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WANL-TME-805

May 25, 1964

PRELIMINARY DATA REPORT

PRESSURE TRANSDUCERS EXPERIMENT NO. 23/W505

IRRADIATED AT PLUM BROOK REACTOR FACILITY

PBRF CYCLE 16P-

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TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 TEST HISTORY	1
3.0 DESCRIPTION OF TEST	3
3.1 DESCRIPTION OF TEST SPECIMEN	3
3.2 DESCRIPTION OF TEST FIXTURE	3
3.3 TEST PROCEDURE	7
3.4 TEST RESULTS	11
3.5 RAW DATA	11

LIST OF ILLUSTRATIONS

	<u>Page</u>
1 Reactor Power Profile, Pressure Transducers Test	2
2 Pressure Transducer Fixture (Side Facing Core)	4
3 Pressure Transducer Fixture End View	5
4 Transducer Test Fixture	6
5 Pneumatic System	8
6 Physical Sciences Pressure Transducer Wiring Diagram	9
7 CCC Pressure Transducer Wiring Diagram	10

LIST OF TABLES

	<u>Page</u>
1 Types of Pressure Transducers Tested	3
2 Output Voltages, Physical Science Transducer -1	12
3 Output Voltages, Physical Science Transducer -2	13
4 Output Voltages, CCC Transducer -1	14
5 Output Voltages, CCC Transducer -2	15
6 Output Voltages, CCC Transducer -3	16
7 Coil and Insulation Resistances, Physical Science Transducer -1	17
8 Coil and Insulation Resistances, Physical Science Transducer -2	18
9 Coil and Insulation Resistances, CCC Transducer -1	19
10 Coil and Insulation Resistances, CCC Transducer -2	20
11 Coil and Insulation Resistances, CCC Transducer -3	21
12 System Hourly Data Sheet W-2 Inpile Loop	22

1.0 INTRODUCTION

This report describes the preliminary results of the irradiation of five pressure transducers which were dynamically tested in the HT-1 facility of the Plum Brook Reactor on April 21-22, 1964. The test was designated Experiment No. 23/W505. The purpose of this experiment was to obtain operational data on NRX-A candidate transducers in a high dose rate radiation environment.

Design and hazards information for the loop is described in WANL-TNR-119¹, for the experiment, in WANL-TME-732². Specifications for this test are described in WANL-TME-581³.

2.0 TEST HISTORY

Five transducers were irradiated and dynamically tested in the W-2 facility of the Plum Brook Reactor at a power level of approximately 50 MW. During this cycle (Cycle 16P) the sample fixture containing the transducers was exposed to an average water temperature of 127°F and an average pressure of 128 psig. The fixture was irradiated for 18 hours at an average reactor power of 41.5 MW, acquiring an exposure of 745 MW-hr.

Figure 1 is the reactor power profile, obtained from the PBRF water power computer. The test was initiated at 1500 hours on April 21, 1964, and was completed at 1000 hours on April 22, 1964. The test was prematurely terminated due to the condition of the transducers.

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1. WANL-TNR-119, "Experiment Design Manual and Hazards Analysis, Plum Brook Reactor Facility, Exp. No. 63-05", Westinghouse Astronuclear Laboratory.
 2. WANL-TME-732, "Design Manual and Hazards Analysis for Exp. No. 23/W505 Pressure Transducers", Radiation Effects Programs, April 10, 1964, Westinghouse Astronuclear Laboratory.
 3. WANL-TME-581, "Final Test Specifications for NRX-A Candidate Pressure Transducers to be Irradiated at the Plum Brook Reactor (23/W505)", Westinghouse Astronuclear Laboratory, March, 1964.

Figure 1. Reactor Power Profile, Pressure Transducer Test

3.0 DESCRIPTION OF TEST

3.1 DESCRIPTION OF TEST SPECIMENTS

Table 1 lists the types of pressure transducers tested, and also references the Instrumentation Data Book code numbers.

Table 1

Types of Pressure Transducers Tested

<u>Quantity</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>Range</u>	<u>Instrumentation Data Book Code No.</u>
2	Physical Science	PT 1001	0 to 250 psia	PR-30
1	Consolidated Controls Corporation	413M31	0 to 200 psia	PR-26
2	Consolidated Controls Corporation	413M31	0 to 150 psid	DPR-22

The Physical Science pressure transducers are variable reluctance types and the CCC transducers are the LVDT type.

3.2 DESCRIPTION OF TEST FIXTURE

A full, side view of the test fixture is shown in Figure 2. The fixture consists of an aluminum cage contained in the same shroud and attached to the same Unitrace sample holder tube as described in WANL-TNR-119, except for a 1/8-inch vent hole in the top of the shroud to eliminate the possibility of air entrapment. A gas manifold is located in the center of the cage by radial webs.

Figure 3 is an end view that details the arrangement of the transducers in the fixture. The five transducers were clamped to the inside edge of the cage around the core side of the fixture. The temperature of each transducer was measured by a stainless steel sheathed copper-constantan thermocouple pressure fitted between the clamp and the transducer.

