A	20	1.86	-	4.87	4.87
4B	12	2.61	-	5.35	5.35
4C	52	3.33	-	3.92	3.92
CORE AVERAGE				4.36	11.25

SURRY UNIT 1 - CYCLE 2

FIGURE 2.1.6

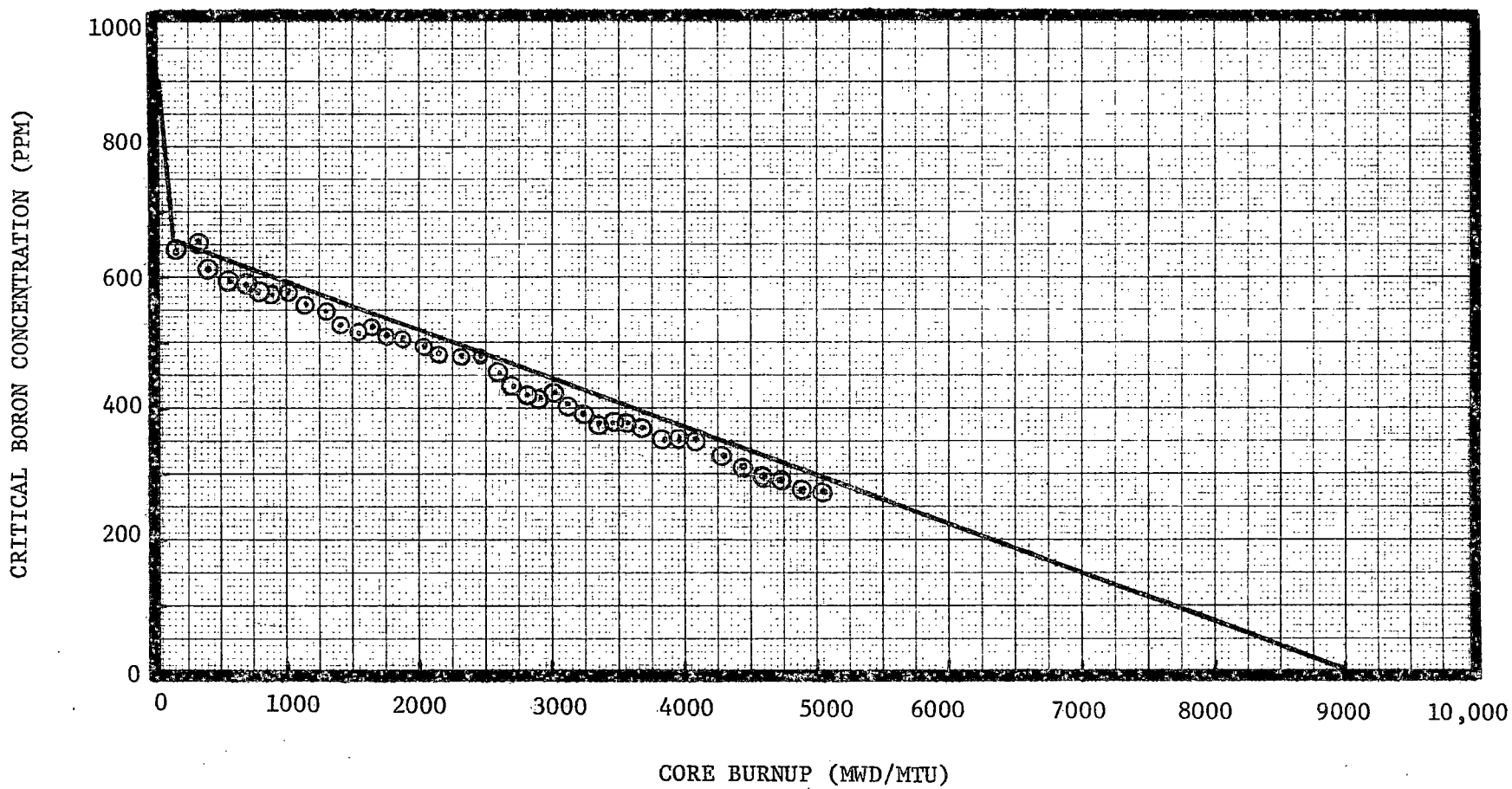
BATCH BURNUP SHARING



SURRY UNIT 1 - CYCLE 2

FIGURE 2.2.1

CRITICAL BORON CONCENTRATION
VS.
BURNUP



SURRY UNIT 1 - CYCLE 2

TABLE 2.3.1

SUMMARY TABLE OF INCORE FLUX MAPS

FOR ROUTINE OPERATION

MAP NO.	DATE	% PWR	BANK D (STEPS)	CORE $\overline{F}_z$	F_Q^T HOT CHANNEL FACTOR				$F_{\Delta H}^N$ HOT CHANNEL FACTOR			TILT		AVERAGE AXIAL OFFSET (%)	BURNUP (MWD/MTU)	NO. OF MONITORED THIMBLES
					ASSY.	PIN	AXIAL POINT	F_Q^T (1)	ASSY	PIN	$F_{\Delta H}^N$ (2)	MAX	QUAD LOC			
S1-2-10	2/13/75	100	215	1.152	B-6	DE	44	1.842	B-6	DE	1.481	1.007	SW	+0.18	285	45
S1-2-11	2/21/75	100	213	1.154	K-14	JD	34	1.841	N-8	KH	1.485	1.021	NE	+0.11	560	40
S1-2-12	3/17/75	98	222	1.147	H-9	HI	13	1.778	C-8	EH	1.470	1.007	SE	+1.55	1085	45
S1-2-13	4/14/75	100	227	1.145	B-6	DE	45	1.835	B-6	DJ	1.478	1.005	SW	-0.11	2025	46
S1-2-16(3)	5/21/75	99	226	1.150	K-14	JD	45	1.756	H-9	GH	1.433	1.012	SW	-1.15	3080	43
S1-2-17	6/17/75	99	223	1.154	K-14	JD	45	1.787	B-6	DJ	1.434	1.006	SW	-1.80	4065	43

NOTES: Hot spot locations are specified by giving assembly locations (e.g. H-8 is the center-of-core assembly), followed by the pin location (denoted by the "y" coordinate with the fifteen rows of fuel rods lettered A through O, and the "x" coordinate designated in a similar manner). In the "z" direction the core is divided into 61 axial points starting from the top of the core.

(1) F_Q^T includes a measurement uncertainty of 1.05 and an engineering uncertainty of 1.03.

(2) $F_{\Delta H}^N$ includes a measurement uncertainty of 1.04.

(3) Maps S1-2-14 and S1-2-15 were aborted due to insufficient movable detector data.

SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.1

ASSEMBLYWISE POWER DISTRIBUTION

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.66 0.66 -0.8	0.84 0.83 -0.8	0.66 0.66 0.1				PREDICTED MEASURED P/C DIFFERENCE			1
				0.77 0.79 3.5	1.03 1.01 -2.2	0.85 0.84 -2.1	0.76 0.75 -2.0	0.85 0.85 -0.5	1.03 1.04 1.2	0.77 0.78 1.5					2
			0.85 0.88 3.0	1.03 1.04 1.0	0.83 0.81 -2.0	1.03 1.01 -2.4	1.24 1.20 -3.0	1.03 1.02 -1.7	0.83 0.82 -0.6	1.03 1.04 0.6	0.85 0.87 2.1				3
		0.85 0.88 3.3	0.95 0.97 1.8	0.98 0.97 -0.5	1.02 1.01 -1.3	1.07 1.04 -3.3	1.15 1.11 -3.3	1.07 1.04 -2.6	1.02 1.00 -2.2	0.98 0.96 -1.5	0.95 0.94 -1.1	0.85 0.88 3.0			4
	0.77 0.79 2.2	1.03 1.06 2.2	0.98 0.99 1.1	1.04 1.06 1.7	1.14 1.12 -1.3	1.21 1.15 -4.3	1.23 1.19 -3.3	1.21 1.18 -1.8	1.14 1.12 -1.4	1.04 1.03 -1.5	0.98 0.94 -4.0	1.03 1.07 3.5	0.77 0.86 11.5		5
	1.03 1.03 -0.3	0.83 0.83 -0.3	1.02 1.02 -0.3	1.14 1.12 -1.7	1.07 1.06 -0.8	1.19 1.17 -1.4	1.04 1.03 -1.7	1.19 1.18 -0.7	1.07 1.06 -0.9	1.14 1.12 -2.2	1.02 0.99 -3.4	0.83 0.84 2.0	1.03 1.11 8.2		6
0.66 0.72 8.1	0.65 0.66 1.1	1.03 1.00 -3.0	1.07 1.06 -1.1	1.21 1.20 -0.4	1.19 1.20 0.8	1.15 1.17 1.9	1.18 1.19 0.5	1.15 1.16 0.6	1.19 1.20 0.3	1.21 1.19 -1.6	1.07 1.04 -3.1	1.03 1.05 1.0	0.85 0.89 4.0	0.66 0.68 3.0	7
0.84 0.91 8.0	0.76 0.78 2.7	1.24 1.25 0.8	1.15 1.15 0.4	1.23 1.25 1.6	1.05 1.07 2.0	1.18 1.21 2.4	0.93 0.95 1.8	1.18 1.19 1.1	1.05 1.06 1.0	1.23 1.23 -0.3	1.15 1.14 -0.6	1.24 1.27 2.0	0.76 0.77 1.4	0.84 0.87 2.9	8
0.66 0.72 8.1	0.65 0.67 2.2	1.03 1.03 -0.7	1.07 1.08 0.1	1.21 1.23 1.8	1.19 1.21 1.8	1.15 1.18 2.4	1.18 1.14 -3.5	1.15 1.16 1.1	1.19 1.20 1.1	1.21 1.20 -0.3	1.07 1.06 -1.4	1.03 1.04 0.8	0.85 0.88 2.6	0.66 0.69 3.9	9
	1.03 1.00 -3.1	0.83 0.80 -3.1	1.02 1.00 -2.1	1.14 1.13 -0.6	1.07 1.06 -0.7	1.19 1.15 -3.6	1.04 1.01 -3.5	1.19 1.18 -1.2	1.07 1.07 -0.4	1.14 1.12 -2.2	1.02 0.98 -3.8	0.83 0.82 -0.4	1.03 1.06 3.2		10
	0.77 0.80 3.9	1.03 1.07 3.9	0.98 1.00 2.0	1.04 1.04 -0.6	1.14 1.12 -1.4	1.21 1.17 -3.0	1.23 1.19 -3.4	1.21 1.16 -3.5	1.14 1.11 -2.5	1.04 1.02 -2.2	0.98 0.97 -0.6	1.03 1.05 1.3	0.77 0.79 3.0		11
		0.85 0.95 10.6	0.95 1.02 6.4	0.98 0.97 -0.6	1.02 1.00 -1.7	1.07 1.05 -2.6	1.15 1.12 -2.8	1.07 1.04 -2.8	1.02 1.00 -2.4	0.98 0.97 -0.7	0.95 0.97 1.9	0.85 0.88 2.8			12
			0.85 0.91 6.5	1.05 1.05 2.3	0.83 0.83 -0.0	1.03 1.01 -2.5	1.24 1.22 -1.6	1.03 1.04 0.9	0.83 0.82 -1.4	1.03 1.02 -0.6	0.85 0.87 2.5				13
				0.77 0.78 2.3	1.03 1.07 4.1	0.85 0.88 3.2	0.76 0.79 3.6	0.85 0.90 5.7	1.03 1.05 2.5	0.77 0.75 -2.4					14
						0.66 0.71 6.9	0.84 0.90 7.2	0.66 0.71 7.6				PREDICTED MEASURED P/C DIFFERENCE			15

MAP NO. S1-2-10 DATE 2/19/75 POWER ~2441 MWT

CONTROL ROD POSITIONS

BANK C AT 228 STEPS

BANK D AT 215 STEPS

BANK P/L 228 STEPS

$F^N_{\Delta H}$ =1.481 AT B6-DE*

F^T_Q =1.842 AT B6-DE*

$\overline{F}_z$ =1.15

A.O.=+.18%

BURNUP = ~285 MWD/MTU

INCORE TILT

NW - 0.997

NE - 0.998

SW - 1.007

SE - 0.998

* Includes uncertainties

SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.2

ASSEMBLYWISE POWER DISTRIBUTION

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.68	0.85	0.68				PREDICTED			
						0.70	0.88	0.69				MEASURED			1
						3.6	3.6	1.8				P/C DIFFERENCE			
				0.77	1.02	0.87	0.77	0.87	1.02	0.77					
				0.78	1.02	0.87	0.77	0.87	1.01	0.77					2
				2.0	-0.8	-0.2	-0.0	-0.3	-0.9	0.2					
			0.85	1.04	0.82	1.01	1.24	1.01	0.82	1.04	0.85				
			0.87	1.05	0.81	1.00	1.21	0.99	0.81	1.04	0.87				3
			1.7	0.8	-0.6	-1.1	-2.8	-1.8	-0.8	0.4	1.9				
		0.85	0.97	0.96	0.99	1.04	1.11	1.04	0.99	0.96	0.97	0.85			
		0.87	1.00	0.97	1.00	1.00	1.07	1.02	0.99	0.96	0.97	0.89			4
		2.0	2.5	1.1	0.3	-3.3	-3.2	-1.7	-0.7	-0.4	-0.3	4.0			
	0.77	1.04	0.96	1.02	1.15	1.18	1.25	1.18	1.15	1.02	0.96	1.04	0.77		
	0.78	1.06	0.98	1.08	1.15	1.12	1.20	1.16	1.14	1.02	0.94	1.09	0.86		5
	2.1	2.1	2.3	5.7	-0.1	-5.5	-3.9	-1.7	-1.0	-0.5	-2.3	5.0	12.7		
	1.02	0.82	0.99	1.16	1.07	1.23	1.06	1.23	1.07	1.16	0.99	0.82	1.02		
	1.02	0.81	1.00	1.13	1.07	1.20	1.04	1.22	1.05	1.14	0.98	0.85	1.12		6
	-0.4	-0.4	0.3	-2.1	-0.6	-2.3	-1.9	-1.3	-1.8	-1.5	-1.6	3.6	9.4		
0.68	0.87	1.01	1.04	1.18	1.23	1.17	1.25	1.17	1.23	1.18	1.04	1.01	0.87	0.68	
0.73	0.88	0.98	1.02	1.15	1.22	1.17	1.25	1.17	1.23	1.17	1.03	1.03	0.92	0.71	7
7.6	0.9	-2.4	-2.2	-2.7	-1.1	0.6	-0.2	0.0	-0.4	-1.2	-1.2	2.3	5.3	5.1	
0.85	0.77	1.24	1.11	1.25	1.06	1.25	0.97	1.25	1.06	1.25	1.11	1.24	0.77	0.85	
0.92	0.79	1.23	1.10	1.24	1.05	1.26	0.98	1.25	1.06	1.24	1.11	1.26	0.80	0.90	8
7.6	2.2	-0.5	-1.3	-1.5	-0.5	0.9	0.7	-0.7	-0.2	-1.4	0.0	1.9	3.8	4.8	
0.68	0.87	1.01	1.04	1.18	1.23	1.17	1.25	1.17	1.23	1.18	1.04	1.01	0.87	0.68	
0.73	0.89	1.01	1.03	1.16	1.21	1.15	1.24	1.14	1.19	1.14	1.01	1.02	0.90	0.71	9
7.6	2.4	-0.1	-0.6	-1.5	-1.4	-1.4	-1.4	-2.4	-3.6	-3.1	-2.3	1.0	3.6	4.8	
	1.02	0.82	0.99	1.16	1.07	1.23	1.06	1.23	1.07	1.16	0.99	0.82	1.02		
	1.02	0.82	0.99	1.15	1.06	1.21	1.03	1.18	1.04	1.12	0.95	0.81	1.06		10
	-0.2	-0.2	-0.2	-0.2	-0.9	-1.7	-2.5	-3.9	-2.9	-3.2	-4.5	-0.8	3.4		
	0.77	1.04	0.96	1.02	1.15	1.18	1.25	1.18	1.15	1.02	0.96	1.04	0.77		
	0.81	1.10	0.99	1.02	1.13	1.14	1.21	1.14	1.14	1.02	0.96	1.05	0.79		11
	5.8	5.8	3.2	-0.2	-1.8	-3.2	-3.5	-3.6	-0.8	-0.7	0.3	1.6	2.8		
		0.85	0.97	0.96	0.99	1.04	1.11	1.04	0.99	0.96	0.97	0.85			
		0.96	1.04	0.96	0.97	0.99	1.07	1.01	0.98	0.98	1.02	0.88			12
		11.6	7.1	-0.2	-2.8	-4.3	-3.7	-2.6	-1.0	1.4	4.3	2.7			
			0.85	1.04	0.82	1.01	1.24	1.01	0.82	1.04	0.85				
			0.92	1.07	0.81	0.97	1.21	1.02	0.82	1.05	0.89				13
			7.3	2.8	-0.9	-3.8	-2.1	1.5	-0.1	1.4	4.1				
				0.77	1.02	0.87	0.77	0.87	1.02	0.77					
				0.79	1.07	0.90	0.80	0.93	1.06	0.76					14
				2.8	4.7	3.5	4.0	6.6	3.7	-1.1					
						0.68	0.85	0.68				PREDICTED			
						0.73	0.92	0.73				MEASURED			15
						7.8	8.1	8.5				P/C DIFFERENCE			

MAP NO. S1-2-13 DATE 4/14/75 POWER ~2441 MWT

CONTROL ROD POSITIONS

BANK C AT 228 STEPS

BANK D AT 227 STEPS

BANK P/L 228 STEPS

$F^N_{\Delta H}$ = 1.478 AT B6-DJ*

F^T_Q = 1.835 AT B6-DE*

$\overline{F}_z$ = 1.15

A.O.= -.11%

BURNUP =~2025 MWD/MTU

INCORE TILT

NW - 0.996

NE - 1.002

SW - 1.005

SE - 0.997

*Includes uncertainties

SURRY UNIT 1 - CYCLE 2 FIGURE 2.3.3

ASSEMBLYWISE POWER DISTRIBUTION

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.76 0.75 -0.9	0.95 0.92 -3.5	0.76 0.71 -6.4				PREDICTED MEASURED P/C DIFFERENCE			1
				0.82 0.80 -2.8	1.09 1.08 -0.9	0.98 0.96 -1.9	0.84 0.82 -2.5	0.98 0.93 -5.3	1.09 1.02 -6.4	0.82 0.79 -4.6					2
			0.90 0.88 -2.6	1.11 1.10 -1.5	0.85 0.85 -0.6	1.02 1.01 -1.3	1.24 1.21 -2.9	1.02 0.99 -2.6	0.85 0.83 -2.6	1.11 1.09 -2.2	0.90 0.88 -1.6				3
		0.90 0.87 -3.2	1.01 1.00 -0.6	0.96 0.96 0.3	0.96 0.97 0.4	0.99 0.98 -1.7	1.06 1.04 -1.4	0.99 0.98 -0.8	0.96 0.98 1.4	0.96 0.96 0.2	1.01 1.00 -1.3	0.90 0.89 -1.2			4
	0.82 0.80 -3.4	1.11 1.08 -3.4	0.96 0.97 0.6	0.97 1.01 3.7	1.08 1.09 1.1	1.08 1.07 -1.2	1.21 1.22 0.8	1.08 1.10 2.0	1.08 1.10 2.2	0.97 0.99 1.8	0.96 0.94 -2.6	1.11 1.10 -1.0	0.82 0.84 1.4		5
	1.09 1.08 -3.4	0.85 0.82 -3.4	0.96 0.97 0.9	1.08 1.10 1.7	0.97 0.99 2.2	1.13 1.18 3.0	0.98 1.03 4.7	1.13 1.18 4.4	0.97 0.99 2.5	1.08 1.09 1.2	0.96 0.96 -0.0	0.85 0.85 -0.2	1.09 1.10 0.5		6
0.76 0.76 0.4	0.98 0.98 -0.2	1.02 1.01 -0.7	0.99 0.99 0.2	1.08 1.09 1.2	1.13 1.17 3.9	1.07 1.13 5.6	1.22 1.28 5.5	1.07 1.13 5.2	1.13 1.18 4.4	1.08 1.11 2.9	0.99 1.01 1.5	1.02 1.02 0.3	0.98 0.97 -0.5	0.76 0.76 -0.7	7
0.95 0.98 0.4	0.84 0.84 -0.2	1.24 1.23 -0.7	1.06 1.05 -0.7	1.21 1.22 1.2	0.98 1.03 5.6	1.21 1.28 5.6	0.94 0.99 5.6	1.21 1.26 3.7	0.98 1.02 4.3	1.21 1.24 2.4	1.06 1.07 1.0	1.24 1.25 0.3	0.84 0.83 -0.8	0.95 0.95 -0.6	8
0.76 0.76 0.4	0.98 0.97 -0.8	1.02 1.01 -1.3	0.99 0.98 -1.3	1.06 1.10 1.5	1.13 1.16 4.4	1.07 1.12 4.4	1.22 1.27 4.4	1.07 1.08 1.3	1.13 1.13 -0.3	1.08 1.09 1.3	0.99 1.00 0.4	1.02 1.02 -0.4	0.98 0.97 -0.5	0.76 0.76 -0.4	9
	1.09 1.07 -1.9	0.85 0.84 -1.9	0.96 0.96 -0.6	1.08 1.10 1.5	0.97 1.00 3.2	1.13 1.18 4.1	0.98 1.01 2.9	1.13 1.13 0.0	0.97 0.97 -0.3	1.08 1.09 0.3	0.96 0.98 1.3	0.85 0.84 -1.2	1.09 1.08 -1.1		10
	0.82 0.82 -0.1	1.11 1.11 -0.1	0.96 0.97 0.6	0.97 0.99 1.5	1.08 1.10 2.0	1.08 1.10 2.0	1.21 1.23 1.5	1.08 1.09 1.3	1.08 1.09 1.3	0.97 0.98 1.1	0.96 0.96 -0.5	1.11 1.09 -1.8	0.82 0.81 -1.8		11
		0.90 0.92 1.8	1.01 1.03 1.7	0.96 0.98 1.5	0.96 0.97 0.8	0.99 0.99 0.1	1.06 1.05 -0.5	0.99 0.97 -1.8	0.96 0.95 -1.6	0.96 0.95 -0.7	1.01 1.00 -1.0	0.90 0.88 -2.4			12
			0.90 0.90 -0.1	1.11 1.09 -2.0	0.85 0.85 -0.8	1.02 1.01 -1.5	1.24 1.22 -2.3	1.02 1.01 -1.2	0.85 0.83 -2.6	1.11 1.09 -2.5	0.90 0.88 -1.7				13
				0.82 0.81 -2.0	1.09 1.09 -0.7	0.98 0.97 -0.5	0.84 0.84 0.3	0.98 1.00 1.9	1.09 1.09 -0.2	0.82 0.80 -3.5					14
						0.76 0.77 1.3	0.95 0.97 2.0	0.76 0.78 3.1				PREDICTED MEASURED P/C DIFFERENCE			15

MAP NO. S1-2-17 DATE 6/17/75 POWER ~2417

CONTROL ROD POSITIONS

BANK C AT 228 STEPS

BANK D AT 223 STEPS

BANK P/L 228 STEPS

$F^N_{\Delta H}$ = 1.434 AT B6-DJ*

F^T_Q = 1.787 AT K14-JD*

$\overline{F}_z$ = 1.15

A.O.= -1.8%

BURNUP = ~4065 MWD/MTU

INCORE TILT

NW - 0.998

NE - 0.999

SW - 1.006

SE - 0.997

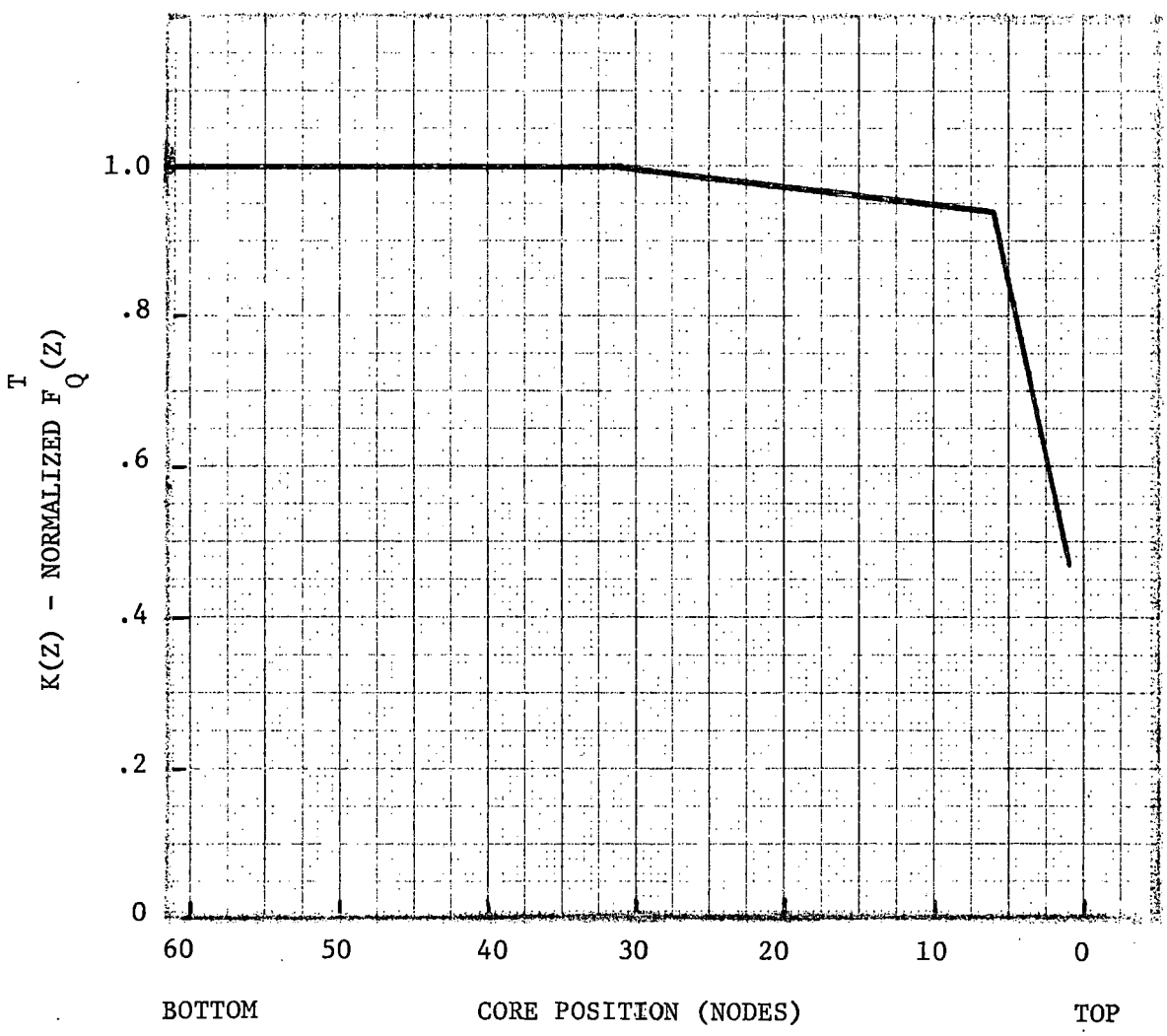
* Includes uncertainties

FIGURE 2.3.4

EFFECTIVE DATE
6/16/75

HOT CHANNEL FACTOR NORMALIZED
OPERATING ENVELOPE

SURRY POWER STATION
UNIT 1



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.5

AXIAL DEPENDENT HEAT FLUX HOT CHANNEL FACTOR

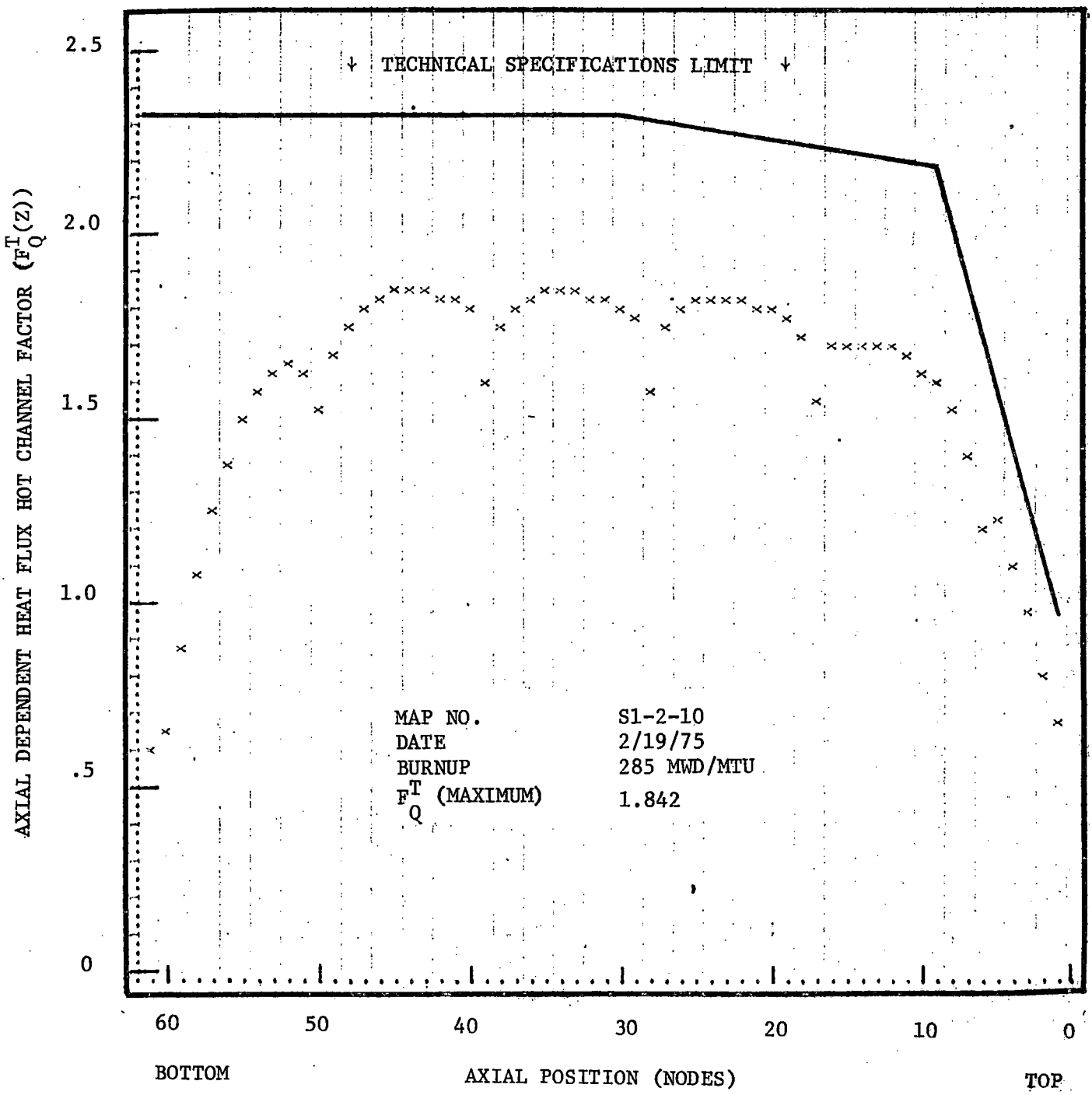
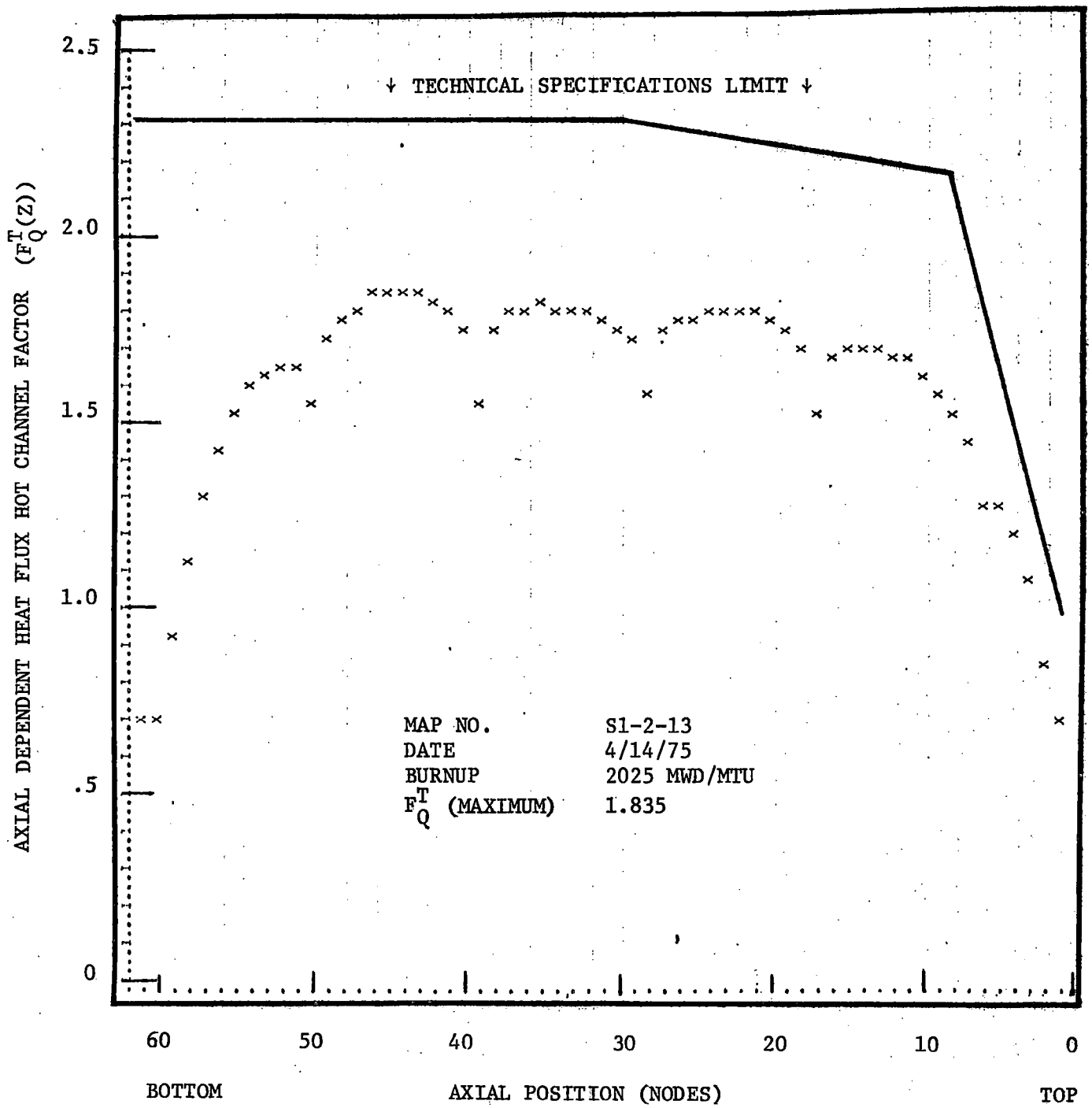


FIGURE 2.3.6

SURRY UNIT 1 - CYCLE 2

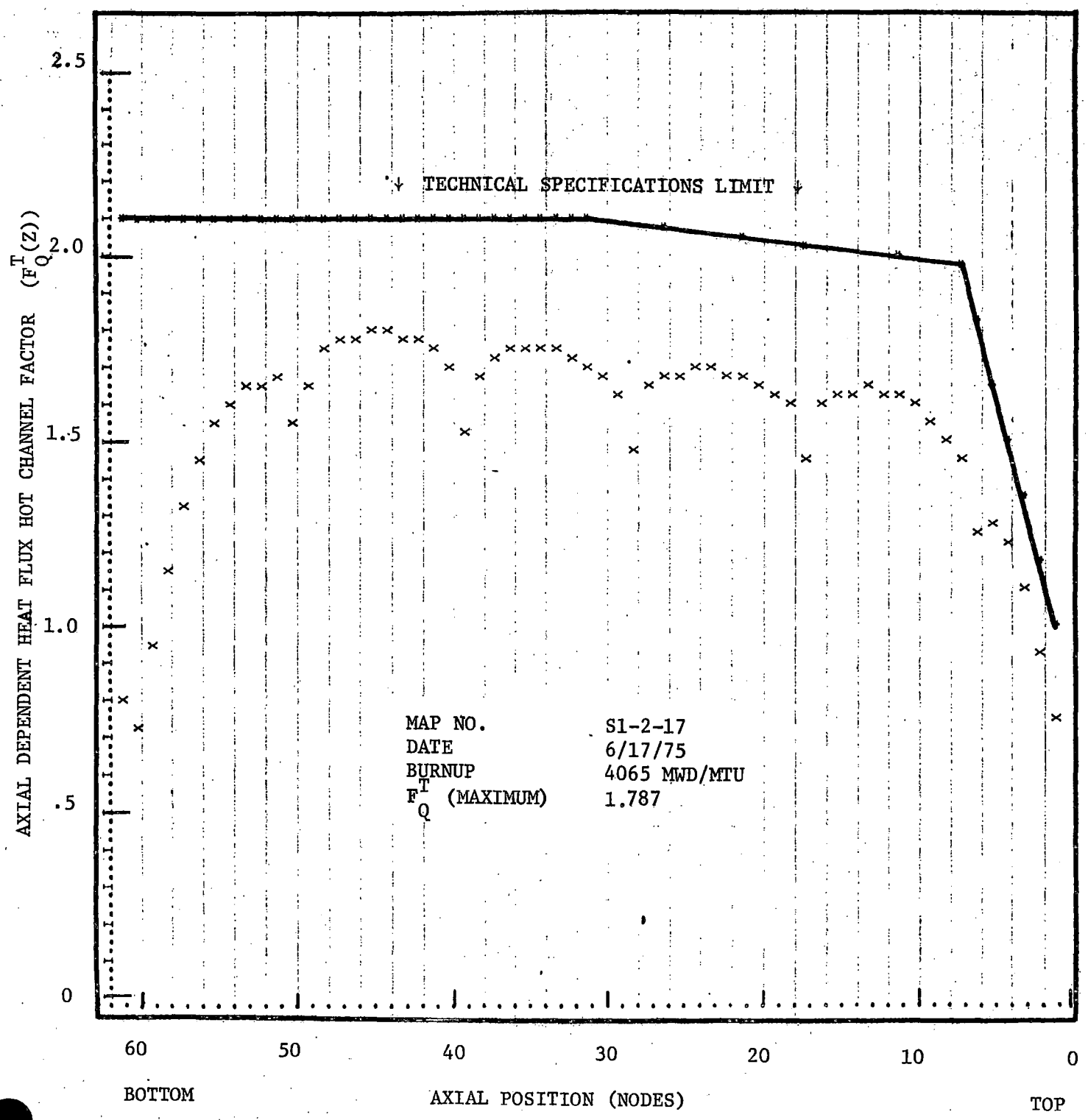
AXIAL DEPENDENT HEAT FLUX HOT CHANNEL FACTOR



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.7

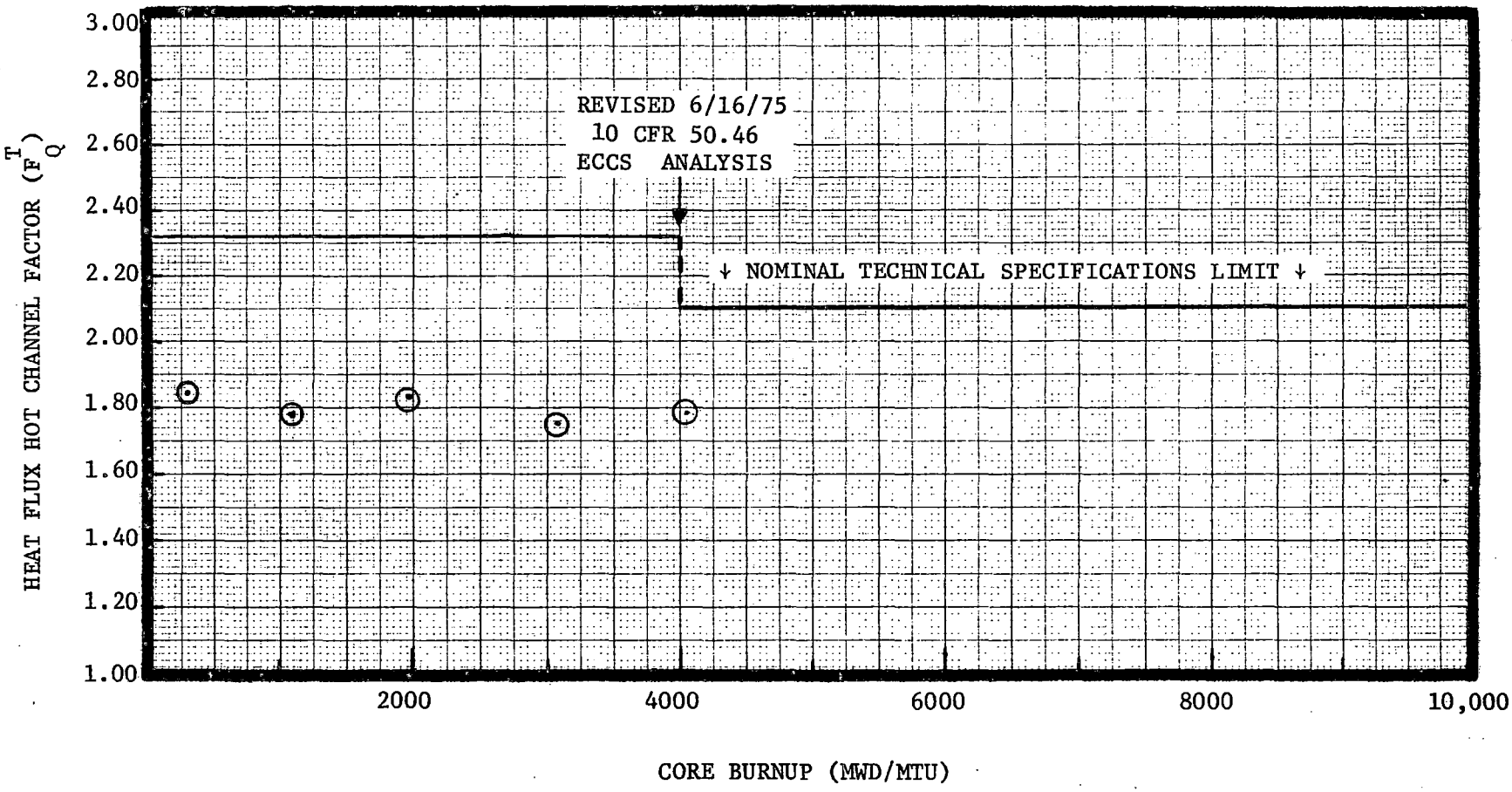
AXIAL DEPENDENT HEAT FLUX HOT CHANNEL FACTOR



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.8

MAXIMUM HEAT FLUX HOT CHANNEL FACTOR
vs.
BURNUP



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.9

PEAK LINEAR POWER DENSITY
vs.
BURNUP

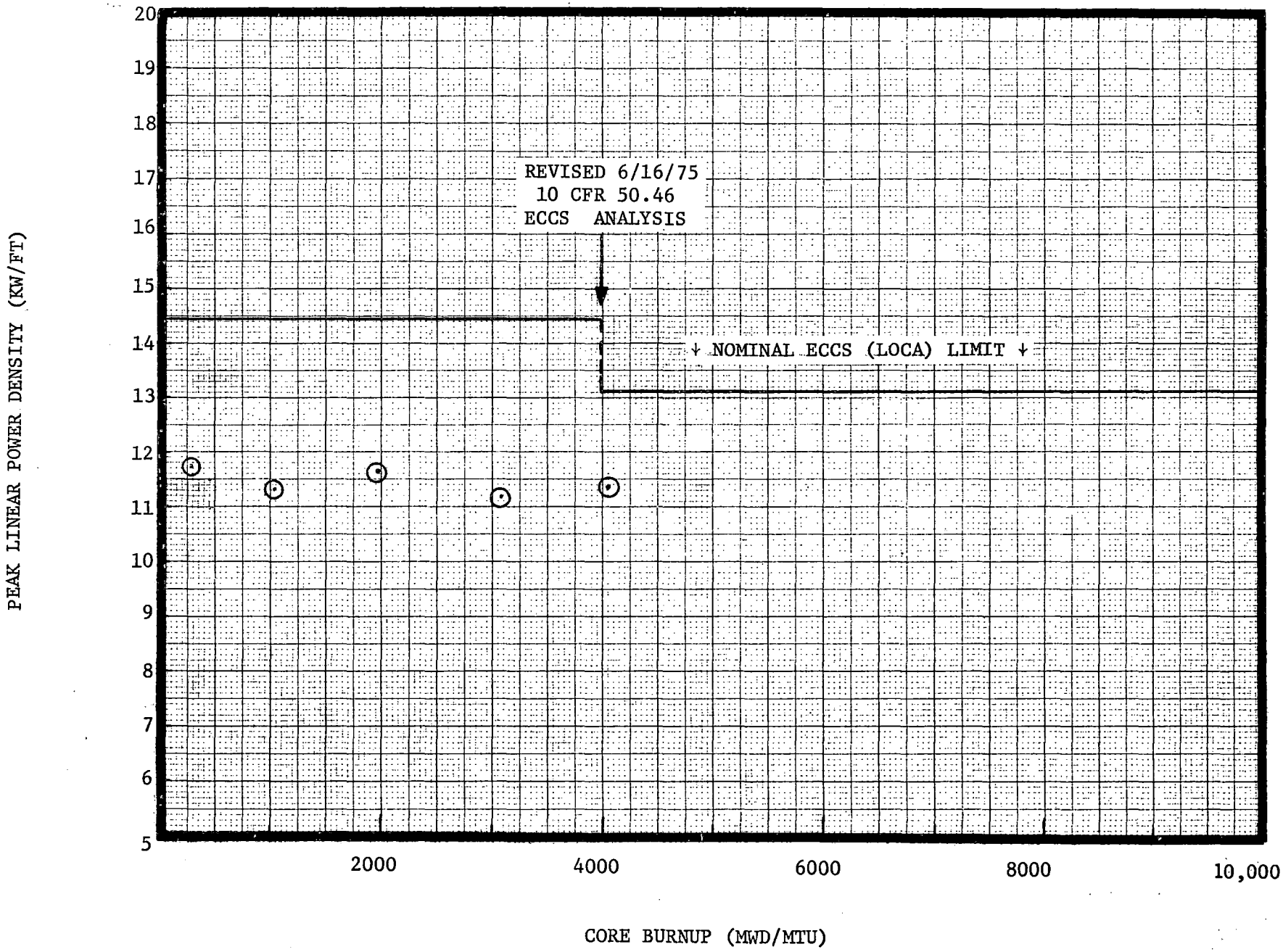
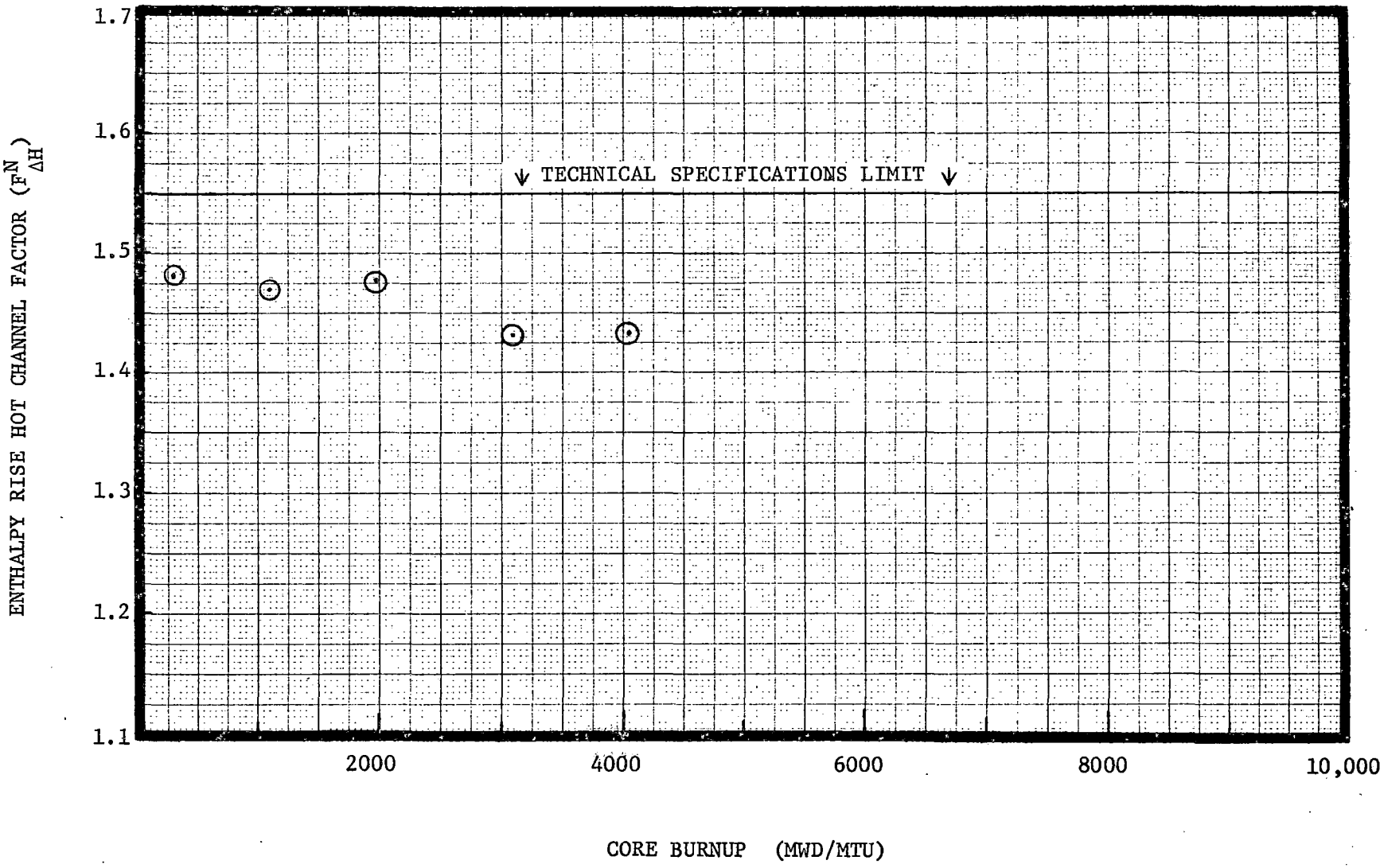


FIGURE 2.3.10

SURRY UNIT 1 - CYCLE 2

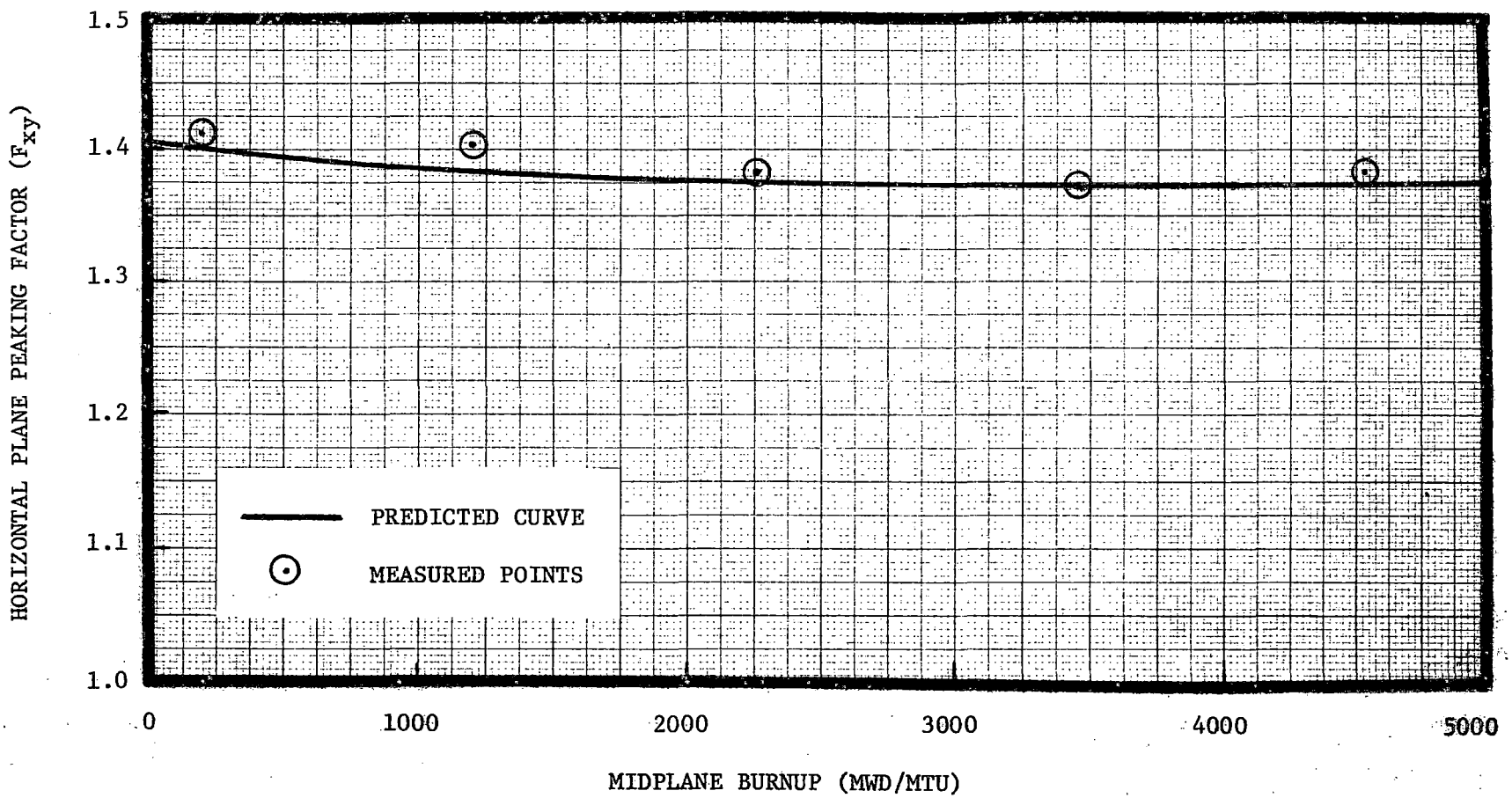
ENTHALPY RISE HOT CHANNEL FACTOR
vs.
BURNUP