Figure 4 depicts the "as built" drawing of the test fixture. The transducers contained a 13-foot long stainless steel sheathed, MgO insulated cable welded to the case of the transducer so as to be an integral part of it. The CCC units had two integral cables each: .090-inch diameter on the absolute unit, .062-inch diameter on the two differential units. The Physical Science transducers contained one .090-inch diameter cable per unit.

The radiation exposure of each transducer was measured by five dosimeter packets wired to the cage in close proximity to each transducer.

Figure 2. Pressure Transducer Fixture
(Side Facing Core)

Figure 3. Pressure Transducer Fixture End View

ITEM NO	W	X	Y
1	1.35	—	—
2	—	3.5	—
3	1.35	—	—
4	—	4.0	—
5	1.35	—	—
6	—	—	0.2
7	—	—	1.0
8	—	—	0.8
9	—	—	1.0

ITEM NO	ITEM	QTY	UNIT
1	1/2" DIA. TUBING	1	PC
2	1/2" DIA. TUBING	1	PC
3	1/2" DIA. TUBING	1	PC
4	1/2" DIA. TUBING	1	PC
5	1/2" DIA. TUBING	1	PC
6	1/2" DIA. TUBING	1	PC
7	1/2" DIA. TUBING	1	PC
8	1/2" DIA. TUBING	1	PC
9	1/2" DIA. TUBING	1	PC
10	1/2" DIA. TUBING	1	PC
11	1/2" DIA. TUBING	1	PC
12	1/2" DIA. TUBING	1	PC
13	1/2" DIA. TUBING	1	PC
14	1/2" DIA. TUBING	1	PC
15	1/2" DIA. TUBING	1	PC
16	1/2" DIA. TUBING	1	PC
17	1/2" DIA. TUBING	1	PC
18	1/2" DIA. TUBING	1	PC
19	1/2" DIA. TUBING	1	PC
20	1/2" DIA. TUBING	1	PC
21	1/2" DIA. TUBING	1	PC
22	1/2" DIA. TUBING	1	PC
23	1/2" DIA. TUBING	1	PC
24	1/2" DIA. TUBING	1	PC
25	1/2" DIA. TUBING	1	PC
26	1/2" DIA. TUBING	1	PC
27	1/2" DIA. TUBING	1	PC
28	1/2" DIA. TUBING	1	PC
29	1/2" DIA. TUBING	1	PC
30	1/2" DIA. TUBING	1	PC
31	1/2" DIA. TUBING	1	PC
32	1/2" DIA. TUBING	1	PC
33	1/2" DIA. TUBING	1	PC
34	1/2" DIA. TUBING	1	PC
35	1/2" DIA. TUBING	1	PC

Figure 4. Transducer Test Fixture

4. BUY FROM PACIFIC-HAWAIIAN CORP.
 CLEVELAND, OHIO OR EQUAL.
 5. BUY FROM IMPERIAL-BRYTHAN CORP.
 CHICAGO, ILL. OR EQUAL.
 6. BUY FROM PHYSICAL SCIENCES CORP.
 PASADENA, CALIF. OR EQUAL.
 7. BUY FROM CONQUANT CONTROLS CORP.
 BETHEL, CONN. OR EQUAL.

NOTES

3.3 TEST PROCEDURE

A schematic diagram of the gas supply and reference vent systems for the pressure transducer test is shown in Figure 5. The gas supply system was basically the same as that described in WANL-TNR-119 with one exception. A Heise pressure gage, 0 to 750 psi, was inserted in the gas supply line between the sample and valve SA-V1 to determine the exact pressure applied to the transducers.

To maintain the reference side of the CCC differential pressure transducers at CV pressure, the following system was provided. The reference side of the transducers was interconnected to a manifold and through the backplate by 1/8-inch OD aluminum tubing. From the back plate, 1/4-inch stainless steel flexible tubing was used through the quadrant to the control panel. The connections made at the control panel are shown in Figure 5. During operation, valve SA-V102 was closed and the pressure in the line monitored by a 0 - 50 psi Heise gage for indication of pressure build-up. Valve SA-V102 was opened only to vent the accumulated gas to the reactor tank vent system.

During operation, gas was slowly admitted to the transducers by opening valve SA-V1 and observing the 0 - 750 psi Heise pressure gage. Pressure was increased in 30 psi increments up to 150 psi. After reaching 150 psi, valve SA-V1 closed, the reactor off-gas valve (SA-V3) opened and pressure released in 30 psi increments. The increase in pressure from 0 psig to 150 psig, followed by decrease in pressure to 0 psig, is defined as one data cycle in which transducer outputs in millivolts were recorded. In addition to voltage outputs, insulation resistance and pin-to-pin resistances were recorded during each data cycle. Wiring diagrams (Figures 6 and 7) indicate the instrumentation utilization and connections.

Data cycles were taken at zero power, 100KW, 1MW, 10MW, 25MW and at full power every hour.