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.11

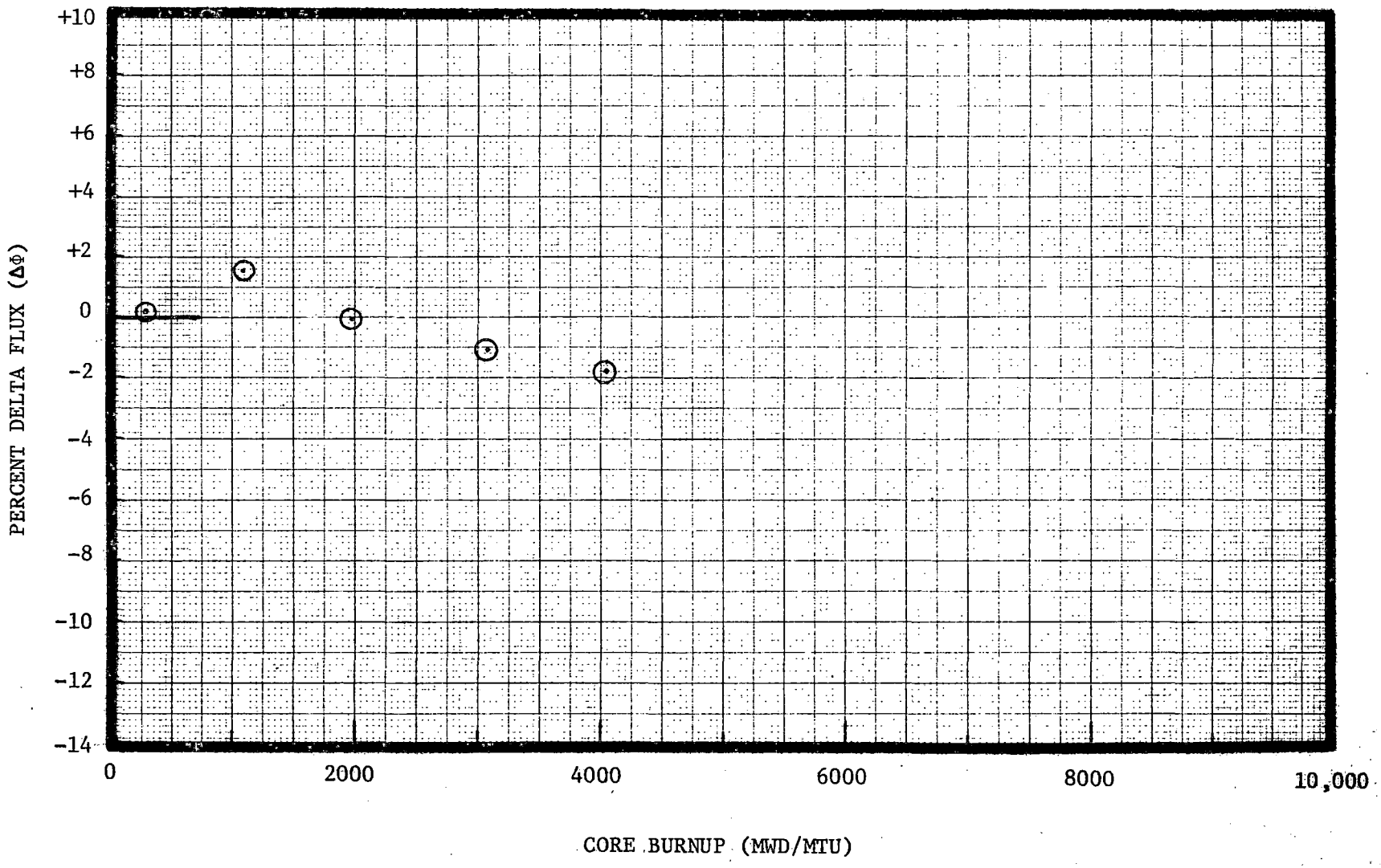
HORIZONTAL PLANE PEAKING FACTOR AT CORE MIDPLANE
vs.
BURNUP



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.12

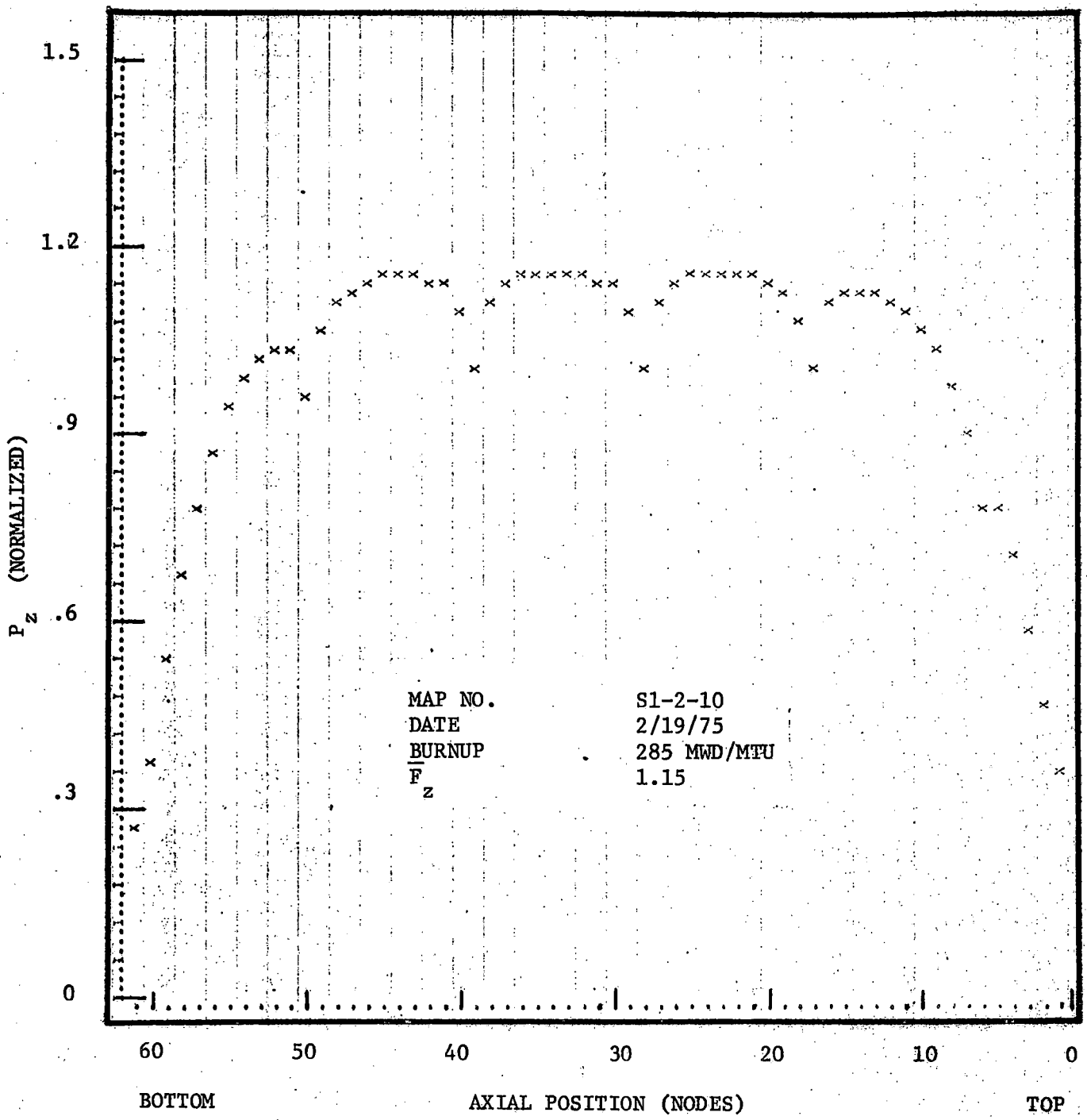
DELTA FLUX
vs.
BURNUP



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.13

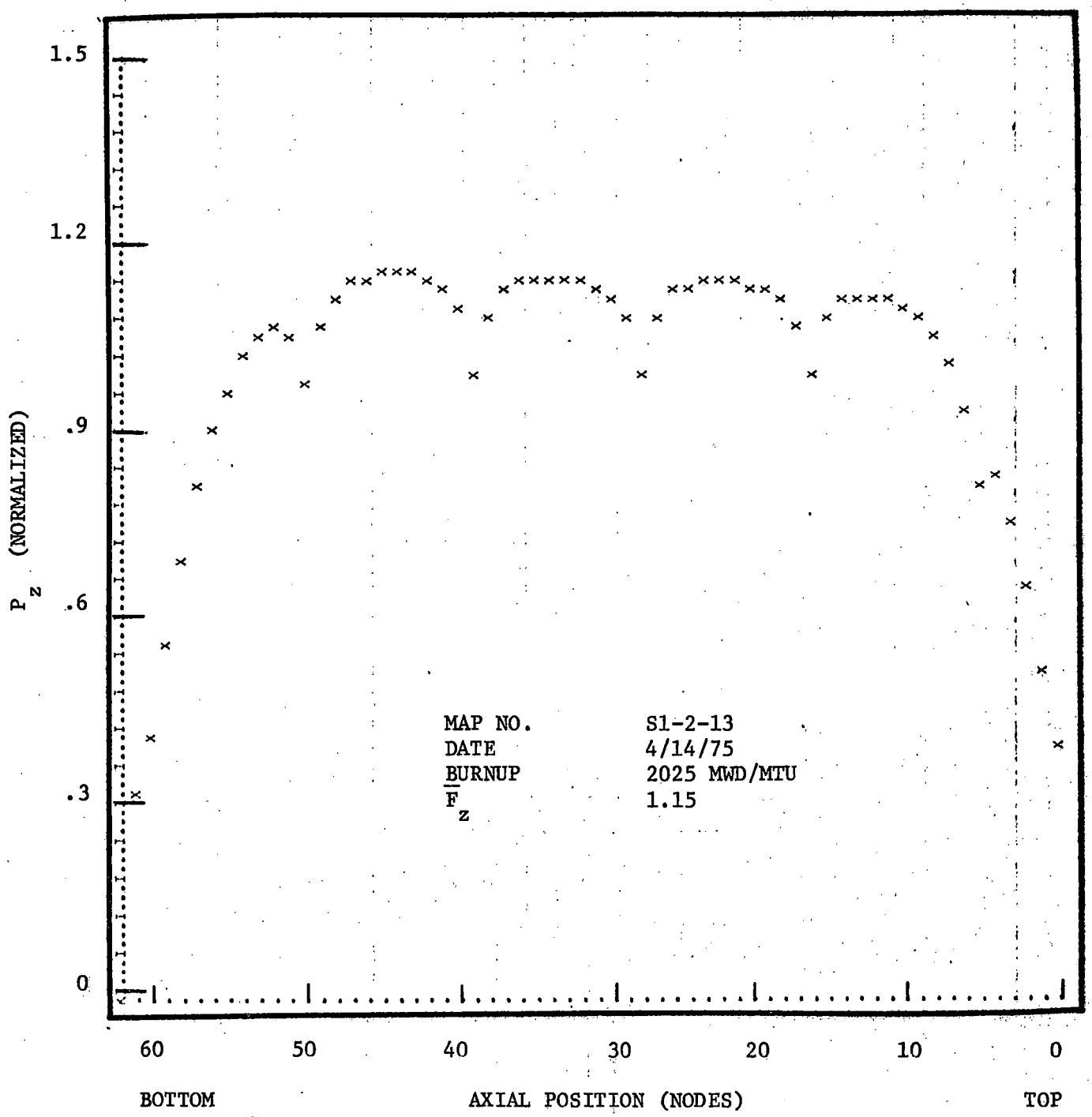
CORE AVERAGE AXIAL POWER DISTIBUTION



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.14

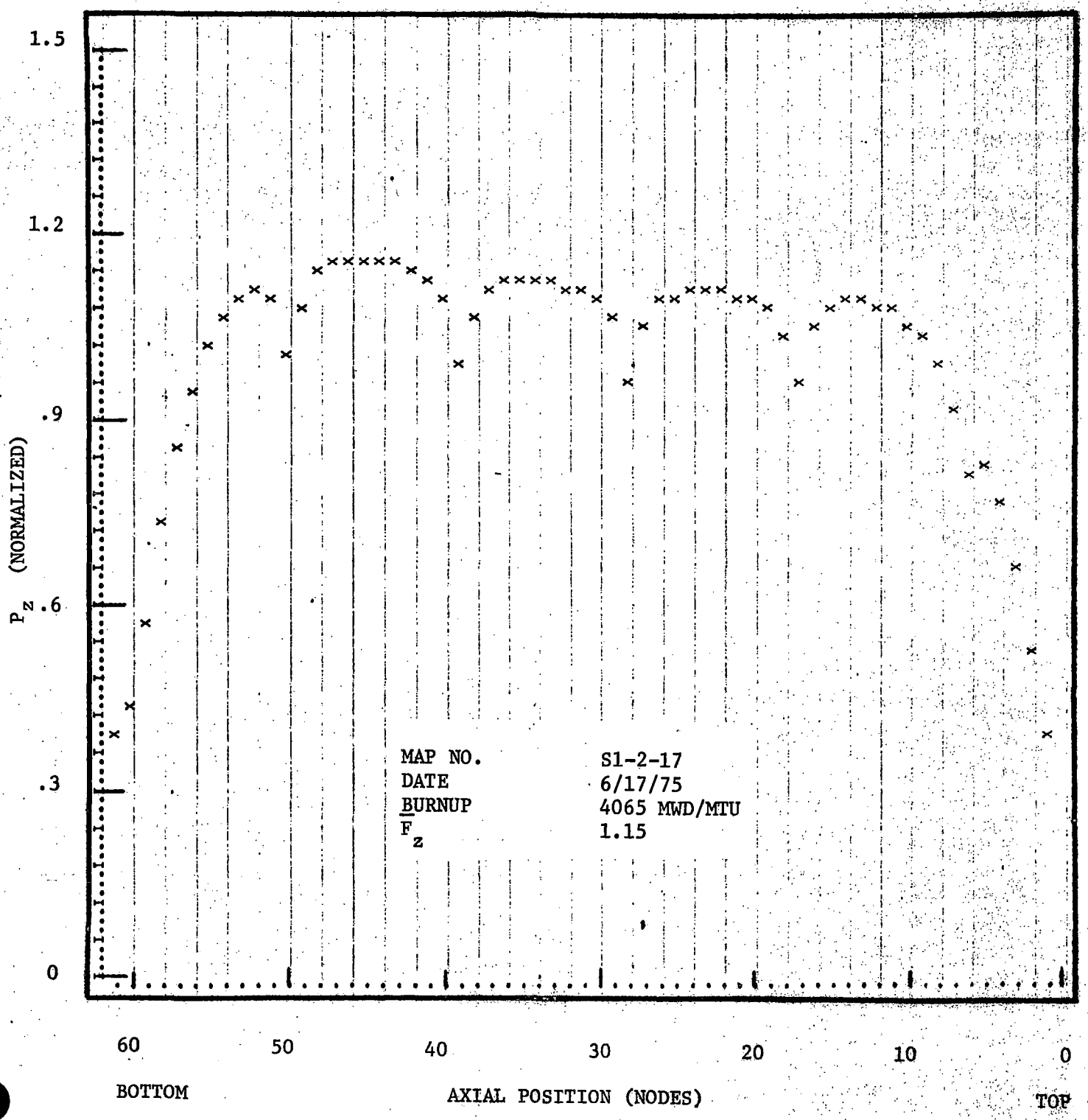
CORE AVERAGE AXIAL POWER DISTRIBUTION



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.15

CORE AVERAGE AXIAL POWER DISTRIBUTION



SURRY UNIT 1 - CYCLE 2

FIGURE 2.3.16

CORE AVERAGE AXIAL PEAKING FACTORS
vs.
BURNUP

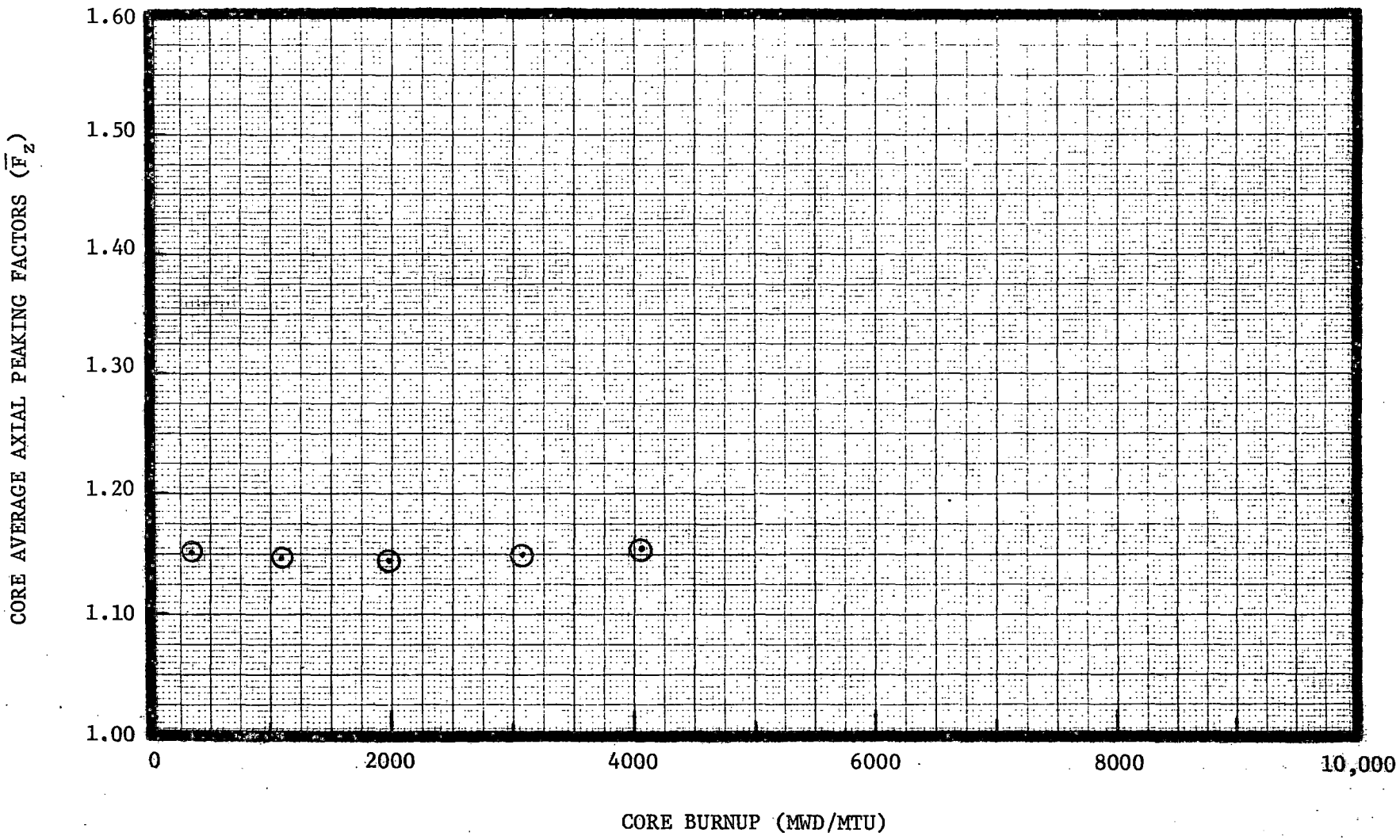


FIGURE 2.4.1

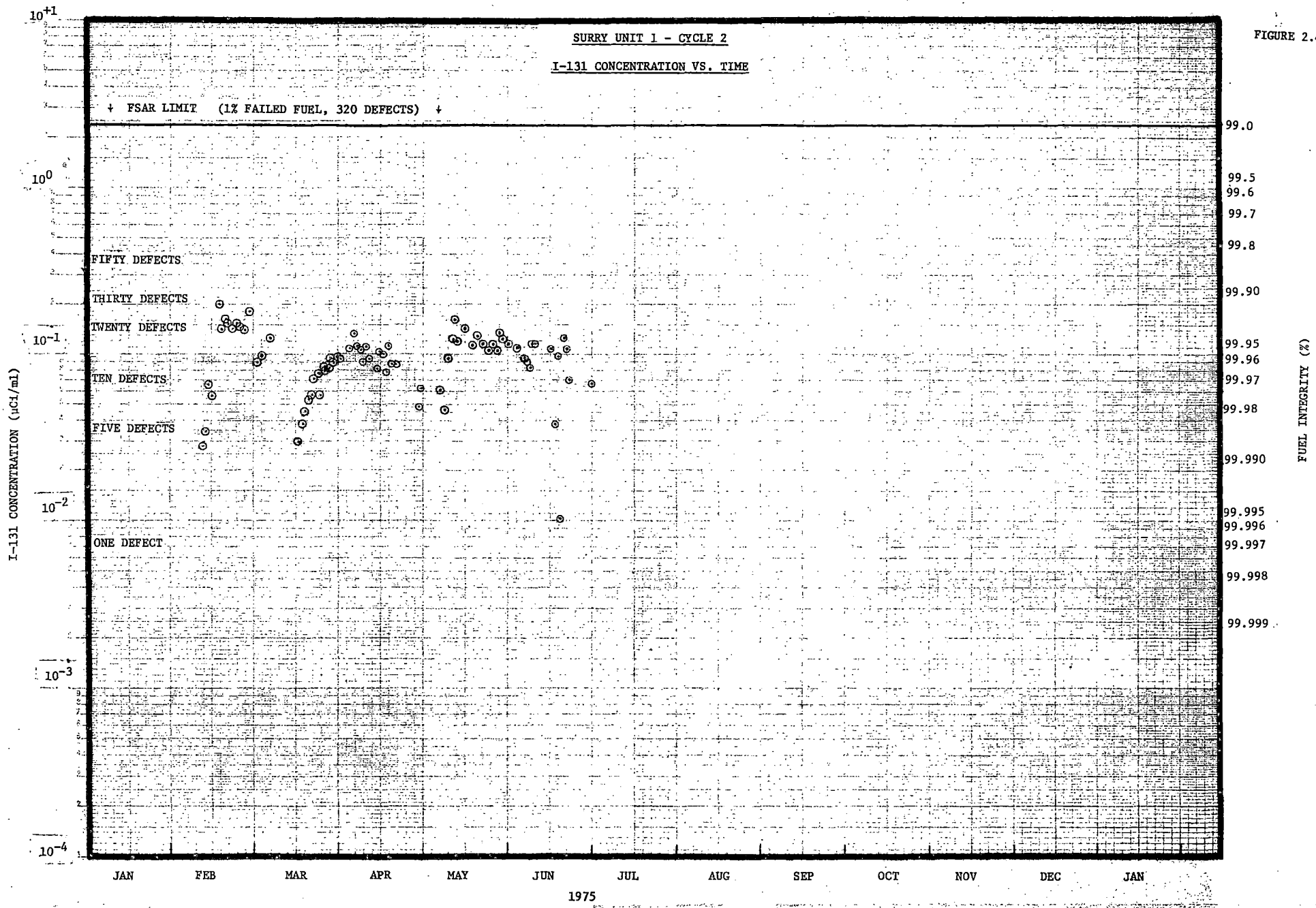

SURRY UNIT 1 - CYCLE 2
I-131 CONCENTRATION VS. TIME
FSAR LIMIT (1% FAILED FUEL, 320 DEFECTS)
FIFTY DEFECTS
THIRTY DEFECTS
TWENTY DEFECTS
TEN DEFECTS
FIVE DEFECTS
ONE DEFECT
I-131 CONCENTRATION (μCi/ml)
10^{+1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
FUEL INTEGRITY (%)
99.0
99.5
99.6
99.7
99.8
99.90
99.95
99.96
99.97
99.98
99.990
99.995
99.996
99.997
99.998
99.999
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
1975

FIGURE 2.4.2

SURRY UNIT 1 - CYCLE 2

I-131/I-133 RATIO vs. TIME

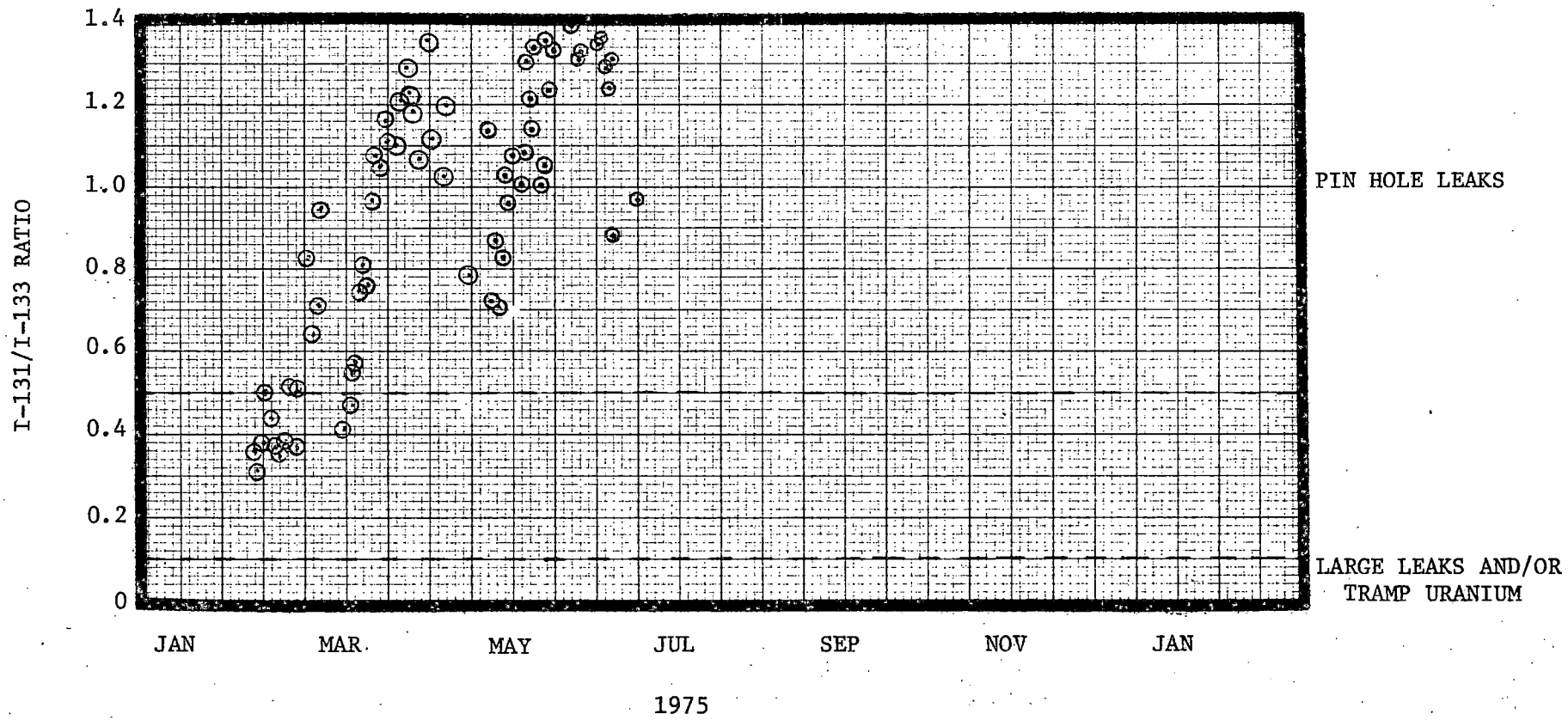


TABLE 2.5.1

-- SURRY UNIT 1 --

LOCATIONS OF DENSIFICATION POWER SPIKES

Strip-Chart Figure Number(1)	Assembly Location	Detectors	Fuel Region	Enrich-ment (w/o U235)	UO_2 Density (% Theoretical)	Power Spike (%) June 30, 1975	Change in Last 3 Maps	Location of Spike(2)	Status
1	E-11	A	2	2.57	92.9	1.6	moderate	1,2	confirmed
2	D-7	C	2	2.57	92.9	1.2	nil	1,2	confirmed
3	J-7	A11	2	2.57	92.9	1.9	moderate	1	confirmed
4	E-5	D	2	2.57	92.9	9.8	moderate	2,3	confirmed
5	J-5	B	2	2.57	92.9	0.5	nil	1	confirmed
6	L-11	B	2	2.57	92.9	0.8	large	1	suspected
7	L-5	E	2	2.57	92.9	0.5	moderate	1,2	suspected
8	N-5	D	4C	3.33	94.4	0.4	moderate	2	suspected

(1) See Appendix E

(2) 1-upper third; 2-midplane third; 3-lower third

CONCLUSION

The Surry 1 - Cycle 2 core has operated for nearly half of its normal cycle with all performance indicators comparing closely to design predictions and all Technical Specifications limits being met by a significant margin. No abnormalities in core reactivity, power distributions or burnup accumulation have been detected. Radioiodine analyses for Cycle 2 indicates that a number of fuel defects have occurred; however, the number is relatively small and the integrity of the core remains quite acceptable. As anticipated, observed fuel densification power spikes have been very small during Cycle 2.

DEFINITION OF TERMS

ACTIVITY - Number of nuclear disintegrations per unit time taking place in a radioactive nuclide. Usually expressed in terms of μCi (3.7×10^4 disintegrations per second).

AXIAL OFFSET - The percent difference between the fraction of total core power produced in the upper half of the core and that produced in the lower half of the core.

BATCH - A group of assemblies which are inserted into the reactor at the same time. All of the assemblies in a batch may or may not have the same nuclear characteristics or be discharged at the same time. (See REGION)

BORON (Soluble) - A strong neutron absorber which is dissolved in the reactor coolant and used for reactivity control. The boron concentration in the coolant is expressed in terms of parts per million water (ppm).

BURNUP - The quantity of energy produced per unit weight of fuel. It is a measure of fuel consumption and typically has units of megawatt-days per metric ton of initially contained uranium (MWD/MTU).

CRITICAL - Condition in which the neutron chain reaction in a reactor is just self-sustaining.

CRITICAL BORON CONCENTRATION - The concentration of soluble boron in the coolant at which the reactor is just critical.

CRITICAL HEAT FLUX (DNB) - The point of transition between nucleate boiling and film boiling at the coolant-clad interface. Beyond this critical heat flux point, a vapor blanket forms on the cladding surface and acts as an insulator, thereby resulting in abnormally high clad temperatures.

DENSIFICATION - A recently discovered phenomenon in which the UO_2 fuel pellets shrink both radially and axially as a result of neutron irradiation.

DENSIFICATION-INDUCED GAPS - When a column of UO_2 pellets in a fuel rod shrinks due to densification, gaps may be formed in the pellet column due to pellet-clad interaction.

FISSION PRODUCTS - Residual nuclei which are generated during the fission process and which retain nearly all of the energy formed in the process.

FLUX (Neutron) - A measure of the intensity of neutrons, i.e., the number of neutrons passing through one square centimeter in one second.

FLUX MAP - A three-dimensional representation of the flux distribution throughout the core. It is obtained from measurements made with the movable detector system. (See MOVABLE DETECTOR)

HALF-LIFE - Period of time in which a radioactive element decays to half its original concentration.

IODINE-131; IODINE-133 - Fission products which, because of their radioactive properties, can be used to determine fuel clad defects.

LINEAR POWER DENSITY - Power generated per unit length of fuel rod. This parameter is a measure of the central temperature of the fuel rod and stored heat. Usually expressed in units of Kw/ft.

LOAD FACTOR - The ratio of the actual reactor energy generated over a period of time to the potential energy which could have been generated by the reactor over that same period of time.

MOVABLE DETECTOR - A traversing incore fission chamber which generates a voltage signal proportional to the flux level the chamber "sees". Five such detectors are moved at one time through the core to monitor the flux distribution. A total of 50 locations are traversed to generate a complete flux map of the core (See FLUX MAP)

NODE - The core is divided into 60 equally spaced axial segments by the movable detector monitoring system. Nodal representation is then used by the INCORE program in deriving the power distributions.

POWER DENSITY - Power generated per unit volume in the core. Usually expressed in units of Kw/Liter.

POWER SPIKE - A local increase in power due to densification-induced gaps in the pellet stack.

RADIAL POWER MAP - An X-Y distribution of power on an assembly basis, normalized to the average assembly power.

REACTIVITY - In a nuclear reactor, a measure of the departure from a just critical condition. Usually expressed in units of pcm (10^{-5} $\Delta K/K$), it is normal to refer to a pcm quantity of reactivity associated with some component of the reactor since removing that component will change the reactivity of the reactor by that amount.

REGION - A group of assemblies which have essentially the same nuclear design characteristics and are inserted into the reactor at the same time. (See BATCH)

TECHNICAL SPECIFICATIONS - The document setting forth mandatory operational and surveillance requirements for a nuclear facility. It is issued by the AEC as part of the operating license.

TILT - A deviation from perfect symmetry. Usually used with respect to radial burnup or power distributions and relates each quadrant to the average of all four quadrants.

XENON - A gaseous fission product which has a very strong neutron absorption capability. Unless controlled, xenon concentration can shift up and down the axial axis of the core, thereby causing axial power transients.

$\Delta K/K$ - Mathematical expression for reactivity, where "K" is the ratio of the number of neutrons present in a reactor in any one neutron generation to that in the immediately preceding generation. (See REACTIVITY)

Appendix B

TOTE PROGRAM DESCRIPTION

TOTE is an isotopic and burnup follow program written by Westinghouse to accurately keep track of core isotopics and accumulated burnup. It is presently operational on the Virginia Electric and Power Company's IBM-370 computer system.

In the analysis of in-core flux maps the INCORE code punches out burnup rate information for every fuel region. These regions normally include each fuel assembly (and fueled follower) and about one hundred individual fuel rods of interest. The burnup rate is given as the megawatt-hours generated in a given fuel region per 1000 megawatt-hours generated by the core. The total for the fuel region is given as well as the value for each of four axial segments of approximately equal length. In addition, the core average axial power distribution is punched out.

The TOTE user inputs: (a) the core energy (megawatt-hours) associated with each of the above burnup rate decks; (b) cards describing each fuel region (including MTU, corresponding INCORE source number, previous burnup, isotopic depletion type, etc.); (c) tables of the change in isotopics (U-235, U, Pu, etc., up to ten) with burnup; and, (d) the burnup rate decks from INCORE. Printed output includes input; core, cycle and fuel region burnup; isotopics; the energy weighted core average axial power distribution; and the initial and current uranium values for each fuel batch and the core. Interpolation for isotopics is quadratic generally using the two preceding and one succeeding table entry. Interpolation for uranium value is linear. Punched output consists of Item (b) above for subsequent TOTE runs.

Appendix C

FOLLOW PROGRAM DESCRIPTION

FOLLOW is a data analysis computer program written by Westinghouse to process reactor operation data and calculate nominal boron concentrations. It is presently operational on the Virginia Electric and Power Company's IBM-370 computer system.

The FOLLOW Code is designed to describe the nearly linear relationship between available core reactivity and cycle burnup. It is most convenient to use boron as a measure of core reactivity with off nominal* corrections being made for power, xenon and samarium, temperature, and control rods in terms of their boron worth. These off nominal corrections are made as can be seen from this equation:

$$\begin{array}{l}
\text{corrected or nominal boron concentration} = \text{measured boron concentration} + \left[\text{inverse boron worth}\right]\left[\begin{array}{c}\text{off nominal}\\ \text{reactivity correction}\\ \text{due to rod group}\\ \text{1 position}\end{array}\right] \\
\quad + \begin{array}{c}\text{off nominal}\\ \text{reactivity correction}\\ \text{due to rod group}\\ \text{2 position}\end{array} + \begin{array}{c}\text{off nominal}\\ \text{reactivity correction}\\ \text{due to moderator}\\ \text{temperature}\end{array} \\
\quad + \begin{array}{c}\text{off nominal}\\ \text{reactivity correction}\\ \text{due to power}\end{array} + \left.\begin{array}{c}\text{off nominal}\\ \text{reactivity correction}\\ \text{due to xenon and}\\ \text{samarium behavior}\end{array}\right]
\end{array}$$

Options should be chosen so as to satisfy the above equation in ways appropriate to the reactor and its method of operation.

---

* Nominal conditions have generally meant hot full power equilibrium conditions with control rods at their upper limits.

The boric acid concentration in the primary loops of operating PWR's is typically measured one to three times per day. After proper normalization, this data is plotted against cycle burnup and form the "boron depletion curve". Since this curve is well behaved and nearly linear from beginning to end of the cycle, it can provide the following information:

1) Detection of abnormal (unexpected) behavior in core reactivity Technical Specifications require boron follow for this purpose.

2) Extrapolation to end-of-cycle life for scheduling refueling, or determination of end-of-life for contractual purposes.

3) Rate of loss of reactivity with burnup for confirmation of design procedures.

4) Indication of the need for updating reactivity coefficients needed for plant operation.

5) Best estimate of beginning of cycle, hot-full-power criticality under equilibrium conditions.

Appendix D

INCORE PROGRAM DESCRIPTION

INCORE is a data analysis computer program written by Westinghouse to process information obtained by in-core instrumentation. It is presently operational on the Virginia Electric and Power Company's IBM-370 computer system.

In the reduction of in-core flux and temperature measurements the INCORE code performs the following:

1. Reads input consisting of (a) a description of the amount and type of data to be read in (such as number of flux traces and thermocouple readings, etc.); (b) a description of the reactor when the measurements were made (such as power level, inlet and outlet temperature, etc.); (c) the actual data and information relevant to it (such as what flux thimbles were used, neutron cross sections of the sensor, etc.); (d) analytical information (such as calculated thimble fluxes); and (e) specification of options as to what thimbles will be employed in local power predictions, what calculations are to be done, etc.
2. Corrects raw pointwise flux measurements for background current, changes in power level between measurements, relative detector sensitivities, etc., to determine pointwise reaction rate in the flux thimbles.
3. Compares the measured reaction rates determined above with expected values and rejects data if they differ from expected values by more than an input rejection criteria. An error analysis is performed for subsequent determination of the uncertainty to attach to calculated peaking factors.

4. Computes relative local power in each fuel assembly, and in each fuel rod chosen for attention. Local relative power is computed as:

$$\frac{\left[\text{Reaction Rate in Flux Thimble}\right]_{\text{Measured}} \times \left[\frac{\text{Local Power}}{\text{Reaction Rate in Flux Thimble}}\right]_{\text{Analytical}}}{\left[\text{Average of Numerator for All Fuel in Core}\right]}$$

Local absolute power or heat flux is then computed by multiplying the above quantity by the average specific power or heat flux in the core determined from the measured total core power at the time the data were taken. A weighted average of data from all nearby thimbles can be used in determining local relative power. Different PDQ ratios of power to reaction rate are used depending on the control rod configuration at each elevation.

5. Calculates the relative quadrant powers and the power weighted average axial distribution in the core. The expected and measured power peaking factors are compared for each power generating region.

6. Outputs the twenty highest values of $F_{\Delta H}^{N}$ and F_{Q}^{N} in descending order with an identifying number so that hot spot locations in the core can be determined.

7. Calculates the rate at which burnup is being accumulated for four axial regions for each fueled area.

8. Corrects thermocouple data for calibration, and converts them to local enthalpy. Relative local enthalpy rise is then calculated using the vessel inlet and outlet temperatures and the core bypass flow. The local enthalpy rise measured by thermocouples is compared with

that predicted from flux measurements using relative local flow rates.

9. Calculates the margin to departure from nucleate boiling (DNB) using the W-3 correlation for selected channels.

10. Outputs the input data, parameters used, and major calculated values.

Appendix E

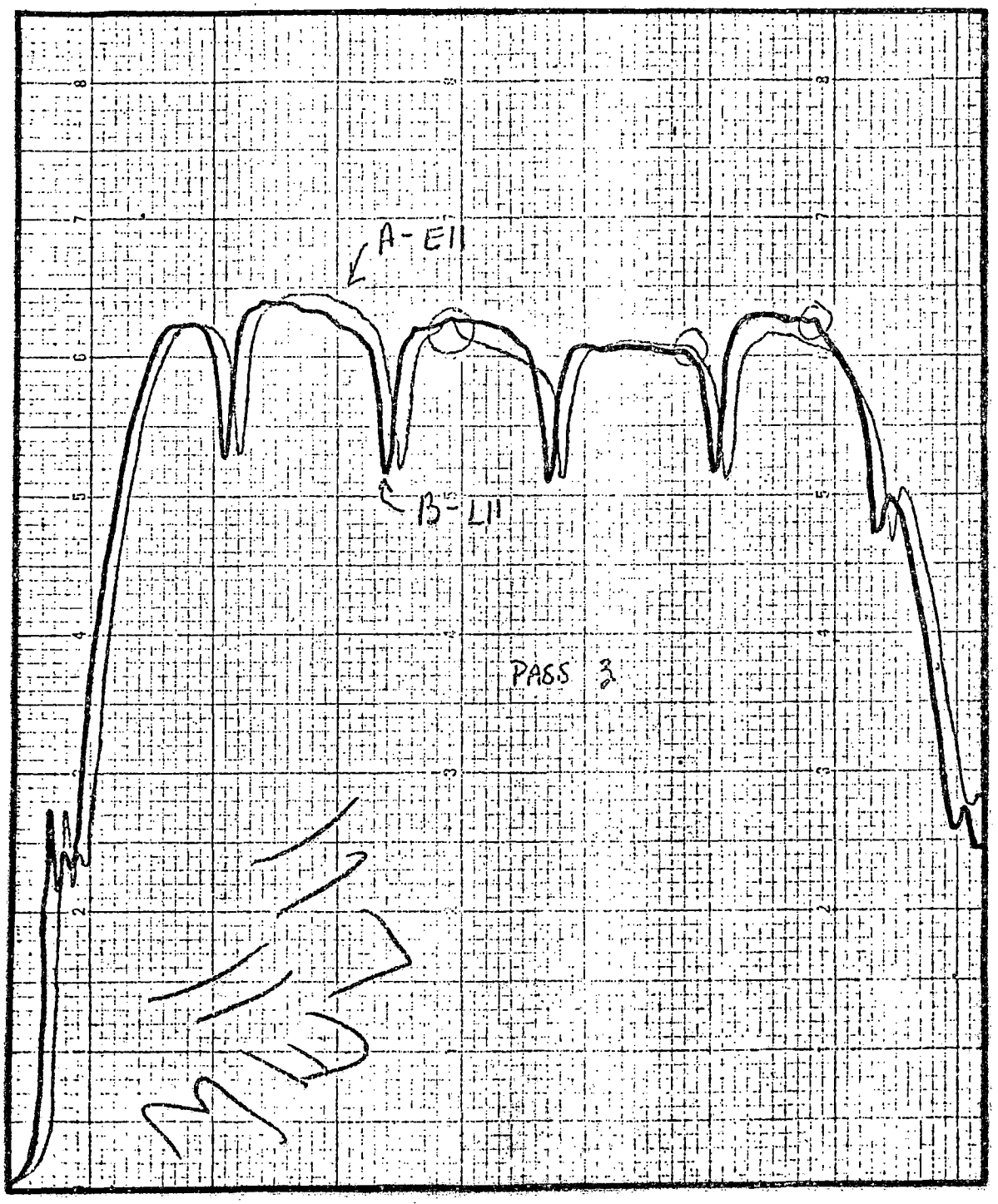
DENSIFICATION STRIP-CHART TRACES

The following eight figures are strip-chart recorder traces taken during the flux mapping process and show confirmed or suspected power spikes encircled:

Figure No.	Thimble	Map No.
1	E-11	17
2	D-7	17
3	J-7	17
4	E-5	17
5	J-5	17
6	L-11	17
7	L-5	17
8	N-5	17

FIGURE 1

THIMBLE E 11-DETECTOR A

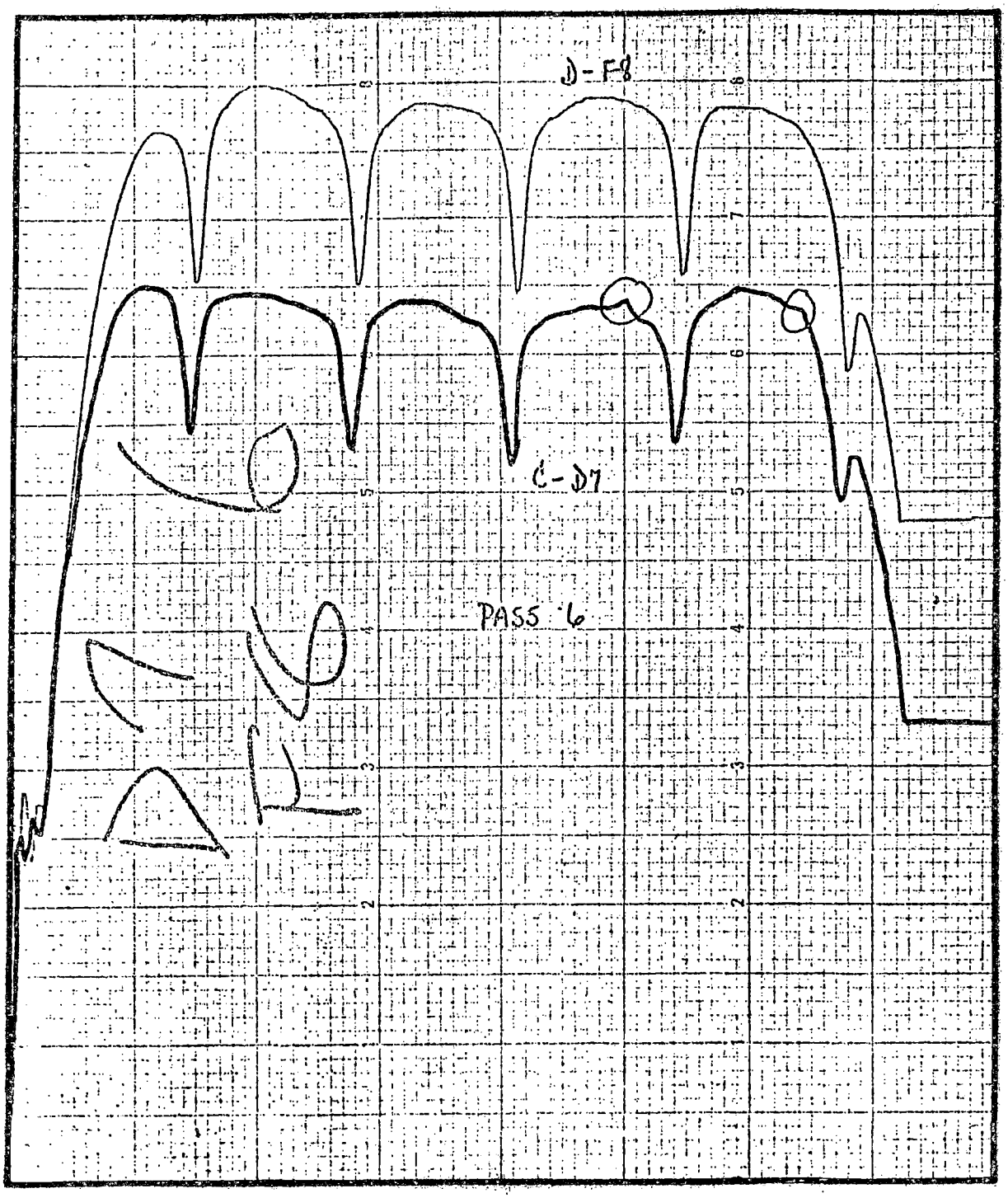


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 2

THIMBLE D 7-DETECTOR C

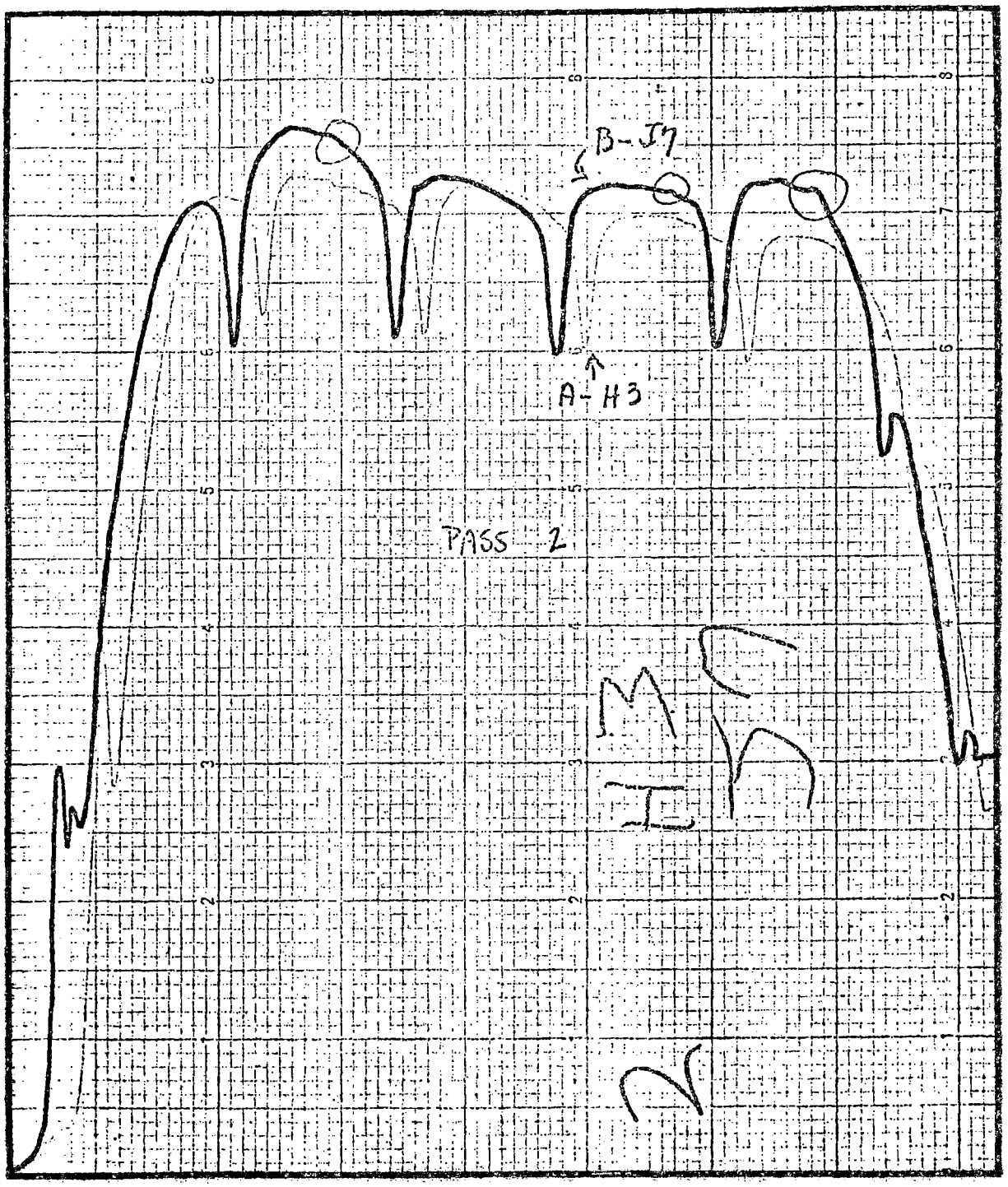


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 3

THIMBLE J 7-ALL DETECTORS

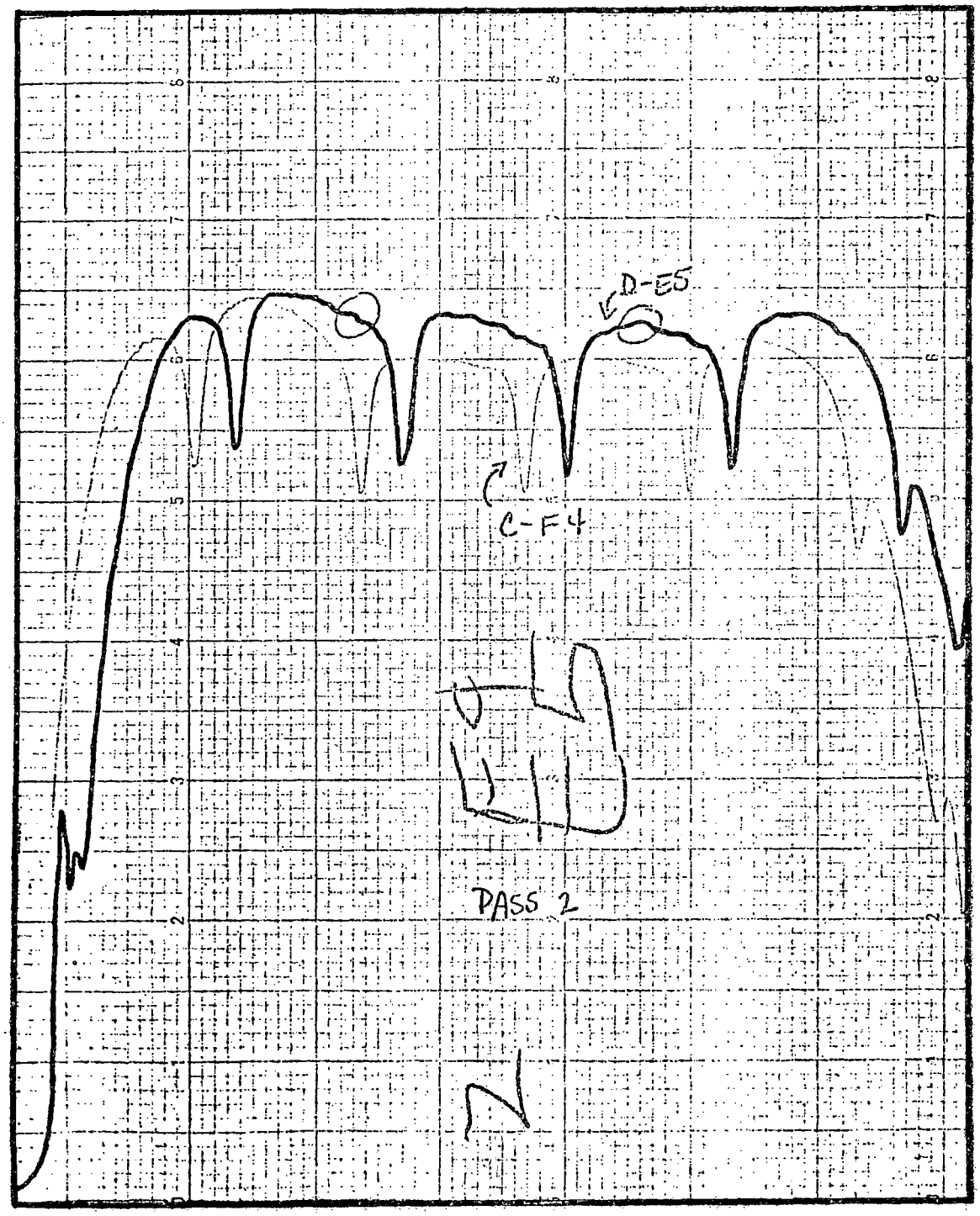


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 4

THIMBLE E 5-DETECTOR D

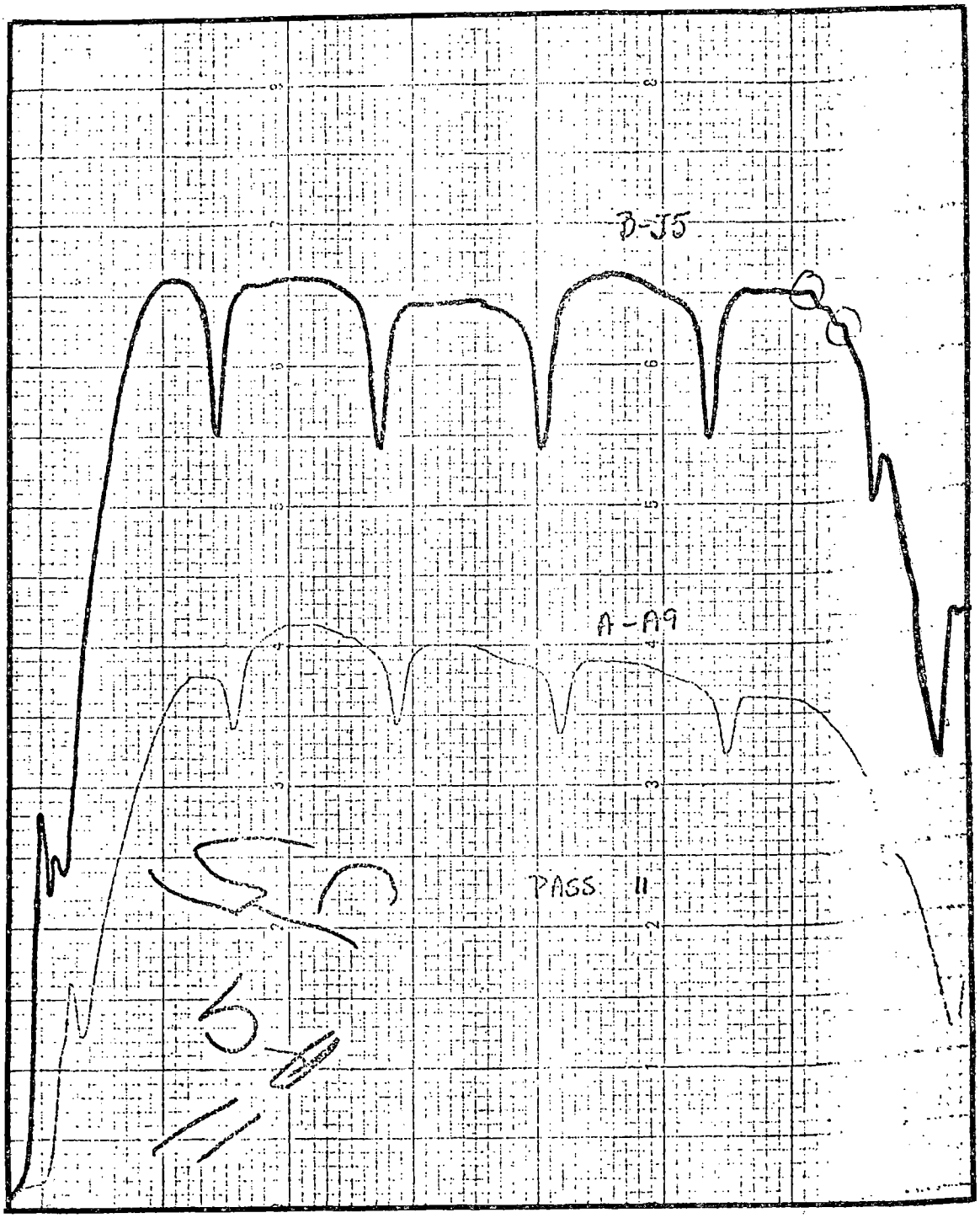


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 5

THIMBLE J 5-DETECTOR B

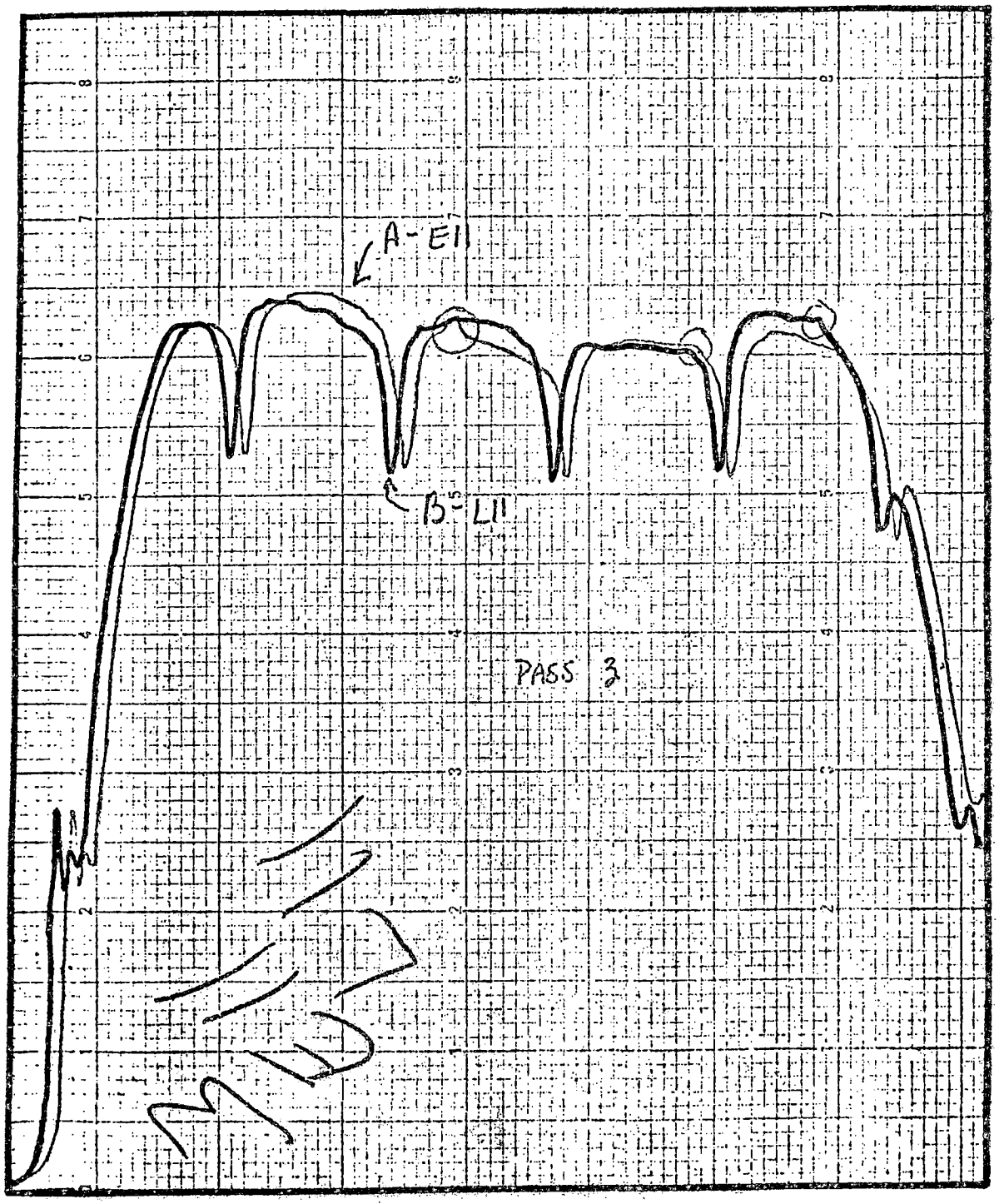


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 6

THIMBLE L 11-DETECTOR B

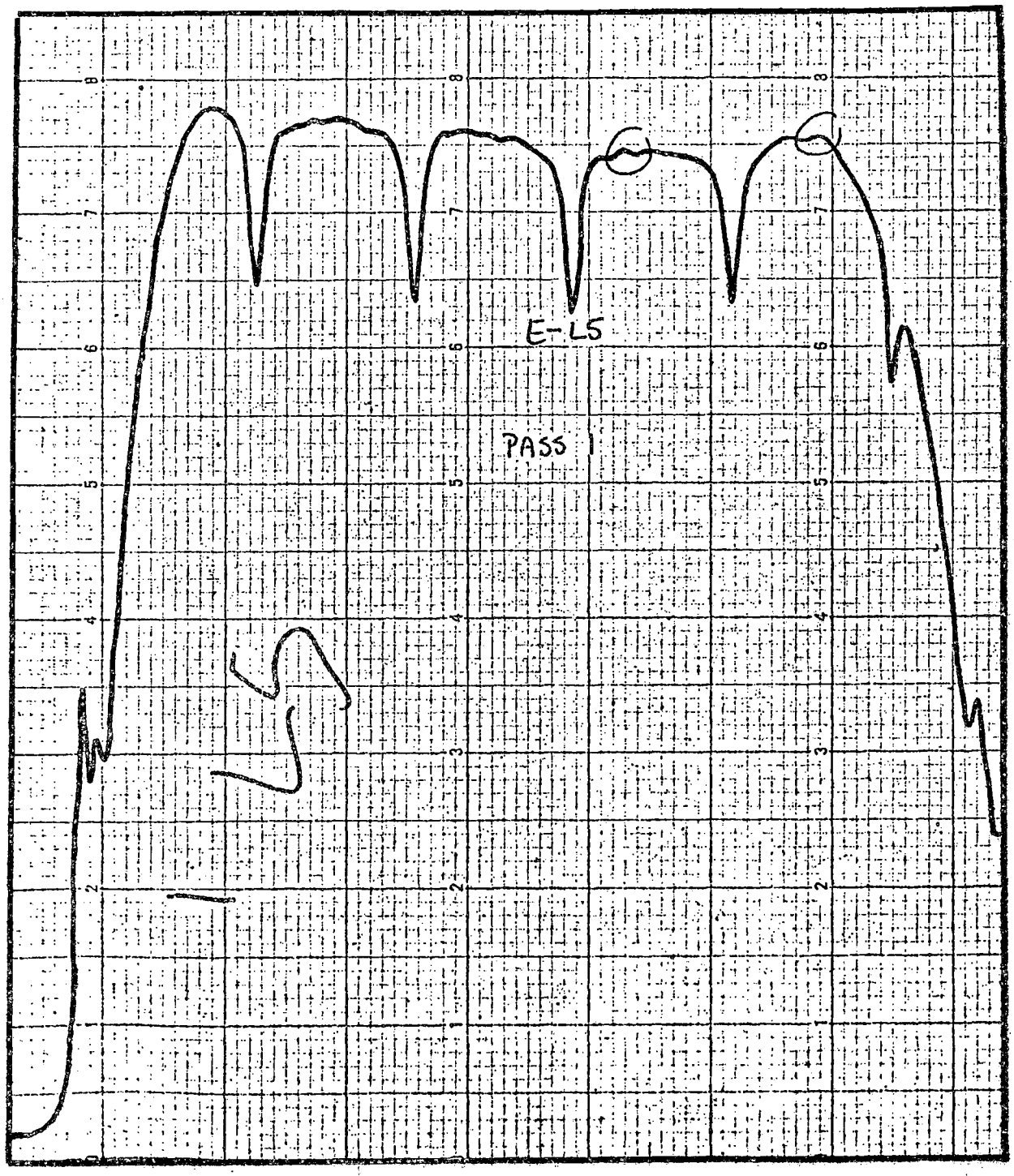


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 7

THIMBLE L 5-DETECTOR E

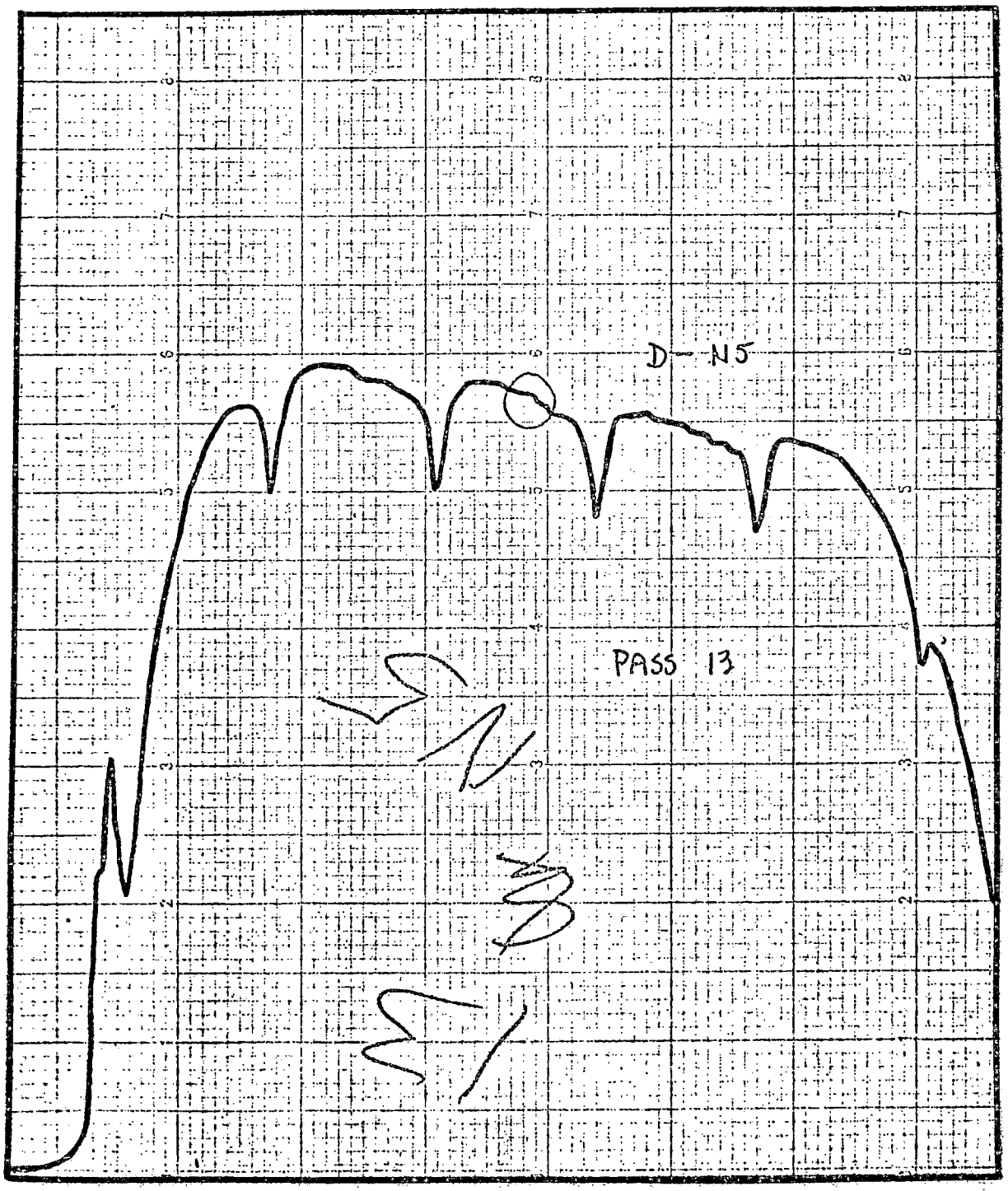


61 1

BOTTOM CORE POSITION (NODES) TOP

FIGURE 8

THIMBLE N 5-DETECTOR D



61 1

BOTTOM CORE POSITION (NODES) TOP

ACKNOWLEDGMENTS

The authors would like to acknowledge the cooperation of the staff at Surry Power Station in supplying the basic data for this report. Special thanks is due Messrs. D. Benson, K. Bowers, and W. Earl.

10.5 CHANGES TO PROCEDURES

The following changes were made to the station procedures during this reporting period:

10.5.1 Administrative Procedures

A summary of the changes to Administrative Procedures made during this reporting period is presented in Table 10.5.1-1.

10.5.2 Abnormal Procedures

A summary of the changes to Abnormal Procedures made during this reporting period is presented in Table 10.5.2-1.

10.5.3 Annunciator Procedures

A summary of the changes to Annunciator Procedures made during this reporting period is presented in Table 10.5.3-1.

10.5.4 Chemistry and Health Physics Procedures

A summary of the changes to Chemistry and Health Physics Procedures made during this reporting period is presented in Table 10.5.4-1.

10.5.5 Emergency Procedures

A summary of the changes to Emergency Procedures made during this reporting period is presented in Table 10.5.5-1.

10.5.6 Maintenance Procedures

A summary of the changes to Maintenance Procedures made during the reporting period is presented in the following Tables:

10.5.6-1 Mechanical Maintenance Procedures

10.5.6 Maintenance Procedures (Con't.)

10.5.6-2 Electrical Maintenance Procedures

10.5.6-3 Instrument Maintenance Procedures

10.5.7 Operating Procedures

A summary of the changes to Operating Procedures made during this reporting period is presented in the following Tables:

10.5.7-1 Operating Procedures

10.5.7-2 Maintenance Operating Procedures

10.5.8 Periodic Test Procedures

A summary of the changes to Periodic Test Procedures made during this reporting period is presented in Table 10.5.8-1.

10.5.9 Start-Up Test Procedures

A summary of the changes to the Start-Up Test Procedures made during this reporting period is presented in Table 10.5.9-1.

10.5.10 Special Test Procedures

A summary of the changes to the Special Test Procedures made during this reporting period is presented In Table 10.5.10-1.

SUMMARY OF
ADMINISTRATIVE PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION

PROCEDURE NUMBER	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
ADM-1	Station Organization and Responsibility	1-22-75	Insert Assistant Operating Supervisor into organization.
ADM-2	Station Nuclear Safety and Operating Committee	2-19-75	Amplify procedure.
ADM-2	Station Nuclear Safety and Operating Committee	3-26-75	Revised distribution list.
ADM-4	Station Entrance & Egress	4-23-75	Rewritten to comply with new security program.
ADM-12	General Employee Training	5-23-75	New procedure.
ADM-13	Review of Procedures	2-26-75	
ADM-15	Incoming Mail	4-09-75	New procedure.
ADM-16	Reasons for notifying Operating Supervisor and/or Superintendent Station Oper.	2-28-75	Cancelled - included in ADM-29.
ADM-16	Explosive Safety	5-30-75	New procedure.
ADM-17	Vehicle Maintenance Proc.	6-23-75	New procedure.
ADM-29	Conduct of Operations	2-28-75	Provide more comprehensive procedure.

Table 10.5.1-1

SUMMARY OF
ABNORMAL PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	AP-1.2	Rod Control Continuous Rod Insertion	1-17-75	Amend for 2235# pressure operations.
2	AP-1.2	Continuous Rod Insertion	6-11-75	Conform with 2235 psig.
1,2	AP-1.4	Rod Malfunction - Dropped	4-02-75	Insert directions to avoid exceeding TS limit.
1,2	AP-9	Reactor Coolant Pump	2-06-75	Conform to new vibration readout system.
1,2	AP-16	Excessive Primary Plant Leakage	6-11-75	Adjusted for failure of No. 1 seal of Reactor Coolant Pump.
1	AP-20	Main Control Rm. Inaccessibility	1-17-75	Amend for 2235# pressure operations.
2	AP-20	Main Control Rm. Inaccessibility	6-11-75	Conform with 2235 psig.
1,2	AP-21	Loss of Feedwater Flow	3-19-75	Update procedure following DC-73-122.
1,2	AP-22	Fuel Transfer Equipment Malfunction	4-02-75	Update in accordance with OP-4.0.
1,2	AP-28	Loss of Instrument Air	2-28-75	Reflect initiation of EP-6.
1	AP-31	Failure of Pressurizer Pressure Control	1-17-75	Amend for 2235# pressure operations.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	AP-31	Failure of Pressurizer Pressure Control	6-11-75	Conform with 2235 psig.
1,2	AP-35	Oil Spill Control	1-15-75	Amend to reflect change in personnel assigned.
1,2	AP-35	Oil Spill Control	4-02-75	Add QA Engineer Review

Table 10.5.2-1

SUMMARY OF
ANNUNCIATOR PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	ALL	Annunciator Procedures	2-28-75	All Annunciator Procedures for both Units 1 and 2 were rewritten and approved by the Safety Committee on 2-28-75.
1	1WD-40	Hi Level Waste Drain Tank A Hi-Low Level	3-19-75	Correct typing error.
1	1B-37	Service Air Compressor 1	3-19-75	Correct typing error.
1	1E-66	Hi Containment Pressure	3-19-75	Correct typing error.
1	1E-67	Delta Flux	4-09-75	Rewrite to comply with existing alarm.
2	2E-67	Delta Flux	4-09-75	Rewrite to comply with existing alarm.
1	1A-49	Traveling Screens Hi Differential Level	5-02-75	Change setpoint.
2	2A-49	Traveling Screens Hi Differential Level	5-02-75	Change setpoint.
1	1E-67	Delta Flux	5-02-75	Eliminate Fz Surveillance latitude.
2	2E-67	Delta Flux	5-02-75	Eliminate Fz Surveillance latitude.

SUMMARY OF
CHEMISTRY AND HEALTH PHYSICS PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	HP-3.1-3A	Low Background Counting System Beckman - Wide Beta II - Planchet Counting System	4-02-75	New procedure.
1,2	HP-3.1-10	Source Calibration - Nuclear Data 4420	4-02-75	New procedure.
1	HP-3.5-1	Radioactive Liquid Waste Discharges; Contaminated Drains, Low Level Liquid Waste & Boron Recovery Test Tank Systems - No Primary to Secondary Leakage	1-27-75	Liquid Waste Procedures being rewritten to reflect: 1. Operation without Primary to Secondary leakage. 2. Operation with Primary to Secondary leakage.
1	HP-3.5-1A	Radioactive Liquid Waste Discharges; Unplanned & Miscellaneous Releases - No Primary to Secondary Leakage	1-27-75	New procedure.
1	HP-3.5-2	Radioactive Liquid Waste Discharges; Contaminated Drains, Low Level Liquid Waste & Boron Recovery Test Tank Systems - With Primary to Secondary Leakage	1-31-75	Liquid Waste Procedures being rewritten to reflect: 1. Operations without Primary to Secondary leakage. 2. Operations with Primary to Secondary leakage.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	HP-3.5-2A	Radioactive Liquid Waste Discharges; Unplanned & miscellaneous Releases - With Primary to Secondary Leakage	1-27-75	New procedure.
1	HP-3.5-3	Radioactive Liquid Waste Discharges; With Primary to Secondary Leakage	1-31-75	Liquid Waste Procedures being rewritten to reflect: 1. Primary to Secondary Leakage. 2. No Primary to Secondary Leakage conditions.
1	HP-3.5-4A	Gaseous Waste Discharges: Unplanned Gaseous Releases	1-31-75	New procedure.
1	HP-3.5-4	Gaseous Waste Discharges Waste Gas Decay Tanks	2-26-75	Rewritten for clarity.
1,2	HP-3.5-5	Gaseous Waste Discharges Containment Purging and Hogging Operations.	3-13-75	Rewritten to conform with other gaseous discharge procedures.
1,2	HP-3.5-5A	Gaseous Waste Discharges With Primary to Secondary Leakage-Condenser Air Ejector, Steam Generator B.D. Tank Vent and Main Steam Losses	3-26-75	New procedure.
1	HP-3.5-7	Gaseous Waste Discharges Process Vent System	2-26-75	Rewritten for clarity.
1	HP-3.5-8	Gaseous Waste Discharges Ventilation Vent System	2-26-75	Rewritten for clarity.
1,2	HP-3.9.3	Receipt of Radioactive Material	3-26-75	New procedure.
1,2	HP-3.9-4	Radioactive Waste - Estimating Radioactivity in 55 Gal Drums	4-02-75	New procedure.

Table 10.5.4-1

SUMMARY OF
EMERGENCY PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS.1 & 2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	EP-2	Loss of Reactor Coolant	3-19-75	Amend to conform with DC 74-116.
1	EP-2	Loss of Reactor Coolant	4-18-75	Add hot leg recirc.
2	EP-2	Loss of Reactor Coolant	5-02-75	Change step at which bottled air is initiated.
1,2	EP-2	Loss of Reactor Coolant	6-13-75	To comply with single failure criteria in accordance with new ECCS operating procedure.
1,2	EP-2	Loss of Reactor Coolant	6-16-75	Modified to revise procedure for valves 1860 and 2860 A and B.
1,2	EP-3	Main Steam Rupture	5-02-75	Amend procedure following implementation of design change.
1,2	EP-6	Non-Recoverable Loss of Air	2-28-75	New procedure.

SUMMARY OF
MECHANICAL MAINTENANCE PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	MMP-C-RC-009	Disassembly, inspection and/or Repair & Re-assembly of RCP	1-28-75	Addition of shim removal/replacement to procedure.
1,2	MMP-C-RC-010	Primary Manway Removal and Reinstallation S/G	4-23-75	Add QA Hold Points.
1,2	MMP-C-RC-012	S/G Secondary Manway and/or Handhole Removal & Reinstallation	4-23-75	Add QA Hold Points.
1,2	MMP-C-RC-014	84" ID Personnel Air Locks for Reactor Containment	4-23-75	Add QA Hold Points.
1,2	MMP-C-RC-017	Corrective Maintenance for Piping Components	2-11-75	Insert QA Hold Points.
1,2	MMP-C-RC-017	Corrective Maintenance for Piping Components	6-03-75	Change designation to MMP-C-G-017 for more Universal use.
1,2	MMP-C-RC-019	Bergen-Patterson Hydraulic Snubbers Inspection & Repair	4-23-75	Add QA Hold Points.
1,2	MMP-C-RC-022	Rod Drive Chamfer Modification	5-27-75	New procedure.
1,2	MMP-C-RC-028	Flux Wire Thimble Retraction and Reinsertion	3-31-75	Rewrite procedure.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	MMP-C-RC-033	CRDM Ventilation & Missile Shield Removal & Reinstallation	3-31-75	Add QA Review section.
1,2	MMP-C-RC-034	Disassembly & Reassembly of Instrument Port	3-31-75	New procedure.
1,2	MMP-C-RC-035	Disassembly & Reassembly of Part Length Conoseals	3-31-75	New procedure.
1,2	MMP-C-RC-036	Removal & Reinstallation of Reactor Vessel Head Insulation	3-31-75	New procedure.
1,2	MMP-C-RC-037	Installation & Removal of Reactor Cavity Seal Ring	4-02-75	Add QA Engineer Review.
1,2	MMP-C-RC-038	Removal & Reinstallation of Reactor Vessel Studs	4-02-75	New procedure.
1,2	MMP-C-RC-038	Removal & Reinstallation of Reactor Vessel Studs	6-03-75	Correct typographical errors.
1,2	MMP-C-RC-039	Removal & Reinstallation of Upper Internals	4-02-75	New procedure.
1,2	MMP-C-RC-040	Installation & Removal of Head Lifting Rig	4-02-75	New procedure.
1	MMP-C-RC-041	Grouting of Steam Generator Restraint Supports	1-08-75	New procedure.
1	MMP-C-RC-042	Removal of Arc Strikes	1-08-75	New procedure.
1,2	MMP-C-RS-043	Repair of Recir. Spray Heat Exchangers	1-09-75	New procedure.

Table 10.5.6-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	MMP-C-RH-015	Residual Heat Pump Inspection	4-23-75	Add QA Hold Points.
1,2	MMP-C-G-001	Valves in General	4-23-75	Add QA Hold Points.
1,2	MMP-C-G-050	Field Repair of Valves to Meet Minimum Wall Thickness	4-29-75	New procedure.
1,2	MMP-C-1A-006	Removal, Internal Inspection Overhaul and/or Replacement of Containment Instrument Air Compressor	4-23-75	Add QA Hold Points.
1,2	MMP-C-MS-002	Inspection of a Main Steam Trip Valve	4-23-75	Add QA Hold Points.
1,2	MMP-C-EE-051	Corrective Maint. Procedure - Emergency Diesel Generator Engine	5-16-75	New procedure.
1,2	MMP-C-G-052	Procedure for Weld Test Ports	6-03-75	New procedure.

Table 10.5.6-1

SUMMARY OF
ELECTRICAL MAINTENANCE PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	EMP-C-EE-28	Removal from Service of Switchyard Bus 5&6 (34.5KV)	6-04-75	New procedure.
1,2	EMP-C-PE-21	Electrical Penetration Flange Seal Integrity Test	4-23-75	Replaces EMP-S-PE-02. New procedure.
1,2	EMP-C-PDC-09	Single Phase Static Inverters	5-02-75	Rewritten to replace EMP-C-PDC-01.
1,2	EMP-C-HT-20	Safety Related Heat Tracing Equipment	5-02-75	Rewritten to replace EMP-C-HT-01.
1,2	EMP-C-EPL-7	480 Volt Motor Control Circuits	5-02-75	Rewritten to replace EMP-C-PL-04.
1,2	EMP-C-EPL-12	Safety Related 480 Volt Motors	5-02-75	Rewritten to replace EMP-C-PL-04.
1,2	EMP-C-EPL-15	Corrective Maintenance Procedure for Safety Related Immersion Heaters	4-16-75	New procedure.
1,2	EMP-C-MOV-11	Safety Related MOV (Disconnect and Reconnect)	5-02-75	Rewritten to replace EMP-C-MOV-01.
1,2	EMP-C-MOV-18	Safety Related MOV (Troubleshooting.	5-02-75	Rewritten to replace EMP-C-MOV-01.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	EMP-C-MOV-19	Safety Related MOV (Testing)	5-02-75	Rewritten to replace EMP-C-HT-01.
1	EMP-C-EPH-01	Reactor Coolant Pump Motor 1-RC-P-1A	4-23-75	New procedure.
1	EMP-C-EPH-02	Reactor Coolant Pump Motor 1-RC-P-1B	4-23-75	New procedure.
1	EMP-C-EPH-03	Reactor Coolant Pump Motor 1-RC-P-1C	4-23-75	New procedure.
2	EMP-C-EPH-04	Reactor Coolant Pump Motor 2-RC-P-1A	4-23-75	New procedure.
2	EMP-C-EPH-05	Reactor Coolant Pump Motor 2-RC-P-1C	4-23-75	New procedure.
1,2	EMP-C-EPH-13	Safety Related 4160 Volt Motors	5-02-75	Rewritten to replace EMO-C-PH-02.
1,2	EMP-C-EPCR-08	Rod Drive Synchronous Alternator	4-29-75	New procedure.
1,2	EMP-C-EPDC-10	Safety Related Battery Chargers	5-02-75	New procedure.
1,2	EMP-C-EPCR-14	Disconnecting Reactor Head Control Rod Drive & Position Indicator System Cable	4-23-75	New procedure.
1,2	EMP-C-EPDC-16	Reconnecting Reactor Head Control Rod Drive & Position Indication System Cable	5-02-75	New procedure.
1,2	EMP-C-EPCR-17	Part Lenght Control Rod Drive Stator DC Coil Resistance and Insulation Resistance Test	4-23-75	New procedure.

Table 10.5.6-2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	EMP-C-EPCR-17	Part Length Control Rod Drive Stator DC Coil Resistance & Insulator Resistance Test	4-30-75	Modify in consonance with OP-4.5 and OP-4.6.
1,2	EMP-C-EPDC-22	Emergency Diesel Generator Chargers	5-02-75	New procedure.

Talbe 10.5.6-2

SUMMARY OF
INSTRUMENT MAINTENANCE PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	IMP-C-2FM-2	Replacing Incore Thermocouple	2-06-75	New procedure.
1,2	IMP-C-G-1	FOXBORO TYPE 13A D/P Pneumatic Flow Transmitter	6-23-75	New procedure.
1,2	IMP-C-G-2	Fischer & Porter P to I Converter Series 50 EW 1020	6-23-75	New procedure.
1,2	IMP-C-G-3	ITT Barton Differential Pressure Indicators	6-23-75	New procedure.
1,2	IMP-C-G-4	ITT Barton Electronic Differential Pressure Transmitters	6-23-75	New procedure.
1,2	IMP-C-G-5	Fischer & Porter D/P Transmitters	6-23-75	New procedure.
1,2	IMP-C-G-6	Fischer & Porter Pressure to Current Transmitters	6-23-75	New procedure.
1,2	IMP-C-G-7	Repair/Bench Testing Proc. for W Hagan MV/1 Amplifier	6-23-75	New procedure.
1,2	IMP-C-G-8	Repair/Bench Testing Proc. W Hagan Manual/Automatic Controller System	6-23-75	New procedure.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	IMP-C-G-9	Repair/Bench Testing Proc. for W Hagan Multiplier/Divider	6-23-75	New procedure.
1,2	IMP-C-G-10	Repair/Bench Testing Proc. for W Hagan Function Generator	6-23-75	New procedure.
1,2	IMP-C-G-11	Repair/Bench Testing Proc. for W Hagan Signal Isolator	6-23-75	New procedure.
1,2	IMP-C-G-12	Repair/Bench Testing Proc. for W Hagan Signal Summator	6-23-75	New procedure.
1,2	IMP-C-G-13	Repair/Bench Testing Proc. for W Hagan Leak/Lag Derivative Amplifier	6-23-75	New procedure.
1,2	IMP-C-G-14	Repair/Bench Testing Proc. for W Hagan Signal Comparator	6-23-75	New procedure.

Table 10.5.6-3

SUMMARY OF
OPERATING PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	OP-1A	Pre-Startup Checkoff List	1-02-75	Rewritten to eliminate repetitive data.
1	OP-1A	Pre-Startup Checkoff List	1-08-75	Delete repetitive data.
1	OP-1C	Estimated Rod Bank Positions After Shutdown or Trip	2-06-75	Amend curves for Cycle II.
1	OP-1C	Effective Rampdown Time Calculation for Xenon Worth	3-26-75	Amended for clarification of step 2.2 of Appendix B.
1	OP-1C	Estimated Rod Bank Positions After Shutdown or Trip	6-11-75	Provide procedure common to both units.
1,2	OP-1E	Containment Integrity Check Sheet	2-10-75	Addition of further instructions for checking valves.
1	OP-1F	Shutdown Margin Calculations	2-06-75	New curves for Cycle II.
1	OP-1F	Shutdown Margin Calculations	6-11-75	Provide procedure common to both units.
1,2	OP-1.1	Unit Start-Up	5-02-75	Add reference to completed PT-14.2.
2	OP-1.1	Unit Start-Up Operation RSD to 230°F	6-05-75	Add caution for N-20.
2	OP-1.2	Unit Start-Up Operation	6-06-75	Caution for N-20.
1	OP-1.3	Unit Start-Up Operation	1-17-75	Amend for 2235# pressure operations.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	OP-1.3	Unit Start-Up Operation 350/450 to HSD	1-22-75	Amend proc. to avert hydraulic shock to piping during and following ½P-7.1.
2	OP-1.3	Unit Start-Up Operation 350/450 to HSD	6-06-75	Change to 2335 spig.
1,2	OP-1.3	Unit Start-Up Operation 350/450 to HSD	6-25-75	Accomodate single failure criteria.
1,2	OP-1.4	Unit Start-Up Operation HAD to 2%	6-25-75	Accomodate single failure criteria.
1,2	OP-2.1	Unit Power Operation	4-18-75	Add minimum rate of power decrease.
1	OP-3	Unit Shutdown Operation	1-17-75	Amend for 2235# pressure operations.
2	OP-3	Unit Shutdown Operation	4-09-75	Replace master copy.
1	OP-3	Unit Shutdown Operation	5-02-75	Modified in accordance with DC 73-82.
2	OP-3	Unit Shutdown Operation	6-11-75	Conform with 2235 psig.
1,2	OP-3	Unit Shutdown Operation	6-26-75	Prevent transfer of water from RWST to loops.
1,2	OP-4 4.1-4.16	Refueling & Fuel Handling	3-19-75	Amended to conform to techniques developed during first refueling.
1,2	OP-4.0	Refueling & Fuel Handling	4-18-75	Add OP-4.17 to index.
1,2	OP-4.1	Controlling Procedure for Refueling	4-02-75	To assure Chemistry requirements met.
1,2	OP-4.1	Controlling Procedure for Refueling	4-11-75	Amend to conform to T.S.3.11.
1,2	OP-4.1	Controlling Procedure for Refueling	4-18-75	Indicate steps which may be done simultaneously.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	OP-4.5	P/L Control Rod Drive Shaft Handling Tool (Unlatched)	4-25-75	Delete Attachment #1.
1,2	OP-4.6	P/L Control Rod Drive Shaft Handling Tool (Latched)	4-25-75	Delete Attachment #1.
1,2	OP-4.9	Irradiated Sample Tool	4-09-75	Update specimem locations.
1,2	OP-4.17	Surveillance Sample Shipping Cask	6-02-75	Amend to allow procedure to be used for both Units 1 and 2 shipping cask.
2	OP-5.0	Reactor Coolant System	4-18-75	Add OP-5.8 to index.
1	OP-5.0	Reactor Coolant System	5-02-75	Add OP-5.8 to index.
2	OP-5.1	Reactor Coolant System Filling and Venting the RCS	6-05-75	New format.
1	OP-5.3	Reactor Coolant System Leak Test	1-17-75	Amend for 2235# pressure operations.
2	OP-5.3	Reactor Coolant System Leak Test	6-11-75	Conform with 2235 psig.
2	OP-5.4	Draining the RCS	4-09-75	Connect temporary indicator to 1-RC-104.
2	OP-5.4	Draining the RCS	4-18-75	Rewritten for clarity.
1	OP-5.4	Draining the RCS	5-02-75	Complete revision.
2	OP-5.7	Two Loop Operation	5-02-75	Revise procedure.
2	OP-5.8	Reactor Vessel Level Adjustment	4-18-75	New procedure.
1	OP-5.8	Reactor Vessel Level Adjustment	5-02-75	New procedure.

Table 10.5.7-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	OP-6	Emergency Diesel Generator	2-10-75	Insertion of additional(step syncroscope to off position.)
1	OP-7.1	Safety Injection	1-17-75	Amend for 2235# pressure operations.
1,2	OP-7.1	Safety Injection	1-22-75	Amend proc. to avert hydraulic shock to piping.
2	OP-7.1	Filling Reactor Refueling Cavity	4-09-75	To conform to OP-4 update.
1	OP-7.1	Filling Reactor Refueling Cavity	5-02-75	Amend to conform to OP-4.1
1,2	OP-7.1	Safety Injection	6-11-75	Clarify procedure.
1	OP-8.1	CVCS Placing the System in Service	5-16-75	Insert precaution on charging pump lube oil temperature. Change format.
1,2	OP-8.2	Demineralizer Operation	2-10-75	Change format.
1	OP-8.2	Fuel Pit Ion Exchanger Resin Change	4-02-75	Amended to improve procedure.
2	OP-8.2	Deborating Demineralizer 2-CH-1-3B Operation	4-02-75	Add new steps.
1,2	OP-8.4	Chemical Addition	2-10-75	Change format.
2	OP-8,10	Step by Step Fuel Movement Sequence and Maps	4-18-75	New procedure.
1,2	OP-10	Boron Recovery System	2-10-75	Increase operations covered during Boron Recovery Operations
1,2	OP-10.1	Gas Stripper Operation	2-10-75	Insert additional setpoints.
1,2	OP-10.1A	Valve Sheet Checkoff	2-10-75	New valve installed in system.

Table 10.5.7-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	OP-10.2	Boron Evaporator Operation	2-10-75	New valve installed in system.
1,2	OP-10.2A	Valve Sheet Checkoff	2-10-75	New valve installed in system.
1,2	OP-10.3	Boron Evaporator Bottoms Loop and Tank Operations	2-10-75	Include operation of loop and tank in same procedure.
1,2	OP-10.4	Release of Boron Recovery Test Tanks	2-10-75	New procedure.
1,2	OP-11	Primary Vent System	2-10-75	New format.
1,2	OP-11	Primary Vent System	5-02-75	Rewrite procedure.
1	OP-14	Residual Heat Removal System	3-05-75	Delete step.
1	OP-14	Residual Heat Removal System	3-26-75	Add reference to MOV-1701 interlock.
2	OP-14	Residual Heat Removal System	4-09-75	Add section for dewatering.
1	OP-14	Residual Heat Removal System	5-02-75	Add section for dewatering.
2	OP-14	Residual Heat Removal System	5-11-75	Amend to conform to DC 73-82.
2	OP-15	Reactor Cavity Purification System	4-09-75	Modify section on a skimmer pump operation.
1	OP-15	Reactor Cavity Purification System	5-02-75	Eliminate skimmer operation.
1,2	OP-17	Sump Drains System	2-10-75	New format.
1,2	OP-19	Containment Vacuum System	2-10-75	New format.
1	OP-19	Valve Sheet Checkoff	2-10-75	Addition of valves.

Table 10.5.7-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	OP-23.4	Post Accident Blower Operation	2-10-75	Add use of blowers for evacuation of reactor vessel head.
2	OP-23.4	Post Accident Blower Operation	4-18-75	Add precautionary note on reversing blower.
2	OP-23.4	Post Accident Blower Operation	4-23-75	Add precautionary section on reversing blower.
1	OP-23.4	Post Accident Blower Operation	5-02-75	Add new section.
1,2	OP-27	Heat Tracing	2-10-75	New format.
1,2	OP-28	Main Steam System	2-10-75	Reflect containment spray turbine no longer operational.
1,2	OP-30	Condensate System	2-10-75	New format.
2	OP-31.2	Steam Generator Auxiliary Feedwater System (valve lineup)	3-19-75	Update valve lineup following DC-73-108 and DC-73-122.
1,2	OP-31.2	Steam Generator Auxiliary Feedwater System	3-26-75	Change format.
1,2	OP-32	Steam Generator Blowdown System	2-10-75	New format.
1,2	OP-33	Chemical Feed System (Secondary)	2-10-75	New format.
1,2	OP-34	Secondary Drain System	2-10-75	New format.
1,2	OP-35	Auxiliary Steam System	2-10-75	New format.
1,2	OP-36	Air Ejectors	2-10-75	New format.
1,2	OP-37	Hogger Air Ejectors	2-10-75	New format.
1,2	OP-39	Gland Seal Steam System	2-10-75	New format.

Table 10.5.7-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	OP-40	EHC System	2-10-75	New format.
1,2	OP-41	Lube Oil System	2-10-75	New format.
1,2	OP-41.1	Main Lube Oil System	2-10-75	New format.
1,2	OP-41.2	Transfer of Lube Oil from Storage Tank to Reservoir Through Bowser Filtering System	2-10-75	New format.
1,2	OP-41.3	Transfer of Lube Oil from Reservoir to Storage Tank	2-10-75	New format.
2	OP-41.3	Transfer of Lube Oil from Reservoir to Storage Tank	5-02-75	Modify valve numbers.
1,2	OP-41.4	Bowser Filtering System	2-10-75	New format.
1,2	OP-41.5	Sharples Super-Centrifuge	2-10-75	New format.
1,2	OP-42	Hydrogen Seal Oil System	2-10-75	New format.
1,2	OP-43.6	Operating Procedure for H_2 Manifold (Generator)	3-19-75	New procedure.
1	OP-47.2	Regeneration of Demineralizer	3-26-75	Amended to insure quality water.
1,2	OP-48	Circulating Water	2-10-75	New format.
1,2	OP-48.1	Low Level Intake Traveling Water Screens & Wash Pumps	2-10-75	New format.
1,2	OP-48.2	Circulating Water System	2-10-75	New format.
1,2	OP-48.3	High Level Traveling Water Screens and Wash Pumps	2-10-75	New format.

Table 10.5.7-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	OP-48.3	Valve Sheet Checkoff	2-10-75	Valve use has changed.
1,2	OP-48.4	Discharge Tunnel Vacuum Priming System	2-10-75	New format.
1,2	OP-48.5	Station Vacuum Priming System	2-10-75	New format.
1,2	OP-48.6	Amertap Condenser Tube Cleaning System	2-10-75	New format.
1	OP-48.7	Intake Vacuum Priming System	2-10-75	New format.
1	OP-48.8	Trash Rake System	2-10-75	New format.
1	OP-48.8	Trash Rake System	5-02-75	Amend to reflect operational experience.
1,2	OP-49	Service Water System (Index)	5-09-75	New format.
1,2	OP-49.1	Service Water System	5-09-75	New format.
1,2	OP-49.2	Emergency Service Water System	5-09-75	New format.
1,2	OP-50	Bearing Cooling Water System	2-10-75	New format.
1	OP-51.2	Chilled Water System	5-09-75	New format.
1	OP-51.3	Chilled Component Cooling System	5-09-75	New format.
1,2	OP-53	Fuel Oil Storage & Transfer	2-10-75	New format.
1,2	OP-54	Gas Turbine Generators	2-10-75	New format.
1,2	OP-54.1	Gas Turbine Generator (Model W-191-GO	2-10-75	New format

Table 10.5.7-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	OP-54.2	Gas Turbine Generator (Model W-251-AA)	2-10-75	New format.
1,2	OP-56.2	Cold Shutdown to Hot Shutdown	3-19-75	Deleted. Incorporated into OP-1,2,3.
1,2	OP-56.3	Hot Shutdown to Power Operation	3-19-75	Deleted. Incorporated into OP-1,2,3.
1,2	OP-56.4	Power Operations to Hot Shutdown	3-19-75	Deleted. Incorporated into OP-1,2,3.
1,2	OP-56.5	Hog Shutdown to cold Shutdown	3-19-75	Deleted. Incorporated into OP-1,2,3.
1,2		Curve Book	1-17-75	Amend for 2235# pressure operations.
1		Curve Book	2-10-75	Insert cycle 2 curves.
2		Curve Book	2-10-75	Addition of new blended flow curve.
1		Curve Book	3-05-75	Add Rod Control worth.
1,2		Curve Book	4-02-75	Expand and update.
1		Control Rm. Curve "RCS Pressure vs. Temperature"	4-02-75	Replace existing curve.

Table 10.5.7-2

SUMMARY OF
MAINTENANCE OPERATING PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	MOP-5.18	Removal of Loop Fill Valve HCV-2556C for Maintenance	2-19-75	Amend reference NPSQAM vice ADM #36.
2	MOP-5.19	Return of Loop Fill Valve HCV-2556C after Maintenance	2-19-75	Amend reference NPSQAM vice ADM #36.
2	MOP-5.20	Return of Drain Valve HCV-2556C after Maintenance	2-19-75	Amend reference NPSQAM vice ADM #36.
2	MOP-5.21	Removal of Drain Valve HCV-2557C for Maintance	2-19-75	Amend reference NPSQAM vice ADM #36.
1,2	MOP-7.1	Removal of Containment Spray Pump 1-CS-P-1A (2-CS-P-1A0 from Service for Maintenance	2-19-75	New format.
1,2	MOP-7.2	Return of Containment Spray Pump 1-CS-P-1A (2-CS-P-1A) to Service after Maintenance	2-19-75	New format.
1	MOP-7.3	Removal of Containment Spray Pump 1-CS-P-1B from Service for Maintenance	2-19-75	New format.
1	MOP-7.4	Return of Containment Spray Pump 1-CS-P-1B to Service after Maintenance	2-19-75	New format.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	MOP-7.5	Removal of Containment Outside Recirculation Spray Pump 1-RS-P-2A from Service for Maint.	2-19-75	New format.
1	MOP-7.6	Return of Containment Outside Recirculation Spray Pump 1-RS-P-2A to Service after Maint.	2-19-75	New format.
1	MOP-7.7	Removal of Containment Outside Recirculation Spray Pump 1-RS-P-2B from Service for Maint.	2-19-75	New format.
1	MOP-7.8	Return of Containment Outside Recirculation Spray Pump 1-RS-P-2B to Service after Maint.	2-19-75	New format.
1	MOP-7.9	Isolating & Draining 10"-S1-6-153, 12"-S1-5-153 & 16"-S1-5-153 for Cross Connect Modification	2-19-75	New format.
2	MOP-7.9	Repairs of MOV-2867 A & B	2-19-75	New format.
1	MOP-7.10	Fill & Return 10"-S1-5-153, 12"-S1-5-153, 16"-S1-5-153 to Service after Cross Connect Modification	2-19-75	New format.
2	MOP-7.10	Return of MOV-2867 A & B after Maintenance	2-19-75	New format.
2	MOP-7.11	Isolating & Draining 10"-S1-206-153, 12"-S1-205-153, and 16"-S1-205-153.	2-19-75	New format.
1	MOP-7.12	Removing MOV-1860A from Service	2-10-75	New procedure.

Table 10.5.7-2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	MOP-7.12	Fill & Return 10"-S1-206-153, 12"-S1-205-153, 16"-S1-205-153 to Service after Cross Connect Modification	2-19-75	New format.
1	MOP-7.13	Removing MOV-1860B from Service	2-10-75	New procedure.
2	MOP-7.13	Removal of Containment Spray Pump 2-CS-P-1B from Service fro Maintenance	2-19-75	New format.
1	MOP-7.14	Returning MOV-1860A & B to Service	2-10-75	New procedure.
2	MOP-7.14	Returning of Containment Spray Pump 2-CS-P-1B to Service after Maintenance	2-19-75	New format.
2	MOP-7.15	Repair of 2-S1-109	2-19-75	New format.
2	MOP-7.16	Maintenance on MOV-2865C (2-S1-TK-1C)	2-19-75	New format.
2	MOP-7.17	Restore 2-S1-TK-1C to Normal after Maintenance	2-19-75	New format.
1,2	MOP-14.1	Hook-Up of Air Connection Needed to Oxygenate the Reactor Coolant System Prior to Refueling	3-19-75	New procedure.
1,2	MOP-14.2	Removal of Air Connection Used to Oxygenate the Reactor Coolant System Prior to Refueling.	3-19-75	New procedure.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	MOP-22.2	Relocating Liquid Waste Discharge Monitor (LW-RM-108)	2-19-75	Renumber procedure.
1,2	MOP-22.3	Returning LW-RM-108 to Service	2-19-75	Renumber procedure.
1,2	MOP-22.4	Chemical Cleaning Liquid Waste Evaporator	2-19-75	Renumber procedure.
1,2	MOP-28.1	Maintenance on Main Steam Line Trip Valves	2-19-75	New format.
2	MOP-28.2	Return of MS Trip Valves from Maintenance Conditions	2-19-75	New format.
1	MOP-28.8	840 PSIG Pressure Test of Steam Generator 1B Shell Side	2-19-75	Renumber procedure.
1	MOP-31.1	Removal of Auxiliary Feedwater System for Installation of Discharge Cross Connect	2-19-75	Change procedure number.
1	MOP-31.2	Return of Auxiliary Feedwater System After Installation of Discharge Cross Connect	2-19-75	Change procedure number.
1	MOP-31.3	Remove Auxiliary Feed System for Installation of Discharge Cross Connect in the Containment	2-19-75	Change procedure number.
1	MOP-31.4	Return of Auxiliary Feed System After Installation of Discharge Cross Connect in the Containment	2-19-75	Amend to reference NPSQAM.
1	MOP-31.6	Removing 1-FW-P-3A from Service for Installation of Suction Modification (DC-73-108)	2-19-75	Renumber procedure.

Table 10.5.7-2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	MOP-31.7	Return 1-FW-P-3A to Service After Suction Modification	2-19-75	Renumber procedure.
1	MOP-31.8	Remove 1-FW-P-3B from Service for Suction Modification	2-19-75	Renumber procedure.
1	MOP-31.9	Return 1-FW-P-3B to Service after Suction Modification	2-19-75	Renumber procedure.
1	MOP-31.10	Remove 1-FW-P-2 from Service for Suction Modification	2-19-75	Renumber procedure.
1	MOP-31.11	Return 1-FW-P-2 to Service after Suction Modification	2-19-75	Renumber procedure.
1	MOP-46.1	Containment Instrument Air System	2-19-75	Renumber procedure.
2	MOP-46.1	Isolating 2"-ACC-122 for Installation of MS Trip Valve Test Station	2-19-75	Renumber procedure.
1	MOP-46.2	Containment Instrument Air System	2-19-75	Renumber procedure.
2	MOP-46.2	Returning 2"-ACC-122 to Service	2-19-75	Renumber procedure.
1	MOP-46.3	Containment Instrument Air System	2-19-75	Renumber procedure.
2	MOP-46.3	Isolation of MS Trip Valves Test Stations for Relocation	2-19-75	New format.
1	MOP-46.4	Containment Instrument Air System	2-19-75	Renumber procedure.