Figure 5. Pneumatic System

Figure 6. Physical Sciences Pressure Transducer Wiring Diagram

Figure 7. CCC Pressure Transducer Wiring Diagram

3.4 TEST RESULTS

As indicated in Section 2, the reactor was shut down after 18 hours of operation because of the condition of the transducers. The Physical Science units were still operative at the conclusion of the test but experienced a pronounced zero shift.

3.5 RAW DATA

Pre-irradiation and irradiation transducer output voltages are given in Tables 2, 3, 4, 5, and 6.

Transducer coil resistance and insulation resistance values for the five transducers are given in Tables 7, 8, 9, 10 and 11.

Sample temperatures are listed in Table 12 as a part of the system hourly data sheet.

Table 2. Output Voltages, Physical Science Transducer -1
(Expressed in Millivolts)

DATE	TIME	POWER	SUPPLY VOLTAGE	NOMINAL PRESSURE												
				0	30	60	90	120	150	120	90	60	30	0		
4/17/64	1000	0	9.0	+	4.8	12.0	19.9	28.0	35.8	43.6	35.5	27.6	19.5	11.4	+	3.5
4/17/64	1630	0	9.0	-	.6	10.1	18.1	26.1	34.4	42.3	34.5	26.6	18.5	10.4	+	2.6
4/19/64	2000	0	9.0	+	3.0	11.1	19.1	27.4	35.4	43.2	35.7	27.5	19.8	11.3	+	3.4
4/19/64	2315	0	9.0	+	.3	8.0	15.9	24.0	32.2	40.2	32.3	24.3	16.1	8.0	+	0.2
4/20/64	1000	0	9.0	+	.7	8.7	16.7	24.6	32.9	40.8	32.9	24.9	16.9	8.7	+	.9
4/20/64	1508	0	9.0	-	.4	7.3	15.4	23.5	31.4	39.3	31.5	23.5	15.5	7.4	-	.5
4/20/64	1645	0	9.0	+	.1	7.6	15.9	24.0	31.9	39.9	32.0	24.0	16.0	7.9	-	0.1
4/21/64	1230	0	9.0													
4/21/64	1532	0	9.0	-	.3	7.6	15.7	23.8	31.9	39.9	32.1	23.9	15.8	7.7	-	.3
4/21/64	1600	100 KW	9.0	+	.1	7.6	15.8	23.9	32.0	40.0	32.0	23.9	15.8	7.6	-	.1
4/21/64	1617	1 MW	9.0	+	2.2	9.9	17.9	26.0	34.0	41.9	34.0	25.9	18.0	9.8	+	2.0
4/21/64	1700	10 MW	9.0	+	26.2	32.8	40.1	47.4	54.5	61.5	54.1	50.0	42.9	34.6	+	27.0
4/21/64	1815	25 MW	9.0	+	73.5	80.1	86.8	93.4	99.9	106.5	100.6	95.0	87.5	81.0	+	75.1
4/21/64	1845	25 MW	9.0	+	117.2	122.0	127.5	132.8	138.1	143.7	138.3	132.9	127.5	122.2	+	117.0
4/21/64	2130	47.6 MW	9.0	+	118.8	124.3	129.3	134.6	139.9	145.4	140.6	135.4	130.1	124.8	+	119.7
4/21/64	2230	47.6 MW	9.0	+	121.9	127.7	132.8	138.2	143.6	149.1	143.5	138.4	132.9	128.1	+	122.8
4/21/64	2330	47.9 MW	9.2	+	123.1	128.2	133.5	138.8	144.0	149.2	144.1	138.8	133.6	128.9	+	125.3
4/22/64	0030	48.1 MW	9.0	+	125.2	130.3	136.0	141.3	146.2	151.8	145.8	140.6	135.4	130.4	+	123.8
4/22/64	0130	48.1 MW	9.0	+	128.2	133.3	138.7	144.0	149.3	154.4	149.3	144.2	138.7	133.6	+	129.1
4/22/64	0230	48.1 MW	8.8	+	129.2	135.5	140.8	146.1	151.6	157.0	152.0	146.6	143.8	138.3	+	133.4
4/22/64	0330	49.1 MW	9.0	+	135.0	140.6	144.8	150.2	155.8	161.3	156.0	150.9	145.4	140.1	+	135.0
4/22/64	0430	49.1 MW	9.0	+	134.0	139.2	144.9	150.3	155.5	160.6	157.5	151.8	145.0	140.1	+	134.6
4/22/64	0530	49.5 MW	9.0	+	135.7	140.4	147.0	151.3	156.4	161.7	157.2	151.9	146.7	141.4	+	135.9
4/22/64	0630	49.5 MW	9.0	+	136.0	141.1	146.8	151.9	156.8	162.3	157.1	151.7	146.5	141.4	+	135.8
4/22/64	0730	49.5 MW	9.0	+	135.9	140.9	146.7	151.7	157.0	162.5	157.7	151.9	146.3	141.1	+	136.1
4/22/64	0830	50.7 MW	9.0	+	138.5	143.9	148.8	153.8	159.3	164.4	158.7	154.2	148.7	144.3	+	137.9
4/22/64	1035	0	9.0	-	1045.0	-1041	-1039	-1033	-1026.5	-1020.7	1028.9	1036.5	1044.4	1052.8	-	1061.1
4/22/64	1230	0	9.0	-	1294.9	-1290.4	-1286.9	1280.7	1274.9	1268.9	1274.3	1280.9	1287.2	1293.9	-	1300.1
4/22/64	1300	0	9.0		0.0	6.9	13.9	20.9	27.9	34.9	27.9	20.8	14.0	7.0	+	0.0