Table 10.5.7-2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	MOP-46.6	Returning MS Trip Valve Test Stations to Normal	2-19-75	New format.
1	MOP-46.7	Remove "D" Condenser Waterbox	2-19-75	Amend to reference NPSQAM.
1	MOP-51.1	Removal of Component Cooling Water Heat Exchangers 1-CC-E-1A, 1B, 1C, 1D for Tube Leak Check	1-02-75	New procedure.
2	MOP-51.1	Removal of Charging Pump Service Water Pump 2-SW-P-10A for Maintenance	2-19-75	Renumber procedure.
1	MOP-51.2	Return of 1-SW-P-10A after Maintenance	2-19-75	Renumber procedure.
2	MOP-51.2	Return of 2-SW-P-10A after Maintenance	2-19-75	Renumber procedure.
1	MOP-51.3	Removal of Charging Pump Service Water Pump 1-SW-P-10B for Maintenance	2-19-75	Renumber procedure.
2	MOP-51.3	Removal of Charging Pump Service Water Pump 2-SW-P-10B for Maintenance	2-19-75	Renumber procedure.
1	MOP-51.4	Return of Charging Pump Service Water Pump 1-SW-P-10B after Maintenance	2-19-75	Renumber procedure.
2	MOP-51.4	Return of Charging Pump Service Water Pump 2-SW-P-10B after Maintenance	2-19-75	Renumber procedure.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	MOP-51.5	Removing 1-CD-P-1C from Service for Maintenance	2-19-75	New format.
1	MOP-51.6	Returning 1-CD-P-1C to Service after Maintenance	2-19-75	New format.
1	MOP-51.7	Removal of Charging Pump Service Water Pump 1-SW-P-10A for Maintenance	2-19-75	New format.

Table 10.5.7-2

SUMMARY OF
PERIODIC TEST PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	PT-1.1	NIS Trip Channel Prior to Start-Up	2-26-75	Prevent back logging computer during PT.
1,2	PT-1.1	NIS Trip Channel Prior to Start-Up	6-27-75	Overpower trip setpoint change.
1,2	PT-1.2	NIS Trip Channel Test During Power Operation	2-26-75	Prevent back logging computer during PT.
1	PT-2.1	Reactor Coolant Temperature	1-08-75	Amend for cycle #2 operation.
2	PT-2.1	Reactor Coolant Temperature	6-06-75	Conform to cycle #2 operation.
1,2	PT-2.1	Reactor Coolant Temperature	6-23-75	Clarify frequency of testing requirements.
1,2	PT-2.1A	Reactor Coolant Wide Range Temperature	6-23-75	Clarify frequency of testing requirements.
2	PT-2.1	Reactor Coolant Temperature	6-25-75	Change value of 100% ΔT.
1	PT-2.3	PZR Level L-1-459	1-08-75	Amend for cycle #2 operation.
2	PT-2.3	PZR Level	6-06-75	Conform to cycle #2 operation
1	PT-2.4	Pressurizer Pressure P1-455, 456, 457	1-08-75	Amend for cycle #2 operation.
2	PT-2.4	Pressurizer Pressure	6-06-75	Conform to cycle #2 operation.

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	PT-2.18	Accumulator Tank Level	6-06-75	Amend to reflect setpoint change 74-30.
1,2	PT-2.21	Intake Canal Level Calibration	6-23-75	New procedure.
1,2	PT-3	Incore TC/RTD Cross Calibration	4-02-75	Amend test temperature.
2	PT-4	Updating of Upper Pressurization Limits for Heatup and Cooldown	4-02-75	Update Curve Book.
1,2	PT-5	Analog Rod Position Instrumentation	2-26-75	Avoid redundant measurements.
1,2	PT-5.2	Analog Rod Position Instrumentation	4-02-75	New procedure.
1,2	PT-7	Control Rod Drop Test	2-12-75	Revise drop requirement for rods at variance with normal drop time.
1,2	PT-7A	Control Rod Drop Test	2-12-75	Revise drop requirement for rods at variance with normal drop time.
1,2	PT-7A	Control Rod Drop Test Supplement	6-06-75	Correct format numbering.
1,2	PT-8.1	Reactor Protection System Logic Test for Normal Operations	2-26-75	Amend to eliminate deviations encountered during past tests.
1,2	PT-8.2	Reactor Protection Logic	3-26-75	Eliminate requirements for calibration of channels prior to test.
1,2	PT-8.3A	Safety Injection Logic	4-02-75	Amend to control relays while testing.

Table 10.5.8-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	PT-8.3B	Safety Injection System Logic	3-26-75	Eliminate requirement for calibration of channels prior to test.
1	PT-8.4	Consequence Limiting Safeguard (Hi Train)	1-22-75	Provide for refueling commitment in accordance with Technical Specifications.
2	PT-8.4	Consequence Limiting Safeguard (Hi Train)	2-26-75	Change frequency of test.
1,2	PT-8.5	Consequence Limiting Safeguard (Hi-Hi Train)	2-19-75	Amend for circuit change.
1,2	PT-8.5	Consdquence Limiting Safeguard (Hi-Hi Train)	2-26-75	Re-arrange sequency of steps.
1,2	PT-8.5	Consequence Limiting Safeguard (Hi-Hi Train)	4-11-75	Change frequency of test.
1,2	PT-8.5A	Consequence Limiting Safeguard Functional Test (Hi-Hi)	4-11-75	Modify valve listings.
2	PT-8.5A	CLS Hi Hi 3/4 Matrix Check	4-30-75	Add addendum.
1,2	PT-12	Pressurizer Safety Valve Setpoint	4-11-75	Add acceptance criteria.
1,2	PT-15	Steam Generator Auxiliary Feedwater Pumps	4-02-75	Rewritten for clarity.
2	PT-16.2	Containment Penetration Local Leakage	4-11-75	Add electrical penetration data sheet.
2	PT-16.2	Containment Penetration Local Leakage	4-25-75	Amend procedure numbering for valve testing.
1,2	PT-16.2	Containment Penetration Local Leakage.	5-27-75	Update procedure/placed in new format.
1,2	PT-16.3	Containment Leakage Rate	2-26-75	Change frequency of test.

Table 10.5.8-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
2	PT-16.4	Containment Isolation Valve Leakage Test	5-16-75	Change format.
2	PT-18.2	Safety Injection System Test	4-18-75	Revise procedure.
1	PT-18.5	Hi Head SI Test and Flushing of Stainless Steel Piping	4-02-75	Modify for conditions above 2000 psig.
2	PT-18.5	Hi Head S1 Component Test & Flushing of Sensitized Steel piping.	6-06-75	Amend for installation of manual bypass switch for accumulator isolation valves.
1,2	PT-20.1	Fuel Handling System	3-19-75	Modified based upon experience of past refueling.
1	PT-20.2	Spent Fuel Pit Cooling and Purification System	2-26-75	Change flow control point.
1,2	PT-21	4KV Voltage and Frequency	5-08-75	Increase stated tolerance of relays.
2	PT-22.1	Emergency Diesel Generator Load Test	4-11-75	New procedure.
1	PT-22.4A	Diesel No. 1 Refueling Inspection	4-11-75	New procedure.
2	PT-22.4B	Diesel No. 2 Refueling Inspection	4-11-75	New procedure.
1,2	PT-22.4C	Diesel No. 3 Refueling Inspection	4-11-75	New procedure.
1,2	PT-23.5	Station Batteries 1A & 1B	4-11-75	Add precautions to prevent reversing polarity.
1	PT-24.2	High Pressure CO_2 System	3-31-75	Change frequency to semi-annual.
1	PT-24.2	High Pressure CO_2 System	5-30-75	Changes requested by NEPIA.
1	PT-24.3	Low Pressure CO_2 System	3-31-75	Change frequency to semi-annual.

Table 10.5.8-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	PT-24.4	Fire Protection System	3-31-75	New procedure.
1	PT-24.4	Fire Protection System	5-30-75	Changes requested by NEPIA.
1	PT-24.5	Fire Protection System - Smoke Detectors	3-31-75	New procedure.
1	PT-24.6	Fire Protection System - Halon 1301 System	3-31-75	New procedure.
1	PT-24.6	Fire Protection System - Halon 1301 System	5-30-75	Changes requested by NEPIA
1	PT-24.6A	Fire Protection System - Halon 1301 System	3-31-75	New procedure.
1	PT-24.7	Fire Protection - Deluge System	3-31-75	New procedure.
1,2	PT-24.7	Fire Protection - Deluge System	5-16-75	Insert changes requested by NEPIA.
1,2	PT-24.7	Fire Protection - Deluge System	6-23-75	Re-evaluated acceptance criteria.
2	PT-27	Heat Tracing System	2-26-75	Change current readings.
1,2	PT-28.4	Fz Surveillance Using the Computer	3-09-75	New procedure.
1,2	PT-29.1	Turbine Inlet Valves	4-02-75	Add steps to procedure.
2	PT-29.1A	Turbine Main Steam Stop and Governor Valve Tests	2-06-75	Change frequency of test.
1,2	PT-29.1A	Turbine Main Steam Stop and Governor Valve Tests	2-12-75	Delete procedure.
1	PT-31.2	Seismic Instrumentation Calibration	4-18-75	Revise to provide more complete test of seismic instrumentation.

Table 10.5.8-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	PT-32	HEPA and Charcoal Filter Tests	4-11-75	Consult (Westinghouse) Procedure included in body of test. (Consultant procedure simultaneously approved).
1,2	PT-32.1	HEPA & Charcoal Filter Tests	5-16-75	Change number form PT-32.
1,2	PT-32.2	Elemental Charcoal Efficiency Removal Test	5-16-75	New procedure.
1	PT-33	Control Rm Leakage Test	1-07-75	Change sequence of steps for conducting test.
1	PT-33	Control Rm Leakage Test	1-13-75	Rewritten to conform with Technical Specifications.
1	PT-35	Reactor Power Calibration	2-12-75	Amend to operate reactor on heat balance vice NI output in percent.
1,2	PT-36	Instrument Surveillance	2-06-75	Expand surveillance.
1,2	PT-36	Instrument Surveillance	6-23-75	Amend to agree with TSC-29.
1,2	PT-37.1	Electric Hydrogen Recombiner 2A	6-23-75	Provide more information on method of conduction test.
1,2	PT-38.1	Primary Coolant & Steam Generator Chemistry	4-02-75	Modify to include hydroxides in Chemistry.
1	PT-38.7	Chemistry Sampling - Ventilation Vent	4-02-75	Reflect actual flow rate.
1,2	PT-38.14	Reactor Cavity Liquid	2-26-75	Update procedure.
1,2	PT-38.14	Reactor Cavity Liquid	5-30-75	Addition of sampling frequency for clarity.
1	PT-38.17A	Chemical Sampling Station - Discharge No. 008.	3-13-75	New procedure.
1	PT-38.17A	Chemical Sampling Station - Discharge No. 008.	4-18-75	Insert initial conditions.

Table 10.5.8-1

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1	PT-38.17B	Chemical Sampling Station - Discharge No. 009	3-13-75	New procedure.
1	PT-38.17B	Chemical Sampling Station - Discharge No. 009	4-18-75	Insert initial conditions.
1	PT-38.18	Chemical Sampling Station - Discharge No. 201	3-13-75	New procedure.
1	PT-38.18	Chemical Sampling Station - Discharge No. 201	4-18-75	Add step to obtain heat rejection.
1,2	PT-38.19	Chemical Sampling Station - Discharge No. 001	3-13-75	New procedure.
1,2	PT-38.19	Chemistry Sampling Station - Discharge No. 001.	4-11-75	Clarify procedure.
1,2	PT-38.19A	Flash Evaporator Blowdown Flow Discharge No. 001	3-13-75	New procedure.
1,2	PT-42	Maximum Load Test	2-06-75	Delete SS, RSS, RWIP from data sheet.
1,2	PT-43	Pipe Hanger Inspection	2-06-75	Add steps to comply with ISI.
1,2	PT-43	Pipe Hanger Inspection	4-11-75	Establish revision requirement.
1,2	PT-45	Steam Generator Blowdown Excess Flow	4-11-75	New procedure.
1,2	PT-45	Steam Generator Blowdown	6-23-75	Change number to PT-2.22.

Table 10.5.8-1

SUMMARY OF
START-UP TEST PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	SU-70	Generator Trip From 100% Power	2-06-75	Amend to be generator trip vice plant trip.
2	SU-70	Generator Trip From 100% Power	4-02-75	Add acceptance criteria.

Table 10.5.9-1

SUMMARY OF
SPECIAL TEST PROCEDURE CHANGES
JANUARY THROUGH JUNE, 1975
SURRY POWER STATION
UNITS NOS. 1&2

UNIT	PROCEDURE NO.	TITLE	EFFECTIVE DATE OF CHANGE	DESCRIPTION OF CHANGE
1,2	ST-30	Discontinue Use of Pressurizer Pressure Transmitter Cubicle Temperature Control System	1-02-75	New procedure.
2	ST-33	Automatic Feedwater Bypass Control System Test for Cycle 2 Initial Start-Up	6-16-75	New procedure.

Table 10.5.10-1

10.6 UNIT 1 MAINTENANCE

The following is a summary of the maintenance performed during the reporting period.

10.6.1 Unit 1 Mechanical Maintenance

A summary of Unit 1 Mechanical Maintenance is tabulated in Table 10.6.1-1.

10.6.2 Unit 1 Electrical Maintenance

A summary of Unit 1 Electrical Maintenance is tablulated in Table 10.6.2-1.

10.6.3 Unit 1 Instrument Maintenance

A summary of Unit 1 Instrument Maintenance is tabulated in Table 10.6.3-1.

SURRY POWER STATION

MECHANICAL MAINTENANCE

JANUARY THROUGH JUNE, 1975

UNIT NO. 1

Table 10.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
10-18-74	Component Cooling Pump 1-CC-P-2A	Mechanical Seal Normal Use	None	Renewed Mechanical Seal MR-S1-002553	N/A	20 hours
11-1-74	Control Rod Drive Modification	None-Westinghouse ECR	None	Performed chamfer modification as per MMP-C-RC-022 MR-S1-002748	N/A	40 hours
11-6-74	Reactor Coolant System Instrument Conoseal	None-Cut seal weld for removal of head	None	Ground seal weld for refueling MR-S1-2790	Cold Shutdown	12 hours
11-9-74	Reactor Cavity filter 1-RL-F-1	None-Normal Use	None	Renewed filters MR-S1-2817	Cold Shutdown	2 hours
11-9-74	Incore Inst. thimbles	None	None	Pulled thimbles, installed seal table washers, & caps MR-S1-2852	Cold Shutdown	4 hours
11-15-74	Moisture Separators	Manway's gasket seatting surface	None	Machined manway cover gasket surfaces MR-S1-2177	Cold Shutdown	4 days
11-19-74	Steam Generator Seismic Restraint Concrete	Seismic Restraint frozen causing hairline cracks in concrete	None	Cracks were repaired by Adhesive Engineering Co. MR-S1-2726	Cold Shutdown	1 day
11-26-74	Steam Generators 1-RC-E-1A,B,C,	None-Westinghouse Modification	None	Installed perforated plates on swirl vane seats MR-S1-2995 & 2755	Cold Shutdown	25 days

Table 10.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
11-27-74	Bearing Cooling heat exchangers 1-BC-E-1A,B, C,	Erosion-Leaking tubes	None	Plugged (7) tubes in (A) Plugged (3) tubes in (B) Installed zinc plates in A,B,C repaired eroded portions and applied epoxy coating MR-S1-2872	Cold Shutdown	6 days
12-10-74	Main Steam Trip Valve TV-MS-101C	None-Completed change out of rockshaft	None	Renewed Rockshaft out of 410 stainless MR-S1-002978,002979 002980	N/A	12 days
12-13-74	Pressurizer Safety valves	None-Test	None	Removed valves, bench tested reinstalled MR-S1-3098	Cold Shutdown	69 hours
12-19-74	Steam Generators 1-RC-E-1A,B,C	None	None	Sludge lanced A,B,C S/G MR-S1-3065	Cold Shutdown	14 days
12-12-74	None-Return Valves NRV-MS 101,A,B,C,	None	None	Installed modified Piston Disc. Assy. MR-S1-3116	Cold Shutdown	8 days
12-25-74	Main Condensors 1-CS-S1A,B,C,D	None	None	Probologed tubes, fluoricine Dye Check & Plugged tubes MR-S1-3158,2468 & 3109	Cold Shutdown	5 days
1-9-75	Recirc. Spray Check Valves 1-RS-17 & 11	Cracked shafts excessive counter weights	None	Renewed Rockshafts, packing gaskets, modified counterweights MR-S1-3023	Cold Shutdown	3 days
1-9-75	Containment Spray Check Valves 1-CS-13 & 24	Cracked shafts excessive counter weights	None	Renewed rockshafts, packing gaskets, modified counterweights MR-S1-3226	Cold Shutdown	10 hours
1-11-75	Steam Generator Seismic Restraints 1-RC-E-1A,B,C,	Seismic restraints cracked	None	Installed new restraints as per Design Change 74-108 MR-S1-3117, 2698, 2699, 2931	Cold Shutdown	3 months
1-11-75	Cont. Inst. Air Compressors 1-1A-C-2A, B	None-Normal Wear	None	Overhauled compressors MR=S1-2145, 2905	Cold Shutdown	28 hours

Table 10.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
1-11-75	Component Cooling heat exchanger 1-CC-E-1C	Erosion-Tube leak	None	Probologed heat exch. and plugged (41) tubes MR-S1-3148	Cold Shutdown	21 days
1-17-75	Recirc. Spray Valve MOV-RS-155A & B	Leaks by seat	None	Repaired seats & discs MR-S1-2962	Cold Shutdown	17 days
1-17-75	CVCS System FCV-1160	Erosion	None	Renewed stem plug and cage assy. MR-S1-2857	Cold Shutdown	24 hours
1-17-75	Safety Injection MOV-1860A,B,	Valve not sealing properly	None	Lapped & Blued seats MR-S1-002963	Refueling Shutdown	32 hours
1-17-75	Reactor Refueling	None	None	Refueled #1 Unit as per OP-4 from 10-31-74 to 1-17-75 MR-S1-002747	Refueling Shutdown	
1-18-75	Reactor Coolant Pump 1-RC-P-1A,B,C	None - Preventative Maintenance	None	Modified #3 seal ring clamps inspected and replaced #3 seal on 1-RC-P-1C MR-S1-002763	Refueling Shutdown	30 days
1-19-75	Steam Generator 1-RC-E-1A,B,C	Tube Leak 1A Eddy Current Inspection	None	Plugged tubes with over 50% wastage. After E.C. Inspection MR-S1-002563 & 3330	Refueling Shutdown	300 hours
1-20-75	Residual Heat Valve 1-RH-34	Crack in heat affected zone.	None	Ground out & rewelded MR-S1-3224	Intermediate shutdown	10 hours
1-21-75	Containment Inst. Air Compressor 1-1A-C-2A	Valves and piston rings	None	Renewed one discharge valve and renewed piston rings MR-S1-3357	N/A	10 hours
1-25-75	Safety Injection Check Valves 1-S1-79 82,85,88,91,94,109, 130,147,242,243	Gasket-Cyclic Stress	None	Renewed gaskets MR-S1-003391	N/A	200 hours

Table 10.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
1-27-75	Component Cooling heat exchanger 1-CC-E-1D	None-Probolog Wall thickness	None	Probologed and plugged 60 tubes MR-S1-3256	N/A	15 days
2-1-75	Reactor Coolant Pump 1-RC-P-1C	#3 Seal not seating	None	Removed shims as per W Instructions MR-S1-3451	N/A	3 hours
2-2-75	Containment Inst. Air Compressor 1-1A-C-2A	Crankshaft	None	Installed spare compressor MR-S1-3452	N/A	6 hours
2-9-75	Containment Inst. Air compressor 1-1A-C-2A	Crankshaft	None	Installed spare air compressor MR-S1-3531, 3445	N/A	16 hours
3-10-75	Containment Vacuum Pump 1-CV-P-1A	None-Normal wear	None	Renewed with rebuilt pump MR-S1-3759	N/A	2½ hours
3-10-75	Containment Vacuum Pump 1-CV-P-1B	None-Normal wear	None	Renewed with rebuilt pump MR-S1-3758	N/A	2½ hours
4-2-75	Inst. Air compressors 1-1A-C-1	None-Annual PM	None	Performed PM MR-S1-003896	N/A	14 hours
4-2-75	#1 Turbine	Annual inspection	None	Performed annual inspection #1 Turbine and necessary repairs MR-S1-002741	Refueling Shutdown	
4-22-75	Turbine Governor Valves	None-Design Change	None	Replaced Governor Valve spring retainer bolts and made modifications as per DC-75-13	Cold Shutdown MR-S1-004005	10 hours
4-22-75	Component Cooling Pump 1-CC-P-2A	Mechanical Seal	None	Replaced mechanical seal	Cold Shutdown	8 hours
4-24-75	Chemical and Volume Control Valve HCV-1310A	Gasket	None	Renewed bonnet & cage gaskets MR-S1-004032	Cold Shutdown	10¼ hours

Table 10.6-1.1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-01-75	Pressurizer Surge Tank	Unit #1 trip.	None.	Renewed rutpure disc. MR-S1-4091	Hot shutdown.	12 hours
5-20-75	Containment Spray Valve MOV-CS-102B	Unknown.	None.	Inspected valve, cleaned and reassembled, test satisfactory. MR-S1-4200	N/A	2 hours
5-23-75	Nitrogen Gas System 1-S1-221	Improper use of valve wrench.	None.	Replaced valve. MR-S1-4121	N/A	2 hours
5-23-75	Charging Pump Component Cooling Pump 1-CC-P-2A	None - mechanical seal, normal.	None.	Replaced mechanical seal. MR-S1-4215.	N/A	8 hours
6-03-75	Containment Vacuum Pump 1-CV-P-1A	Vanes & bearings.	None.	Installed new gast pump.	N/A	8 hours
6-24-75	Component Cooling 1-CC-E-1A	None, preventative.	None.	Performed eddy current testing & plugged 40 tubes. MR-S1-4379.	N/A	12 hours
6-25-75	Residual Heat Removal 1-RH-MOV-1700	Packing gland vibrated & packing blew.	None.	Replaced all packing. MR-S1-4422.	Reactor at cold shutdown.	21 hours

SURRY POWER STATION
UNIT NO. 1
ELECTRICAL MAINTENANCE
JANUARY THROUGH JUNE, 1975

Table 10.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
1-02-75	1-RCP-1C	Reinstallation of Surry "C" motor.	None.	Set motor, complete assembly and tested. RWP-74-SWP-3.	Reactor at cold shutdown.	75 Hrs.
1-02-75	FWP-1A1, 1A2	Annual.	None.	Replaced bearings, reassembled motor, bridge & megger, P.I. Curve. Test run, all normal SWP-3.	Reactor at cold shutdown.	62 Hrs.
1-02-75	"C" Recirc. Fan	Annual.	None.	Repaired base and installed motor.	Reactor at cold shutdown.	5 Hrs.
1-03-75	#1 Emergency Generator	Low oil temp. alarm.	None.	No trouble found. Trouble in temperature & pressure switch. Referred to Instrument Shop.	Reactor at cold shutdown.	3 Hrs.
1-04-75	Penetrations	Low nitrogen pressure.	None.	Filled to normal levels. MR-S1-2984, 2920, 3177.	Reactor at cold shutdown.	2 Hrs.
1-07-75	1-RCP-1B	Annual	None.		Reactor at cold shutdown.	15 Days
1-08-75	1-BR-P-1B	Operation Dept. request.	None.	Jumpered level switch.	Reactor at cold shutdown.	2 Hrs.
1-13-75	MOV-1590, 1591, 1592 1593, 1594	Annual.	None.	Bridge, megger & load checks. EMP-C-MOV-01.	Reactor at cold shutdown.	3 Hrs.
1-14-75	Containment Air Recirc. Fan	Annual.	None.	Bridge & megger. All normal.	Reactor at cold shutdown.	1 Hr.

Table 10.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
1-14-75	Motor Generators 1 & 2	Annual.	None.	Balanced both units.	Reactor at cold shutdown.	10 Hrs.
1-16-75	MOV-CS-101 A,B,C,D	Annual.	None.	Bridge & megger, and load test.	Reactor at cold shutdown.	5 Hrs.
1-16-75	1-MOV-NRV-101A	Testing.	None.	Bridge, megger & load test. All normal.	Reactor at cold shutdown. EMP-C-MOV-01	1 Hr.
1-17-75	BR-P-6	Motor zero ground.	None.	Removed motor & prepared to install motor.	Reactor at cold shutdown.	7 Hrs.
1-17-75	TV-CV-150 A,B	Not operating.	None.	150A, adjusted limit switch, 150B, cut in air.	Reactor at cold shutdown.	1 Hr.
1-17-75	MOV-SW-102A	Motor wet.	None.	Assemble, test & load check. MR-S1-3303.	Reactor at cold shutdown.	2 Hrs.
1-20-75	MOV-FW-151D	Mechanical Dept. request.	None.	Disconnected, reconnected, test and load test. MR-S1-3395	Reactor at cold shutdown. EMP-C-MOV-01 75-SWP-4	7½ Hrs.
1-27-75	1-FW-P-4A, 4B	Bearing noisy.	None.	No trouble found. MR-Si-3219.	Reactor at cold shutodown.	1½ Hrs.
1-27-75	Heat tracing.	None.	None.	Tagged to Mech. Dept. MR-S1-2663	Reactor at cold shutdown.	1 Hr.
1-27-75	1-CS-P-3	Motor trips on overload.	None.	No trouble found. MR-S1-3358.	Reactor at cold shutdown.	½ Hr.
1-31-75	RIS Cab #1	Loss of power.	None.	Replaced light bulb. MR-S1-3104.	Reactor at cold shutdown.	2 Hrs.
1-31-75	Instrument Air Compressor 1-1A-C-1	Bad coil.	Compressor not running.	Replaced coil.	Reactor at cold shutdown.	2 Hrs.
2-03-75	1-CH-P-1C	Annual.	None.	Removed motor, disassembled, clean, assemble, bridge and megger. MR-S1-1042.	RWP-1 EMP-S-20	27 Hrs.
2-07-75	Penetration E-16 & 17	Low nitrogen pressure.	None.	Pressurized to normal levels. MR-S1-3523.	N/A	½ Hr.

Table 10.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
2-14-75	1-CH-P-1B	Inspection.	None.	Disassembled motor, inspected assembled and tested. MR-S1-3575	EMP-S-20.	32 Hrs.
2-18-75	Trash Rake Hoist - Low Level Intake	Motor defective.	None.	Installed repaired motor.	N/A	6 Hrs.
2-18-75	1-SW-P-2A	Inspection.	None.	Replaced thrust bearing, cleaned, assembled & tested.	N/A	7 Hrs.
2-19-75	Pressurizer Heater Fan Motor	Open windings.	None.	Ordered motor.	N/A	2 Hrs.
2-19-75	Heat Tracing	PT-27	None.	Complete.	N/A 75-SWP-2	3 Hrs.
3-03-75	1-CC-P-1A	Annual maintenance.	None.	Tagged & disconnected, disassembled, cleaned.	None.	31 Hrs.
3-03-75	SW-P-10A	Motor will not run in auto.	None.	All test normal.	None.	1 Hr.
3-12-75	#1 Emergency Diesel	Fast start light will not reset.	None.	All normal, no trouble found. MR-S1-3039	None.	3 Hrs.
3-13-75	1-FW-P-3A, 3B	Testing	None.	All test normal.	None.	2 Hrs.
3-13-75	1-RS-P-2B	Alarm condition during operation.	None.	Adjust vibration switch. MR-S1-2832	75-SWP-10.	2 Hrs.
3-13-75	1-CS-P-1A,B	Testing.	None.	Bridge & megger, all test normal	None.	4 Hrs.
3-20-75	TV-SS-102B	Micro switch mounting loose.	Valve will not close.	Adjusted switch & tightened.	None.	2 Hrs.
3-20-75	#1 Emergency Diesel Batteries	Water low.	None.	Added water to normal levels.	None.	1 Hr.

Table 10.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
3-26-75	1-AS-P-1A	Reconnect motor.	None.	Reconnected motor and tested, all normal.	None.	3 Hrs.
3-26-75	1-AS-P-1B	Level switch defective.	Will not run in auto.	Replaced level switch.	None.	1 Hr.
4-02-75	1-CS-P-1A	Aux. contacts on 480 volt breaker defective.	MOV-CS-101A will not close.	Replaced Aux. contacts. MR-S1-3901	None.	3 Hrs.
4-03-75	1-VS-E-4A	Condenser leak.	Air conditioner will not operate.	Assist B & Z	None.	1½ Hrs.
4-03-75	1-VS-4-C	Solenoid valve leaks.	Unit will not run.	Repaired valve and charged system.	None.	1½ Hrs.
4-09-75	1-LW-P-6B	No discharge pressure.	None.	Meggered and bridged. Referred to Mech. Dept.	None.	2½ Hrs.
4-09-75	1-LW-EH-4	Heater burned open.	None.	Heater on order.	None.	7 Hrs.
4-25-75	FCV-FW-150B	Limit switch assembly loose.	None.	Replaced broken bolt and remounted switch assembly. MR-S1-4062	None.	1½ Hrs.
4-22-75	1-RC-P-1B	Low lube oil alarm in.	None.	Added ½ gallon IND #21 oil.	None.	1 Hr.
4-23-75	1-RCP-1C	Breaker trip.	None.	Breaker tripped due to low coolant temp. Bridged and meggered, satisfactory.	None.	1 Hr.
4-23-75	1-FW-151 Valves	Routine check.	None.	Cycled and load checked all FW valves.	None.	1 Hr.
5-01-75	1-VS-E-4B	TH1 and RT Thermostat contacts open.	None.	Cleaned & tightened terminals.	None.	2 Hrs.
5-09-75	1-SW-P-2B	Motor windings open and grounded.	None.	Replaced motor with spare.	None.	3½ Hrs.

Table 10.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-13-75	1-VS-F-1C	Control transformer windings open.	None.	Replaced transformer S1-4182.	None.	1 Hr.
5-15-75	1-CS-MR-1A	Burned control transformer.	None.	Replaced transformer.	None.	1 Hr.
5-16-75	1-VS-1B	Burned control transformer.	None.	Replaced transformer. SL-4383	None.	1 Hr.
5-22-75	1-GW-F-1A	Motor grounded.	None.	Replaced motor.	None.	3 Hrs.
6-09-75	1-1A-C-1	On-Off-Auto Switch	None.	Cleaned contact cycled.	None.	1 Hr.
6-09-75	1-VS-P-1A	Elect. tests.	None.	Bridged & meggered.	None.	1½ HRs
6-14-75	Fire System	Alarm.	None.	Investigate alarm.	None.	1½ Hrs
6-19-75	1-VS-40A	Noisy bearing.	None.	Found noise level to be normal.	None.	1½ Hrs.
6-19-75	1-VS-E-4A	Tripped.	None.	Adjusted Thermostat from 45° to 41° and reset.	None.	2 Hrs.
6-19-75	1-VS-47	Bad bearings.	None.	Replaced both bearings.	None.	5 Hrs.
6-23-75	Halon 1301 System	PT.	None.	Performed PT-24.6A.	None.	4 Hrs.
6-23-75	1-CS-MR-1A	Coil.	None.	Bypass solenoid coil open. Ordered new one.	None.	2 Hrs.

SURRY POWER STATION

INSTRUMENTATION & CONTROLS

JANUARY THROUGH JUNE, 1975

UNIT NO. 1

Table 10.6.3-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
2-07-75	L-461 Pressurizer Level Transmitter	Electronic zero and span shift.	The control room indication was 3% higher than redundant channels	Checked strain gauge for proper resistance, satisfactory, recalibrated transmitter, returned to service.	Placed channel in defeat on control board. Placed channel in test, used approved procedures. Redundant channels in service & normal.	4 hours
2-14-75	Pressurizer Pressure Comparator PC-1-457C	Electronic component failure.	Comparator would have tripped 7.1% in the non-conservative direction, at 1818 psig instead of 1875 psig.	Replaced comparator with spare module calibrated chacked for proper operation, returned to service.	Placed channel in test, used approved procedures. Redundant channels in service and normal.	1 hour
2-15-75	OPOT Channel 1 Low Level Amplifier TM-1-412H	Electronic component failure. Max output was 1.5V rather than expected 5.0V, but module was variable between 1 and 1.5V.	Channel 1 OPOT protection was inoperable and had to be placed in test. Failure in another channel would not have caused a reactor trip.	Replaced low level amplifier with spare module, calibrated, checked for proper operation & returned channel to operation. Returned bad module to Inst. Shop for analysis and repair.	Placed channel in test. Used approved procedures. Redundant channels in service and normal.	2 hours
2-19-75	OPOT Channel 1 Protection Low Level Amplifier TM-1-412H	Electronic component failure would not respond to change in input resistance.	Channel 1 OPOT protection was inoperable and had to be placed in test. Failure in another channel would not have caused a reactor trip.	Replaced low level amplifier with spare module, calibrated, checked for proper operation and returned channel to normal. Returned bad module to Inst. Dept for analysis and repair.	Placed channel in test. Used approved procedures. Redundant channels in service and normal.	2 hours
4-08-75	Containment Pressure Comparator PC-LM-100C3 Protection Channel II	Electronic drift causing eratic trip.	No adverse affect on safe operation, as the remaining three channels were in service and performing normally.	Removed comparator, replaced with a spare unit. Calibrated and returned to service.	Used approved procedures. Placed channel in test. Performed PT-2.11 following repair.	1 hour

Table 10.6.3-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-13-75	Containment Pressure Comparator PS-LM-100 B1 Channel 1 Protection	Electronic component failure resulting in no comparator dead-band.	Comparator output No. 1 tripped and reset at the same point ≈ 22.3 PSIA. Normal trip point is 23 PSIA.	Replaced comparator with spare module. Calibrated & returned to service.	Channel in test, used approved procedures. Redundant channels in service and normal.	½ hour
6-03-75	Reactor Coolant Temp. OPOT Setpoint NM-1-432B Delta Flux Function Generator	Electronic drift.	Setpoint was out of spec. in the conservative direction except at the 50% Δ flux (max. flux lower) setpoint which was 20 MV unconservative resulting in a 38 MV unconservative setpoint on over power trip.	Calibrated function generator, checked for proper operation and returned to service.	Used approved procedure, channel in test redundant channels in service and operating properly.	2 hours
6-16-75	Steam Generator Level LT-1-475 Failed Low	Loop power supply failure.	Low level partial trip signal initiated.	Replaced power supply with spare unit.	Used approved procedures. Placed channel in test, redundant channels in service & operating properly	1 hour

10.7 RESULTS OF SURVEILLANCE TESTS

The majority of periodic test results for this reporting period were satisfactory; however, the following problems were noted:

JANUARY

a) PT-15 - Steam Generator Aux. Feedwater Pumps, 1-4-75

An abnormal noise was detected in the motors for the motor driven auxiliary feedwater booster pumps (1-FW-P-4A,B). The noise was attributed to bad bearings. These bearings were greased, and the test was performed again on 1-30-75. No abnormal noise was noted.

b) PT-17.1 - Containment Spray, 1-03-75.

The periodic test was not performed during the month of January as required by Tech. Spec. Sec. 4.0 because system was tagged for maintenance. The test was performed satisfactorily on 2-06-75.

c) PT-17.2 - Containment Inside Recirculation Spray Pumps, 2-06-75

High amp readings were detected on 1-RS-P-1B. This is a reoccurring problem on both spray pumps and can be attributed to water trapped in the pump casing. The test was otherwise satisfactory.

d) PT-18.1 - Lo Head SI Test and Flushing of Stainless Steel Piping, 1-01-75.

The test was not performed on the monthly schedule as required by Technical Specification Sec. 4.0 due to the system being tagged for maintenance. The test was performed satisfactorily on 1-31-75.

e) PT-18.5 - Hi Head SI Test and Flushing of Stainless Steel Piping, 1-18-75.

The periodic test was not performed on the monthly schedule as required by Tech. Spec. Sec. 4.0. Following maintenance, the test was performed satisfactorily on 2-01-75.

f) PT-24.1 - Fire Protection Water Pump

1) 1-02-75 - The Diesel pump failed to start due to a dead battery. The test was satisfactorily completed the following day after the battery was charged.

2) 1-09-75 - The motor driven fire pump failed to start at the proper pressure. The pressure gage was replaced and the periodic test was performed satisfactorily.

3) 1-16-75 - The diesel engine ran at a speed slower than the accepted limit. The engines governor was adjusted to correct the deficiency.

g) PT-34 - Electircal Penetration Leakage Test

On the dates listed below, the following penetrations indicated a loss of pressure. In each case, penetrations were recharged to correct pressure.

1-02-75 A-7, E-16, E-17

1-23-75 A-3, A-7, B-18, C-18, D-2, D-4, E-1

1-31-75 A-7, B-18, C-18, D-2, D-4, D-16, E-1

FEBRUARY

a) PT-24 - Pressurizer Pressure & Cubicle Temperature, 2-14-75

Setpoint for Pressurizer Comparator PC-1-457C drifted low out of spec. The comparator was replaced, calibrated and tested satisfactorily.

b) PT-26.1 - Radiation Monitor Equipment Check, 2-03-75

Radiation monitor RM-RMS-162 failed to respond satisfactorily to the test source. The monitor was repaired and returned to service on 2-08-75.

c) PT-26.2 - Radiation Monitor Equipment Test, 2-18-75

Radiation monitor RM-VG-104 failed in the "calibrate" mode. The monitor was promptly repaired.

d) PT-26.5 - Radiation Monitoring Equipment Calibration, 2-28-75

Radiation monitors (mod E-130-6 serial no. 3800 and model RM-14 serial no. 354) needed repair. Following repair they were calibrated and returned to service.

e) PT-34 - Electrical Penetration Leakage Test

On the dates listed below, the following penetration indicated a loss of pressure. In each case, penetrations were recharged to correct pressure.

2-06-75 E-16, E-17

2-20-75 D-2, E-16, E-17

f) PT-36 - Instrument Test, 2-06-75

Deviation in pressurizer level indication was greater than the specified limits. The indicators were recalibrated and tested satisfactorily.

MARCH

a) PT-8.1 - Reactor Protection Logic, 3-03-75

Relay 27-2XA in the reactor protection logic malfunctioned. The relay was replaced and tested satisfactorily.

b) PT-18.4 - Boron Injection Tank, 3-31-75

Test was not performed as required by Tech. Specifications Sec. 4.1 due to a scheduling error. Test was performed immediately on 4-03-75 following notification of error. Tests results were satisfactory.

c) PT-26.1 - Radiation Equipment Check, 3-21-75 through 3-31-75

Radiation monitor RM-VG-109 was out of service. A maintenance order has been submitted to correct the deficiency.

d) PT-29.1 - Turbine Inlet Valve Test, 3-30-75

Governor valves GV-2 and GV-3 failed to respond when tested. Maintenance was performed and the valves were tested satisfactorily on 4-01-75.

e) PT-34 - Electrical Penetration Leakage Test

On the dates listed below the following penetrations indicated a loss of pressure. In each case, penetrations were recharged to correct pressure.

3-06-75 B-15, B-18, E-17

3-20-75 D-2, E-16

3-27-75 E-17

APRIL

a) PT-2.11 - Reactor Containment Pressure (CLS) 4-08-75

Pressure comparator PS-LM-100C3 failed to trip properly. The comparator was replaced, calibrated, and tested satisfactorily.

b) PT-8.4 - Consequence Limiting Safeguards (Hi Train), 4-28-75

"Open door" annunciator ON for Train A protection racks failed to clear when doors were closed. A maintenance order has been submitted.

c) PT-15 - Steam Generator Auxiliary Feedwater Pumps, 4-4-75

A new pressure gage was installed on 1-FW-P-3A after failure of the old gage.

d) PT-17.2 - Containment Inside Recirculation Spray Pumps

The test was not performed as required by Technical Specification 4.1 due to a liquid waste problem. Sump water level was too high, and the test could not be performed without a containment spray.

e) PT-26.1 - Radiation Monitor Equipment Check

1) 4-19-75 #1 Recirculation Spray monitor, RM-SW-17 failed. It was repaired and tested satisfactorily on the same day.

2) 4-1-75 through 4-3-75. Ventilation Vent Monitor, RM-VG-109 failed to perform satisfactory. It was repaired and put back in service on 4-4-75.

f) PT-29.1 - Turbine Inlet Valve Test, 4-05-75

Governor and stop valves (GV2-SV2 and GV3-SV3) would not function in the test mode. #1 right reheat and intercept valves (1RR-1IR) would not close. Faulty limit switches were repaired and the periodic test was performed satisfactorily on the following day.

g) PT-34 - Electrical Penetration Leak Test

On the dates listed below, the following penetration indicated a loss of pressure. In each case, penetrations were recharged to correct pressure.

4-02-75 B-18, E-17

4-17-75 A-2, D-2, D-4, E-16, E-17

4-24-75 A-1, B-18, D-4

h) PT-36 - Instrument Surveillance - 4-13-75

Loop A cold leg temperature recorder, TR-1-410, failed to function properly. The recorder was repaired and returned to service on 4-15-75.

MAY

a) PT-2.11 - Reactor Containment Pressure (CLS), 5-14-75

Pressure comparator PS-LM-100B1 was replaced after output #1 was found to have a zero deadband. The new comparator was calibrated and tested satisfactorily.

b) PT-6 - Control Rod Assembly Partial Movement, 5-8-75

Control rod B-10 in Bank A failed to insert the required 18 ± 6 steps. Repairs were made and Bank A was retested satisfactorily on 5-10-75.

c) PT-15 - Steam Generator Auxiliary Feedwater Pump, 5-4-75

An oil leak was discovered around the shaft of the steam driven aux. feed pump. A maintenance order was submitted to correct the problem.

d) PT-17.2 - Containment Inside Recirculation Spray Pumps, 5-03-75

The periodic test was not conducted within the time period required by Tech. Spec. because of water in the containment sump. The sump was subsequently drained and the test was conducted satisfactorily on 5-16-75.

e) PT-34 - Electrical Penetration Leak Test

5-01-75 E-16, E-17

5-08-75 E-16

5-15-75 D-2, D-4, E-1, E-16, E-17

5-22-75 D-4, D-16

5-29-75 D-16

JUNE

a) PT-2.1 - Reactor Coolant Temperature, 6-04-75

Channel III Overpower setpoint was found to be out of calibration. Channel was recalibrated and returned to service and performed satisfactorily.

b) PT-8.1 - Reactor Protection Logic, 6-30-75.

Performance of the test revealed the faulty operation of relay 27-2-XB. Relay was binding half-way out. Following repairs relay was returned to service and performed satisfactorily.

c) PT-34 - Electrical Penetration Leak Test

On the dates listed below, the following penetrations indicated a loss of pressure. In each case, penetrations were recharged to the correct pressure.

6-05-75 D-2, E-15, E-16

6-19-75 E-17

6-28-75 E-16, E-17

d) PT-40 - Periodic Test Instrumentation Calibration, 6-12-75

Pressure gage P1-CH-1152, Charging Pump (1-CH-P-1B) Discharge Pressure, was not accurate. A new gage was ordered.

10.8 PERIODIC CONTAINMENT LEAKAGE RATE TESTS

The results of Unit 1 periodic containment leakage rate tests completed during the reporting period are as follows:

1)	Containment Isolation Valve Leakage, (PT-16.4), 1-18-75	=	129.87 SCFH
2)	Containment Penetration Local Leakage, (PT-16.2), 1-17-74, 3-14-74	=	0.48 SCFH
3)	Containment Personnel Air Lock Leakage (PT-16.5), 1-17-75, 4-4-75	=	0.0 SCFH
4)	Equipment Hatch Local Leakage (PT-16.6), 1-17-75	=	0.0 SCFH
	Total Leakage (Type B & C Tests)	=	130.35 SCFH

Combined leakage for Type B and C tests was below 0.06% of the containment volume/24 hours as required by Technical Specification 4.4.

10.9 CHANGES, TESTS AND EXPERIMENTS REQUIRING AUTHORIZATION FROM THE ATOMIC ENERGY COMMISSION

10.9.1 Technical Specification Changes

Changes made to the Technical Specifications, Units Nos. 1 and 2, Surry Power Station during the reporting period are summarized in Table 10.9.1-1. These changes were issued by the U.S. Atomic Energy Commission pursuant to Section 50.59, Title 10, Code of Federal Regulations.

10.9.2 Test or Experiments

There were no tests or experiments conducted on Unit No. 1 during the reporting period which required approval of the U.S. Atomic Energy Commission.

10.9.3 Facility Design Changes

There were no facility design changes implemented during the reporting period which required authorization from the U.S. Atomic Energy Commission.

SUMMARY OF
TECHNICAL SPECIFICATION CHANGES
SURRY POWER STATION
UNIT NOS. 1 & 2
JANUARY THROUGH JULY, 1975

CHANGE NO.	T.S. NO.	DATE ISSUED	TITLE
18	3.11	1-05-75	Effluent Release
19	2.1	12-27-74	Safety Limit, Reactor Core
	2.3	12-27-74	Limiting Safety System Settings, Protective Instrumentation
	3.1	12-27-74	Limiting Conditions for Operation, Reactor Coolant System
	3.10	12-27-74	Refueling
	3.12	12-27-74	Control Rod Assemblies and Power Distribution Limits
	4.3	12-27-74	Reactor Coolant System Integrity Testing Following Opening
	5.3	12-27-74	Design Features, Reactor
20	2.1	6-10-75	Safety Limit, Reactor Core
	2.3	6-10-75	Limiting Safety System Settings, Protective Instrumentation
	3.12	6-10-75	Control Rod Assemblies and Power Distribution Limits
21	1.0	6-16-75	Definitions
	2.1	6-16-75	Safety Limit, Reactor Core
	3.3	6-16-75	Safety Injection System
	3.12	6-16-75	Control Rod Assemblies and Power Distribution Limits

Table 10.9.1-1

SUMMARY OF
TECHNICAL SPECIFICATION CHANGES
SURRY POWER STATION
UNIT NOS. 1 & 2
JANUARY THROUGH JULY, 1975

CHANGE NO.	T.S. NO.	DATE ISSUED	TITLE
21	4.10	6-16-75	Reactivity Anomalies
	5.3	6-16-75	Design Features, Reactor

Table 10.9.1-1

11.0 UNIT NO. 2 OPERATING SUMMARY

11.1 POWER GENERATION

11.1.1 A summary of power generated during each month of the reporting period, the total for the reporting period, and the accumulative total since commercial operations commenced is tabulated in Table 11.1.1-1.

11.1.2 A histogram of thermal power versus time for the reporting period is given in Figure 11.1.2-1.

11.1.3 Operating statistics during the period from initial criticality until the date Unit No. 2 was declared commercial (March 7, 1973 to May 1, 1973) are tabulated in Table 11.1.3-1.

POWER GENERATION SUMMARY
SURRY POWER STATION

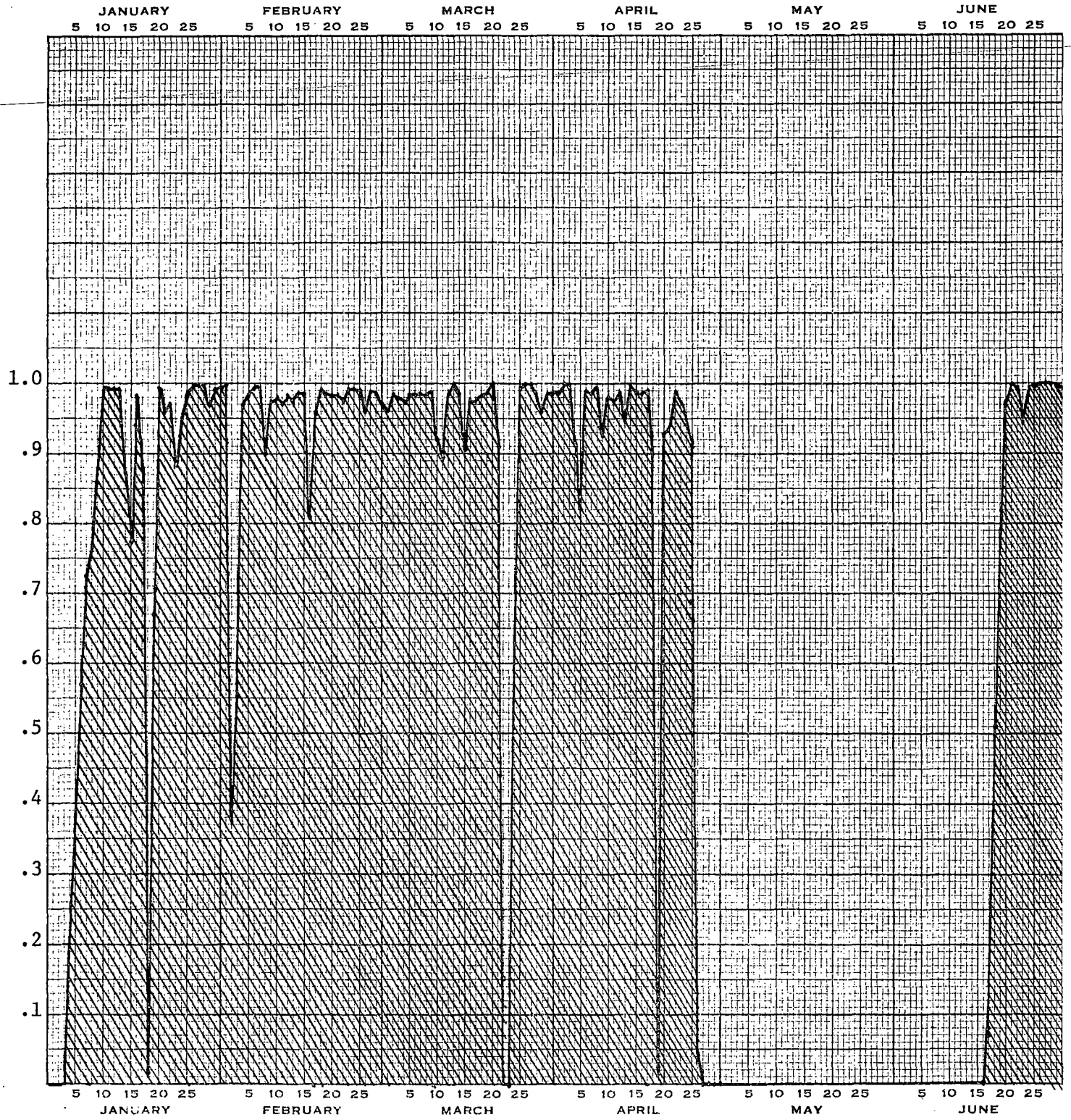
UNIT NO. 2

DESCRIPTION	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	TOTAL FOR PERIOD	* CUMULATIVE TOTAL
1. Gross Thermal Power Generated (MWH)	1,371,463	1,539,183	1,634,413	1,355,720	0	720,968	6,621,747	24,846,536
2. Gross Electrical Power Generated (MWH)	447,815	505,670	540,860	450,290	0	228,827	2,173,462	8,195,929
3. Station Service (MWH)	23,713	25,116	26,707	22,379	0	12,593	110,508	433,676
4. Net Electrical Power Generated (MWH)	424,102	480,554	514,153	427,911	0	216,234	2,062,954	7,762,253
5. Number of Hours Reactor Critical (HRS)	663.3	655.9	719.4	583.1	0	385.4	3,007.1	11,516.1
6. Number of Hours Generator On Line (HRS)	641.4	653.7	690.3	578.2	0	317.6	2,881.2	11,265.4

* Since Commercial Operation

Figure 11.1.2-1

POWER GENERATION HISTOGRAM
UNIT NO. 2
SURRY POWER STATION
JANUARY THROUGH JUNE 1975



K+E 1 YEAR BY DAYS X 150 DIVISIONS 47 2810 MADE IN U.S.A. KEUFFEL & ESSER CO.

PRE-COMMERCIAL OPERATION STATISTICS

SURRY POWER STATION

UNIT NO. 2

Gross Thermal Power Generated (MWH):	1,076,017
Gross Electrical Power Generated (MWH):	343,931
Net Electrical Power Generated (MWH)	312,841
Hours Reactor Was Critical	991.4
Hours Generator Was On-Line	787.7

11.2 OUTAGES

The outages occurring during this reporting period for Unit No. 2 are tabulated in Table 11.2-1.

OUTAGE REPORT
UNIT NO. 2
SURRY POWER STATION
JANUARY 1, 1975 THROUGH JUNE 30, 1975

Table 11.2-1

OUT OF SERVICE		RETURN TO SERVICE		NO. HRS. OUT	UNIT STATUS	METHOD OF SHUTDOWN	CAUSE	CORRECTIVE ACTION
TIME	DATE	TIME	DATE	HRS MIN				
2045	9-06-74	0756	1-04-75	2865 - 11	CSD	Reactor trip by turbine trip	High turbine vibration.	Renewing turbine blades.
2358	1-17-75	0802	1-18-75	8 - 4	HSD	Manual	To repair steam leak in by-pass line and "B" main feed-water pump discharge valve.	N/A
0804	1-18-75	2243	1-18-75	14 - 39	HSD	Automatic	Feed water control sensitiv-ity.	N/A
0902	2-02-75	1040	2-02-75	1 - 38	HSD	Automatic	Feed water control sensitiv-ity.	N/A
1102	2-02-75	0235	2-03-75	15 - 33	HSD	Automatic	Feed water control sensitiv-ity.	N/A
2235	3-21-75	0415	3-24-75	53 - 40	HSD	Automatic	Malfunction of turbine EHC control system during sched-uled maintenance on second-ary system.	Replaced several EHC Control Cards.

OUTAGE REPORT
UNIT NO. 2
SURRY POWER STATION
JANUARY 1, 1975 THROUGH JUNE 30, 1975

Table 11.2-1

OUT OF SERVICE		RETURN TO SERVICE		NO. HRS. OUT	UNIT STATUS	METHOD OF SHUTDOWN	CAUSE	CORRECTIVE ACTION
TIME	DATE	TIME	DATE	HRS MIN				
2220	4-18-75	2320	4-19-75	25 - 0	HSD	Manual	Start-Up Test 70 - Trip from 100% power.	N/A
0311	4-26-75	1825	6-17-75	1263 - 14	CSD	Manual	Refueling.	N/A

11.3 CHANGES IN FACILITY DESIGN

Changes in facility design implemented during this reporting period for Unit 2 are found in Section 10.3.

11.4 PERFORMANCE CHARACTERISTICS

11.4.1 Abnormal Occurrences

A tabulation of the Abnormal Occurrences as defined by Technical Specification 1.0.I which occurred during this reporting period is contained in Table 11.4.1-1. These reports have been previously submitted to the Nuclear Regulatory Commission..

11.4.2 Unusual Safety Related Events

There were no Unusual Safety Related Events for Unit 2 during this reporting period.