Table 3. Output Voltages, Physical Science Transducer -2
(Expressed in Millivolts)

DATE	TIME	POWER	SUPPLY VOLTAGE	N O M I N A L P R E S S U R E										
				0	30	60	90	120	150	120	90	60	30	0
4/17/64	1000	0	9.0	- .3	7.2	15.5	23.8	31.9	39.9	32.1	24.2	16.1	7.9	+ .3
4/17/64	1630	0	9.0	+ 1.9	7.4	15.6	23.8	32.0	40.0	32.2	24.3	16.2	8.0	+ .2
4/19/64	2000	0	9.0	+ 0.1	8.0	16.0	24.4	32.5	40.3	32.9	24.7	16.7	8.1	+ 0.4
4/19/64	2315	0	9.0	+ .5	7.9	16.0	24.3	32.5	40.5	32.7	24.6	16.3	8.2	+ 0.5
4/20/64	1000	0	9.0	+ .3	8.0	16.2	24.3	32.6	40.5	32.7	24.7	16.5	8.3	+ .5
4/20/64	1508	0	9.0	+ .1	7.5	15.8	24.0	32.1	40.0	32.3	24.2	16.1	7.9	+ .1
4/20/64	1645	0	9.0	0.0	7.3	15.6	23.8	31.7	39.6	31.9	23.9	15.9	7.7	0.0
4/20/64	1230	0	9.0											
4/21/64	1532	0	9.0	- .4	7.2	15.5	23.8	32.0	40.1	32.3	24.0	15.8	7.5	- .4
4/21/64	1600	100 KW	9.0	+ .1	7.5	15.9	24.2	32.4	40.4	32.6	24.4	16.1	7.8	+ .1
4/21/64	1617	1 MW	9.0	+ 3.4	11.1	19.3	27.6	35.7	43.6	35.8	27.7	19.6	11.3	+ 3.6
4/21/64	1700	10 MW	9.0	+ 36.5	43.3	51.0	58.7	66.1	73.4	66.2	60.2	52.7	44.6	+ 37.3
4/21/64	1815	25 MW	9.0	+ 97.8	104.0	110.9	117.6	124.3	130.7	125.0	119.5	111.3	104.5	+ 98.6
4/21/64	1845	25 MW	9.0	+153.8	159.0	164.8	170.1	175.5	181.1	176.1	170.7	165.1	159.8	+ 154.6
4/21/64	2130	47.6 MW	9.0	+159.8	164.5	170.0	175.3	180.6	186.1	181.0	176.0	170.6	165.2	+ 160.1
4/21/64	2230	47.6 MW	9.0	+163.2	168.0	173.6	179.0	183.9	189.4	184.0	178.8	173.5	168.3	+ 163.2
4/21/64	2330	47.9 MW	9.2	+163.2	168.2	173.6	178.9	184.0	189.6	184.6	178.6	173.9	169.9	+ 166.2
4/22/64	0030	48.1 MW	9.0	+165.5	170.3	175.6	181.2	186.3	191.5	186.7	181.3	176.1	170.6	+ 165.7
4/22/64	0130	48.1 MW	9.0	+166.3	171.0	176.3	181.8	187.0	192.1	187.3	181.9	176.7	171.4	+ 166.4
4/22/64	0230	48.1 MW	8.8	+166.0	110.8	176.3	181.8	187.1	191.9	186.7	181.6	172.6	167.6	+ 162.5
4/22/64	0330	49.1 MW	9.0	+162.9	167.9	173.1	178.2	183.3	188.7	184.0	178.8	173.5	168.0	+ 162.7
4/22/64	0430	49.1 MW	9.0	+167.3	171.7	177.6	182.9	188.3	193.5	186.5	181.2	177.7	172.7	+ 167.7
4/22/64	0530	49.5 MW	9.0	+167.1	174.0	175.3	182.3	187.5	192.6	185.9	180.8	175.8	170.5	+ 165.6
4/22/64	0630	49.5 MW	9.0	+168.1	172.2	178.3	183.7	188.7	193.9	189.1	184.0	178.7	174.0	+ 169.0
4/22/64	0730	49.5 MW	9.0	+169.6	174.1	179.3	184.7	189.8	195.2	190.2	184.9	179.8	174.4	+ 169.5
4/22/64	0830	50.7 MW	9.0	+168.8	173.6	179.3	184.7	189.8	195.2	190.2	185.2	180.1	174.9	+ 170.0
4/22/64	1035	0	9.0	+ 18.9	26.6	34.4	42.6	50.9	59.2	51.5	43.3	35.1	26.9	+ 19.0
4/22/64	1230	0	9.0	+ 11.9	20.9	27.9	36.9	44.9	52.9	44.9	36.9	28.9	19.9	+ 11.9
4/22/64	1300	0	9.0	+ .4	7.9	15.9	24.9	32.9	41.9	33.9	24.9	16.9	8.9	+ 1.0

Table 4. Output Voltages, CCC Transducer -1
(Expressed in Millivolts)

DATE	TIME	POWER	SUPPLY VOLTAGE	N O M I N A L P R E S S U R E											
				0	30	60	90	120	150	120	90	60	30	0	
4/17/64	1000	0	28.0	+ .5	20.9	42.6	64.5	86.0	107.3	85.8	64.7	43.3	21.6	+ .5	
4/17/64	1630	0	28.0	- .9	20.3	41.6	63.4	85.2	106.5	85.9	63.3	42.2	20.2	- .3	
4/19/64	2000	0	28.0	+ 1.6	21.3	42.5	64.6	85.8	107.0	88.9	64.7	43.9	20.8	- 0.1	
4/19/64	2315	0	28.0	+ .7	21.5	43.0	64.5	86.4	107.9	86.4	65.1	43.3	21.5	+ .5	
4/20/64	1000	0	28.0	+ .2	21.9	43.4	64.7	86.6	107.6	86.6	65.4	43.9	22.2	+ .8	
4/20/64	1508	0	28.0	- 1.1	19.8	41.7	63.2	84.9	105.6	84.8	63.2	42.2	20.3	- 1.1	
4/20/64	1645	0	28.0	+ .1	20.8	43.0	64.7	85.5	106.8	85.6	64.4	43.1	21.5	+ 0.2	
4/21/64	1230	0	28.0												
4/21/64	1532	0	28.0	+ .2	21.6	43.2	64.6	86.1	107.4	86.4	64.8	43.3	21.7	+ .2	
4/21/64	1600	100 KW	28.0	+ .4	20.8	42.9	64.5	86.0	107.4	86.2	64.7	43.0	21.3	+ .3	
4/21/64	1617	1 MW	28.0	+ 0.7	21.8	43.7	65.0	86.9	108.0	86.5	65.0	43.6	22.0	+ 0.6	
4/21/64	1700	10 MW	28.0	+ 3.9	24.6	46.0	67.6	89.0	110.1	88.5	66.6	37.2	20.3	+ .3	
4/21/64	1815	25 MW	28.0	+ 77.1	101.1	124.0	145.6	168.6	194.9	170.1	143.2	118.8	96.1	+ 72.3	
4/21/64	1845	25 MW	28.0	+ 59.5	58.9	58.1	57.5	57.2	56.7	56.3	55.8	55.3	55.0	+ 54.6	
4/21/64	2130	47.6 MW	28.0	+ 39.8	39.7	39.7	39.6	39.6	39.6	39.5	39.5	39.5	39.5	+ 39.5	
4/21/64	2230	47.6 MW	27.8	+ 37.9	38.0	37.8	37.9	37.8	37.9	37.9	37.9	37.9	37.7	+ 37.8	
4/21/64	2330	47.9 MW	28.0	+ 37.5	37.5	37.5	37.5	37.6	37.6	37.6	37.7	37.5	37.5	+ 37.5	
4/22/64	0030	48.1 MW	28.0	+ 37.6	37.7	37.7	37.6	37.6	37.7	37.6	37.6	37.7	37.7	+ 37.7	
4/22/64	0130	48.1 MW	28.0	+ 37.9	37.9	38.0	37.9	37.9	37.9	37.9	37.9	37.9	37.9	+ 37.9	
4/22/64	0230	48.1 MW	27.8	+ 37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7	+ 37.7	
4/22/64	0330	49.1 MW	28.2	+ 37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	+ 37.6	
4/22/64	0430	49.1 MW	28.0	+ 37.3	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	+ 37.4	
4/22/64	0530	49.5 MW	28.0	+ 37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	+ 37.4	
4/22/64	0630	49.5 MW	28.0	+ 37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	+ 37.4	
4/22/64	0730	49.5 MW	28.0												
4/22/64	0830	50.7 MW	28.0	+ 37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1	+ 37.1	
4/22/64	1035	0	28.0	+ 50.3	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	+ 50.4	
4/22/64	1230	0	28.0	+ 50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	+ 50.9	
4/22/64	1300	0	28.0												

Table 5. Output Voltages, CCC Transducer -2
(Expressed in Millivolts)