11.4.3 Equipment Performance

Section 11.6 of this report summarizes the important maintenance which was performed on unit equipment and is indicative of equipment performance.

Equipment problems experienced in the performance of surveillance tests are summarized in section 11.7.

The abnormal occurrences also provide information on equipment performance.

ABNORMAL OCCURRENCE REPORTS
UNIT NO. 2
SURRY POWER STATION

JANUARY THROUGH JUNE, 1975

NUMBER	TITLE	OCCURRENCE DATE
1	The Flooding of the Valve Pit Containing Service Water Valves	1-09-75
2	Steam Generator Level Indication	1-10-75
3	Failure of Steam Generator Narrow Range Level Detector Indications	1-31-75
4	Failure of Steam Generator Narrow Range Level Detector Indicator	2-14-75
5	Core Quadrant Tilt	2-17-75
6	Failure of CLS Hi-Hi Train B	4-27-75
7	Circulating Water Condenser Valves	4-27-75
8	Failure of Accumulator Discharge Valve MOV-2865C	4-27-75
9	Emergency Condensate Storage Tank Low Level	6-13-75
10	Service Water Isolation Valve MOV-SW-202B	6-24-75
11	Failure of 4KV Undervoltage Detector	6-30-75

11.4.4 FUEL PERFORMANCE

A summary of fuel performance is contained in the attached report.

VEP-FRD-12

SURRY UNIT 2
CORE PERFORMANCE REPORT
Cycle 1 - March 7, 1973 to April 26, 1975

by

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S. P. Keck
K. F. McLaughlin

Nuclear Fuel Engineering and
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Fuel Resources Department

July, 1975

Approved:

J. T. Rhodes

J. T. Rhodes, Director
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Section 1

INTRODUCTION AND SUMMARY

On April 26, 1975, after almost twenty-four months of commercial operation, Surry 2 completed Cycle 1. Since its initial criticality on March 7, 1973, the reactor core has produced some 85 x 10^6 MBTU (14,870 Megawatt days per metric ton of contained uranium) which has resulted in the generation of over 8.2 x 10^9 kwhr of electrical energy. The purpose of this report is to present an analysis of the core performance for routine operation during Cycle 1. Non-routine operation was covered in the Surry 2 startup physics test report[1] and, therefore, will not be included here.

Routine core follow involves the analysis of four principal performance indicators. These are burnup distribution, reactivity depletion, power distribution, and primary coolant activity. The core burnup distribution is followed to verify both burnup symmetry and proper batch burnup sharing, thereby ensuring that the fuel held over for the next cycle will be compatible with the new fuel inserted. Reactivity depletion is monitored to: detect the existence of any abnormal reactivity behavior, determine if the core is depleting as designed, and indicate at what burnup level refueling will be required. Core power distribution follow includes the monitoring of nuclear hot channel factors to verify that they are within the Technical Specifications limits thereby ensuring that adequate margins to linear power density and critical heat flux thermal limits are maintained. Lastly, as part of normal core follow, the primary coolant activity is monitored to assess the integrity of the fuel.

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(1) Gardner, D. A., and Keck, S. P., Surry Unit 2 Startup Physics Test Report, VEP-FRD-2, Richmond, Virginia, June, 1973.

In addition to the above, the effects of fuel densification were monitored. Although not normally part of routine core follow, this phenomenon is treated here because of its impact on core performance.

Each of the four performance indicators, as well as the status of observed fuel densification effects, is discussed in detail for the Surry 2 Cycle 1 core in the body of this report.[2] The results are summarized below:

1. Burnup Follow - The burnup tilt (deviation from quadrant symmetry) on the core is less than $\pm$ 0.2% with the burnup accumulation in each batch deviating from design prediction by less than 3%.
2. Reactivity Depletion Follow - The critical boron concentration, used to monitor reactivity depletion, has consistently been within $\pm$ 0.4% $\Delta K/K$ of the design prediction which is well within the $\pm$ 1% $\Delta K/K$ margin allowed by the Technical Specifications.
3. Power Distribution Follow - Maps taken during each month indicate that the radial power distributions were generally within $\pm$ 5% of the design predictions with all hot channel factors meeting the Technical Specifications limits.
4. Primary Coolant Activity Follow - The iodine-131 activity level in the primary coolant at the end of Cycle 1 is on the order of 10^{-3} μCi/ml, which indicates that there is approximately one defect in the core. This gives the unit a >99.99% fuel integrity factor.

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(2) See Appendix A for definition of terms used in this report.

5. Fuel Densification Status - There are five confirmed and four suspected assembly locations with power spikes due to gap formation. However, all power spikes are small, that is, less than 3% in magnitude.

Section 2

CORE PERFORMANCE ANALYSIS

2.1 Burnup Follow

The burnup history for the Surry Unit 2 core is graphically depicted in Figure 2.1.1. A chronology of the associated operating power level is given in Figure 2.1.2. Cycle 1 burnup for the Surry 2 core was 14,870 MWD/MTU, which is approximately 300 MWD/MTU beyond the normal reactivity end-of-life. As shown in Figure 2.1.3, the average Surry 2 load factor for Cycle 1 is 58% when referenced to maximum permitted power or 57% when referenced to rated power (2441 MW (t)).

The burnup sharing on a batch basis is monitored to verify that the core is operating as designed and to enable accurate end-of-cycle batch burnup predictions to be made for use in reload fuel design studies. As seen in Figure 2.1.4, the batch burnup sharing for Surry 2 followed design predictions very closely with each batch deviating less than 3% from design; this is considered excellent agreement.

Radial (X-Y) burnup maps distribute the gross core burnup among the various assemblies and thereby allow a more detailed burnup distribution analysis. The TOTE computer code (see Appendix B) is used to calculate these assemblywise burnups. Figure 2.1.5 is a radial burnup map in which the core's assemblywise burnup accumulation as of April 26, 1975 (end of Cycle 1) is given. For comparison purposes, the predicted values are also given. As can be seen from this figure, the accumulated assembly burnups are generally within $\pm$ 3% to the predicted values. In addition, deviation from

quadrant symmetry in the core, as indicated by the burnup tilt factors, is less than ± 0.2%. Therefore, symmetric burnup in conjunction with good agreement between actual and predicted assemblywise burnups and batch burnup sharing indicate that the Cycle 1 core depleted as designed.

2.2 Reactivity Depletion Follow

The primary coolant critical boron concentration is monitored for the purposes of following core reactivity and flagging any anomalous reactivity behavior. The FOLLOW computer code (see Appnedix C) is used to normalize "actual" critical boron concentration to design conditions taking into consideration off-normal rod positions, xenon and samarium concentrations, moderator temperatures, and power levels. The normalized critical boron concentration versus burnup curve for the Surry 2 Cycle 1 core is shown in Figure 2.2.1. It can be seen that the measured data compare within ± 20 to 30 ppm of the design prediction. This corresponds to within ± 0.3 to 0.4% $\Delta K/K$ which is well within the ± 1% $\Delta K/K$ criteria for reactivity anomalies set forth in Section 4.10 of the Technical Specifications.

In conclusion, the trend indicated by the critical boron concentration verifies that the Cycle 1 core depleted as expected with no reactivity anomalies.

2.3 Power Distribution Follow

Analysis of core power distribution data on a routine basis is necessary to verify that the hot channel factors are within the Technical Specifications limits and to ensure that the reactor is operating with no abnormal conditions which could cause an "uneven"

burnup distribution. Three-dimensional core power distributions are determined from movable detector flux map measurements using the INCORE computer program (see Appendix D). A summary of all flux maps taken since completion of startup physics testing for Surry 2 is given in Table 2.3.1. Power distribution maps are generally taken monthly with additional maps taken as needed.

Radial (X-Y) core power distributions for a representative series of maps are given in Figures 2.3.1 through 2.3.3. Figure 2.3.1 shows a map that was taken early in cycle life, Figure 2.3.2 shows one that was taken near mid-cycle burnup and Figures 2.3.3 shows a map that was taken late in Cycle 1 life. All of the radial maps shown were taken under equilibrium operating conditions with the Unit operating at 90% to 100% power. In each case, the measured assembly powers are generally within 5% of the predicted values, which is considered good agreement. In addition, as indicated by the INCORE tilt factors, the power distributions are essentially symmetric for all cases.

Core average axial power distributions for a representative series of maps are given in Figure 2.3.4 through 2.3.6. One can observe from this sequence of figures the power-flattening effect caused by the preferential depletion in the high-power central core axial region. In Map 23 (Figure 2.3.4), taken at 365 MWD/MTU, the axial power distribution peaks very strongly just below core midplane and has a peaking factor ($\overline{F}_z$) of 1.39. In Map 49 (Figure 2.3.5) taken at 7310 MWD/MTU, the $\overline{F}_z$ has decreased to 1.17 and the central core axial power shape has flattened markedly as expected. Finally, due to central region burnup effects, a "double hump" forms in the

axial power distribution as shown in Map 65 (Figure 2.3.6) taken at 14,520 MWD/MTU. With this "double hump" formation, $\overline{F}_z$ levels off to a value of approximately 1.16. The gradual decrease and leveling off of $\overline{F}_z$ may be noted in a plot of $\overline{F}_z$ vs. burnup, Figure 2.3.7. In Figure 2.3.8, Surry 1 $\overline{F}_z$ values have been added to the graph; it is seen that these values are consistent with those of Surry 2.

The power flattening effect of increasing burnup can also be seen in the plot of axial offset(3) versus burnup, Figure 2.3.9. Axial offset shifts from approximately -5% at the beginning-of-cycle to approximately 0% at 4000 MWD/MTU burnup. It then levels off and hovers around the 0% point. This behavior is consistent with that of Surry 1 as shown by a comaprison plot of axial offset versus burnup, Figure 2.3.10.

Another important aspect of core power distribution follow is the monitoring of nuclear hot channel factors. Verification that these factors are within Technical Specifications limits ensures that linear power density and critical heat flux limits will not be violated, thereby providing adequate thermal margins and maintaining fuel cladding integrity.

The Technical Specifications limits on the heat flux hot channel factor, F_Q changed several times during Cycle 1 as shown in Figure 2.3.11. Throughout the cycle the Surry 2 core has maintained an F_Q (with and without densification penalties) of at least 5% less than the applicable limit. In addition, Surry 2 Cycle 1 core heat flux hot channel factors compare well with the values obtained for Surry 1, as indicated in Figure 2.3.12.

Peak linear power density, which is determined directly from F_Q is given in Figure 2.3.13. This is the limiting parameter from

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(3) Axial Offset $= \frac{Pt - Pb}{Pt + Pb} \times 100$ where Pt = power in core top and Pb = power in core bottom

a loss-of-coolant accident-ECCS standpoint since it directly relates to the stored thermal energy in the core. As shown in Figure 2.3.13, the Surry 2 Cycle 1 core has maintained a peak linear power density of at least 7% below the allowable limit. Figure 2.3.14 shows that Surry 1 and 2 peak linear power densities with burnup compare closely.

A radial hot channel factor routinely followed is $F^N_{\Delta H}$, the enthalpy rise hot channel factor. The Technical Specifications limit for this parameter is set such that the critical heat flux (DNB) limit will not be violated. Figure 2.3.15 shows that at least a 4% margin to this limit has been maintained. Also, as indicated in Figure 2.3.16, the Surry 2 Cycle 1 core enthalpy rise hot channel factors compare closely with those of Surry 1.

Another radial hot channel factor routinely monitored is F_{xy}, the horizontal plane peaking factor. This peaking factor is a ratio of the peak to average power in a given horizontal plane. It is related to, but is not identical to, $F^N_{\Delta H}$ which is the ratio of integral of power along the rod with the highest integrated power to that of the average rod. As shown in Figure 2.3.17, the measured F_{xy} peaking factors, evaluated at core mid-plane, are as much as 3% higher than the nominal design prediction. However, this is well within the design uncertainty of 8%. In addition, as indicated in Figure 2.3.18, Surry 2 Cycle 1 core F_{xy} peaking factors compare well with values obtained for Surry 1.

In conclusion, the Surry 2 Cycle 1 core performed very satisfactorily with power distribution analyses verifying that design predictions are accurate and that hot channel factors are meeting Technical Specifi-

cations limits. In addition, the Surry 2 Cycle 1 core power distribution characteristics followed the Surry 1 Cycle 1 core characteristics closely, which was expected since startup tests results of the two units compared well.[4]

2.4 Primary Coolant Activity Follow

Activity levels of iodine-131 and 133 are important in core performance follow analyses because they are used as indicators of defective fuel. These two isotopes leak into the primary coolant system through a breach in the cladding. I-131 activity is directly correlatable to the number of cladding defects; the ratio of I-131 to I-133 is used to determine the type of fuel failure which has occurred in the reactor core. Use of the ratio for this determination is feasible because I-133 has a short half-life (approximately 24 hours) compared to that of I-131 (approximately eight days) so that for pinhole defects where the diffusion time through the defect is on the order of days, the I-133 decays out leaving I-131 dominant in activity thereby causing the ratio to be 0.5 or more. In the case of large leaks, uranium particles in the coolant, and/or "tramp"[5] uranium, where there is no diffusion time, the I-131/I-133 ratio will generally be less than 0.1.

Figure 2.4.1 shows the I-131 activity history for the Surry 2 Cycle 1 core with the FSAR value for one fuel defect[6] (which is equivalent to one defective rod) and five defects (an equivalent to five defective rods) delineated for comparison purposes. The data shows

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(4) Gardner and Keck, op. cit.

(5) "Tramp" uranium consists of small particles of uranium which adhere to the outside surface of the fuel during the manufacturing process.

(6) This is derived from FSAR Table 9.1-5 where cladding defects in 1% of the fuel rods gives an I-131 primary coolant activity concentration of 1.68 μCi/cc @ 560°F. Samples are analyzed at room temperature; hence, this value is 2.35 μCi/cc when a density correction is made.

considerable scatter but the trend indicates that on the order of one defective fuel rod exists in the core. As shown in Figure 2.4.2, the I-131/I-133 ratio data points fall in the mid-range, thus giving us no indication as to the type of defect.

Small quantities of fuel defects are not uncommon in operating reactors, and in fact, the reactor systems are normally designed to operate with up to approximately 1% failed fuel present. With only one defect present, Surry 2 had a Cycle 1 core integrity factor of >99.99% which is better than most operating reactors and is quite acceptable.

2.5 Fuel Densification Status

Table 2.5.1 gives the assembly locations, along with assembly related data in which densification-induced power spikes have been observed. The total number of suspected and confirmed[7] power spikes has remained the same since the last core performance report (December 31, 1974). The magnitudes of a few of the power spikes have increased since the last report, however, the magnitudes of all power spikes are still very small, the largest being 1.7% for Assembly J-7. It has been noticed that the power spike locations do not generally change from one map to the next although in a few instances confirmed power spikes have disappeared, undoubtedly due to the settling of the fuel column.

Table 2.5.2 compares Surry 1 and Surry 2 densification induced power spikes. It should be noted that power spike formation in Surry 2 Cycle 1 fuel is reduced both in magnitude and number from that

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(7) A confirmed power spike is one which has been observed in two or more recent maps. A suspected power spike is one which has been observed only in the most recent map.

observed in Surry 1 Cycle 1 fuel. This may be attributed, at least in part, to the fact that a less active powder (manufactured at Westinghouse Columbia plant) was used and the sintering temperatures were higher in Regions 2 and 3 of Surry 2 as compared with those of Surry 1.

Figures 1 through 9 of Appendix E are the latest Surry 2 strip-chart traces for all confirmed and suspected assemblies with densification induced gaps. Note that in nearly all cases the power spike is located above the midplane and usually is in the top one-third of the fuel, which is where gap formation of notable size is most likely to occur. Unfortunately, the width of the power spike is not a direct indication of gap width since the detector is running down the center of the assembly and "sees" a composite effect of many fuel pins.

The first sign of gap formation in the Surry 2 Cycle 1 fuel was observed in Map 34 taken at approximately 2100 MWD/MTU. Since previous traces taken at 1850 MWD/MTU showed no signs that gap formation had occurred, it is evident that the actual onset was somewhere between 1850 to 2100 MWD/MTU. This is consistent with Surry 1 data, which indicated that gap formation occurred between 1900 and 2400 MWD/MTU burnup, as detailed in the Surry 1 Cycle 1 core performance report[8].

In conclusion, while the magnitudes of a few of the densification induced power spikes have increased since the last report, all power spikes are still very small.

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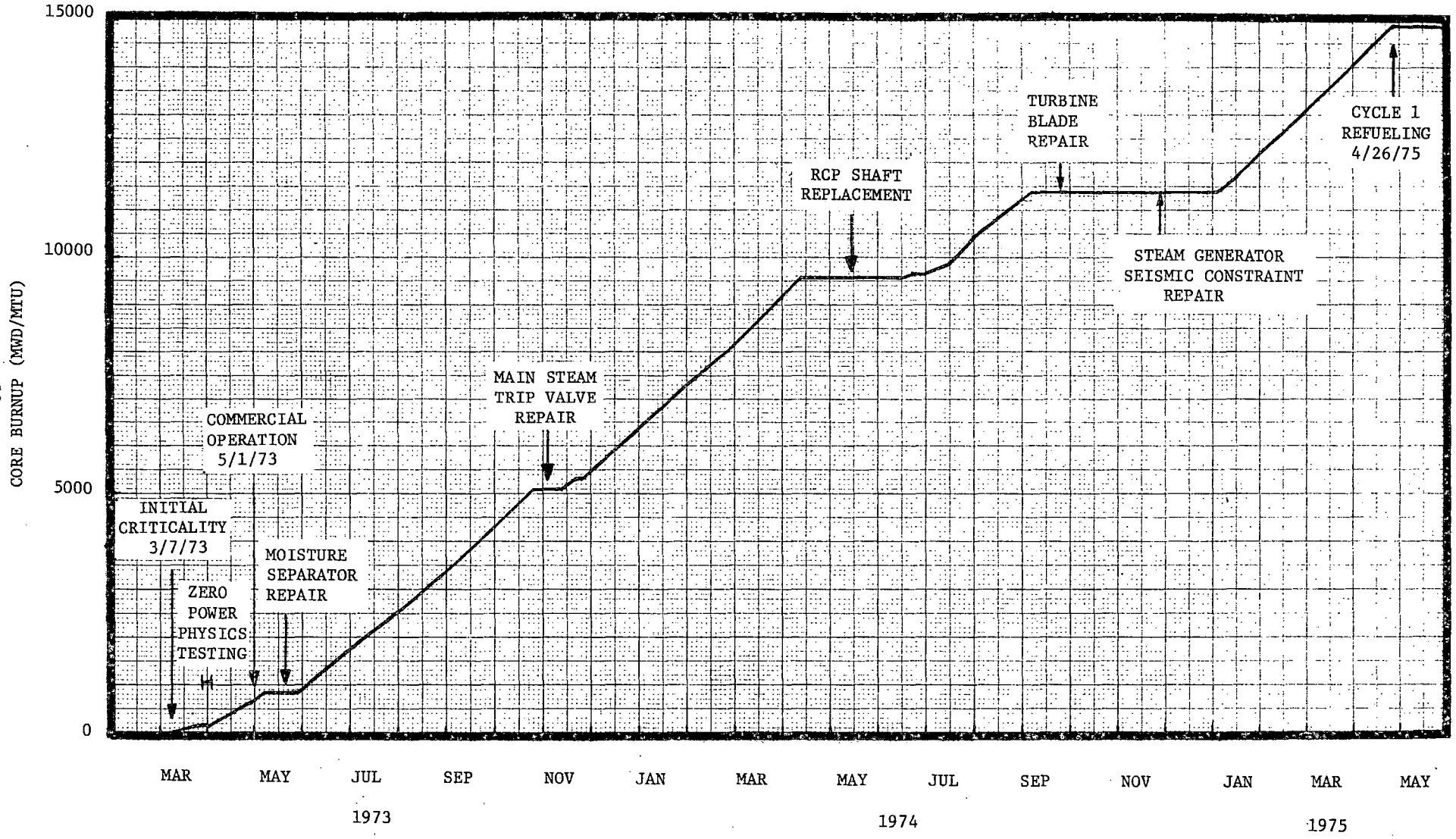
(8) Flournoy, L. L. , Keck, S. P., and Rhodes, J. T., Surry Unit 1 Core Performance Report - Cycle 1, 1975-VEP-FRD-9, Richmond, Virginia, 1975

FIGURE 2.1.1

SURRY UNIT 2 - CYCLE 1
CORE BURNUP HISTORY



SURRY UNIT 2 - CYCLE 1

FIGURE 2.1.2

CHRONOLOGY OF OPERATING POWER LEVEL

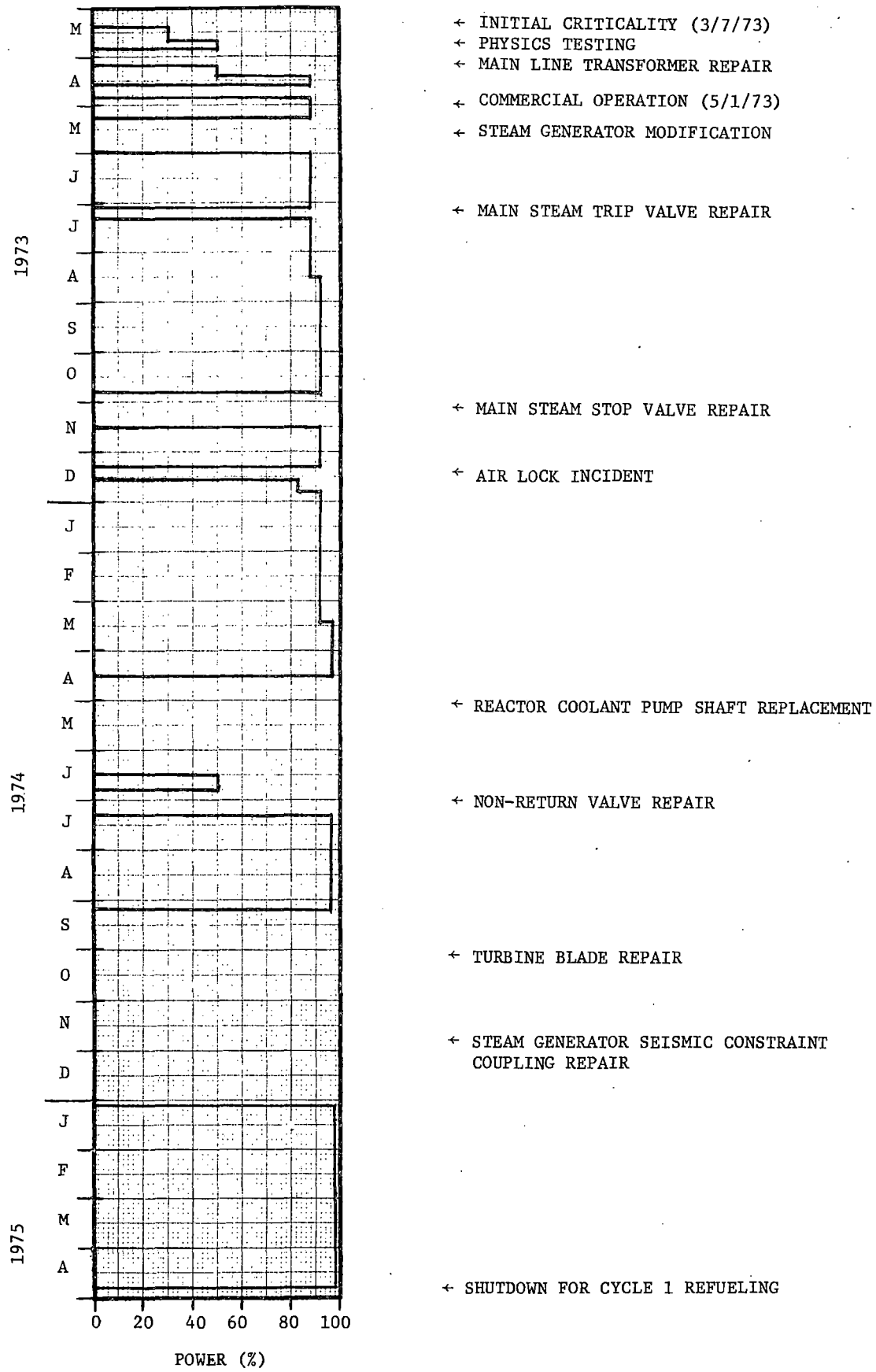
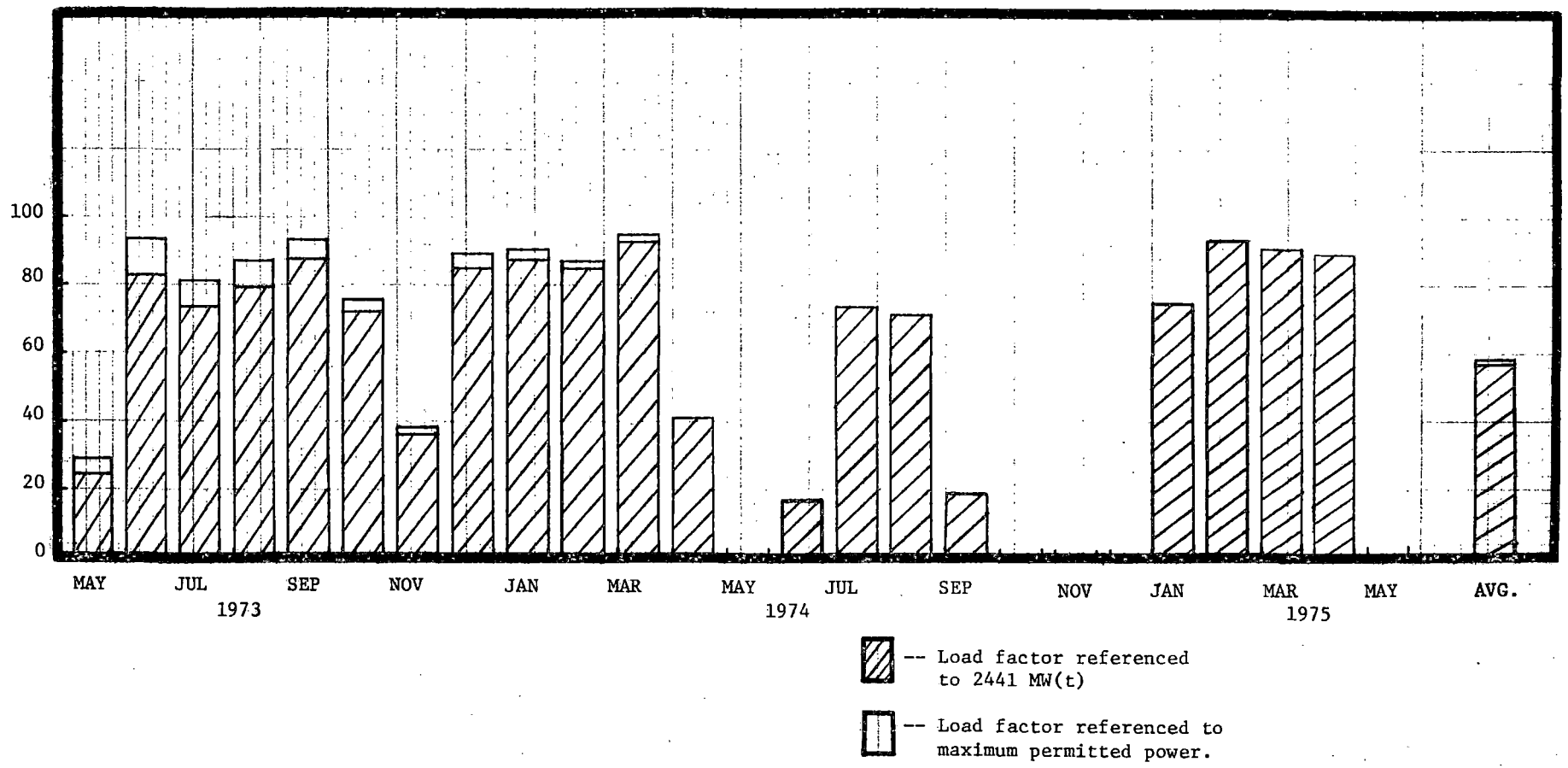


FIGURE 2.1.3

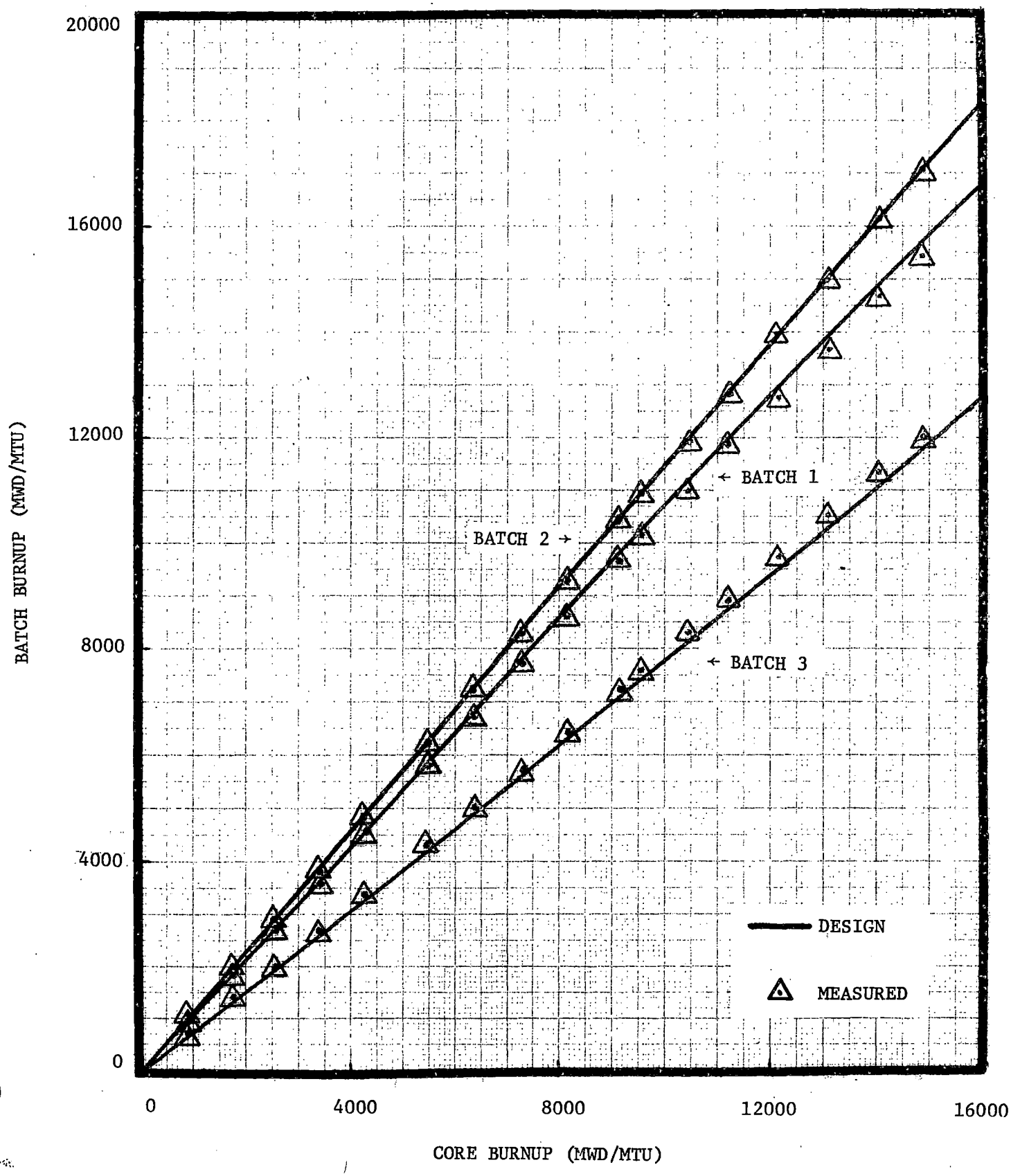
SURRY UNIT 2 - CYCLE 1
MONTHLY AVERAGE LOAD FACTORS



SURRY UNIT 2 - CYCLE 1

FIGURE 2.1.4

BATCH BURNUP SHARING



SURRY UNIT 2 - CYCLE 1

ASSEMBLYWISE ACCUMULATED BURNUP:
COMPARISON OF MEASURED WITH PREDICTED
10^3 MWD/MTU

FIGURE 2.1.5

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							9.05 9.34 +3.2	11.29 11.50 +1.8	9.05 9.11 +.6						
2					9.26 9.57 +3.3	13.30 13.58 +2.1	15.09 15.34 +1.6	14.03 13.60 -3.1	15.09 15.13 +.3	13.30 13.31 +.1	9.26 9.41 +1.6				
3				9.79 10.09 +3.1	14.36 14.63 +1.9	15.76 15.65 -.7	15.45 15.15 -1.9	16.81 16.56 -1.5	15.45 15.08 -2.4	15.76 15.62 -.8	14.36 14.68 +2.2	9.79 10.15 +3.7			
4			9.79 10.06 +2.8	12.63 12.41 -1.7	15.85 15.62 -1.5	15.79 15.42 -2.4	17.41 17.35 -.4	16.25 16.03 -1.4	17.41 17.45 +.2	15.79 15.61 -1.1	15.85 15.97 +.8	12.63 12.53 -.8	9.79 10.13 +3.5		
5		9.26 9.50 +2.5	14.36 14.56 +1.4	15.85 15.69 -1.0	15.77 15.39 -2.4	17.54 17.28 -1.5	16.49 16.20 -1.8	17.85 17.98 +.7	16.49 16.43 -.3	17.54 17.56 +.1	15.77 15.62 -.9	15.85 15.76 -.5	14.36 14.79 +3.0	9.26 9.66 +4.2	
6		13.30 13.69 +3.0	15.76 15.71 -.3	15.79 15.44 -2.2	17.54 17.30 -1.4	16.54 15.98 -3.3	17.97 17.96 -.03	16.69 16.62 -.4	17.97 18.09 +.7	16.54 16.15 -2.4	17.54 17.49 -.3	15.79 15.49 -1.9	15.76 15.67 -.5	13.30 13.56 +2.0	
7	9.05 9.47 +4.6	15.09 15.57 +3.1	15.45 15.22 -1.5	17.41 17.45 +.2	16.49 16.26 -1.4	17.97 17.94 -.2	16.72 16.51 -1.3	18.07 18.21 +.8	16.72 16.65 -.4	17.97 18.15 +1.0	16.49 16.27 -1.3	17.41 17.26 -.9	15.45 15.24 -1.3	15.09 15.22 +.8	9.05 9.20 +1.6
8	11.29 11.77 +4.2	14.03 13.85 -1.2	16.81 16.91 +.6	16.25 16.17 -.5	17.85 18.10 +1.4	16.69 16.57 -.7	18.07 18.11 +.2	16.77 16.58 -1.2	18.07 18.22 +.8	16.69 16.73 +.2	17.85 17.91 +.3	16.25 16.07 -1.1	16.81 17.03 +1.3	14.03 13.90 -.9	11.29 11.55 +2.2
9	9.05 9.49 +4.9	15.09 15.54 +3.0	15.45 15.22 -1.5	17.41 17.52 +.6	16.49 16.34 -.9	17.97 18.03 +.3	16.72 16.47 -1.5	18.07 18.12 +.3	16.72 16.49 -1.4	17.97 17.86 -.6	16.49 16.22 -1.6	17.41 17.35 -.3	15.45 15.34 -.7	15.09 15.54 +2.9	9.05 9.25 +2.3
10		13.30 13.48 +1.4	15.76 15.62 -.9	15.79 15.52 -1.7	17.54 17.48 -.4	16.54 16.09 -2.7	17.97 17.90 -.4	16.69 16.47 -1.3	17.97 17.85 -.7	16.54 15.98 -3.3	17.54 17.31 -1.3	15.79 15.34 -2.8	15.76 15.53 -1.5	13.30 13.53 +1.8	
11		9.26 9.58 +3.4	14.36 14.82 +3.2	15.85 15.91 +.4	15.77 15.48 -1.8	17.54 17.40 -.8	16.49 16.22 -1.6	17.85 17.90 +.2	16.49 16.22 -1.6	17.54 17.40 -.8	15.77 15.49 -1.7	15.85 15.99 +.9	14.36 14.88 +3.6	9.26 9.60 +3.6	
12			9.79 10.29 +5.1	12.63 12.65 +.2	15.85 15.86 +.1	15.79 15.44 -2.2	17.41 17.24 -1.0	16.25 15.92 -2.1	17.41 17.28 -.8	15.79 15.43 -2.3	15.85 15.93 +.5	12.63 12.84 +1.6	9.79 10.34 +5.7		
13				9.79 10.10 +3.2	14.36 14.51 +1.1	15.76 15.52 -1.5	15.45 15.02 -2.7	16.81 16.55 -1.6	15.45 14.98 -3.0	15.76 15.58 -1.1	14.36 14.78 +2.9	9.79 10.37 +6.0			
14					9.26 9.39 +1.4	13.30 13.40 +.8	15.09 15.18 +.6	14.03 13.43 -4.3	15.09 15.08 -.1	13.30 13.40 +.8	9.26 9.41 +1.5				
15							9.05 9.09 +.4	11.29 11.28 -.1	9.05 9.04 -.1						

DATE: April 26, 1975

CORE AVERAGE BURNUP: 14,870 MWD/MTU

PREDICTED
MEASURED
% DIFFERENCE

BURNUP SHARING

	ACTUAL	PREDICTED
Batch 1	15.47	15.72
Batch 2	17.02	17.06
Batch 3	12.04	11.77

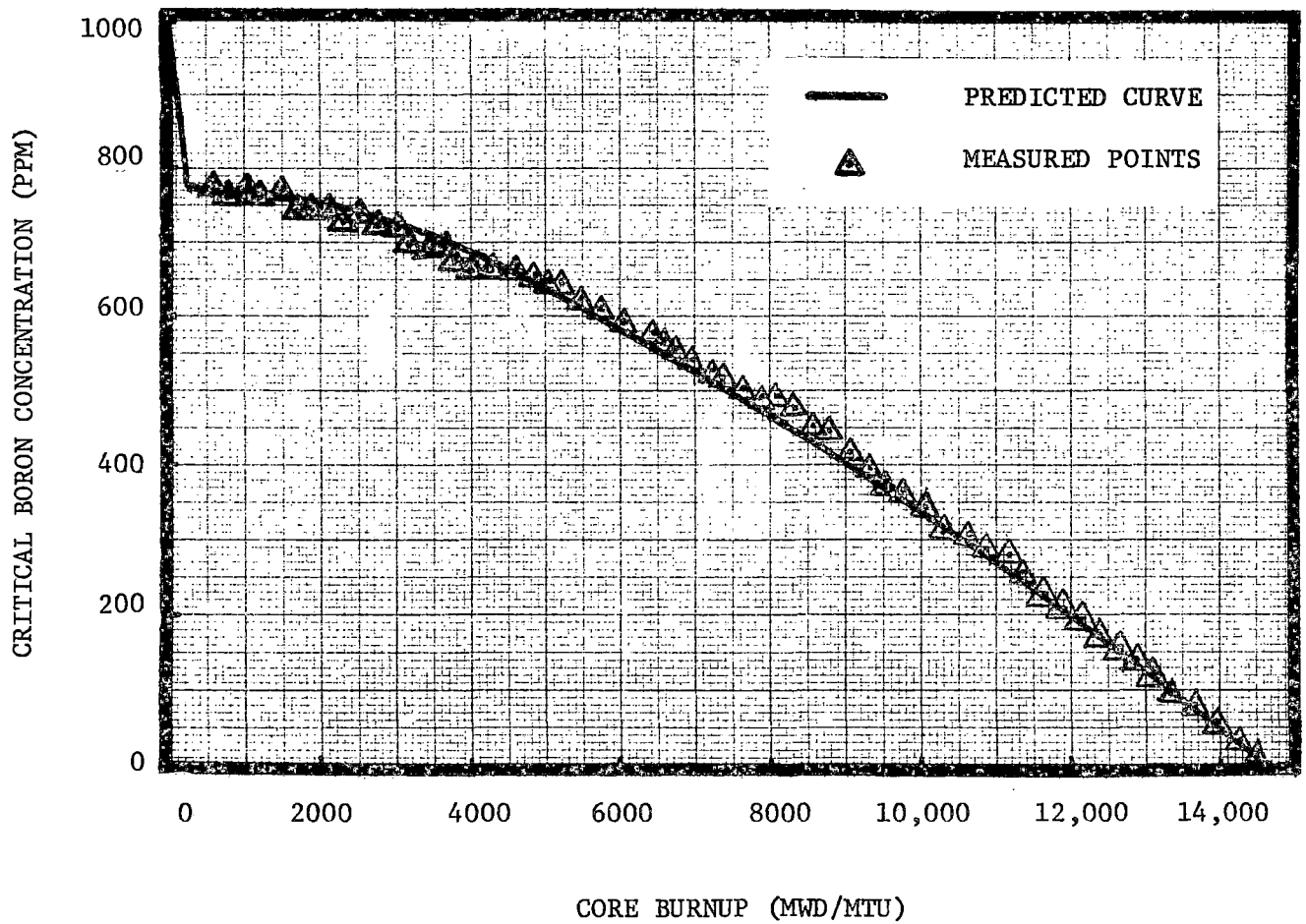
BURNUP TILT

NW - 1.000
NE - 1.002
SW - 1.000
SE - 0.999

SURRY UNIT 2 - CYCLE 1

FIGURE 2.2.1

CRITICAL BORON CONCENTRATION
vs.
BURNUP



SURRY UNIT 2 - CYCLE 1

SUMMARY TABLE OF INCORE FLUX MAPS
FOR ROUTINE OPERATION

MAP NO.	DATE	% PWR	BANK D	BANK P/L	CORE $\overline{F}_z$	F_Q HOT CHANNEL FACTOR						$F_{\Delta H}$ HOT CHANNEL FACTOR			TILT		AVG AXIAL OFFSET	BURNUP (MWD/MTU)	NO. OF MONITORED THIMBLES
						ASSY.	PIN	AXIAL POINT	F_Q^N	S(Z)	$F_Q^{N'}$	ASSY	PIN	$F_{\Delta H}^N$	MAX	QUAD LOC			
22	4/12/73	75	195	228	1.42	J-8	HG	34	2.04	1.096	2.24	H-7	GH	1.42	1.003	NW	-2.8	280	46
23	4/15/73	90	204	228	1.39	F-7	GH	35	2.10	1.093	2.29	H-9	GH	1.45	1.004	SE	-5.5	365	34
27(1)	4/30/73	88	201	228	1.40	F-7	GH	35	2.10	1.093	2.30	F-7	GH	1.46	1.014	NE	-4.8	630	24
30(2)	6/6/73	90	200	228	1.40	J-10	HG	33	2.09	1.100	2.29	E-8	HG	1.46	1.005	SW	-4.6	1080	26
31	6/15/73	90	202	228	1.39	G-8	HG	34	2.06	1.096	2.25	H-7	GH	1.46	1.005	NE	-4.1	1300	43
33(2)	7/3/73	90	202	228	1.37	G-8	HG	34	2.01	1.096	2.20	H-7	GH	1.47	1.006	NW	-4.2	1850	29
34	7/13/73	88	203	228	1.36	J-8	HG	34	2.02	1.096	2.21	H-7	GH	1.48	1.003	NW	-4.4	2030	39
35	8/1/73	88	201	228	1.34	H-9	GH	33	1.96	1.100	2.16	G-8	HG	1.47	1.002	NE	-3.3	2560	24
37(2)	8/6/73	75	195	228	1.33	H-9	GH	33	1.95	1.100	2.15	H-5	GH	1.48	1.019	SE	-2.7	2705	30
38	8/17/73	92	202	228	1.31	H-9	GH	23	1.92	1.131	2.17	H-9	GH	1.47	1.004	NE	-2.3	2950	31
39	8/31/73	93	210	228	1.28	L-8	HG	24	1.89	1.128	2.07	L-8	HG	1.46	1.011	SW	-3.2	3380	17
40	9/13/73	92	213	228	1.25	G-8	HG	22	1.83	1.134	2.07	G-8	HG	1.42	1.004	NW	+1.3	3780	41
41	10/1/73	93	211	228	1.24	G-8	HG	23	1.81	1.131	2.04	G-8	HG	1.43	1.024	NE	-0.3	4320	30
42	10/12/73	94	214	228	1.22	H-9	GH	24	1.74	1.128	1.95	G-8	HG	1.41	1.001	SW	-1.1	4670	41
43	11/19/73	92	213	228	1.21	H-9	GH	24	1.73	1.128	1.95	H-7	GH	1.41	1.002	SW	-1.9	5240	47
44	12/3/73	94	213	228	1.22	L-8	HG	22	1.73	1.134	1.96	G-8	HG	1.39	1.002	NE	+1.8	5560	31
45	12/17/73	83	216	228	1.20	L-8	HG	22	1.68	1.134	1.90	H-7	GH	1.37	1.001	NE	+1.0	5940	49
46	12/31/73	91	194	228	1.23	L-8	HG	23	1.76	1.131	1.99	L-8	HG	1.40	1.014	SW	-1.6	6345	31
47	1/4/74	92	217	228	1.18	H-11	GH	21	1.63	1.137	1.86	H-11	GH	1.37	1.001	NW	+0.9	6460	23
48	1/15/74	91	218	228	1.22	H-11	GH	45	1.67	1.059	1.77	H-7	GH	1.36	1.001	NE	-4.2	6780	50
49	2/1/74	91	215	228	1.17	H-11	GH	23	1.62	1.131	1.80	H-7	GH	1.37	1.004	NE	-0.8	7310	45
50	2/15/74	91	216	228	1.18	H-11	GH	14	1.61	1.156	1.76	G-8	HG	1.36	1.003	SW	-1.6	7725	40
51	3/1/74	82	212	228	1.17	H-9	GH	13	1.60	1.158	1.86	H-9	GH	1.35	1.004	SW	+2.4	8135	24
52	3/15/74	98	214	228	1.15	H-11	GH	13	1.56	1.158	1.78	L-8	HG	1.34	1.003	SW	-0.1	8580	41
53	4/1/74	98	216	228	1.21	H-9	GH	46	1.67	1.056	1.77	H-9	GH	1.35	1.008	SW	-5.2	9135	25
54	4/6/74	98	218	228	1.17	L-8	DG	12	1.62	1.160	1.88	L-8	DG	1.34	1.005	NE	+2.1	9310	20
55	4/7/74	53	154	228	1.37	D-9	DI	45	1.81	1.059	1.92	D-9	IL	1.32	1.006	NE	-19.3	9340	15
56(3)	6/18/74	30	187	228	1.26	N-8	LG	20	1.70	1.053	1.79	L-8	DG	1.33	1.019	NW	+6.5	9557	28
58(2)	6/19/74	50	184	228	1.17	L-8	DG	21	1.61	1.052	1.69	L-8	DG	1.35	1.007	SW	-2.9	9575	48
59(2)	7/16/74	100	216	228	1.14	L-8	DG	13	1.53	1.060	1.62	L-8	DG	1.32	1.003	SE	-0.4	9890	47
61(4)	8/26/74	100	216	228	1.17	L-8	DG	12	1.59	1.061	1.69	L-8	DG	1.33	1.004	SW	+0.5	11025	45
62	1/17/75	100	218	228	1.15	H-11	GL	11	1.54	-(5)	-(5)	H-11	GL	1.30	0.997	NW	+0.1	11740	40
63	2/19/75	100	226	228	1.19	J-8	DG	9	1.60	-	-	N-8	LG	1.34	1.005	NW	+1.2	12770	47
64	3/17/75	98	227	228	1.16	N-11	LE	53	1.53	-	-	G-4	LG	1.30	0.995	NW	-0.9	13650	47
65	4/14/75	100	224	228	1.16	N-11	LE	53	1.54	-	-	F-5	ID	1.30	1.007	NE	-0.8	14520	48

Notes: Hot Spot locations are specified by giving assembly locations (e.g. H-8 is the center-of-core assembly), followed by the pin location (denoted by the "Y" coordinate with the fifteen rows of fuel rods lettered A through O, and the "X" coordinate designated in a similar manner). In the "Z" direction the core is divided into 61 axial points starting from the top of the core.

All hot channel factor values include measurement uncertainty (1.05 on F_Q and 1.04 on $F_{\Delta H}$).

The axial location of S(Z) is determined by locating the maximum value of $F_Q^N \times S(Z)$.

$$F_Q^{N'} = \{F_Q^N (Z) \times S(Z)\}_{MAX}$$

(1) Maps 24-26 were operational maps for F_Z monitoring only.
(2) Maps 28, 29, 32, 36, 57, and 60 were aborted due to M/D problems.
(3) New densification model WCAP-8219 accepted.
(4) No maps taken in September, October, November, and December 1974 since the Unit was down.
(5) The spike penalty factor was incorporated into the Technical Specification Limit in the ECCS Analysis performed in accordance with 10CFR50.46.