DATE	TIME	POWER	SUPPLY VOLTAGE	N O M I N A L P R E S S U R E											
				0	30	60	90	120	150	120	90	60	30	0	
4/17/64	1000	0	28.0	- 1.0	28.3	58.1	87.9	116.7	145.4	116.8	88.0	58.9	29.1	+ .4	
4/17/64	1630	0	28.0	- .6	28.0	57.3	87.0	116.5	144.6	117.1	86.7	57.7	27.6	- .5	
4/19/64	2000	0	28.0	- 2.6	27.2	56.2	86.6	115.8	144.1	117.0	87.4	58.7	27.6	- 1.3	
4/19/64	2315	0	28.0	+ .6	29.3	58.6	88.0	117.4	146.3	117.7	88.6	58.9	29.4	+ .6	
4/20/64	1000	0	28.0	+ .2	29.9	59.3	88.1	117.9	146.1	117.8	89.0	59.7	29.8	+ .9	
4/20/64	1508	0	28.0	- .4	28.2	58.4	87.8	116.7	144.9	116.9	87.6	58.9	29.1	- .2	
4/20/64	1645	0	28.0	- .2	28.6	58.6	88.1	116.4	144.9	116.6	87.9	58.8	29.2	- .1	
4/21/64	1230	0	28.0												
4/21/64	1532	0	28.0	- .1	29.2	58.9	88.1	117.4	146.0	118.0	88.4	59.2	29.5	-0-	
4/21/64	1600	100 KW	28.0	+ .5	28.8	59.1	88.5	117.7	146.0	117.5	88.5	58.9	29.0	+ .4	
4/21/64	1617	1 MW	28.0	+ 1.4	30.2	60.0	89.6	119.0	147.2	118.7	89.2	60.1	30.2	+ 1.0	
4/21/64	1700	10 MW	28.0	+ 8.9	38.3	67.1	97.9	126.7	155.3	126.5	96.4	67.8	37.6	+ 8.7	
4/21/64	1815	25 MW	28.0	+ 54.0	83.7	114.6	145.0	175.8	207.2	181.1	150.1	120.7	91.9	+ 64.3	
4/21/64	1845	25 MW	28.0												
4/21/64	2130	47.6 MW	28.0	+2.161	2.188	2.212	2.234	2.257	2.282	2253	2228	2202	2174	2149	
4/21/64	2230	47.6 MW	27.8	+1.8329	1.8508	1.8879	1.9049	1.9209	1.9457	1.9056	1.8669	1.8301	1.8071	1.7717	
4/21/64	2330	47.9 MW	28.0	+1740.6	1759.8	1788.4	1810.8	1791.9	1814.3	1776.6	1743.4	1706.9	1721.2	1676.0	
4/22/64	0030	48.1 MW	28.0	+1545.9	1560.6	1592.3	1618.9	1646.3	1670.5	1644.3	1618.2	1590.5	1563.3	1537.9	
4/22/64	0130	48.1 MW	28.0	+1500.5	1524.2	1549.8	1577.4	1604.3	1627.9	1601.9	1575.9	1547.8	1518.3	1488.5	
4/22/64	0230	48.1 MW	27.8	+1392.1	1418.9	1446.6	1474.6	1502.7	1528.4	1499.8	1474.5	1447.2	1418.7	1393.4	
4/22/64	0330	49.1 MW	28.2	+1385.0	1412.7	1442.2	1569.5	1496.9	1524.3	1495.0	1469.7	1441.3	1413.5	1387.7	
4/22/64	0430	49.1 MW	28.0	+1317.0	1347.7	1377.9	1407.2	1434.4	1463.5	1435.3	1406.6	1379.4	1350.9	1322.6	
4/22/64	0530	49.5 MW	28.0	Very erratic										→	
4/22/64	0630	49.5 MW	28.0	Erratic										→	
4/22/64	0730	49.5 MW	28.0												
4/22/64	0830	50.7 MW	28.0	+1312.5	1342.0	Erratic								→	
4/22/64	1035	0	28.0	+ 80.5	108.2	135.3	162.5	189.5	216.3	189.7	162.7	135.9	108.2	80.4	
4/22/64	1230	0	28.0	+ 78.9	104.9	132.9	159.9	186.9	213.9	187.9	160.9	133.9	105.9	77.9	
4/22/64	1300	0	28.0	+ 38.9	65.9	93.9	120.9	147.9	174.9	147.9	121.9	93.9	67.0	38.9	

Table 6. Output Voltages, CCC Transducer -3
(Expressed in Millivolts)

DATE	TIME	POWER	SUPPLY VOLTAGE	NOMINAL PRESSURE										
				0	30	60	90	120	150	120	90	60	30	0
4/17/64	1000	0	28.0	+ .4	30.5	61.1	91.5	120.7	149.9	120.9	91.7	61.9	31.6	+ 2.1
4/17/64	1630	0	28.0	+ 2.1	31.4	61.3	91.7	121.6	150.1	122.1	91.2	61.8	31.0	+ 2.1
4/19/64	2000	0	28.0	- 1.7	28.7	58.5	89.6	119.3	148.0	120.4	90.5	61.1	29.6	+ 0.1
4/19/64	2315	0	28.0	+ .5	29.9	60.0	90.0	120.0	149.1	120.2	90.7	60.3	30.0	+ .4
4/20/64	1000	0	28.0	+ .3	30.7	60.8	90.4	120.6	149.1	120.5	91.2	61.3	30.7	+ 1.0
4/20/64	1508	0	28.0	+ .2	29.8	60.4	90.6	120.0	148.6	120.3	90.5	61.1	30.6	+ .4
4/20/64	1645	0	28.0	- .1	29.7	60.1	90.2	119.0	147.9	119.2	90.0	60.3	30.0	0.0
4/21/64	1230	0	28.0											
4/21/64	1532	0	28.0	- .4	29.7	60.1	89.9	119.5	148.6	120.0	90.1	60.3	30.0	- .5
4/21/64	1600	100 KW	28.0	+ .3	29.3	60.2	90.2	119.9	148.7	119.9	90.3	60.2	29.6	+ .1
4/21/64	1617	1 MW	28.0	+ 3.2	32.6	63.2	93.2	123.1	151.8	122.9	93.0	63.2	32.9	+ 3.0
4/21/64	1700	10 MW	28.0	+ 19.1	49.3	79.1	109.7	138.9	167.7	139.0	108.6	79.4	48.8	+ 19.4
4/21/64	1815	25 MW	28.0	+ 70.5	102.1	132.3	163.2	194.4	226.9	204.4	171.8	142.2	113.0	+ 85.9
4/21/64	1845	25 MW	28.0											
4/21/64	2130	47.6 MW	28.0	+ .425	.420	.420	.420	.417	.4009	390 erratic	300+ erratic	300+ erratic	370+ erratic	386+ erratic
4/21/64	2230	47.6 MW	27.8	+ .3499	.3405	.3389	.2900	.3143	.3534	.3699	.3009	.3501	.3019	.3494
4/21/64	2330	47.9 MW	28.0	+354.9	309.7	300.9	315.7	307.9	300.8	300.5	317.1	316.9	310.3	370.0
4/22/64	0030	48.1 MW	28.0	+388.0	383.9	380.9	370.9	369.9	332.9	330.8	350.0	365.5	300.9	308.0
4/22/64	0130	48.1 MW	28.0	+ 56.9	58.3	82.9	85.0	60.0	Erratic					
4/22/64	0230	48.1 MW	27.8	Very erratic										+150.9
4/22/64	0330	49.1 MW	28.2	Very erratic										
4/22/64	0430	49.1 MW	28.0	Very erratic										
4/22/64	0530	49.5 MW	28.0	Very erratic										
4/22/64	0630	49.5 MW	28.0	Erratic										
4/22/64	0730	49.5 MW	28.0											
4/22/64	0830	50.7 MW	28.0	410+ erratic	380+ erratic									
4/22/64	1035	0	28.0	-600 erratic	-620 erratic	-620	-620	erratic	erratic	erratic			-640 erratic	-640
4/22/64	1230	0	28.0	+618 erratic										
4/22/64	1300	0	28.0											

Table 7. Coil and Insulation Resistances,
Physical Science Transducer -1

DATE	TIME	POWER	SUPPLY VOLTAGE	COIL RESISTANCE		INSULATION RESISTANCE	
				A-C	E-F	A-Gnd	F-Gnd
4/17/64	1000	0	9.0	43		> 100 meg	
4/17/64	1630	0	9.0	44		> 100 meg	
4/19/64	2000	0	9.0	25		800 meg	
4/19/64	2315	0	9.0	43 Ω		800 meg	
4/20/64	1000	0	9.0	44 Ω		300 meg	
4/20/64	1508	0	9.0	44		310 meg	
4/20/64	1645	0	9.0	44.67		290 meg	
4/21/64	1230	0	9.0	44.95 Ω		320 meg	
4/21/64	1532	0	9.0	45.87		200 meg	
4/21/64	1600	100 KW	9.0				
4/21/64	1617	1 MW	9.0				
4/21/64	1700	10 MW	9.0	58.62		0.9 meg	
4/21/64	1815	25 MW	9.0	79.85 Ω		0.3 meg	
4/21/64	1845	25 MW	9.0				
4/21/64	2130	47.6 MW	9.0	109.61		8 K	
4/21/64	2230	47.6 MW	9.0				
4/21/64	2330	47.9 MW	9.2	111.1 Ω		10 K Ω	
4/22/64	0030	48.1 MW	9.0				
4/22/64	0130	48.1 MW	9.0	120 Ω		5.5 K Ω	
4/22/64	0230	48.1 MW	8.8				
4/22/64	0330	49.1 MW	9.0	120 Ω		10 K	
4/22/64	0430	49.1 MW	9.0				
4/22/64	0530	49.5 MW	9.0	120 Ω		26 K	
4/22/64	0630	49.5 MW	9.0				
4/22/64	0730	49.5 MW	9.0	120 Ω		25 K	
4/22/64	0830	50.7 MW	9.0	113.8		9 K	
4/22/64	1035	0	9.0	44.62		1.8 meg	
4/22/64	1230	0	9.0				
4/22/64	1300	0	9.0	47.40		3.5 meg	