SURRY UNIT 2 - CYCLE 1

FIGURE 2.3.1

ASSEMBLYWISE POWER DISTRIBUTION

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.65 0.66 0.3	0.85 0.85 0.3	0.65 0.66 0.9							1
				0.62 0.61 -1.9	0.93 0.86 -7.5	1.03 1.00 -3.5	0.99 0.96 -3.5	1.03 1.02 -1.2	0.93 0.95 1.7	0.62 0.64 2.7					2
			0.63 0.62 -1.9	0.89 0.88 -1.9	1.00 0.98 -1.9	1.06 0.98 -7.4	1.11 1.03 -7.4	1.06 1.03 -2.7	1.00 1.01 0.9	0.89 0.91 2.3	0.63 0.66 4.2				3
		0.63 0.62 -1.9	0.81 0.80 -1.2	0.98 0.96 -1.7	1.05 1.06 0.3	1.14 1.14 -0.4	1.12 1.09 -2.9	1.14 1.11 -2.9	1.05 1.05 0.1	0.98 0.98 0.1	0.81 0.81 0.2	0.63 0.63 0.2			4
	0.62 0.62 -0.3	0.89 0.89 -0.0	0.98 0.99 -1.3	1.04 1.04 -0.6	1.14 1.15 0.4	1.15 1.19 4.0	1.20 1.24 3.4	1.15 1.18 2.8	1.14 1.18 2.8	1.04 1.04 -0.1	0.98 0.94 -3.9	0.89 0.86 -3.9	0.62 0.58 -7.0		5
	0.93 0.93 -0.3	1.00 1.00 -0.3	1.05 1.04 -1.2	1.14 1.12 -2.2	1.14 1.15 0.6	1.22 1.25 3.0	1.19 1.22 2.7	1.22 1.27 4.0	1.14 1.21 5.6	1.14 1.15 0.9	1.05 1.03 -2.6	1.00 0.96 -4.0	0.93 0.87 -7.0		6
0.65 0.68 4.8	1.03 1.05 1.7	1.06 1.06 -0.3	1.14 1.15 0.5	1.15 1.16 1.1	1.22 1.24 1.7	1.20 1.23 2.4	1.25 1.28 2.5	1.20 1.25 4.1	1.22 1.28 5.5	1.15 1.16 1.4	1.14 1.14 -0.6	1.06 1.05 -1.1	1.03 0.97 -5.7	0.65 0.61 -6.9	7
0.85 0.89 4.9	0.99 1.02 2.8	1.11 1.11 -0.3	1.12 1.15 2.0	1.20 1.25 4.1	1.19 1.22 2.7	1.25 1.28 2.3	1.22 1.25 2.5	1.25 1.27 1.7	1.19 1.21 1.2	1.20 1.19 -0.5	1.12 1.15 1.8	1.11 1.15 3.2	0.99 0.98 -1.5	0.85 0.81 -4.2	8
0.65 0.68 4.8	1.03 1.05 2.0	1.06 1.05 -0.8	1.14 1.16 1.1	1.15 1.15 0.5	1.22 1.24 1.8	1.20 1.23 2.3	1.25 1.28 2.6	1.20 1.23 2.3	1.22 1.22 0.6	1.15 1.17 1.5	1.14 1.19 4.1	1.06 1.11 4.4	1.03 1.04 0.4	0.65 0.64 -2.5	9
	0.93 0.93 -0.8	1.00 1.00 -0.8	1.05 1.05 -0.6	1.14 1.14 -0.2	1.14 1.14 -0.4	1.22 1.19 -2.1	1.19 1.19 -0.2	1.22 1.22 0.2	1.14 1.14 -0.1	1.14 1.15 0.5	1.05 1.08 3.0	1.00 1.04 3.5	0.93 0.91 -2.5		10
	0.62 0.61 -0.9	0.89 0.89 -0.9	0.98 0.97 -0.9	1.04 1.04 -0.2	1.14 1.09 -4.3	1.15 1.11 -3.2	1.20 1.17 -2.3	1.15 1.13 -1.8	1.14 1.13 -1.4	1.04 1.04 -0.4	0.98 0.99 1.6	0.89 0.92 2.9	0.62 0.60 -2.5		11
		0.63 0.63 -0.9	0.81 0.84 4.0	0.98 1.02 4.0	1.05 1.01 -4.3	1.14 1.10 -3.9	1.12 1.10 -2.6	1.14 1.13 -1.0	1.05 1.05 -0.5	0.98 0.98 0.3	0.81 0.82 2.0	0.63 0.65 2.3			12
			0.63 0.66 4.0	0.89 0.93 4.0	1.00 1.00 -0.2	1.06 1.03 -2.8	1.11 1.10 -1.7	1.06 1.06 -0.3	1.00 1.01 0.8	0.89 0.91 1.4	0.63 0.65 2.3				13
				0.62 0.64 4.0	0.93 0.95 2.1	1.03 1.02 -1.1	0.99 0.98 -1.4	1.03 1.03 -0.3	0.93 0.94 0.8	0.62 0.62 0.8					14
						0.65 0.65 -0.8	0.85 0.84 -0.9	0.65 0.65 -0.8			PREDICTED MEASURED P/C DIFFERENCE				15

MAP NO. 23 | DATE 4/15/73 | POWER ∿2200 MWT

CONTROL ROD POSITIONS

BANK C AT 228 STEPS

BANK D AT 204 STEPS

BANK P/L 228 STEPS

$F^N_{\Delta H}$ = 1.45 AT H9-GH *

F^N_Q = 2.10 AT F7-GH *

$\bar{F}_z$ = 1.39

A.O.= -5.5

BURNUP = ∿ 365 MWD/MTU

INCORE TILT

NW - 0.997

NE - 0.998

SW - 1.000

SE - 1.004

* Includes measurement uncertainty
Does not include densification penalties

FIGURE 2.3.2

SURRY UNIT 2 - CYCLE 1
ASSEMBLYWISE POWER DISTRIBUTION

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.59 0.59 0.2	0.74 0.74 -0.3	0.59 0.55 -6.9							1
				0.62 0.61 -0.5	0.88 0.89 0.2	1.00 1.00 0.0	0.92 0.92 -0.1	1.00 0.96 -4.3	0.88 0.82 -6.9	0.62 0.60 -2.6					2
			0.65 0.65 -0.5	0.95 0.96 0.0	1.06 1.06 0.4	1.04 1.04 0.3	1.13 1.13 0.1	1.04 1.03 -0.8	1.06 1.03 -2.8	0.96 0.96 0.2	0.65 0.68 4.1				3
		0.65 0.65 -0.2	0.85 0.85 0.4	1.07 1.08 0.7	1.07 1.07 -0.1	1.18 1.18 -0.4	1.10 1.11 1.4	1.18 1.20 1.3	1.07 1.08 1.4	1.07 1.09 2.0	0.85 0.87 2.4	0.65 0.67 2.6			4
	0.62 0.62 0.2	0.96 0.96 0.2	1.07 1.08 0.8	1.07 1.08 1.5	1.19 1.19 -0.4	1.12 1.09 -2.5	1.22 1.23 0.7	1.12 1.13 1.5	1.19 1.20 0.6	1.07 1.08 1.3	1.07 1.09 1.3	0.96 0.98 1.9	0.62 0.63 2.5		5
	0.88 0.89 0.2	1.06 1.06 0.2	1.07 1.07 0.6	1.13 1.20 0.4	1.11 1.11 -0.3	1.23 1.23 0.1	1.13 1.16 2.5	1.23 1.24 1.1	1.11 1.10 -1.1	1.19 1.20 0.5	1.07 1.08 1.1	1.06 1.07 0.9	0.88 0.89 0.8		6
0.59 0.61 3.6	1.00 1.03 2.6	1.04 1.05 1.6	1.18 1.19 0.6	1.12 1.12 0.1	1.23 1.23 0.3	1.13 1.14 0.9	1.23 1.26 2.0	1.13 1.15 1.8	1.23 1.24 1.0	1.12 1.13 0.8	1.18 1.20 1.0	1.04 1.05 1.7	1.00 1.00 0.1	0.59 0.60 1.0	7
0.74 0.76 3.6	0.92 0.95 2.5	1.13 1.15 1.6	1.10 1.11 0.8	1.22 1.22 0.1	1.13 1.13 0.3	1.23 1.24 0.6	1.13 1.14 0.7	1.23 1.24 0.5	1.13 1.15 1.9	1.22 1.22 0.4	1.10 1.12 2.3	1.13 1.17 3.4	0.92 0.95 3.1	0.74 0.75 2.1	8
0.59 0.61 3.6	1.00 1.02 2.0	1.04 1.05 1.1	1.18 1.19 0.8	1.12 1.12 0.1	1.23 1.23 -0.0	1.13 1.13 -0.1	1.23 1.24 0.4	1.13 1.14 0.4	1.23 1.20 -2.3	1.12 1.09 -2.2	1.18 1.17 -1.6	1.04 1.05 1.1	1.00 1.02 2.4	0.59 0.61 2.2	9
	0.88 0.89 0.7	1.06 1.07 0.7	1.07 1.05 -1.7	1.19 1.13 -5.4	1.11 1.09 -2.2	1.23 1.23 0.2	1.13 1.15 1.3	1.23 1.23 0.5	1.11 1.11 -0.4	1.19 1.17 -1.8	1.07 1.02 -4.6	1.06 1.03 -2.7	0.88 0.89 0.1		10
	0.62 0.63 1.7	0.96 0.99 1.7	1.07 1.06 -1.4	1.07 1.01 -5.4	1.19 1.15 -3.3	1.12 1.13 1.5	1.22 1.25 2.8	1.12 1.14 2.3	1.19 1.21 1.5	1.07 1.07 0.6	1.07 1.08 0.3	0.96 0.97 0.7	0.62 0.62 1.2		11
		0.65 0.67 2.8	0.85 0.85 -0.5	1.07 1.01 -5.4	1.07 1.01 -5.4	1.18 1.20 1.5	1.10 1.12 1.5	1.18 1.19 0.6	1.07 1.07 -0.1	1.07 1.08 1.1	0.85 0.88 3.2	0.65 0.68 3.2			12
			0.65 0.67 1.6	0.96 0.97 0.5	1.06 1.07 0.5	1.04 1.04 -0.1	1.13 1.13 -0.3	1.04 1.02 -1.6	1.06 1.04 -2.4	0.96 0.96 -0.1	0.65 0.68 3.3				13
				0.62 0.62 0.5	0.88 0.89 1.0	1.00 1.01 0.9	0.92 0.92 -0.6	1.00 0.98 -2.2	0.88 0.86 -2.4	0.62 0.60 -2.4					14
						0.59 0.60 1.5	0.74 0.74 -0.1	0.59 0.58 -2.4			PREDICTED MEASURED P/C DIFFERENCE				15

MAP NO. 49 DATE 2/1/74 POWER ∿ 2230 MWT

CONTROL ROD POSITIONS

BANK C AT 228 STEPS

BANK D AT 215 STEPS

BANK P/L 228 STEPS

$F^N_{\Delta H}$ = 1.37 AT H7-GH *

F^N_Q = 1.62 AT H11-GH *

$\overline{F}_z$ = 1.17

A.O.= -0.8

BURNUP = ∿ 7310 MWD/MTU

INCORE TILT

NW - 1.002

NE - 1.004

SW - 0.996

SE - 0.998

* Includes measurement uncertainty
Does not include densification penalties

SURRY UNIT 2 - CYCLE 1 FIGURE 2.3.3

ASSEMBLYWISE POWER DISTRIBUTION

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.65 / 0.69 / 5.5	0.79 / 0.83 / 5.4	0.65 / 0.66 / 1.6				PREDICTED / MEASURED / P/C DIFFERENCE			1
				0.69 / 0.67 / -3.4	0.54 / 0.92 / -2.3	1.08 / 1.08 / 0.5	0.96 / 0.97 / 1.3	1.08 / 1.07 / -0.4	0.54 / 0.90 / -4.5	0.69 / 0.66 / -4.9					2
			0.74 / 0.71 / -3.5	1.09 / 1.05 / -3.8	1.14 / 1.10 / -3.1	1.04 / 1.02 / -1.9	1.15 / 1.14 / -0.6	1.04 / 1.04 / -0.1	1.14 / 1.14 / 0.4	1.09 / 1.07 / -2.1	0.74 / 0.70 / -5.5				3
		0.74 / 0.70 / -5.4	0.92 / 0.89 / -3.7	1.15 / 1.11 / -3.6	1.06 / 1.04 / -1.4	1.15 / 1.15 / -0.3	1.04 / 1.03 / -0.9	1.15 / 1.17 / 1.5	1.06 / 1.11 / 5.3	1.15 / 1.17 / 1.7	0.92 / 0.91 / -1.6	0.74 / 0.73 / -1.7			4
	0.69 / 0.65 / -6.7	1.09 / 1.02 / -6.7	1.15 / 1.12 / -2.7	1.05 / 1.04 / -0.5	1.14 / 1.14 / 0.0	1.02 / 1.04 / 2.4	1.12 / 1.14 / 2.2	1.02 / 1.05 / 3.5	1.14 / 1.20 / 4.9	1.05 / 1.09 / 4.1	1.15 / 1.14 / -0.8	1.09 / 1.09 / 0.2	0.69 / 0.71 / 2.3		5
	0.94 / 0.90 / -3.9	1.14 / 1.09 / -3.9	1.06 / 1.04 / -1.5	1.14 / 1.15 / 0.5	1.00 / 1.02 / 1.5	1.10 / 1.14 / 3.9	0.99 / 1.04 / 5.0	1.10 / 1.15 / 4.8	1.00 / 1.04 / 3.7	1.14 / 1.17 / 2.4	1.06 / 1.16 / 0.4	1.14 / 1.13 / -0.9	0.94 / 0.93 / -0.6		6
0.65 / 0.67 / 2.4	1.08 / 1.09 / 1.3	1.04 / 1.03 / -0.4	1.15 / 1.17 / 1.8	1.02 / 1.05 / 3.0	1.10 / 1.13 / 3.3	0.98 / 1.02 / 4.0	1.08 / 1.13 / 4.6	0.98 / 1.03 / 4.7	1.10 / 1.14 / 4.3	1.02 / 1.04 / 2.3	1.15 / 1.15 / -0.2	1.04 / 1.03 / -0.6	1.08 / 1.05 / -2.6	0.65 / 0.64 / -2.3	7
0.79 / 0.80 / 2.2	0.96 / 0.97 / 1.9	1.15 / 1.18 / 3.1	1.04 / 1.07 / 2.9	1.12 / 1.17 / 4.8	0.99 / 1.03 / 3.9	1.08 / 1.12 / 3.8	0.97 / 1.01 / 4.0	1.08 / 1.12 / 4.2	0.99 / 1.03 / 4.3	1.12 / 1.15 / 2.9	1.04 / 1.04 / 0.7	1.15 / 1.16 / 0.9	0.96 / 0.95 / -1.1	0.79 / 0.77 / -1.9	8
0.65 / 0.67 / 2.4	1.08 / 1.09 / 1.5	1.04 / 1.05 / 1.1	1.15 / 1.18 / 2.2	1.02 / 1.04 / 2.1	1.10 / 1.12 / 2.4	0.98 / 0.99 / 0.8	1.08 / 1.11 / 2.8	0.98 / 1.02 / 4.1	1.10 / 1.14 / 4.2	1.02 / 1.05 / 2.9	1.15 / 1.16 / 0.4	1.04 / 1.04 / 0.1	1.08 / 1.07 / -0.8	0.65 / 0.64 / -2.0	9
	0.94 / 0.92 / -1.7	1.14 / 1.12 / -1.8	1.06 / 1.05 / -0.4	1.14 / 1.15 / 0.7	1.00 / 1.01 / 0.6	1.10 / 1.11 / 0.8	0.99 / 1.01 / 2.1	1.10 / 1.13 / 2.7	1.00 / 1.02 / 1.8	1.14 / 1.15 / 0.6	1.06 / 1.05 / -0.4	1.14 / 1.12 / -1.2	0.94 / 0.92 / -1.9		10
	0.69 / 0.70 / 0.8	1.09 / 1.10 / 0.8	1.15 / 1.15 / 0.4	1.05 / 1.04 / -0.2	1.14 / 1.14 / 0.3	1.02 / 1.03 / 0.8	1.12 / 1.13 / 0.8	1.02 / 1.01 / -0.8	1.14 / 1.13 / -0.6	1.05 / 1.05 / 0.1	1.15 / 1.14 / -0.6	1.09 / 1.07 / -1.7	0.69 / 0.67 / -2.7		11
		0.74 / 0.76 / 3.5	0.92 / 0.94 / 2.0	1.15 / 1.15 / -0.2	1.06 / 1.06 / 0.4	1.15 / 1.16 / 0.9	1.04 / 1.05 / 1.3	1.15 / 1.15 / -0.1	1.06 / 1.05 / -0.7	1.15 / 1.15 / -0.1	0.92 / 0.92 / 0.0	0.74 / 0.71 / -3.3			12
			0.74 / 0.73 / -0.7	1.09 / 1.04 / -4.8	1.14 / 1.11 / -2.0	1.04 / 1.05 / 1.3	1.15 / 1.16 / 1.4	1.04 / 1.03 / -0.4	1.14 / 1.12 / -1.3	1.09 / 1.08 / -0.5	0.74 / 0.73 / -1.2				13
				0.69 / 0.66 / -4.8	0.94 / 0.99 / -5.1	1.08 / 1.05 / -2.7	0.96 / 0.94 / -1.5	1.08 / 1.06 / -1.4	0.94 / 0.92 / -1.5	0.69 / 0.68 / -1.3					14
						0.65 / 0.62 / -5.7	0.79 / 0.75 / -4.2	0.65 / 0.64 / -1.8				PREDICTED / MEASURED / P/C DIFFERENCE			15

MAP NO. 65 DATE 4/14/75 POWER ∿ 2440 MWT

CONTROL ROD POSITIONS

BANK C AT 228 STEPS

BANK D AT 224 STEPS

BANK P/L 228 STEPS

$F^N_{\Delta H}$ = 1.301 AT F5-ID*

F^N_Q = 1.541 AT N11-LE*

$\overline{F}_z$ = 1.16

A.O.= -.8%

BURNUP = ∿ 14,520 MWD/MTU

INCORE TILT

NW - 0.995

NE - 1.007

SW - 1.000

SE - 0.998

* Includes measurement uncertainty
Does not include densification penalties

FIGURE 2.3.4

SURRY UNIT 2 - CYCLE 1

CORE AVERAGE AXIAL POWER DISTRIBUTION

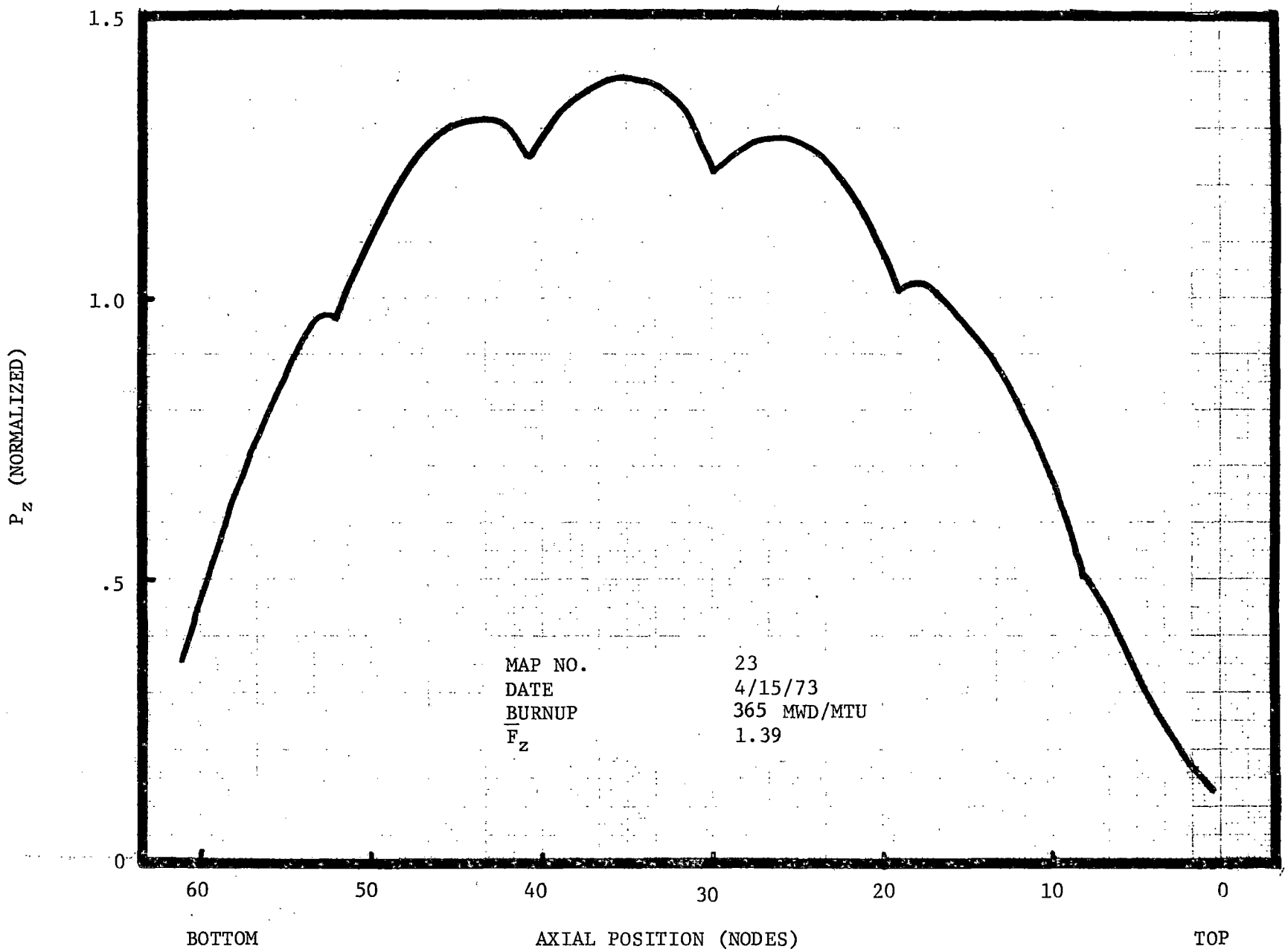
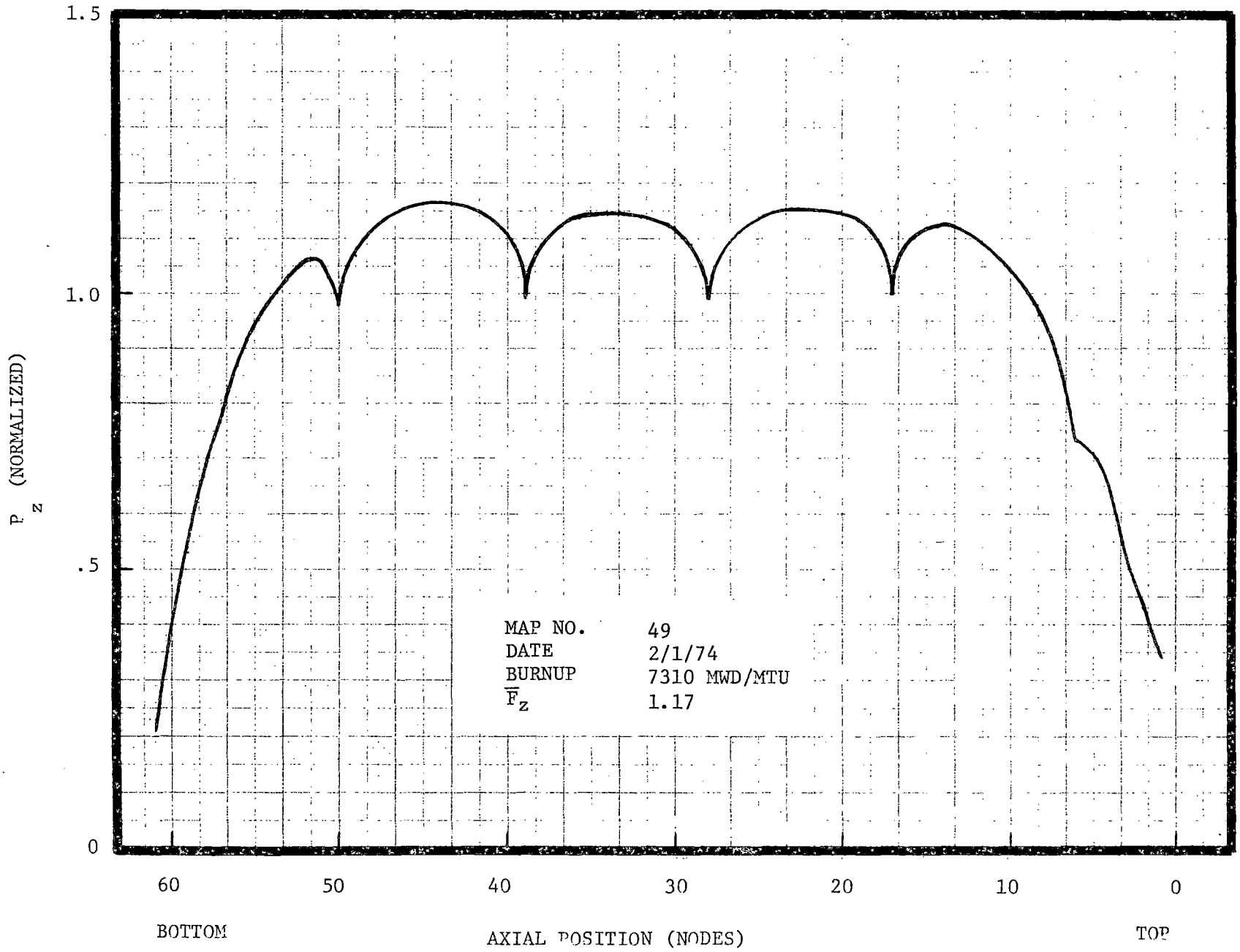


FIGURE 2.3.5

SURRY UNIT 2 - CYCLE 1

CORE AVERAGE AXIAL POWER DISTRIBUTION



SURRY UNIT 2 - CYCLE 1

FIGURE 2.3.6

CORE AVERAGE AXIAL POWER DISTRIBUTION

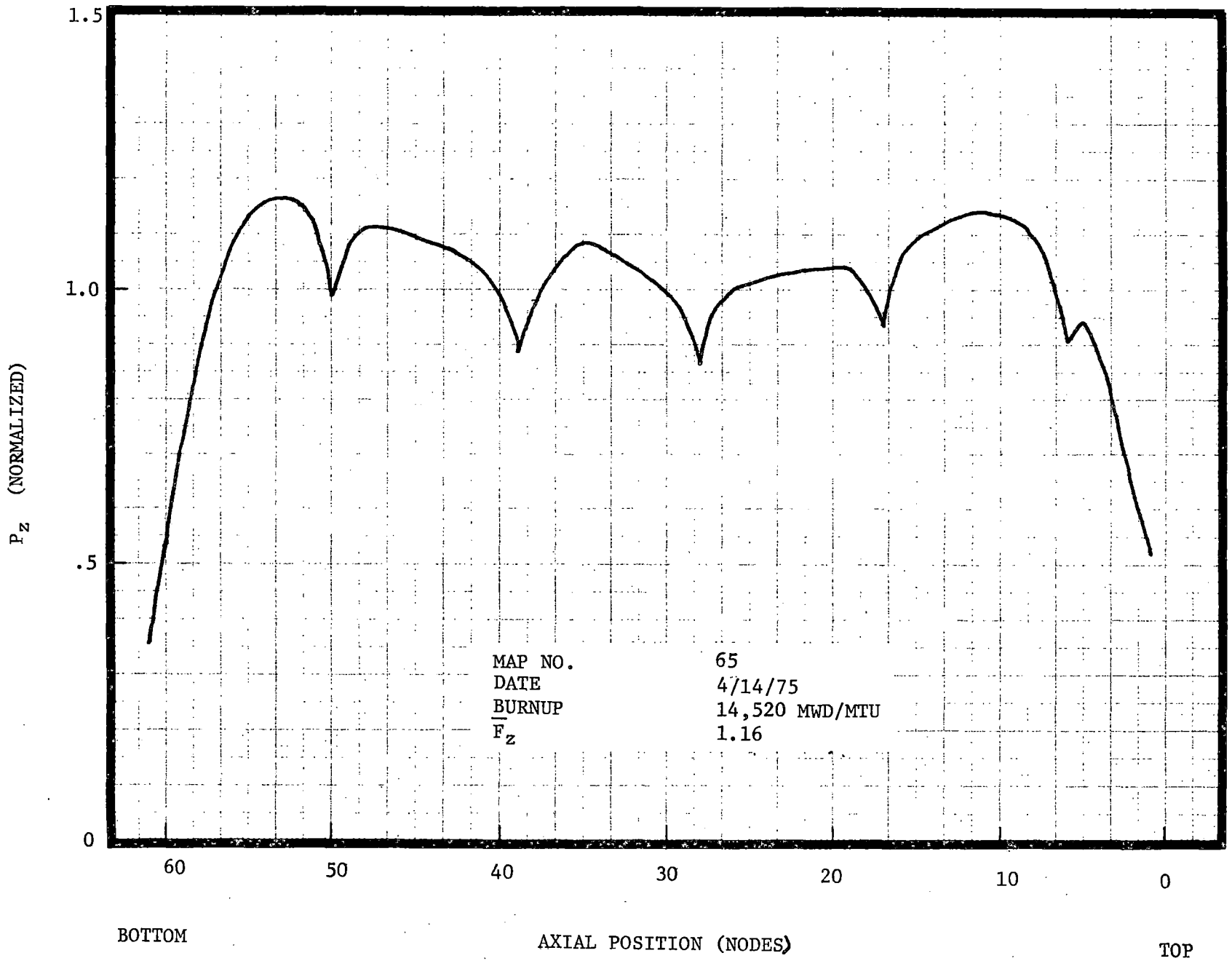


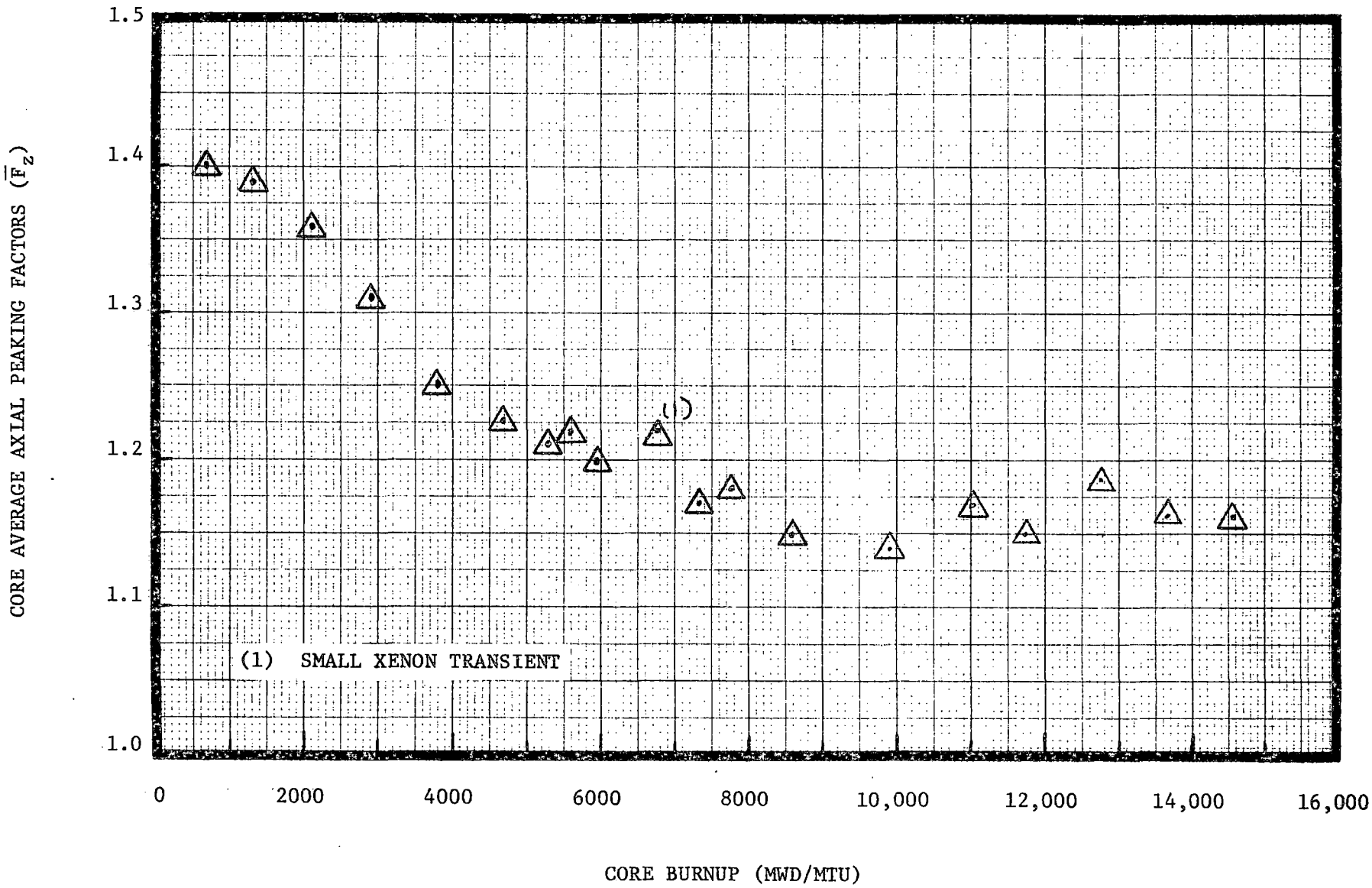
FIGURE 2.3.7

SURRY UNIT 2 - CYCLE 1

CORE AVERAGE AXIAL PEAKING FACTORS

vs.

BURNUP



COMPARISON: SURRY UNIT 1 AND 2 - CYCLE 1

FIGURE 2.3.8

CORE AVERAGE AXIAL PEAKING FACTORS
vs.
BURNUP

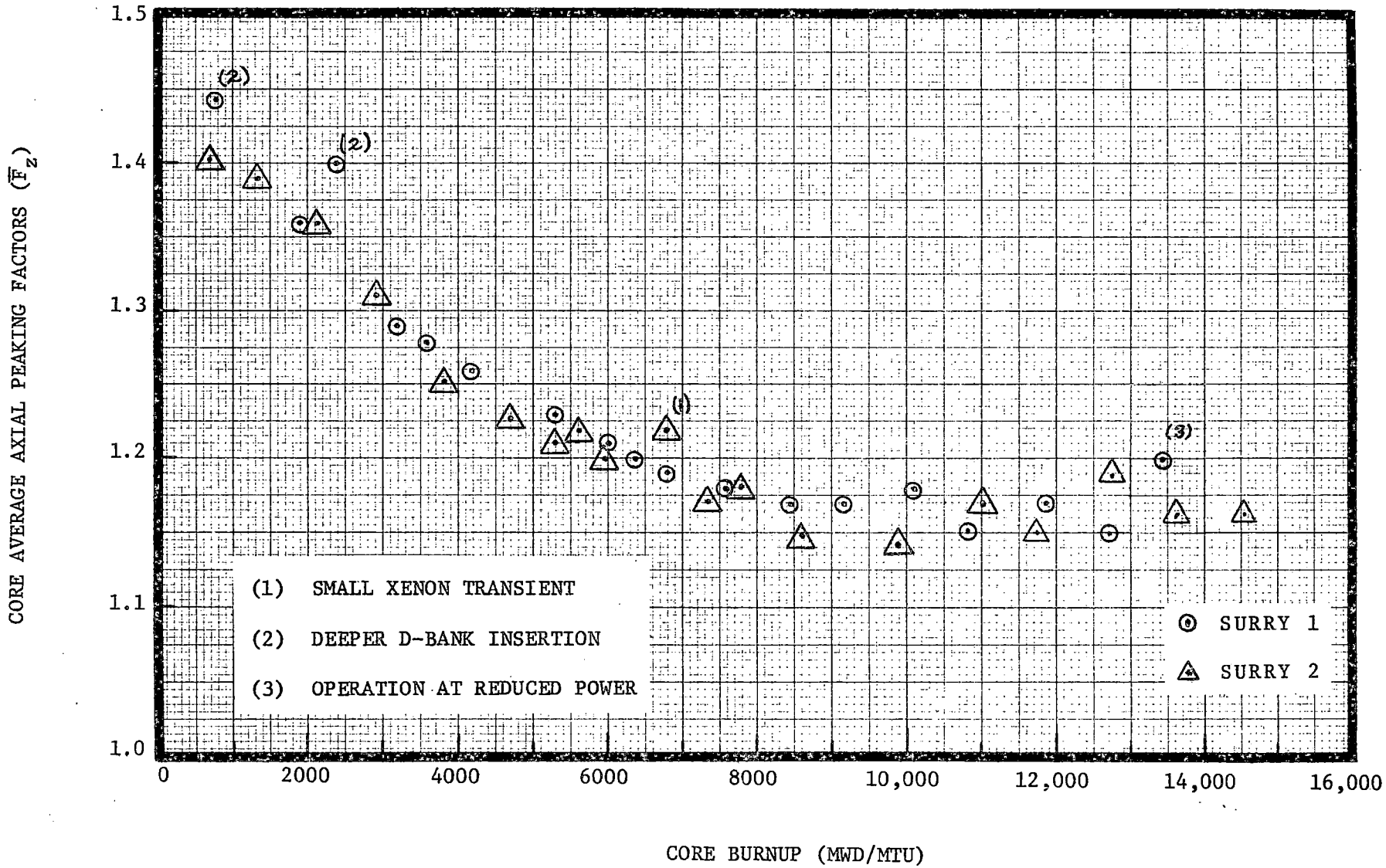
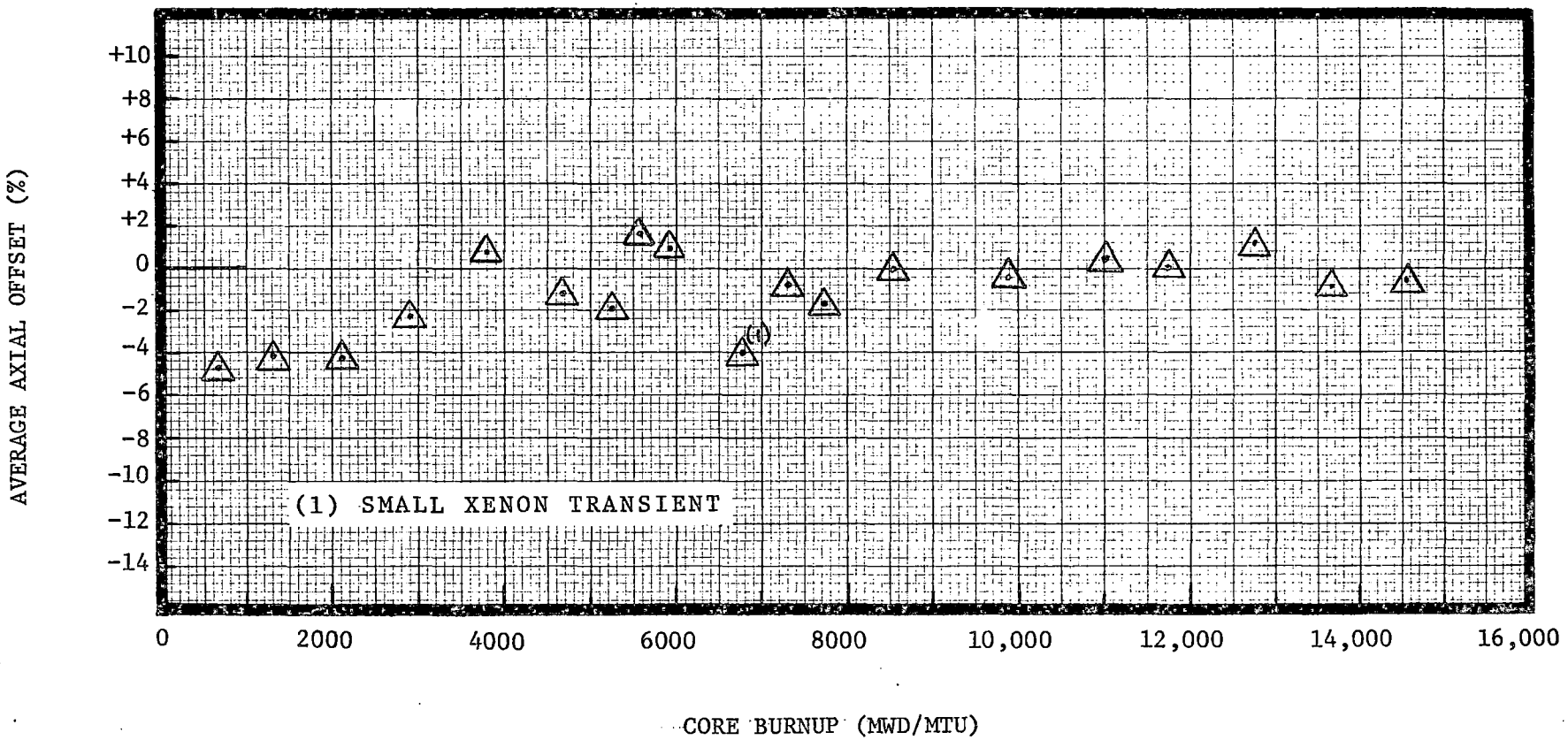


FIGURE 2.3.9

SURRY UNIT 2 - CYCLE 1

AVERAGE AXIAL OFFSET
vs.
BURNUP



COMPARISON: SURRY UNIT 1 AND 2 - CYCLE 1

FIGURE 2.3.10

AVERAGE AXIAL OFFSET
vs.
BURNUP

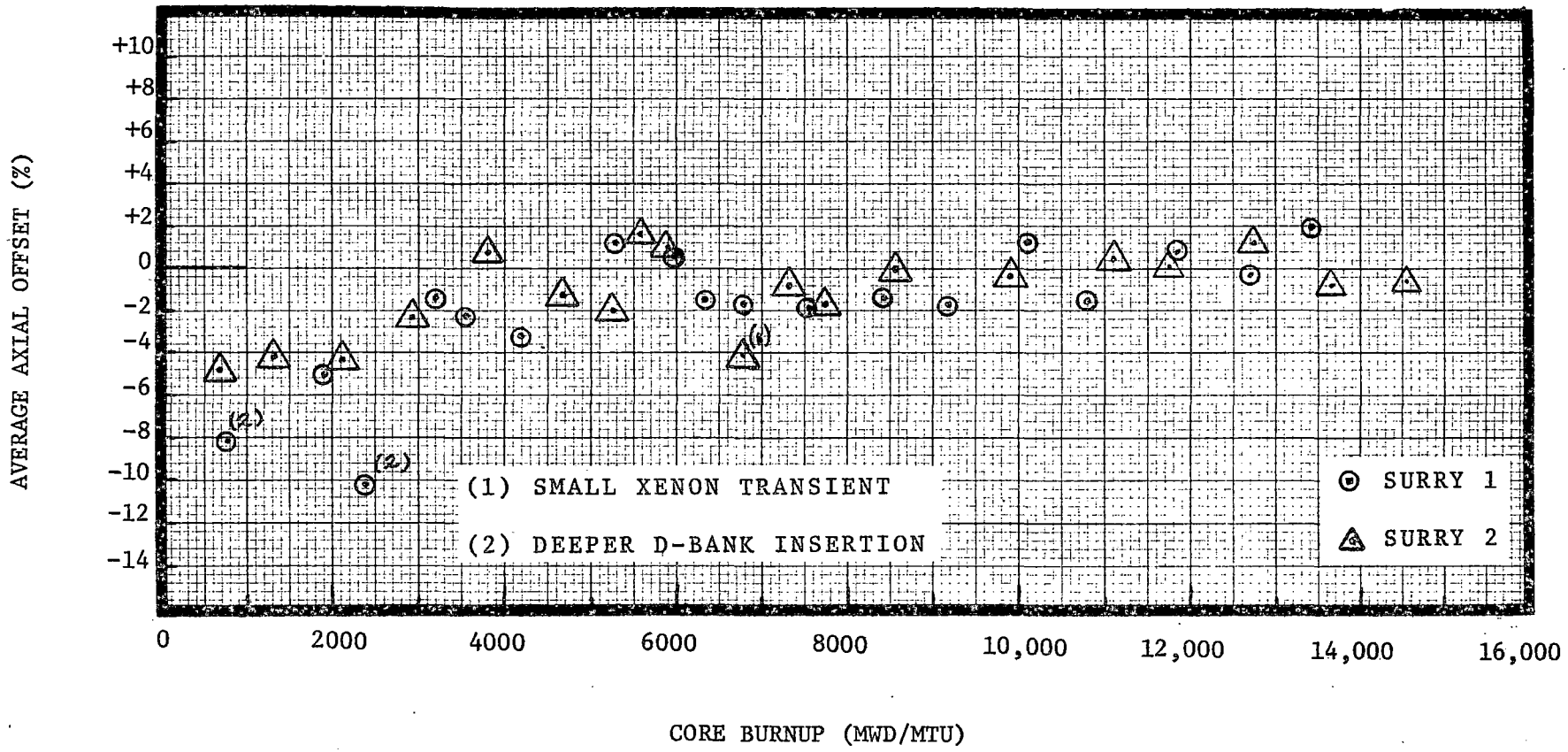
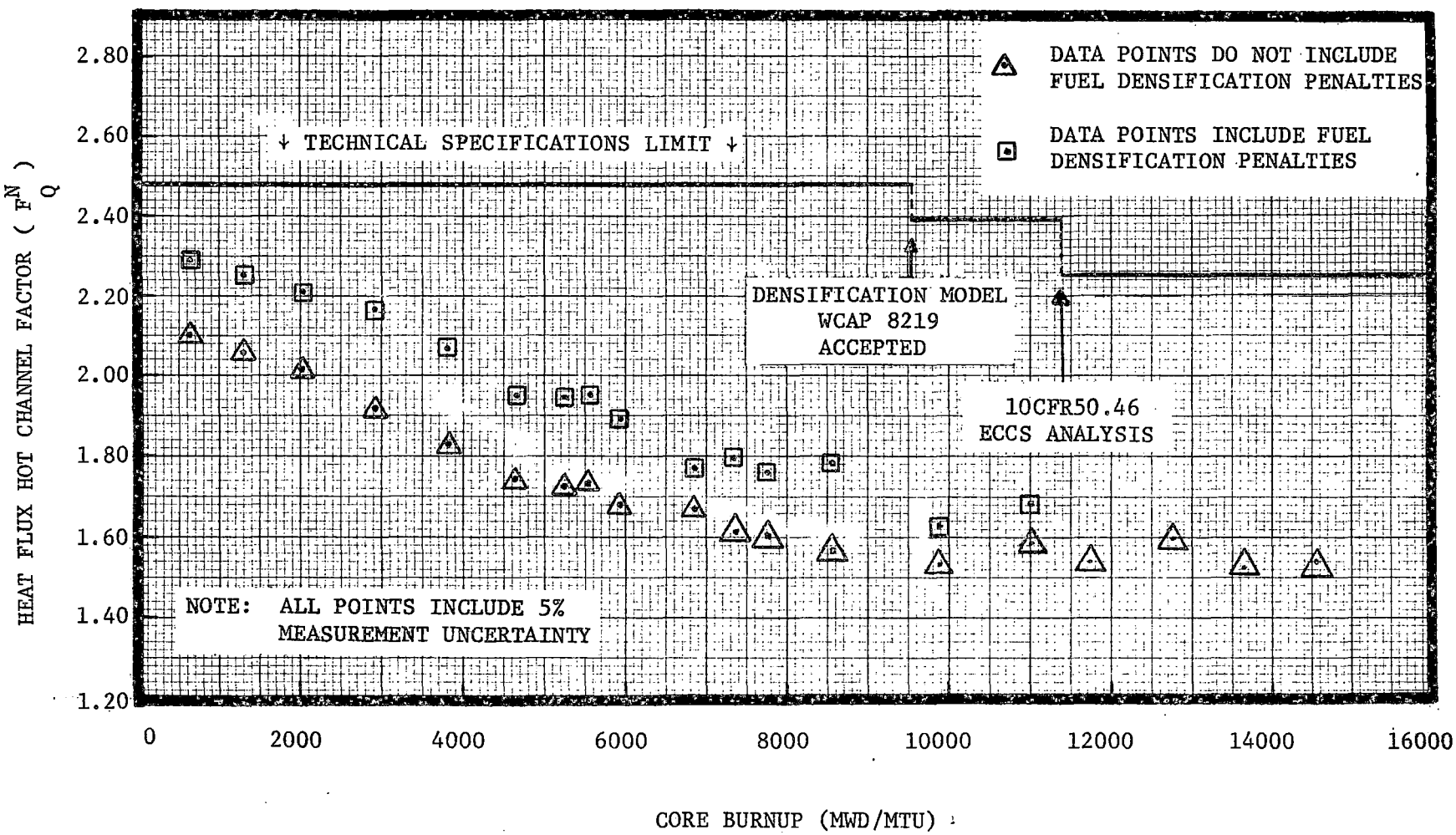


FIGURE 2.3.11

SURRY UNIT 2 - CYCLE 1

HEAT FLUX HOT CHANNEL FACTOR
vs.
BURNUP



COMPARISON: SURRY UNIT 1 AND 2 - CYCLE 1

FIGURE 2.3.12

HEAT FLUX HOT CHANNEL FACTOR

vs.

BURNUP

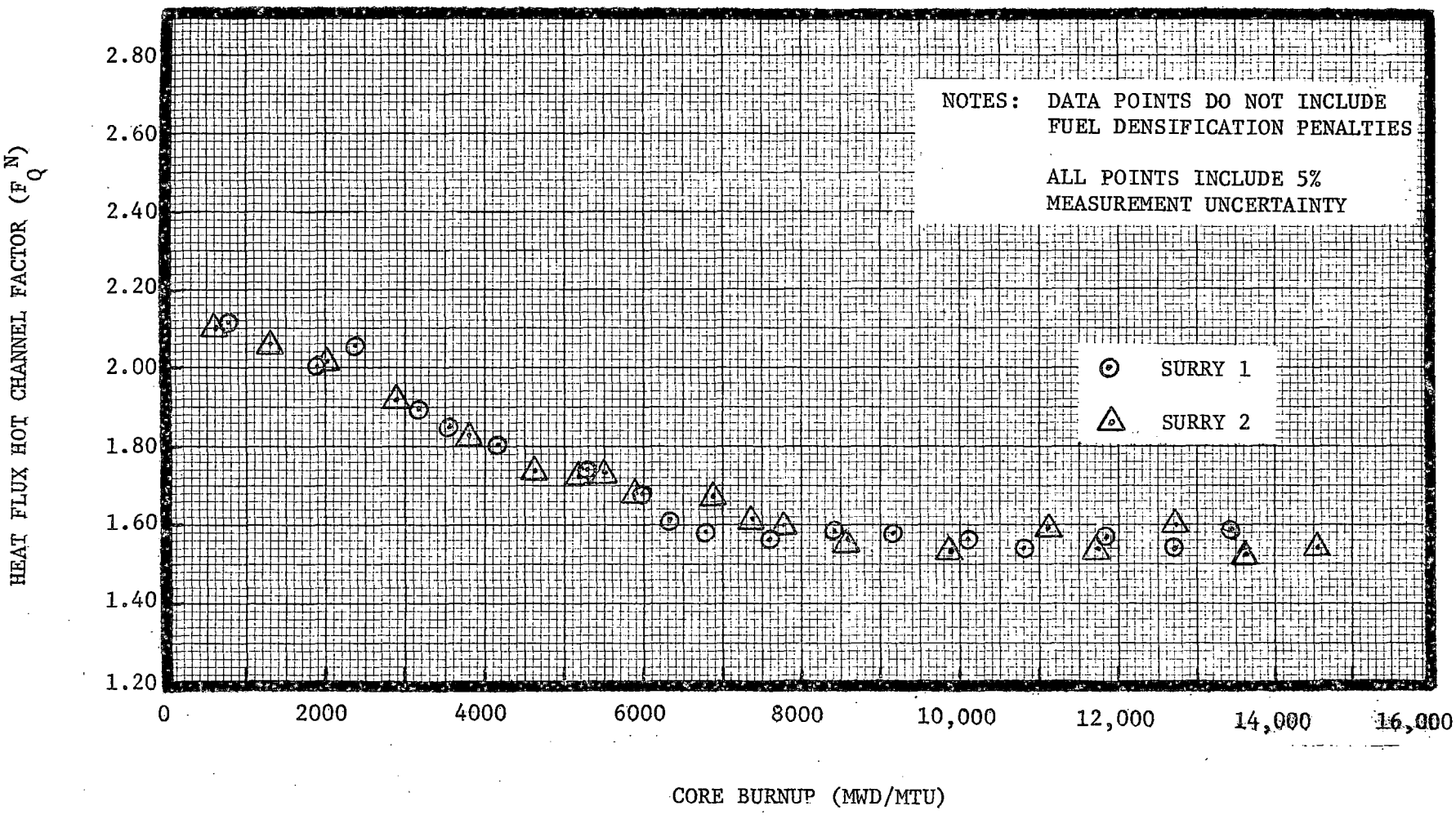
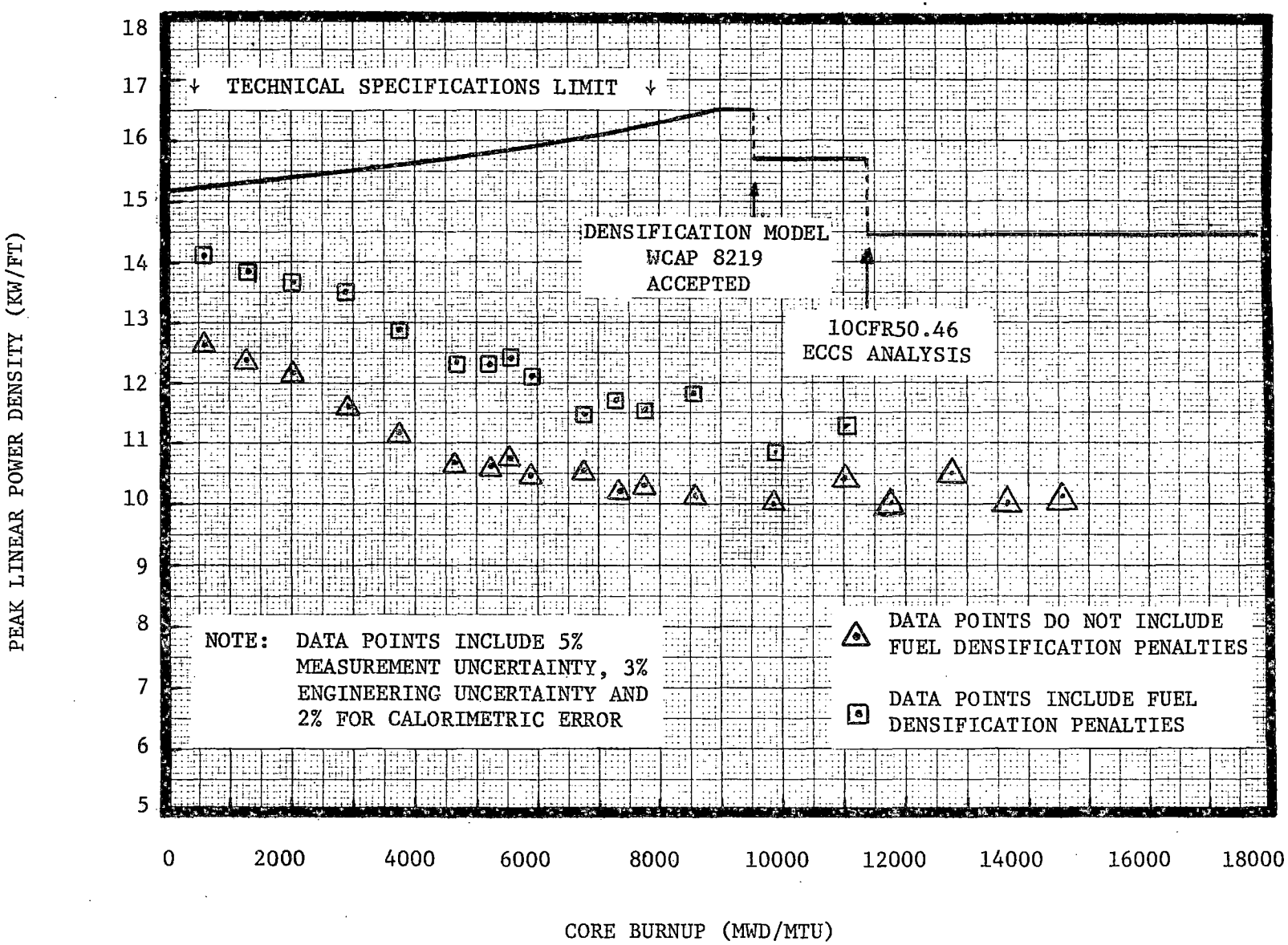


FIGURE 2.3.13

SURRY UNIT 2 - CYCLE 1

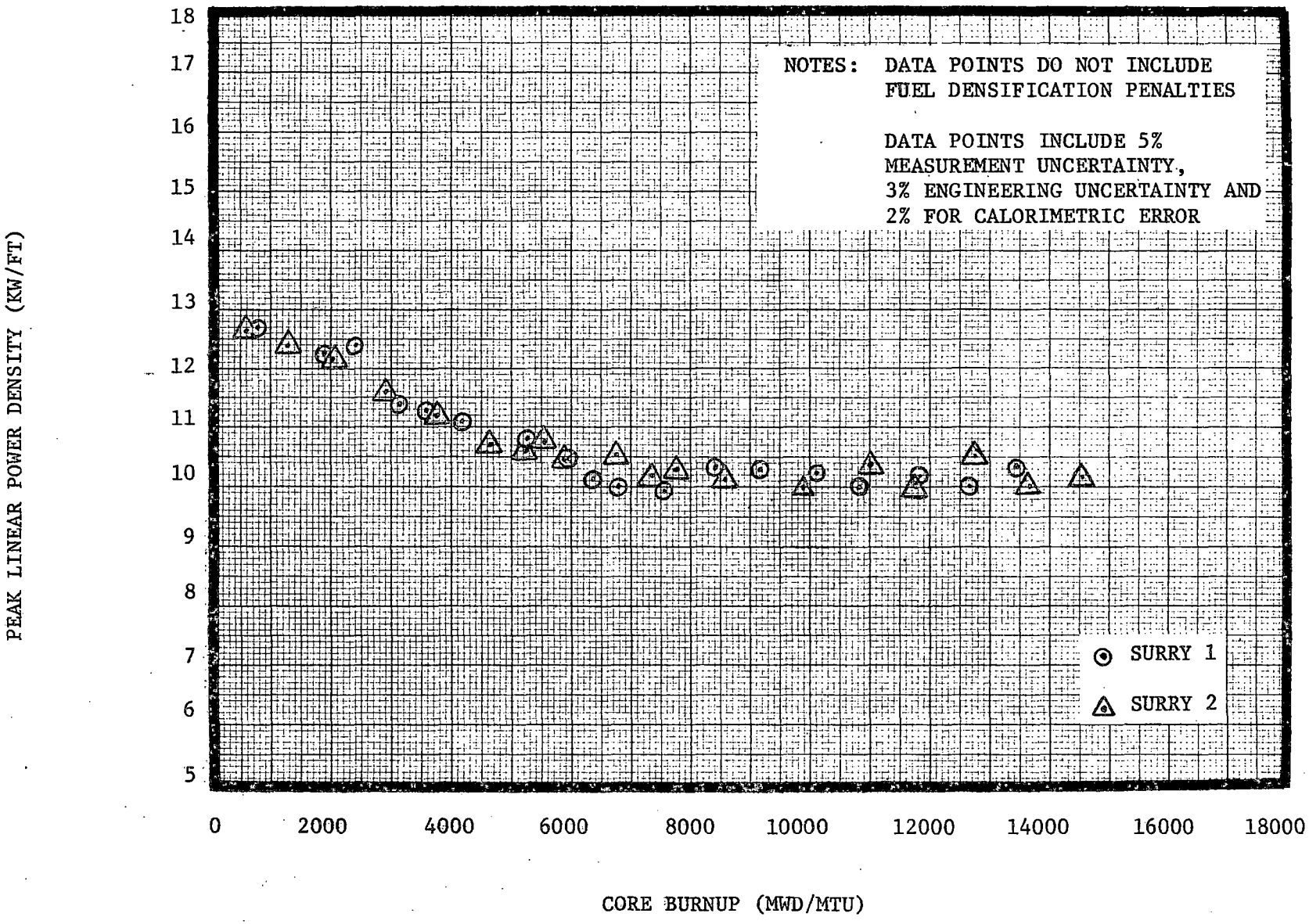
PEAK LINEAR POWER DENSITY
vs.
BURNUP



COMPARISON: SURRY UNIT 1 AND 2 - CYCLE 1

FIGURE 2.3.14

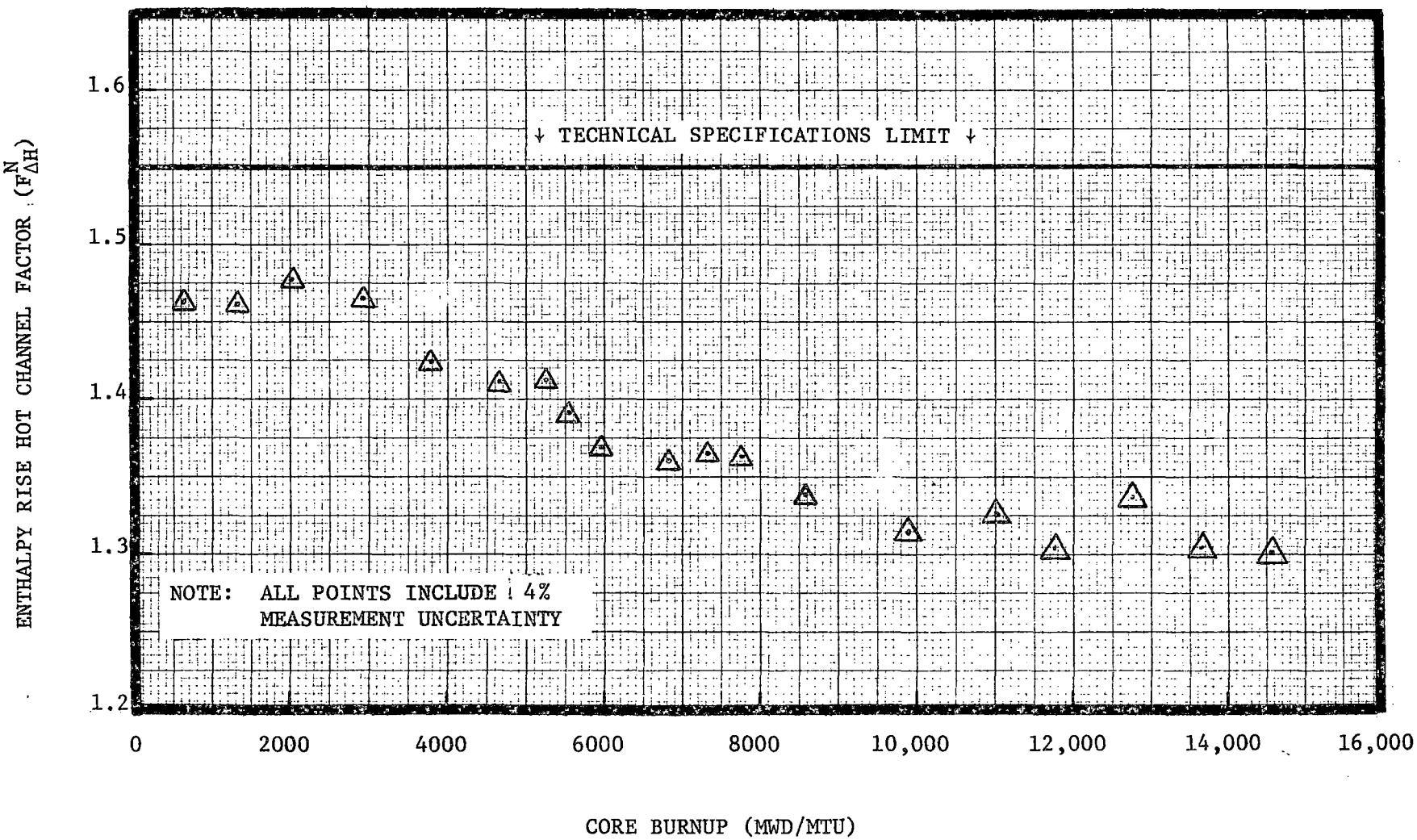
PEAK LINEAR POWER DENSITY
vs.
BURNUP



SURRY UNIT 2 - CYCLE 1

FIGURE 2.3.15

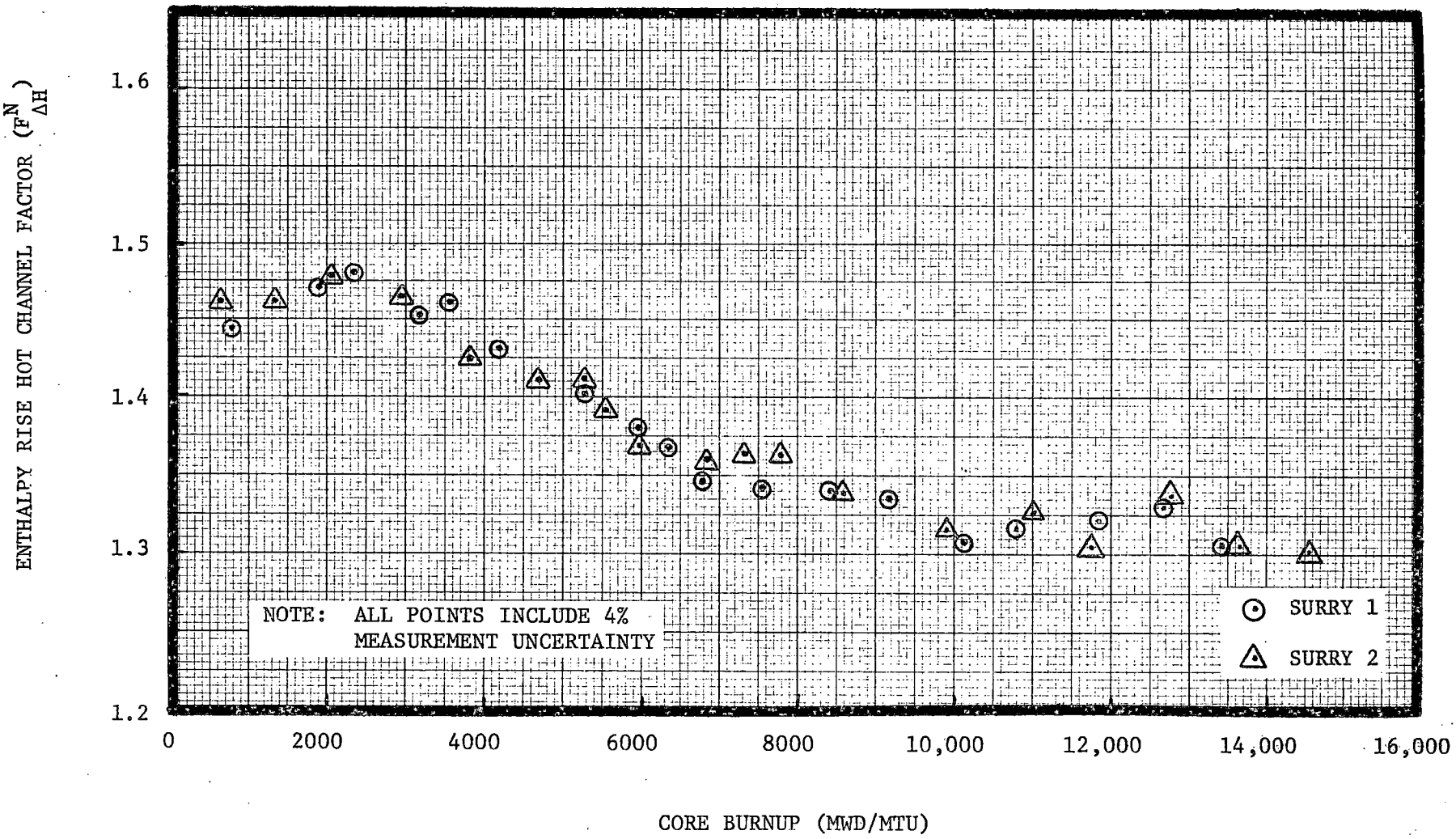
ENTHALPY RISE HOT CHANNEL FACTOR
vs.
BURNUP



COMPARISON: SURRY UNIT 1 AND 2 - CYCLE 1

FIGURE 2.3.16

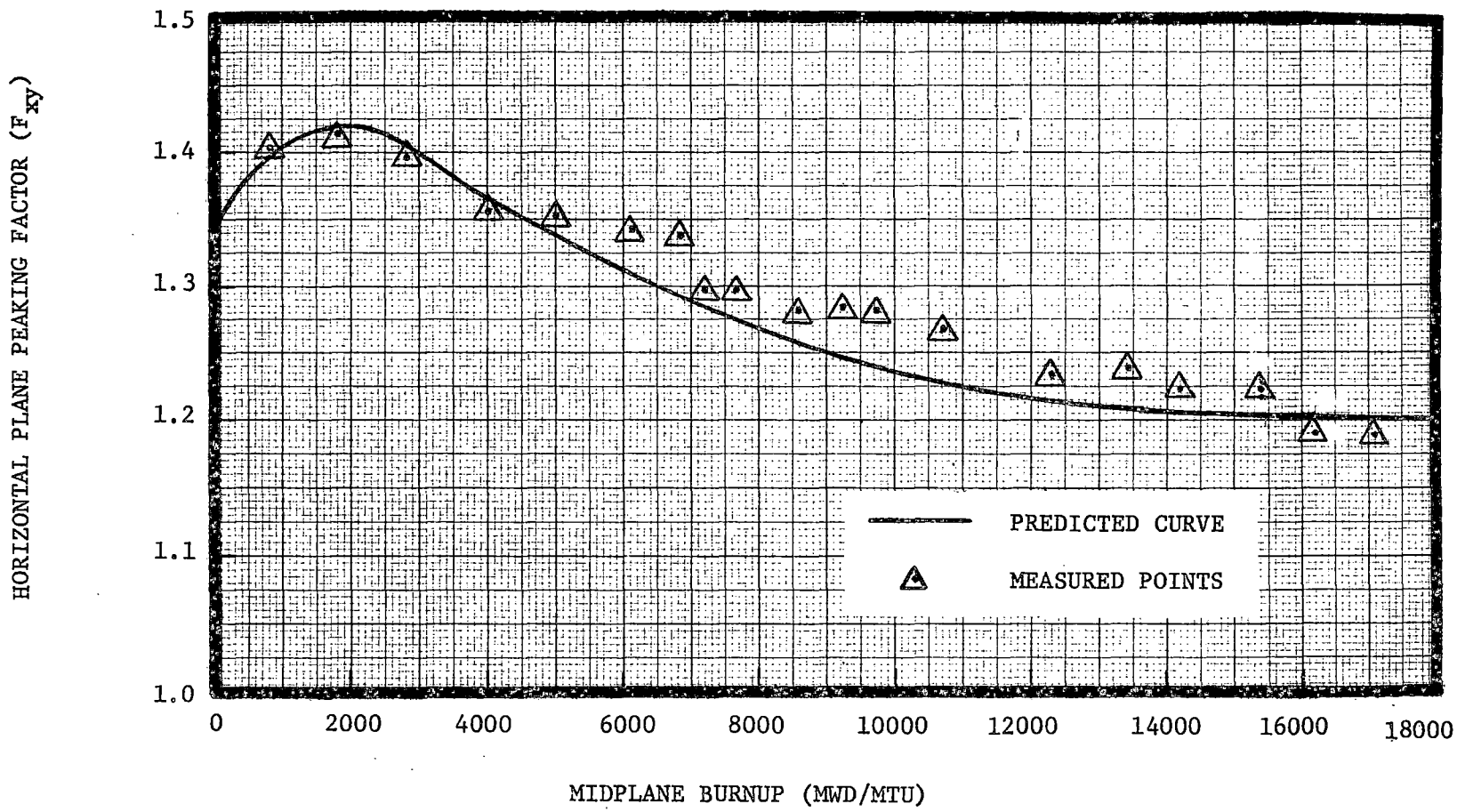
ENTHALPY RISE HOT CHANNEL FACTOR
vs.
BURNUP



SURRY UNIT 2 - CYCLE 1

FIGURE 2.3.17

HORIZONTAL PLANE PEAKING FACTOR AT CORE MIDPLANE
vs.
BURNUP



COMPARISON: SURRY 1 AND 2 - CYCLE 1

FIGURE 2.3.18

HORIZONTAL PLANE PEAKING FACTOR AT CORE MIDPLANE
vs.
BURNUP

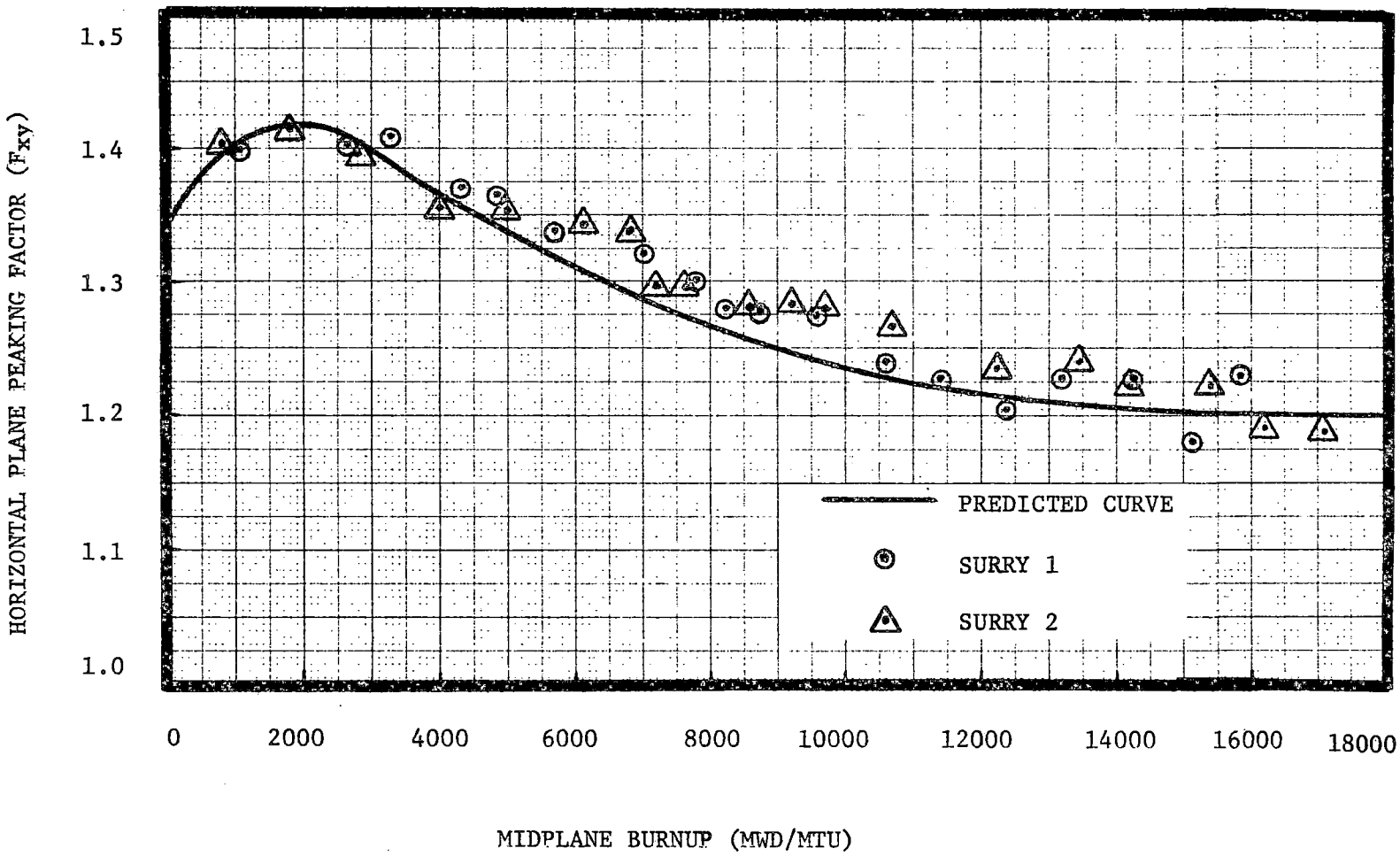
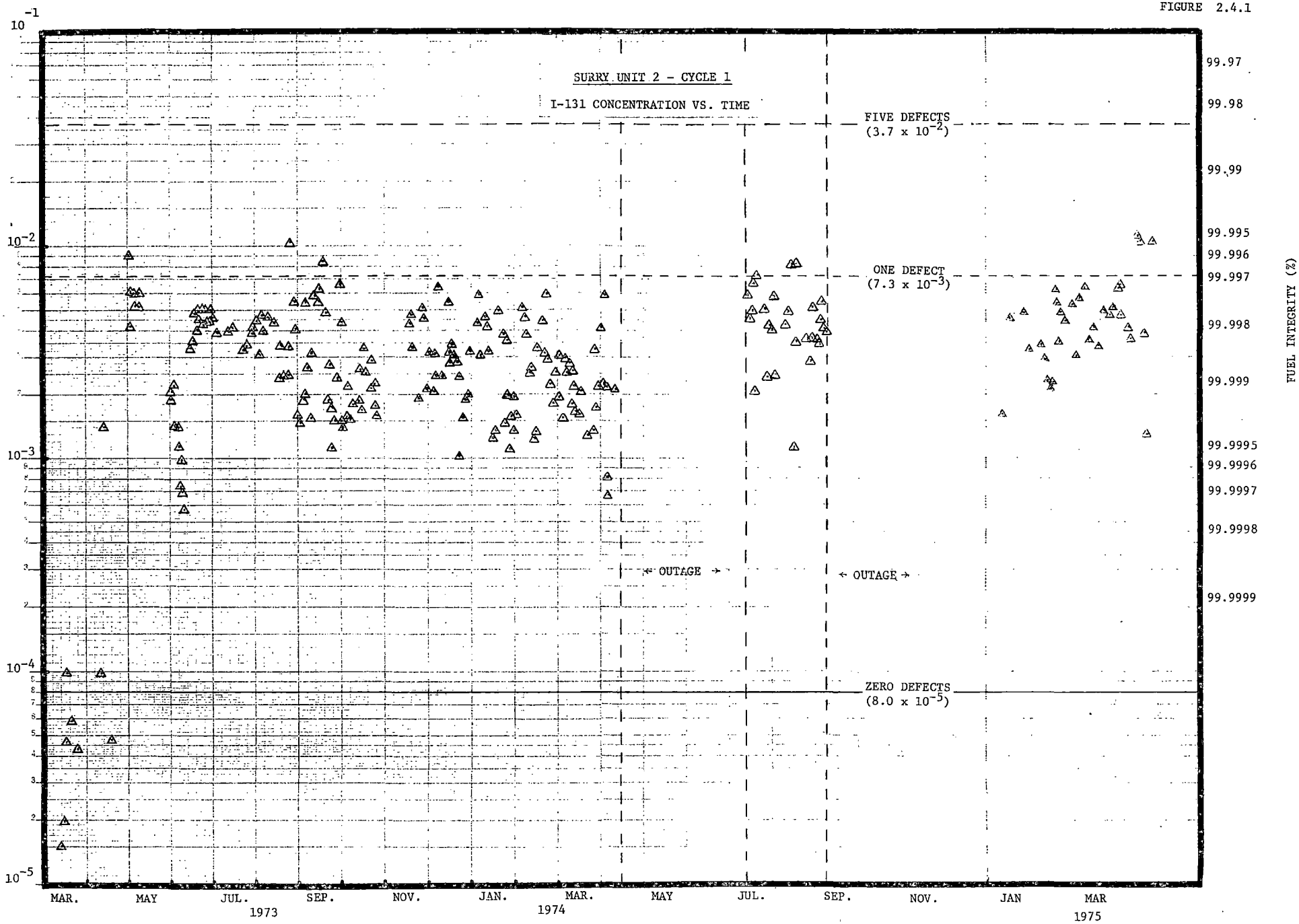


FIGURE 2.4.1


SURRY UNIT 2 - CYCLE 1
I-131 CONCENTRATION VS. TIME
FIVE DEFECTS
(3.7 x 10^-2)
ONE DEFECT
(7.3 x 10^-3)
ZERO DEFECTS
(8.0 x 10^-5)
OUTAGE
OUTAGE
I-131 CONCENTRATION (μCi/ml)
FUEL INTEGRITY (%)
10^-1
10^-2
10^-3
10^-4
10^-5
99.97
99.98
99.99
99.995
99.996
99.997
99.998
99.999
99.9995
99.9996
99.9997
99.9998
99.9999
MAR.
MAY
JUL.
SEP.
NOV.
JAN.
MAR.
MAY
JUL.
SEP.
NOV.
JAN
MAR
1973
1974
1975

SURRY UNIT 2 - CYCLE 1

FIGURE 2.4.2

I-131/I-133 RATIO vs. TIME

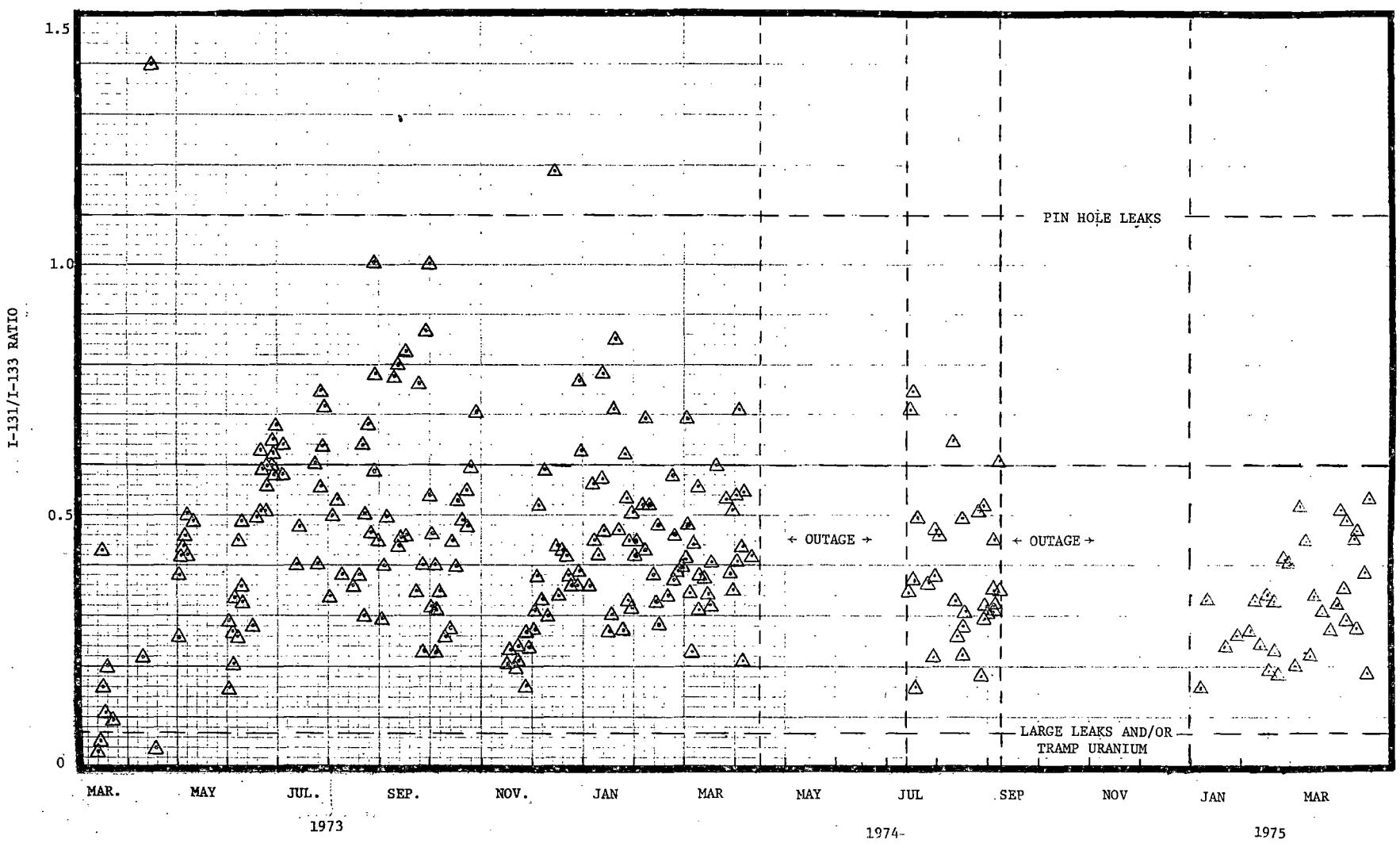


TABLE 2.5.1

LOCATIONS OF DENSIFICATION POWER SPIKES
-- SURRY UNIT 2 --

Strip-Chart Figure Number(1)	Assembly Location	Detector	Fuel Region(2)	Enrich-ment (w/o U235)	UO_2 Density (% Theo-retical)	Power Spike (%)			Change in Last 3 Maps	Location of Spike(3)	Status
						Dec. 11 1974	April 26 1975	Δ			
1	J-7	All	1	1.86	93.7	0.6	1.7	1.1	slight	1	confirmed
2	B-8	D	1	1.86	93.7	0.8	1.5	0.7	moderate	1	confirmed
3	N-7	E	1	1.86	93.7	0.5	0.5	0.0	nil	1	confirmed
4	G-9	E	1	1.86	93.7	0.5	0.5	0.0	nil	1	confirmed
5	F-6	B	1	1.86	93.7	0.2	0.1	0.1	slight	1	confirmed
6	N-12	E	3	3.11	91.8	-	0.9	0.9	large	1,2	suspected
7	J-3	D	1	1.86	93.7	-	0.5	0.5	slight	2	suspected
8	J-5	B	1	1.86	93.7	0.4	0.4	0.0	nil	1,3	suspected
9	L-11	B	1	1.86	93.7	0.2	0.2	0.0	nil	1	suspected

(1) See Appendix E

(2) Standard W region definition

(3) 1-upper third; 2-midplane third; 3-lower third

TABLE 2.5.2

COMPARISON: SURRY 1 AND 2
DENSIFICATION POWER SPIKES

UNIT	ASSEMBLY LOCATION	FUEL REGION	NOMINAL UO_2 DENSITY (% TD)	BLIP MAGNITUDE (%)	CORE AXIAL LOCATION(1)
Surry 1	B-10	3	91.9	4.8	1
	N-12	3	91.9	4.3	1
	F-2	3	91.9	2.8	1
	B-7	3	91.9	2.7	1
	L-8	2	92.9	1.8	1
	H-13	2	92.9	1.5	1
	F-9	2	92.9	1.5	1
	M-3	3	91.9	1.5	1
	R-8	3	91.9	1.4	3
	N-5	3	91.9	1.3	1
	N-10	2	92.9	1.2	1
	A-9	3	91.9	1.0	1
	G-9	1	93.5	0.8	2
	H-11	2	92.9	0.8	2
	H-1	3	91.9	0.8	1
	L-14	3	91.9	0.8	1
	D-7	2	92.9	0.7	2
	L-4	2	92.9	0.5	1
Surry 2	J-7	1	93.7	1.7	1
	B-8	1	93.7	1.5	1
	N-7	1	93.7	0.5	1
	G-9	1	93.7	0.5	1
	F-6	1	93.7	0.1	1

(1) 1-upper third; 2-midplane third; 3-lower third

Section 3

CONCLUSIONS

The Surry 2 core has completed Cycle 1. Throughout the cycle, all performance indicators compared closely to design predictions and all Technical Specifications limits were met by significant margins. No abnormalities in reactivity, power distribution, or burnup accumulation were detected. In addition, the excellent mechanical integrity of the core has not changed perceptibly throughout Cycle 1, as indicated by the radioiodine analysis. Lastly, fuel densification effects in terms of blip formation were less than anticipated.

DEFINITION OF TERMS

ACTIVITY - Number of nuclear disintegrations per unit time taking place in a radioactive nuclide. Usually expressed in terms of μCi (3.7×10^4 disintegrations per second).

AXIAL OFFSET - The percent difference between the fraction of total core power produced in the upper half of the core and that produced in the lower half of the core.

BATCH - A group of assemblies which are inserted into the reactor at the same time. All of the assemblies in a batch may or may not have the same nuclear characteristics or be discharged at the same time. (See REGION)

BORON (Soluble) - A strong neutron absorber which is dissolved in the reactor coolant and used for reactivity control. The boron concentration in the coolant is expressed in terms of parts per million water (ppm).

BURNUP - The quantity of energy produced per unit weight of fuel. It is a measure of fuel consumption and typically has units of megawatt-days per metric ton of initially contained uranium (MWD/MTU).

CRITICAL - Condition in which the neutron chain reaction in a reactor is just self-sustaining.

CRITICAL BORON CONCENTRATION - The concentration of soluble boron in the coolant at which the reactor is just critical.

CRITICAL HEAT FLUX (DNB) - The point of transition between nucleate boiling and film boiling at the coolant-clad interface. Beyond this critical heat flux point, a vapor blanket forms on the cladding surface and acts as an insulator, thereby resulting in abnormally high clad temperatures.

DENSIFICATION - A recently discovered phenomenon in which the UO_2 fuel pellets shrink both radially and axially as a result of neutron irradiation.

DENSIFICATION-INDUCED GAPS - When a column of UO_2 pellets in a fuel rod shrinks due to densification, gaps may be formed in the pellet column due to pellet-clad interaction.

FISSION PRODUCTS - Residual nuclei which are generated during the fission process and which retain nearly all of the energy formed in the process.

FLUX (Neutron) - A measure of the intensity of neutrons, i.e., the number of neutrons passing through one square centimeter in one second.

FLUX MAP - A three-dimensional representation of the flux distribution throughout the core. It is obtained from measurements made with the movable detector system. (See MOVABLE DETECTOR)

HALF-LIFE - Period of time in which a radioactive element decays to half its original concentration.

IODINE-131; IODINE-133 - Fission products which, because of their radioactive properties, can be used to determine fuel clad defects.

LINEAR POWER DENSITY - Power generated per unit length of fuel rod. This parameter is a measure of the central temperature of the fuel rod and stored heat. Usually expressed in units of Kw/ft.

LOAD FACTOR - The ratio of the actual reactor energy generated over a period of time to the potential energy which could have been generated by the reactor over that same period of time.

MOVABLE DETECTOR - A traversing incore fission chamber which generates a voltage signal proportional to the flux level the chamber "sees". Five such detectors are moved at one time through the core to monitor the flux distribution. A total of 50 locations are traversed to generate a complete flux map of the core (See FLUX MAP)

NODE - The core is divided into 60 equally spaced axial segments by the movable detector monitoring system. Nodal representation is then used by the INCORE program in deriving the power distributions.

POWER DENSITY - Power generated per unit volume in the core. Usually expressed in units of Kw/Liter.

POWER SPIKE - A local increase in power due to densification-induced gaps in the pellet stack.

RADIAL POWER MAP - An X-Y distribution of power on an assembly basis, normalized to the average assembly power.

REACTIVITY - In a nuclear reactor, a measure of the departure from a just critical condition. Usually expressed in units of pcm (10^{-5} $\Delta K/K$), it is normal to refer to a pcm quantity of reactivity associated with some component of the reactor since removing that component will change the reactivity of the reactor by that amount.

REGION - A group of assemblies which have essentially the same nuclear design characteristics and are inserted into the reactor at the same time. (See BATCH)

TECHNICAL SPECIFICATIONS - The document setting forth mandatory operational and surveillance requirements for a nuclear facility. It is issued by the AEC as part of the operating license.

TILT - A deviation from perfect symmetry. Usually used with respect to radial burnup or power distributions and relates each quadrant to the average of all four quadrants.

XENON - A gaseous fission product which has a very strong neutron absorption capability. Unless controlled, xenon concentration can shift up and down the axial axis of the core, thereby causing axial power transients.

$\Delta K/K$ - Mathematical expression for reactivity, where "K" is the ratio of the number of neutrons present in a reactor in any one neutron generation to that in the immediately preceding generation. (See REACTIVITY)

Appendix B

TOTE PROGRAM DESCRIPTION

TOTE is an isotopic and burnup follow program written by Westinghouse to accurately keep track of core isotopics and accumulated burnup. It is presently operational on the Virginia Electric and Power Company's IBM-370 computer system.

In the analysis of in-core flux maps the INCORE code punches out burnup rate information for every fuel region. These regions normally include each fuel assembly (and fueled follower) and about one hundred individual fuel rods of interest. The burnup rate is given as the megawatt-hours generated in a given fuel region per 1000 megawatt-hours generated by the core. The total for the fuel region is given as well as the value for each of four axial segments of approximately equal length. In addition, the core average axial power distribution is punched out.

The TOTE user inputs: (a) the core energy (megawatt-hours) associated with each of the above burnup rate decks; (b) cards describing each fuel region (including MTU, corresponding INCORE source number, previous burnup, isotopic depletion type, etc.); (c) tables of the change in isotopics (U-235, U, Pu, etc., up to ten) with burnup; and, (d) the burnup rate decks from INCORE. Printed output includes input; core, cycle and fuel region burnup; isotopics; the energy weighted core average axial power distribution; and the initial and current uranium values for each fuel batch and the core. Interpolation for isotopics is quadratic generally using the two preceding and one succeeding table entry. Interpolation for uranium value is linear. Punched output consists of Item (b) above for subsequent TOTE runs.

Appendix C

FOLLOW PROGRAM DESCRIPTION

FOLLOW is a data analysis computer program written by Westinghouse to process reactor operation data and calculate nominal boron concentrations. It is presently operational on the Virginia Electric and Power Company's IBM-370 computer system.

The FOLLOW Code is designed to describe the nearly linear relationship between available core reactivity and cycle burnup. It is most convenient to use boron as a measure of core reactivity with off nominal* corrections being made for power, xenon and samarium, temperature, and control rods in terms of their boron worth. These off nominal corrections are made as can be seen from this equation:

$$\begin{array}{l}
\text{corrected or nominal boron concentration} = \text{measured boron concentration} + \left[\text{inverse boron worth}\right] \left[\text{off nominal reactivity correction due to rod group 1 position}\right] \\
\quad + \text{off nominal reactivity correction due to rod group 2 position} + \text{off nominal reactivity correction due to moderator temperature} \\
\quad + \text{off nominal reactivity correction due to power} + \text{off nominal reactivity correction due to xenon and samarium behavior}
\end{array}$$

Options should be chosen so as to satisfy the above equation in ways appropriate to the reactor and its method of operation.

---

* Nominal conditions have generally meant hot full power equilibrium conditions with control rods at their upper limits.

The boric acid concentration in the primary loops of operating PWR's is typically measured one to three times per day. After proper normalization, this data is plotted against cycle burnup and form the "boron depletion curve". Since this curve is well behaved and nearly linear from beginning to end of the cycle, it can provide the following information:

1) Detection of abnormal (unexpected) behavior in core reactivity Technical Specifications require boron follow for this purpose.

2) Extrapolation to end-of-cycle life for scheduling refueling, or determination of end-of-life for contractual purposes.

3) Rate of loss of reactivity with burnup for confirmation of design procedures.

4) Indication of the need for updating reactivity coefficients needed for plant operation.

5) Best estimate of beginning of cycle, hot-full-power criticality under equilibrium conditions.

Appendix D

INCORE PROGRAM DESCRIPTION

INCORE is a data analysis computer program written by Westinghouse to process information obtained by in-core instrumentation. It is presently operational on the Virginia Electric and Power Company's IBM-370 computer system.

In the reduction of in-core flux and temperature measurements the INCORE code performs the following:

1. Reads input consisting of (a) a description of the amount and type of data to be read in (such as number of flux traces and thermocouple readings, etc.); (b) a description of the reactor when the measurements were made (such as power level, inlet and outlet temperature, etc.); (c) the actual data and information relevant to it (such as what flux thimbles were used, neutron cross sections of the sensor, etc.); (d) analytical information (such as calculated thimble fluxes); and (e) specification of options as to what thimbles will be employed in local power predictions, what calculations are to be done, etc.
2. Corrects raw pointwise flux measurements for background current, changes in power level between measurements, relative detector sensitivities, etc., to determine pointwise reaction rate in the flux thimbles.
3. Compares the measured reaction rates determined above with expected values and rejects data if they differ from expected values by more than an input rejection criteria. An error analysis is performed for subsequent determination of the uncertainty to attach to calculated peaking factors.

4. Computes relative local power in each fuel assembly, and in each fuel rod chosen for attention. Local relative power is computed as:

$$\frac{\boxed{\text{Reaction Rate in Flux Thimble}}_{\text{Measured}} \times \boxed{\frac{\text{Local Power}}{\text{Reaction Rate in Flux Thimble}}}_{\text{Analytical}}}{\boxed{\text{Average of Numerator for All Fuel in Core}}}$$

Local absolute power or heat flux is then computed by multiplying the above quantity by the average specific power or heat flux in the core determined from the measured total core power at the time the data were taken. A weighted average of data from all nearby thimbles can be used in determining local relative power. Different PDQ ratios of power to reaction rate are used depending on the control rod configuration at each elevation.

5. Calculates the relative quadrant powers and the power weighted average axial distribution in the core. The expected and measured power peaking factors are compared for each power generating region.

6. Outputs the twenty highest values of $F^N_{\Delta H}$ and F^N_Q in descending order with an identifying number so that hot spot locations in the core can be determined.

7. Calculates the rate at which burnup is being accumulated for four axial regions for each fueled area.

8. Corrects thermocouple data for calibration, and converts them to local enthalpy. Relative local enthalpy rise is then calculated using the vessel inlet and outlet temperatures and the core bypass flow. The local enthalpy rise measured by thermocouples is compared with

that predicted from flux measurements using relative local flow rates.

9. Calculates the margin to departure from nucleate boiling (DNB) using the W-3 correlation for selected channels.

10. Outputs the input data, parameters used, and major calculated values.

Appendix E

DENSIFICATION STRIP-CHART TRACES

The following nine figures are strip-chart recorder traces taken during the flux mapping process and show confirmed or suspected power spikes encircled:

FIGURE NO.	THIMBLE
1	J-7
2	B-8
3	N-7
4	G-9
5	F-6
6	N-12
7	J-3
8	J-5
9	L-11

FIGURE 1

J-7

FIGURE 2

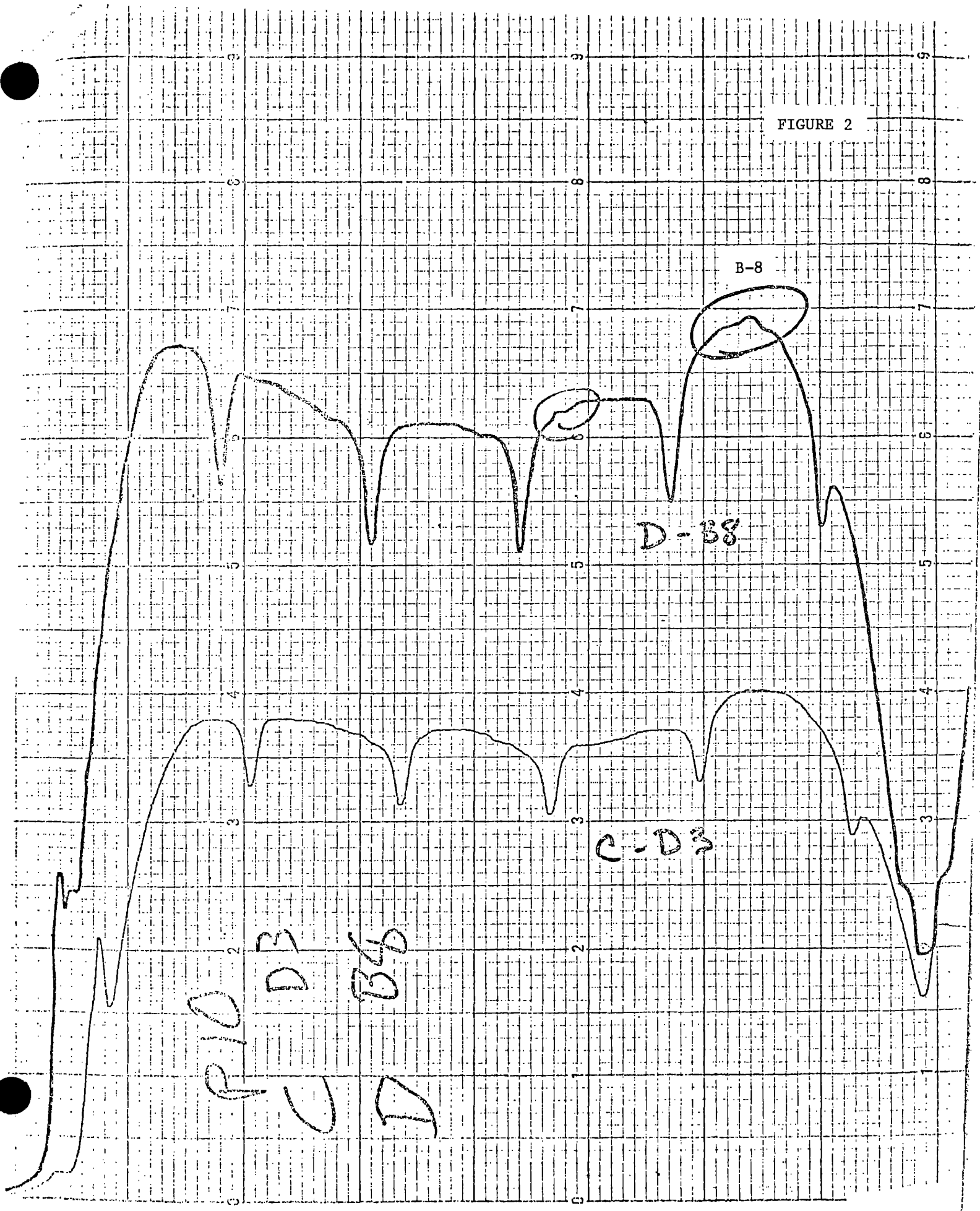


FIGURE 3

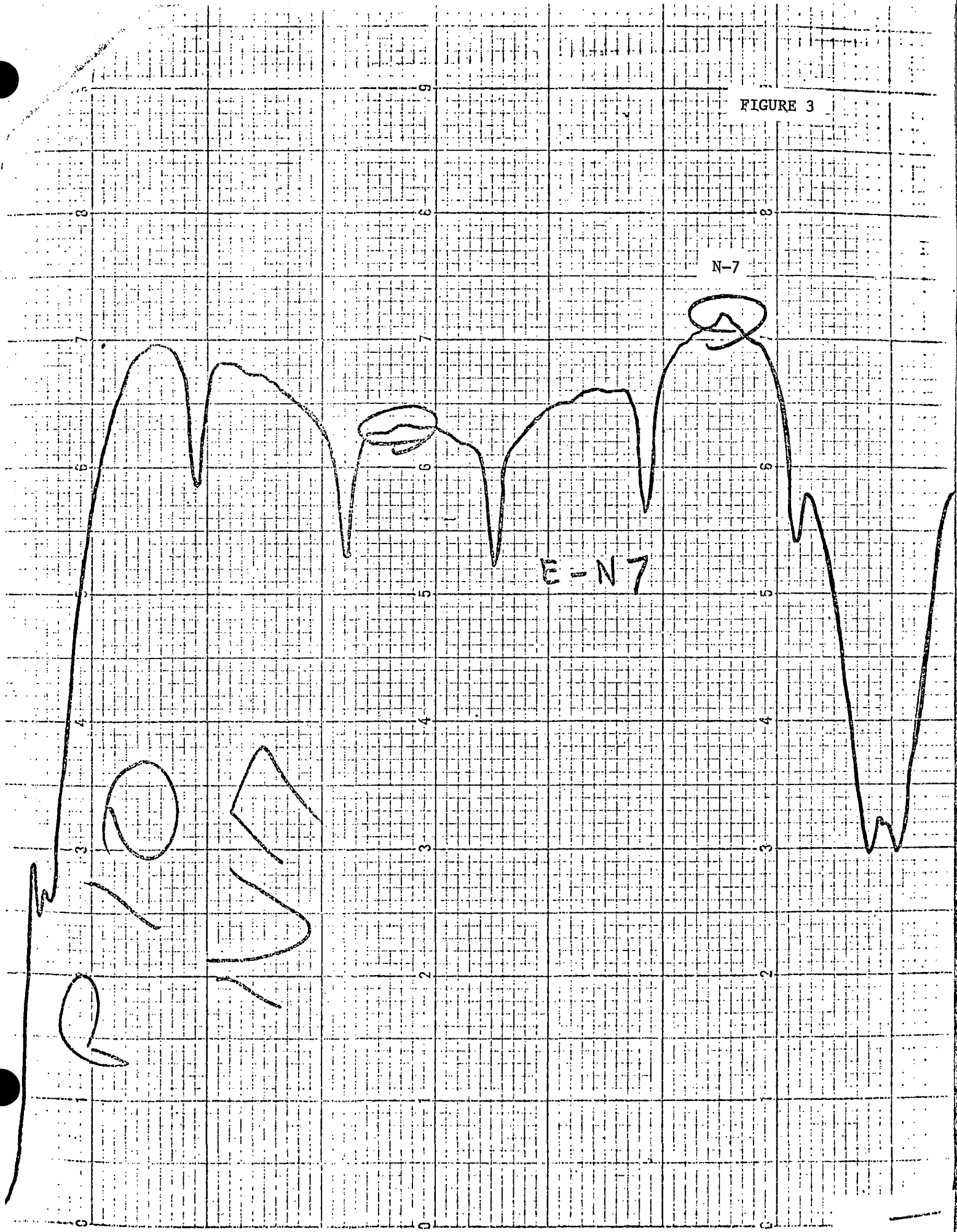


FIGURE 4

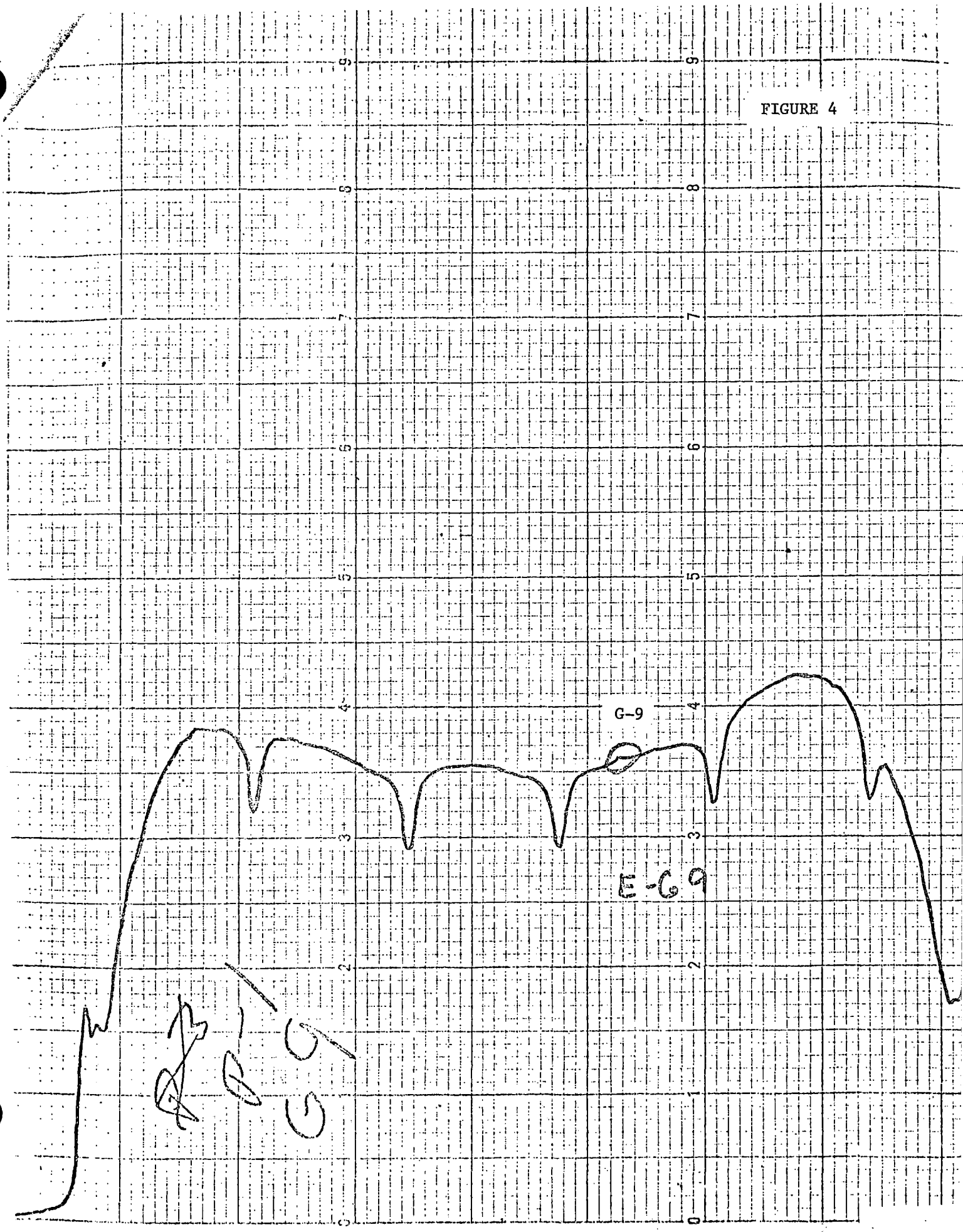


FIGURE 5

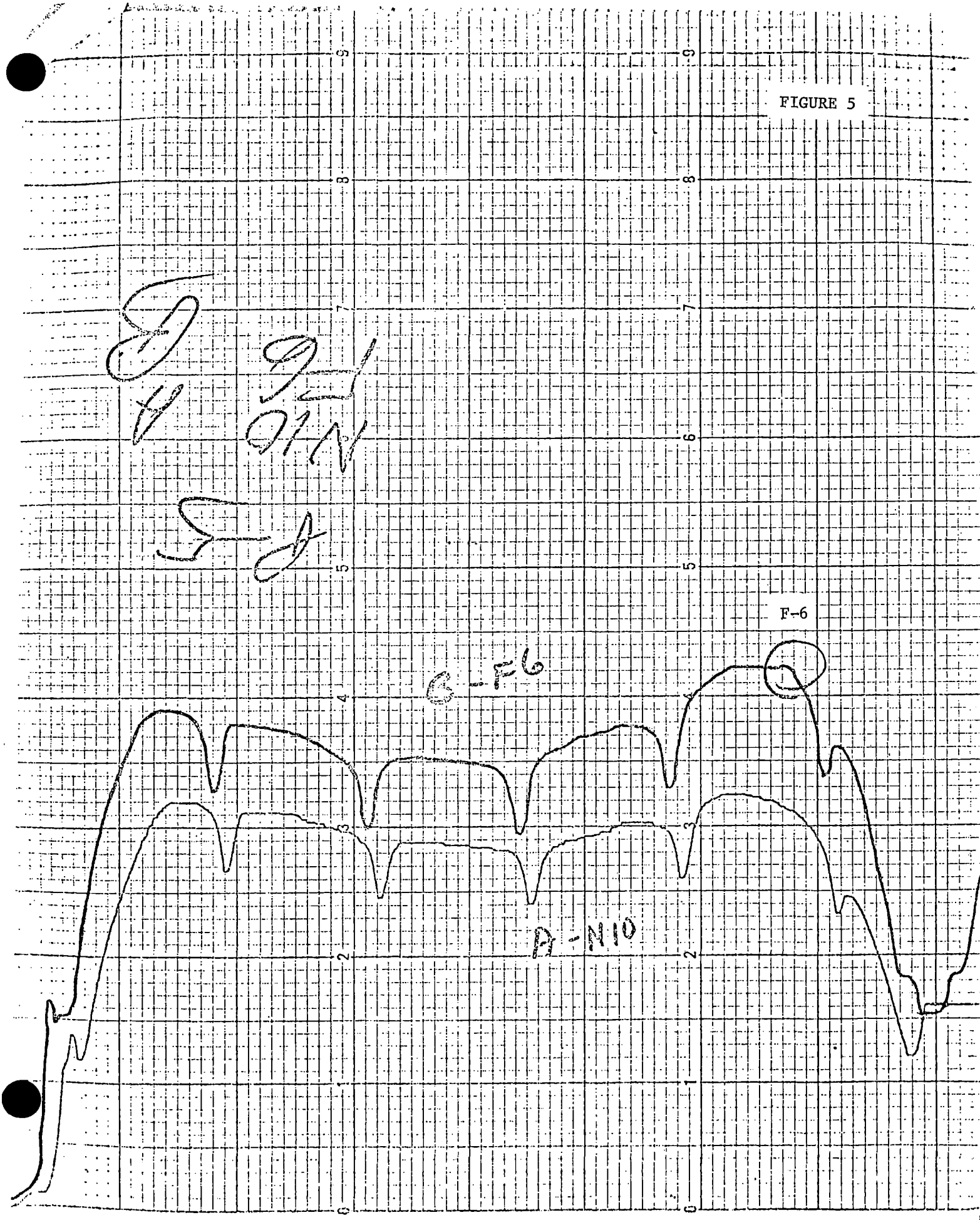


FIGURE 6

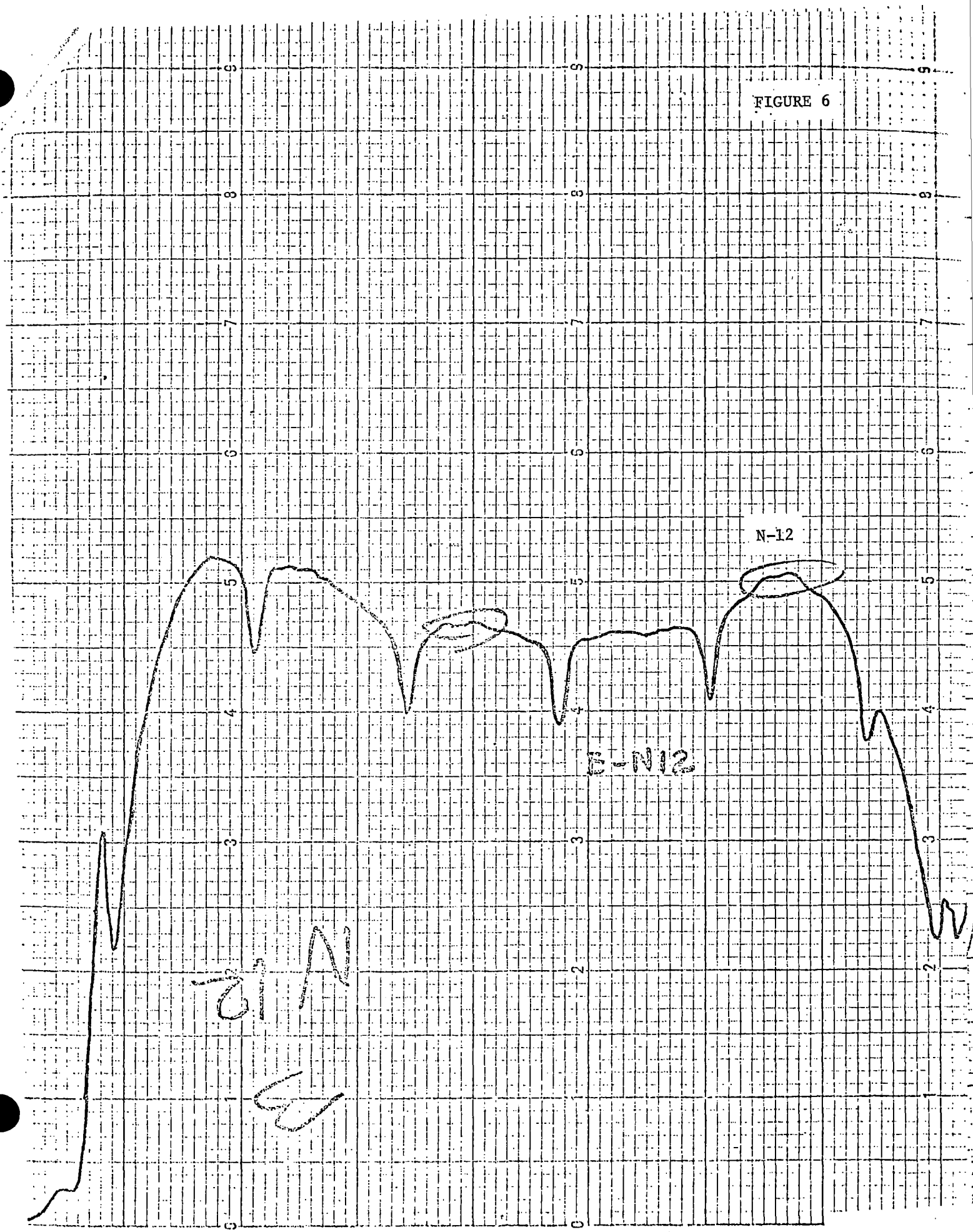


FIGURE 7

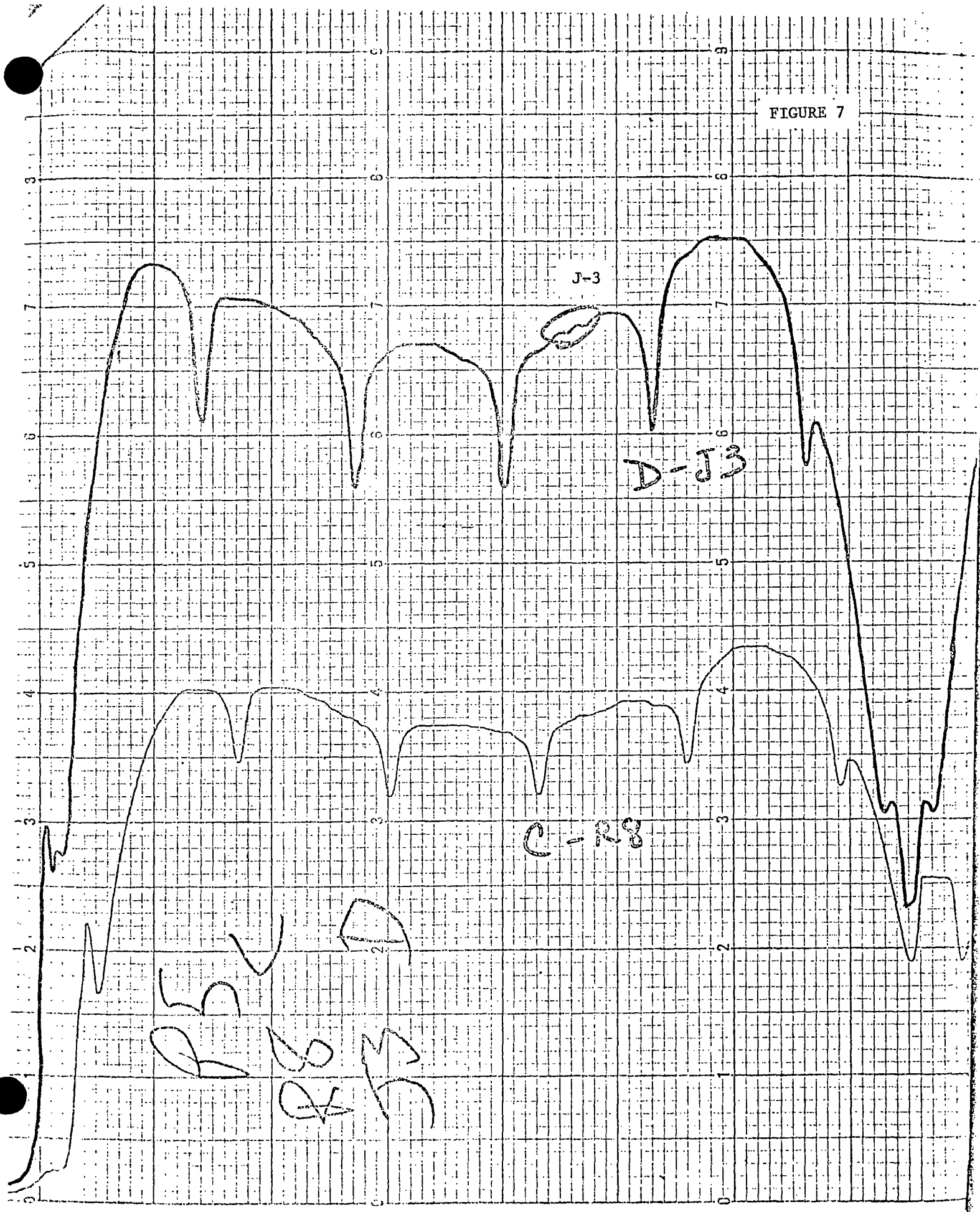


FIGURE 8

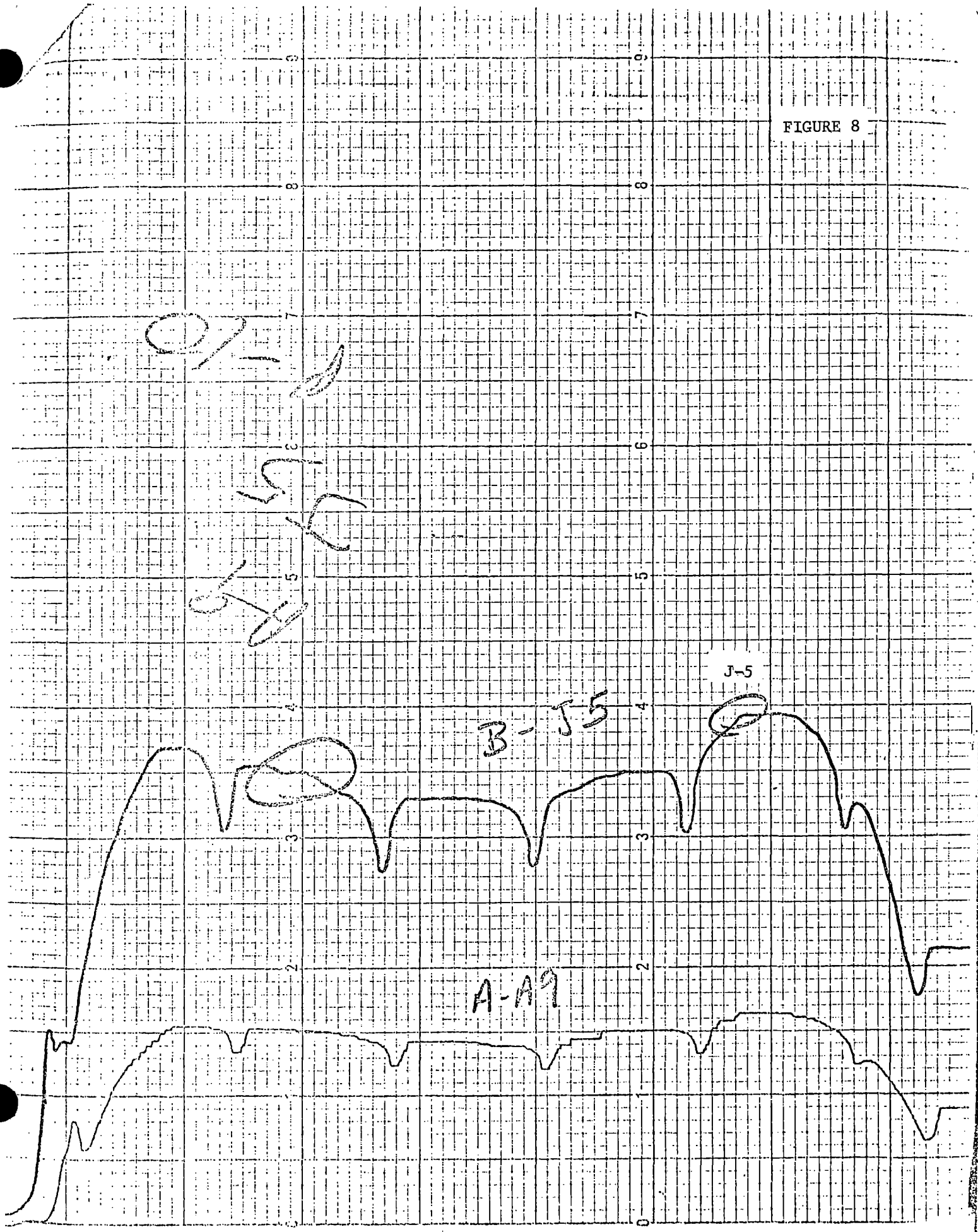
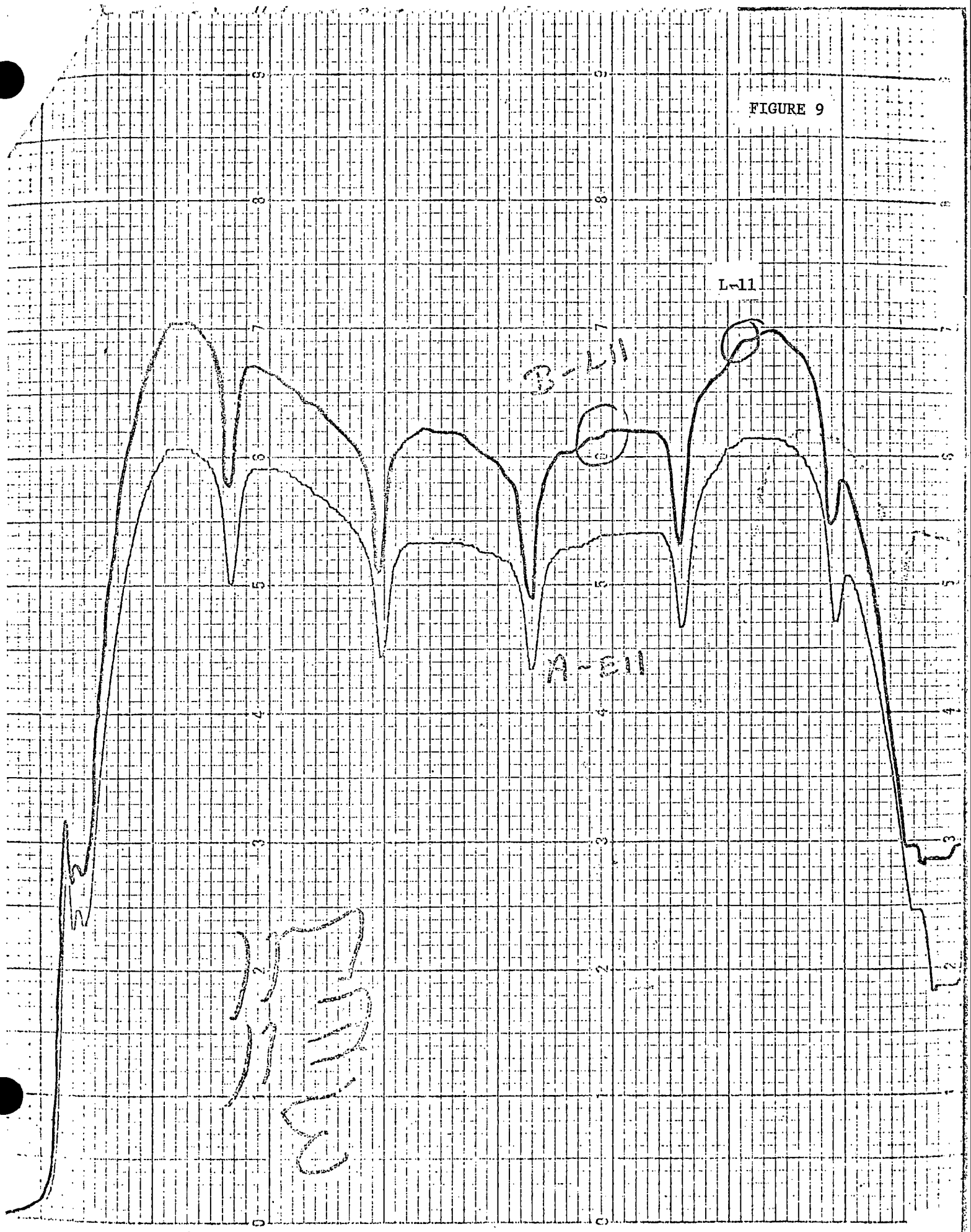


FIGURE 9



ACKNOWLEDGMENTS

The authors would like to acknowledge the cooperation of the staff at Surry Power Station in supplying the basic data for this report. Special thanks is due Messrs. D. Benson, K. Bowers, and W. Earl.

11.5 CHANGES IN PROCEDURES

The following changes were made to the station procedures during the reporting period.

11.5.1 Administrative Procedures

A summary of the changes to Administrative Procedures made during the reporting period is presented in Table 10.5.1-1.

11.5.2 Abnormal Procedures

A summary of the changes to Abnormal Procedures made during the reporting period is presented in Table 10.5.2-1.

11.5.3 Annunciator Procedures

A summary of the changes to Annunciator Procedures made during the reporting period is presented in Table 10.5.3-1.

11.5.4 Chemistry and Health Physics Procedures

A summary of the changes to Chemistry and Health Physics Procedures made during the reporting period is presented in Table 10.5.4-1.

11.5.5 Emergency Procedures

A summary of the changes to Emergency Procedures made during the reporting period is presented in Table 10.5.5-1.

11.5.6 Maintenance Procedures

A summary of the changes to Maintenance Procedures made during this reporting period is presented in the following Tables:

10.5.6-1 Mechanical Maintenance Procedures

10.5.6-2 Electrical Maintenance Procedures

10.5.6-3 Instrument Maintenance Procedures

11.5.7 Operating Procedures

A summary of the changes to Operating Procedures made during this reporting period is presented in the following Tables:

10.5.7-1 Operating Procedures

10.5.7.2 Maintenance Procedures

11.5.8 Periodic Test Procedures

A summary of the changes to Periodic Test Procedures made during this reporting period is presented in Table 10.5.8-1.

11.5.9 Start-Up Test Procedures

A summary of the changes to Start-Up Test Procedures made during this reporting period is presented in Table 10.5.9-1.

11.5.10 Special Test Procedures

A summary of the changes to Special Test Procedures made during this reporting period is presented in Table 10.5.10-1.

11.6 UNIT 2 MAINTENANCE

The following is a summary of the maintenance performed during the report period.

11.6.1 Unit 2 Mechanical Maintenance

A summary of Unit 2 Mechanical Maintenance is tabulated in Table 11.6.1-1.

11.6.2 Unit 2 Electrical Maintenance

A summary of Unit 2 Electrical Maintenance is tabulated in Table 11.6.2-1.

11.6.3 Unit 2 Instrument Maintenance

A summary of Unit 2 Instrument Maintenance is tabulated in Table 11.6.3-1.

SURRY POWER STATION

MECHANICAL MAINTENANCE

JANUARY THROUGH JUNE, 1975

UNIT NO. 2

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
9-26-74	Safety Injection Valve 2867A	Seat Scored-Valve leaked by seat	None	Lapped seats and disc MR-S2-2449	Cold Shutdown	3 days
10-24-74	Containment Inst. Air Compressor 2-1A-C-2A,B,	Worn out	None	Rebuilt both compressors replaced post & prefilters inspected traps MR-S2-2476	Cold Shutdown	20 days
11-20-74	Steam Generator Seismic Restraint Concrete	Seismic Restraints Frozen causing hair-line cracks in concrete	None	Cracks were repaired by Adhesive Engineering MR-S2-2403	Cold Shutdown	1 day
12-25-74	Steam Generator Seismic Supports	Cracked seismic supports. Cracks emanating at shrink ring grooves	None	Installed new steam generator seismic supports MR-S2-2773 & 2776	Cold Shutdown	115 days
12-30-74	Recirc. Spray Check Valve 2-RS-17 and 2-RS-11	Cracked keyways on Rockshafts excess	None	Renewed Rockshaft packing, gaskets, modified counterweights MR-S2-2711 & 2710	Cold Shutdown	2 days
1-2-75	Containment Spray Check Valve 2-CS-13	When valve was disassembled for cracked Rockshaft, found crack in valve body	None	Replaced valve MR-S2-2781	Cold Shutdown	3 days
2-11-75	Chemical Addition Tank Pump 2-CS-P-3	Mechanical Seal	None	Renewed mechanical seal parts and renewed pump coupling MR-S2-3097	N/A	20 hours

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
3-03-75	Service Water Pump 2-SW-P-10B	Normal wear	None	Replaced with rebuilt pump MR-S2-3295	N/A	6 hours
4-29-75	Suppressor 1-WFPD-HSS-3	Linkage came loose vibration.	None	Repaired linkage, renewed sight glass. MR-S2-3661	Refueling shutdown.	6½ hours
4-29-75	Containment Spray	None.	None	Installed specticle flange. MR-S2-3200	Refueling shutdown.	3 hours
4-29-75	Main Steam Trip Valves TV-MS-201 A, B,C	None - inspection, preventative maint.	None	Disassembled and inspected C. Repacked A,B,C. No deficiencies MR-S2-2923.	Refueling shutdown.	55 hours
5-01-75	Main Steam Safety Valves SV-MS-202, 203, 204, 205, A,B,C	None - design change 74-103.	None	Installed new elbows as per D.C. 74-103. MR-S2-3557.	Refueling shutdown.	70 hours
5-01-75	Recirculation Spray Valve 2-RS-17 & 11	None - inspection preventative maint.	None	Inspected valve, no deficiencies noted. MR-S2-3688 & 3689.	Refueling shutdown.	44 hours
5-02-75	Reactor Cavity Purification Filter	None - normal use.	None	Changed filters. MR-S2-3702	Refueling shutdown	3 hours
5-02-75	Containment Spray Valves 2-CS-13 & 24	None - inspection preventative maint.	None	Inspected valves, no deficiencies noted. MR-S2-3686 & 3687	Refueling shutdown.	44 hours
5-03-75	Fuel Transfer	None - design change 75-26.	None.	Installed piping change as per D.C. 75-26. MR-S2-3708.	Refueling shutdown.	14 hours
5-03-75	Component Cooling Valves 2-CC-49,50,51	Slight buildup on seats.	None.	Lapped seats and discs & blued. MR-S2-3706.	Refueling shutdown.	8 hours
5-05-75	Containment Spray Valves MOV-CS-201A,B	None - preventative maintenance. PT-16.4	None.	Inspected, blued seat & disc.	Refueling shutdown.	10 hours
5-05-75	Reactor Coolant Valve 2-RC-80	None- normal.	None.	Repacked valve. MR-S2-2888.	Refueling shutdown.	2½ hours

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-05-75	Reactor Coolant Valve 2-RC-48	None - normal.	None.	Repacked valve. MR-S2-2889.	Refueling shutdown.	2½ hours
5-06-75	Chemical & Volume Control Valve HCV-2310	Gasket - bonnet bolts loose.	None.	Renewed bonnet & cage gaskets. MR-S2-3655 & 3794.	Refueling shutdown.	2 hours
5-07-75	Manipulator Crane	None- Design Change 74-107	None.	Renewed gripper pins. MR-S2-3553	Refueling shutdown.	8 hours
5-08-75	Suppressor 2-SHP-HSS-2A, B & 3B	Loose bolts & fittings vibration.	None.	Tightened bolts, fittings and refilled. MR-S2-3696.	Refueling shutdown.	5½ hours
5-08-75	Blowdown Trip Valve TCV-BD-200A	Gasket not fully compressed.	None.	Inspected, cleaned and renewed gasket. MR-S2-3322	Refueling shutdown.	18 hours
5-09-75	Pressurizer Safety Valves SV-2551 A,B,C	None - PT-12.0	None.	Tested safety's test, satisfactory. MR-S2-3760.	Refueling shutdown.	9 hours
5-09-75	Reactor Coolant Power Operated Relief Valve PCV-2455C	None - packing cage gasket cyclic.	None.	Inspected & renewed gaskets and packing. MR-S2-789.	Refueling shutdown.	2 hours
5-09-75	Reactor Coolant Valve HCV-2519B	Ruptured diaphragm.	None.	Inspected & renewed diaphragm. MR-S2-1495.	Refueling shutdown.	2 hours
5-10-75	Chemical & Volume Control Valve FCV-2160	Bushing binding stem.	None.	Inspected & renewed bushing and gaskets. MR-S2-2807 & 3731.	Refueling shutdown.	10 hours
5-10-75	R.C.C. Change Fixture	Cable failed.	None.	Renewed cable. MR-S2-3750.	Refueling shutdown.	2 hours
5-12-75	Suppressor 2-SHP-HSS-35B	Loose plug.	None.	Tightened plug, refilled. MR-S2-3693.	Refueling shutdown.	2 hours
5-12-75	Blowdown Trip Valve TCV-BD-200D	Gasket - cyclic.	None.	Renewed gaskets. MR-S2-2931.	Refueling shutdown.	7 hours
5-13-75	Suppressor 2-SHP-HSS-33A	Loose plug.	None.	Tightened plug, refilled. MR-S2-3682	Refueling shutdown.	2 hours

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-15-75	Emergency Diesel #2	None - annual PM.	None.	Performed annual PM, inspected seals. MR-S2-3751	Refueling shutdown.	8 days
5-17-75	Pressurizer Surge Line	None.	None.	Reviewed surge line inspection data. MR-S2-3783	Refueling shutdown.	4 hours
5-22-75	Manipulator Crane . Replaced Gripper & Inner mast	Unknown.	None.	Replaced gripper assy. and inner mast. MR-S2-3862.	Refueling shutdown.	16 hours
5-22-75	Instrument Air Compressor 2-1A-C-1	Valves.	None.	Rebuilt valves, repacked, renewed head gaskets. MR-S2-3849	Refueling shutdown.	12 hours
5-24-75	Chemical & Volume Control Valve MOV-2350	Bad heat tracing.	None.	Cleared of solidified boron. MR-S2-3302.	Refueling shutdown.	12 hours
5-27-75	Main Steam Trip Valves TV-MS-201 A,B,C	None - preventative.	None.	Changed O-Rings and inspected air actuators. MR-S2-3797.	Refueling shutdown.	7 hours
5-30-75	Main Steam Header Sample Probes	Design problem.	None.	Installed new valves & probes as per NUS 7176. MR-S2-3882.	Refueling shutdown.	9 days
4-24-75	Containment Instrument Air Comperssor Spare	None, normal wear.	None.	Overhauled compressor. MR-S2-3994.	N/A	72 hours
5-10-75	Reactor Coolant Pumps 2-RC-P-1A,C	None - preventative.	None.	Inspected mechanical seals. MR-S2-3683 & 3684.	Refueling shutdown.	10 days
5-12-75	Steam Generator 2-RC-E-1B	None - preventative.	None.	Eddy current inspection explosive plugged (29) tubes with > 40% wall thinning. MR-S2-3789 and 3718.	Refueling shutdown.	148 hours
5-12-75	Steam Generator 2-RC-E-1C	None - preventative.	None.	Eddy current inspection explosive plugged 67 tubes with >40% wall thinning. MR-S2-3704 & 3581	Refueling shutdown.	144 hours

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-20-75	Residual Heat Pump 2-RHR-P-1B	None - preventative.	None.	Installed new motor & renewed mechanical seal. MR-S2-3804.	Refueling shutdown.	3 Days
5-28-75	Control Rod Drives	None - preventative.	None.	Modified CRDM's as per design change 74-106.	Refueling shutdown.	56 hours
6-01-75	Steam Generators 2-RC-E-1A,B,C	None - preventative.	None.	Sludge lanced each steam generator for approx. 72 hours. MR-S2-3938.	Refueling shutdown.	220 hours
6-01-75	Steam Generator 2-RC-E-1A,B,C	None - preventative.	None.	Installed modification to steam side as per design change 75-22. Perforated plated, feed ring, resistance plates & tube lane blocking. MR-S2-3674,3675, 3676.	Refueling shutdown.	32 days
6-01-75	Flux Wire Thimbles	None - refueling.	None.	Retracted flux wire thimbles for refueling and reinstallation. MR-S2-3698.	Refueling shutdown.	8 hours
6-03-75	Emergency Diesel Generator #3	Starting air motor vanes - normal wear.	None.	Installed starting air motor from #2 Emergency Diesel.	Refueling shutdown.	6 hours
6-04-75	Emergency Diesel Generator #2	Starting air motor vanes - normal wear.	None.	Installed new vanes in starting air motor & installed on #2 Emergency Diesel. MR-S2-3948.	N/A	2 hours
6-04-75	Component Cooling Trip Valve. TV-CC-209B	Rubber seat deteriorated.	None.	Installed new rubber seat. MR-S2-3002.	Refueling shutdown.	4 days
6-04-75	Steam Generator 2-RC-E-1A	None - preventative.	None.	Eddy current inspection, explosive, plugged 35 tubes with >40% wall thinning. MR-S2-3717	Refueling shutdown.	148 hours
6-06-75	Turbine	None - preventative.	None.	Installed bearing lift modification design change 75-21. MR-S2-3732 and 3640.	Refueling shutdown.	38 days

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
6-06-75	Chilled Water Condenser Air Ejector	Tube leaks erosion.	None.	Plugged leaking tubes, reworked divider plates. MR-S2-3960.	N/A	10 hours
6-07-75	Manipulator Fuel Handling Crane	Unknown.	None.	Renewed inner mast assy. work accomplished 5-22-75. MR-S2-3889	Refueling shutdown.	8 hours
6-07-75	Reactor Coolant Pump 2-RC-P-1B	None - preventative.	None.	Inspected mechanical seal. MR-S2-3668.	Refueling shutdown.	10 Days
6-07-75	Containment Inst. Air Compressor 2-1A-C-2A,B	None - preventative.	None.	Rebuilt compressor.. MR-S2-3761.	Refueling shutdown.	18 hours
6-07-75	Reactor Coolant Letdown Filter 2-CH-FL-5	Normal use.	None.	Changed filters. MR-S2-3609.	Refueling shutdown.	4 hours
6-07-75	Reactor	Refueling	None.	Refueled reactor in accordance with OP-4. MR-S2-3652	Refueling shutdown.	45 Days
6-07-75	Safety Injection Check Valves 6" Velan - 9 ea 12" Darling 3 ea.	None - preventative.	None.	Inspected and changed bonnet gaskets. MR-S2-3490.	Refueling shutdown.	4 Days
6-08-75	Containment Liner	Moisture under paint at juncture of liner and floor.	None.	Cleaned, primed & applied finish coat of paint as per NUS Specification. MR-S2-3858.	Refueling shutdown.	14 Days
6-08-75	Steam Generator Level Transmitter Isolation Valves	Flange leaks.	None.	Renewed 3/4" Voght valves with seal welded Velan valves. MR-S2-3808.	Refueling shutdown.	21 Days
6-08-75	Main Steam Sample Probes	Expansion of lines probes not used.	None.	Removed sample lines, plug welded and stress relieved. MR-S2-3943	Refueling shutdown.	6 Days
6-08-75	Safety Injection Valves MOV-2860 A,B	Seat Leakage, PT-16.4	None.	Lapped, blued & tested valves. MR-S2-3527 & 3978	Refueling shutdown.	12 hours
6-08-75	Personnel Hatch Containment	None - preventative	None.	Renewed O-Rings and reworked closing pins. MR-S2-3996	Refueling shutdown.	12 hours

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
6-08-75	Main Steam Non Return Valves. NRV-MS-201B&C	Previous damaged seats.	None.	Repaired valve seats. MR-S2-3679 and 3680.	Refueling shutdown.	250 hours
6-09-75	Containment Spray Valves MOV-CS-201C &D	Seat leakage PT-16.4	None.	Lapped, blued & tested valves. MR-S2-3977.	Refueling shutdown.	48 hours
6-16-75	Turbine	None- annual inspection.	None.	Held annual on H.P. turbine. MR-S2-3640	Refueling shutdown.	50 Days
6-18-75	Steam Generator Seismic Supports	None - preventative.	None.	Performed cold and hot visual inspection of concrete and checked lubricant. MR-S2-3805	N/A	6 hours
6-07-75	Turbine Reheat Interceptor Valves	Valve shaft.	None.	Installed new shaft in actuator. MR-S2-3277.	Refueling shutdown.	14 hours
6-08-75	Recirculation Spray Valves MOV-RS-255 A&B	Seat leakage PT-16.4	None.	Lapped, blued & tested valve. MR-S2-3528	Refueling shutdown.	23 Days
6-04-75	Chiller 1-VS-E-4A	Tube leak.	None.	Plugged leaking tube replaced compressor, evacuated & recharged system. MR-S2-3836.	N/A	50 hours
6-06-75	Turbine Governor Valves	None - preventative fix at Westinghouse recommendation.	None.	Replaced value spring retainer bolts with higher strength material as per design change 75-13.	Refueling shutdown.	100 hours
5-04-75	Safety Injection Valve 2-SI-238	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3590	Refueling shutdown.	9 hours
5-12-75	Safety Injection Valve 2-SI-241	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3587.	Refueling shutdown.	11 Days
5-15-75	Residual Heat Removal Valve MOV-2720B	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3594	Refueling shutdown.	10 hours

Table 11.6.1-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
5-18-75	Hand Control Valve 2303	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3584.	Refueling shutdown.	10 hours
5-19-75	Hand Control Valve 2311	Below minimun valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3585.	Refueling shutdown.	10 hours
5-19-75	Safety Injection Valve 2-SI-242	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3589.	Refueling shutdown.	18 Days
5-23-75	Residual Heat Removal Valve MOV-2720A	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3593.	Refueling shutdown.	7 Days
5-24-75	Pressure Control Valve 2455C	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3586.	Refueling shutdown.	4 Days
5-30-75	Safety Injection Valve 2-SI-82	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3588.	Refueling shutdown.	10 hours
6-03-75	Safety Injection Valve 2-SI-239	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. RM-S2-3592.	Refueling shutdown.	6 Days
6-07-75	Reactor Conoseals	None - refueling.	None.	Removed & replaced conoseals. MR-S2-3695.	Refueling shutdown.	27 hours
6-07-75	Safety Injection Valve 2-SI-91	Below minimum valve wall thickness standards.	None.	Pad welded to meet acceptance criteria. MR-S2-3591	Refueling shutdown.	10 hours

SURRY POWER STATION
UNIT NO. 2
ELECTRICAL MAINTENANCE
JANUARY THROUGH JUNE, 1975

Table 11.6-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
1-01-75	Steam Generator Feed Pump 3B	Instantaneous trip.	None.	Bridge & meggered. No trouble found.	Reactor at cold shutdown.	½ Hr.
1-04-75	2-FW-250 A & B	Torque switch mal-adjusted.	Will not open.	Jumpered torque switch to open and adjusted.	None.	8 Hrs.
1-04-75	Unit 2 Penetrations	Low nitrogen pressures	None.	Fill to normal levels. MR-S2-2855.	N/A	2 Hrs.
1-12-75	2-1AC-2A, 2B	Testing.	None.	Installed reloading voltmeter to monitor run time.	N/A	1 Hr.
2-02-75	TM-MS-201C	Pen sheared in lower limit switch.	Valve will not seal in.	Replaced pin.	None.	3 Hrs.
2-02-75	2-IA-C-1	Motor tripped on over-load.	Will not start.	Motor overloaded, referred to Mech. Dept.	None.	3 Hrs.
2-06-75	Penetration 1-D	Low nitrogen pressure.	None.	Pressurized to 9 PSIG. MR-S2-3148	N/A	¼ Hr.
2-24-75	Instrument Air Comperssor 2-IA-C-1	Motor overloaded.	None.	Referred to Mech. Dept. MR-S2-3253	None.	3 Hrs.
2-27-75	2-RC-P-B	High vibration.	None.	Proximity sensor defective, contacted W for assistance.	None.	3 Hrs.
3-03-75	2-CW-S-1C	Motor failed.	None.	Install motor, test & load check. MR-S2-3296.	None.	3½ Hrs.

Table 11.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
3-03-75	2-SW-P-10B	Mechanical Dept. request.	None.	Disconnect motor, reconnect motor tested and load checked.	None.	3 Hrs.
3-17-75	2-FW-P-4A	Mechanical Dept. request.	None.	Disconnected.	None.	1 Hr.
4-01-75	2-CH-P-1B	Annual maintenance.	None.	MR-S2-3249.	None.	8 Hrs.
4-02-75	2-SW-S-4	Coil defective.	None.	Installed coil.	None.	3 Hrs.
4-10-75	2-CH-P-1B	None.	None.	Took vibration readings.	None.	1 Hr.
4-15-75	2-SW-S4	Coil leads disconnected.	None.	Reconnected coil leads. MR-S2-3488.	None.	1 Hr.
4-21-75	2-CH-P-1A Auxiliary Oil Pump	Defective overload relay.	None.	Replaced overload relay. MR-S2-3579.	None.	1½ Hrs.
5-28-75	MOV-SW-202	MOV flooded.	None.	Dried motor windings and replaced bearings. MR-S2-3795	None.	3 Hrs.
5-30-75	TV-MS-201C	Red light limit switch broken.	None.	Replaced broken pin in limit switch. MR-S2-3578.	None.	2 Hrs.
6-08-75	RCP Motors A,B & C	Upper bearing insulation readings.	None.	Took Ohmic readings on all RCP motors.	None.	3 Hrs.
6-08-75	RCP Motor "A"	Hi-Lo Level Lower brg.	None.	Lower level was low added 1 gal. of oil.	None.	2½ Hrs.
6-08-75	2-1A-D-2	Ck Dryer heating elements.	None.	Took Ohmic readings on 6 heating elements.	None.	2½ Hrs.
6-08-75	2-RC-P-1A,1B,1C	Resistance readings.	EMP-C-EPH-06.	Took Res. readings from bearing to ground.	None.	5 Hrs.
6-09-75	CS-201-C & D	Connect, megger and bridge.	None.	Connected, megger and bridge.	None.	6 Hrs.

Table 11.6.2-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
6-09-75	Recirc. Spray Valves	Install H/Tracing.	None..	Installed H/Tracing on MOV-RS-255A & B.	None.	6 Hours
6-09-75	2-RC-P-1A & 1C	Bearing & winding. temp.	None.	Record bearing & winding temp. at different RPM.	None.	2 Hours
6-10-75	2-RC-P-1A & 1C	Motor bearing and winding temp.	None.	Record motor brg & winding temp.	None.	2 Hours
6-10-75	MOV-RS-255-B	Tests.	None.	Megger & Bridge also load check.	None.	1½ Hours
6-10-75	MOV-RS-255A	Tests.	None.	Megger & Bridge also load check.	None.	1½ Hours
6-10-75	Fire Protection	PT-24.4	None.	Replaced missing extq with spares	None.	10 Hours
6-11-75	2-CS-MR-1A 2-CS-MR-1B	Won't start.	None.	1A flow switch not valved in 1B Tran. in cont, circuit burnt up.	None.	4 Hours
6-11-75	MOV-2-CS-A & B	Disconnect.	EMP-C-MOV-11	Disconnect & reconnect for mech.	None.	5 Hours
6-12-75	2-RC-P-1B	Load check.	None.	Took load check on 3ϕ's.	None.	1 Hour
6-12-75	MOV-CS-201B	Tests.	EMP-C-MOV-11.	Megger & bridge & load.	None.	1½ Hours
6-12-75	MOV-CS-20A	Tests.	EMP-C-MOV-11.	Megger, bridge and load check.	None.	2 Hours
6-14-75	MOV-FW-250B	Won't open.	None.	Investigate.	None.	1½ Hours
6-15-75	MOV-FW-250B	Will not open.	None.	Investigate.	None.	2 Hours
6-17-75	2-CS-MR-1B	Trans.	None.	Replaced defective trans.	None.	3½ Hours
6-23-75	PS-SW-203A	Pressure switch.	None.	Found bad pressure switch, replaced it.	None.	2½ Hours
6-23-75	2-CS-MR-1B	Inspect.	None.	NA.	None.	2 Hours

SURRY POWER STATION

INSTRUMENTATION & CONTROLS

JANUARY THROUGH JUNE, 1975

UNIT NO. 2

Table 11.6.3-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
1-07-75	Steam Generator "C" Steam Flow Comparator FC-2-495	Sporadic output of comparator due to electronic component failure.	Erroneous alarms and partial trip signal on one protection channel.	Malfunctioning module was replaced with a spare unit. Spare unit was calibrated & returned to service.	Placed channel in test. Used approved procedures. Redundant instruments in service and normal.	½ hour
1-18-75	Reactor Coolant Flow Comparator FC-2-434	Electronic drift.	Comparator drifted 45 MV in the un-conservative direction which would have resulted in a trip signal setpoint of 91% versus 92%	Removed comparator, replaced with a spare module, calibrated and returned to service.	Placed channel in test. Used approved procedures. Reactor at cold shutdown. Redundant instruments in service and normal.	½ hour
1-20-75	Pressurizer Pressure Comparator PC-2-456A	Electronic drift.	Comparator was found to be tripping 21 MV in the unconservative direction, which would have resulted in a trip setpoint of 2139 instead of 2135 desired.	Recalibrated comparator to desired trip setpoint. Initiated multiple trips to insure repetition of setpoint. Returned to service.	Placed channel in test. Used approved procedures. Redundant instruments in service and normal.	1½ hours
1-15-75	Steam Generator "B" Narrow Range Level Transmitter L-484 Greater Than 3% Higher than Redundant Instruments	Steam leak at condensing pot isolation valve and an accumulation of sludge in both sensing lines.	Level indication became insensative and drifted high which would have resulted in a high level alarm and trip signal on one channel.	Placed channel in test. Leak was repaired by Mech. Maint. Dept. Sensing lines were cleared by blowdown. Returned to service when indication returned to normal.	Placed channel in test. Used approved procedures. Redundant instruments in service and normal.	24 hours
1-31-75	"C" Steam Generator Narrow Range Level Transmitter L-494	Accumulation of sludge in both transmitter sensing lines.	Level indication became insensative, and drifted high which would have resulted in a high level alarm and trip signal in one channel.	Placed channel in test, cleaned sensing lines by blowdown, Returned to service upon return to normal level indication.	Placed channel in test. Used approved procedures. Redundant instruments in service and normal.	2 hours

Table 11.6.3-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
2-14-75	LT-2-494 "C" Steam Generator Narrow Range Level Channel I Protection, Transmitter	Steam leak at condensing pot caused transmitter to become insensitive and drift high.	One high level trip was in which would have caused a reactor trip if another channel would have failed.	Placed channel in test. Blew down sensing lines. Mechanical Dept. repaired leak. Returned transmitter to service.	Placed channel in test. Used approved procedures. Redundant channels in service and operating normal.	8 hours
2-16-75	Control Rod F2 in A Bank Dropped	Bad fuse contact in stationary gripper circuit.	Turbine runback initiated and rod withdrawal stop.	Replaced fuses in stationary gripper circuit.	Used approved procedures. Reset P/A converter to 0 in bank "A". Opened disconnects for all rod movable gripper in bank A except for F-2. Retrieved rod & returned system to normal.	2 hours
3-25-75	L-494, "C" Narrow Range Steam Generator Level Channel 1	Leak at isolation valve on reference leg condensate pot.	High level indication on LI-494, due to flashing of reference leg.	Mechanical Maint. Dept. peened the leaking bonnet to the valve body, which resulted in considerably less leakage.	Placed channel in test while performing maint. and returned to operation when level indication became normal.	3 hours
3-26-75	L-494, "C" Narrow Range Steam Generator Level Channel 1	Crud buildup in reference and LP sensing lines.	Insensitive level indication and beginning to drift high.	Blew down sensing lines, allowed to fill with condensate then placed in operation, level returned to normal.	Placed channel in test. Used approved procedures. Redundant instruments in service and operating normal.	2 hours
3-26-75	PC-2-494, High Steam Line & Pressure ΔP, "C" Steam Generator Channel II	Electronic drift.	Comparator had drifted 23 MV in the conservative direction which would have caused a reactor trip at 92 psi "ΔP" rather than desired 100 psi "ΔP".	Calibrated comparator, checked for proper operation and returned to service.	Placed channel in test. Used approved procedures. Redundant instruments in service and operating normal.	1 hour
3-31-75	PM-2-446B First Stage Pressure Summator	Electronic drift.	Output had drifted 27 mils low on bias and 22 mils low in span.	Calibrated summator, checked for proper operation. Module will be replaced if drift occurs again.	Placed channel in test. Used approved procedures. Faulty channel had been bypassed.	1 hour

Table 11.6.3-1

Date	System or Component Involved	Cause of the Malfunction	Results and Effect On Safe Operation	Corrective Action Taken To Prevent Repetition	Precautions Taken To Provide for Reactor Safety During Repair	Time Req'd For Maint.
4-10-75	PCV-201A & B Absolute Pressure Transmitters for Containment Vacuum	Electronic drift.	.45 PSIA low indication on total and partial air pressure indicators.	Calibrated transmitters to proper span, checked for repeatability, returned to service.	Used approved procedures. Placed channel in test.	2 hours
6-06-75	PS-LM-200A Dual Comparator Containment Pressure	Electronic drift.	Both setpoints had drifted low approximately 35 MV which was in the conservative direction.	Replaced comparator with spare unit, calibrated and returned to service.	Placed channel in test. Used approved procedures.	1 hour
6-11-75	Pressurizer Level Transmitter LT-459	Electronic drift.	Transmitter had drifted approximately 10% low which would have resulted in an unconservative trip setpoint for high level trip signal.	Calibrated transmitter, checked for proper operation and returned to service.	Placed channel in test. Used approved procedures. Redundant channels in service and normal.	2 hours

11.7 RESULTS OF SURVEILLANCE TESTS

The majority of periodic test results for this reporting period were satisfactory; however, the following problems were noted:

JANUARY

a) PT-2.2 - Reactor Coolant Flow, 1-20-75

Setpoint for flow comparator FC-2-434 was too low. A new comparator was installed. New module was calibrated and tested satisfactorily.

b) PT-2.4 - Pressurizer Pressure and Cubicle Temperature, 1-20-75

Setpoint for pressure comparator PC-2-456A was too high. The module was recalibrated and tested satisfactorily.

c) PT-6 - Control Rod Assembly Partial Movement, 1-17-75

Rod assemblies J-3 and L-5 failed to insert within the proper limits. Modules were adjusted during shutdown on 1-08-75 and tested satisfactorily.

d) PT-10 - Reactor Coolant Leakage, 1-18-75

The Reactor Coolant Leak Test was not performed for this date to meet the daily frequency requirements as per Tech. Spec. Sec. 4.0.

e) PT-26.1 - Radiation Monitoring Equipment Check, 1-01-75 through 1-31-75. PT-26.2 - Radiation Monitoring Equipment Check, 1-15-75.

Radiation monitor RM-SW-220 for the discharge tunnel has been out of service for the entire month. Failure has been attributed to flooding of the monitoring equipment in the

e) Con't.

discharge tunnel. A design change is pending to correct the problem.

f) PT-29.1A - Turbine Main Steam Stop and Governor Valve Test, 1-05-75

Limit switch SV-1 failed to pick up with valve fully closed. Problem was attributed to faulty limit arm which was replaced.

g) PT-34 - Electrical Penetration Leakage Test

On the dates listed below, the following penetrations indicated a loss of pressure. In each case, penetrations were recharged to the correct pressure.

1-01-75 D-1

1-08-75 C-1, D-1, D-9

1-15-75 D-1

1-23-75 D-1

1-29-75 B-3, D-1

FEBRUARY

a) PT-5 - Analog Rod Position Instrumentation, 2-5-75

Rod bottom lights F4, M12, K6 failed to illuminate within the proper limitation. Circuitry was adjusted, and they tested satisfactorily.

b) PT-8.1 - Reactor Protection Logic, 2-5-75

Annunciator E:A-8 failed to function due to an open contact. It was repaired and tested satisfactorily on 2-7-75.

c) PT-15 - Steam Generator Aux. Feedwater Pumps, 2-4-75

An excessive seal leak was noted on motor driven aux. feedwater booster pumps (2-FW-P-4A, B). Parts are unavailable at this time to repair the leak. The problem will be

c) Con't.

corrected as soon as possible.

d) PT-17.3 - Containment Outside Recirculation Spray Pumps, 2-27-75.

Discharge pressure gage 2-RS-P-2B was replaced due to failure of the old gage.

e) PT-26.1 - Radiation Monitor Equipment Check, 2-1-75 through 2-28-75. PT-26.2 - Radiation Monitor Equipment Test, 2-18-75.

Radiation monitor RM-SW-220 for the discharge tunnel has been out of service for the entire month. Failure has been attributed to the flooding of the monitoring equipment in the discharge tunnel. A design change is pending to correct the problem.

f) PT-34 - Electrical Penetration Leakage Test

On the dates listed below, the following penetrations indicated a loss of pressure. In each case, the penetrations were recharged to correct pressure.

2-05-75 D-1

2-06-75 D-1

g) PT-36 - Instrumentation Check

1) 2-12-75 Deviation for rod position indication for control rod G-7 was greater than allowable limits from the other rods in the shutdown bank. Module in the IRPI for G-7 was replaced and tested satisfactorily.

2) 2-14-75 Channel 1 "C" steam generator level detector drifted high out of spec. due to a leak in the detector. The detector was repaired and tested satisfactorily.

MARCH

a) PT-15 - Steam Generator Auxiliary Feedwater Pump, 3-2-75

Motor driven aux. feedwater booster pumps (2-FW-P-4A,B) were not tested due to excessive mechanical seal leaks. The seals remain on order.

b) PT-18.5 - Hi Head SI Test & Flushing of Stainless Steel Piping, 3-6-75.

Flow through on emergency boration line & MOV-2350 could not be established. Other SI flow paths were maintained, and no safety hazard was incurred. The problem cannot be corrected at this time due to unit condition.

c) PT-26.1 - Radiation Monitor Equipment Check, 3-1-75 through 3-31-75.

PT-26.2 - Radiation Monitor Equipment Test, 3-27-75

Radiation Monitor RM-SW-200 for the discharge tunnel has been out of service for the entire month. Failure has been attributed to flooding of the monitoring equipment in the discharge tunnel. A design change is pending to correct the problem.

d) PT-34 - Electrical Penetration Leakage Test

On the dates listed below, the following penetrations indicated a loss of pressure. In each case, penetrations were recharged to the correct pressure.

3-05-75 D-1, E-3

3-12-75 D-1, E-3

3-19-75 D-1

3-26-75 D-1

APRIL

a) PT-5.1 - Analog Rod Position Instrumentation, 4-7-75.

Bank "B" control rod D-10 alarmed early when testing bistable trip setpoints. Setpoint was reset to spec and tested satisfactorily.

b) PT-8.5 - Consequence Limiting Safeguards (Hi-Hi-Train) 4-8-75.

"Open Door" annunciator for Train A protection racks failed to close when doors were closed. A maintenance order has been issued.

c) PT-8.5A - Consequence Limiting Safeguards (Hi-Hi Train) 4-27-75.

Coil R-LM-200C2 failed to operate during functional test of CLS System. Coil was replaced and tested satisfactorily.

d) PT-18.2 - Safety Injection Test, 4-27-75

MOV-2865C failed to function upon receipt of a safety injection signal. MOV-2865C failed due to a lifted lead. Lead was replaced and Abnormal Occurrence report submitted.

e) PT-26.1 - Radiation Monitor Equipment Check

1) 4-1-75 through 4-27-75. Manipulator Crane radiation monitor RM-RMS-262 was out of service. It was repaired before beginning refueling operations.

2) 4-1-75 through 4-30-75 . Radiation monitor RM-SW-220 for the discharge tunnel has been out of service for the entire month. Failure has been attributed to flooding of the monitoring equipment in the discharge

2) Con't.

tunnel. A design change is pending to correct the problem

f) PT-34 - Electrical Penetration Leak Test

On the dates listed below, the following penetrations indicated a loss of pressure. In each case, penetrations were recharged to the correct pressure.

4-02-75 D-1, E-5

4-16-75 D-2, D-9

4-23-75 C-3, D-1, E-3

4-30-75 A-15, B-1, D-1

MAY

a) PT-26.1 - Radiation Monitoring Equipment Check

1) 5-1-75 through 5-11-75

Radiation monitor RM-SW-220 for the discharge tunnel has been out of service for this time period. Failure has been attributed to flooding of the monitoring equipment in the discharge tunnel. A design change to correct the problem has now been completed, and the monitor was returned to service on 5-12-75. It subsequently failed on 5-14-75; however, it was repaired and returned to service the following day.

2) 5-14-75, 5-15-75, 5-21-75

Containment gas monitor RM-SW-260 failed to function properly on each of these dates. In each case a maintenance order was submitted and the deficiency corrected.

3) 5-19-75 and 5-23-75

Containment Hi Range Gamma monitor RM-RMS-261 malfunctioned on each of these two days. Repairs were promptly completed and the monitor returned to service the following day.

b) PT-34 - Electrical Penetration Leak Test, 5-28-75

Pressure reading was low on penetration E-14. The penetration was recharged to its proper pressure.

JUNE

a) PT-2.11 - Reactor Containment Pressure

Pressure comparator PS-LM200A1 setpoints had drifted low. Comparator was replaced. New comparator was calibrated and tested satisfactorily.

b) PT-18.5 - Hi Head Safety Injection Test and Flushing of Stainless Steel Piping

During the performance of this test, valve MOV-2350 was opened and no flow was obtained. A maintenance request was issued. The problem is under investigation.

c) PT-34 - Electrical Penetration, 6-4-75.

Penetration D-9 indicated a loss of pressure. Penetration was recharged.

d) PT-37.1 - Electric Hydrogen Recombiner, 6-4-75.

During the one hour test period, the rate of increase in recombiner temperature was lower than the acceptable rate. A maintenance request was issued.

11.8 PERIODIC CONTAINMENT LEAKAGE RATE TESTS

The results of Unit 2 periodic containment leakage rate tests completed during the reporting period are as follows:

1)	Containment Isolation Valve Leakage, (PT-16.4), 6-12-75	=	163.74	SCFH
2)	Containment Penetration Local Leakage, (PT-16.2), 5-29-75	=	.87	SCFH
3)	Containment Personnel Air Lock Leakage, (PT-16.5), 6-10-75	=	0.0	SCFH
4)	Equipment Hatch Local Leakage, (PT-16.6), 6-9-75	=	0.0	SCFH
	Total Leakage (Type B & C Tests)	=	164.61	SCFH

Combined leakage for Type B and C tests was below .06% of the containment volume/24 hours as required by Technical Specification 4.4.

11.9 CHANGES, TESTS AND EXPERIMENTS REQUIRING AUTHORIZATION FROM THE ATOMIC ENERGY COMMISSION

11.9.1 Technical Specification Changes

Changes made to the Technical Specifications, Units Nos. 1 and 2, Surry Power Station during the reporting period are summarized in Table 10.9.1-1. These changes were issued by the U.S. Atomic Energy Commission pursuant to Section 50.59, Title 10, Code of Federal Regulations.

11.9.2 Test of Experiments

There were no tests or experiments conducted on Unit No. 2 during the reporting period which required approval of the U.S. Atomic Energy Commission.

11.9.3 Facility Design Changes

There were no facility design changes implemented during the reporting period which required authorization from the U.S. Atomic Energy Commission.

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