Table 8. Coil and Insulation Resistances,
Physical Science Transducer -2

DATE	TIME	POWER	SUPPLY VOLTAGE	COIL RESISTANCE		INSULATION RESISTANCE	
				A-C	E-F	A-Gnd	F-Gnd
4/17/64	1000	0	9.0	43		> 100 meg	
4/17/64	1630	0	9.0	43		48 meg	
4/19/64	2000	0	9.0	25		100 meg	
4/19/64	2315	0	9.0	43 $\sim$		270 meg	
4/20/64	1000	0	9.0	44 $\sim$		290 meg	
4/20/64	1508	0	9.0	44		280 meg	
4/20/64	1645	0	9.0	44.55 $\sim$		270 meg	
4/21/64	1230	0	9.0	44.81 $\sim$		284 meg	
4/21/64	1532	0	9.0	45.64		190 meg	
4/21/64	1600	100 KW	9.0				
4/21/64	1617	1 MW	9.0				
4/21/64	1720	10 MW	9.0	58.62		0.9 meg	
4/21/64	1815	25 MW	9.0	79.95		.15 meg	
4/21/64	1845	25 MW	9.0				
4/21/64	2130	47.6 MW	9.0	109.7		8 K	
4/21/64	2230	47.6 MW	9.0				
4/21/64	2330	47.9 MW	9.2	111.1 $\sim$		6 K $\sim$	
4/22/64	0030	48.1 MW	9.0				
4/22/64	0130	48.1 MW	9.0	120 $\sim$		5.5 K $\sim$	
4/22/64	0230	48.1 MW	8.8				
4/22/64	0330	49.1 MW	9.0	120 $\sim$		65 $\sim$	
4/22/64	0430	49.1 MW	9.0				
4/22/64	0530	49.5 MW	9.0	120 $\sim$		4 K	
4/22/64	0630	49.5 MW	9.0				
4/22/64	0730	49.5 MW	9.0	120 $\sim$		26 K	
4/22/64	0830	50.7 MW	9.0	115.4		2 K	
4/22/64	1035	0	9.0	48.46		1.3 meg	
4/22/64	1230	0	9.0				
4/22/64	1300	0	9.0	47.13		1.8 meg	

Table 9. Coil and Insulation Resistances,
CCC Transducer -1

DATE	TIME	POWER	SUPPLY VOLTAGE	COIL RESISTANCE		INSULATION RESISTANCE	
				A-C	E-F	A-Gnd	F-Gnd
4/17/64	1000	0	28.0	14.6	15.2	> 100 meg	> 100 meg
4/17/64	1630	0	28.0	14.7	15.1	> 100 meg	50 meg
4/19/64	2000	0	28.0	15.0	15.5	> 100 meg	> 100 meg
4/19/64	2315	0	28.0	14.9 Ω	15.6	900 meg	1200 meg
4/20/64	1000	0	28.0	14.3 Ω	15.0 Ω	510 meg	690 meg
4/20/64	1508	0	28.0	14.8	15.3	510 meg	660 meg
4/20/64	1645	0	28.0	14.57 Ω	15.25 Ω	490 meg	670 meg
4/21/64	1230	0	28.0	14.60	15.28	510 meg	700 meg
4/21/64	1532	0	28.0	14.89	15.58	340 meg	500 meg
4/21/64	1600	100 KW	28.0				
4/21/64	1617	1 MW	28.0				
4/21/64	1700	10 MW	28.0	20.77	21.98	8.0 meg	19 meg
4/21/64	1815	25 MW	28.0	28.31	32.11	32 K	18 K
4/21/64	1845	25 MW	28.0				
4/21/64	2130	47.6 MW	28.0	12.01	9.89	5.8 Ω	10 Ω
4/21/64	2230	47.6 MW	27.8				
4/21/64	2330	47.9 MW	28.0	11.99 Ω	7.598 Ω	5.8 Ω	50 Ω
4/22/64	0030	48.1 MW	28.0				
4/22/64	0130	48.1 MW	28.0	12 Ω	3 Ω	6 Ω	4.5 Ω
4/22/64	0230	48.1 MW	27.8				
4/22/64	0330	49.1 MW	28.2	12 Ω	8 Ω	6 Ω	4.5 Ω
4/22/64	0430	49.1 MW	28.0				
4/22/64	0530	49.5 MW	28.0	12.5 Ω	8 Ω	67 Ω	4 Ω
4/22/64	0630	49.5 MW	28.0				
4/22/64	0730	49.5 MW	28.0	12.5 Ω	8 Ω	6.8 Ω	3.8 Ω
4/22/64	0830	50.7 MW	28.0	11.91	7.7	5.0 Ω	5.6 Ω
4/22/64	1035	0	28.0	16.24	7.28	10 Ω	3.8 Ω
4/22/64	1230	0	28.0				
4/22/64	1300	0	28.0	16.80	7.21	10.2 Ω	3.8 Ω

Table 10. Coil and Insulation Resistances,
CCC Transducer -2

DATE	TIME	POWER	SUPPLY VOLTAGE	COIL RESISTANCE		INSULATION RESISTANCE	
				A-C	E-F	A-Gnd	F-Gnd
4/17/64	1000	0	28.0	16.3	16.9	12.5 meg	33.8 meg
4/17/64	1630	0	28.0	16.4	16.9	930 K	240 K
4/19/64	2000	0	28.0	17.0	17.0	33 meg	24 meg
4/19/64	2315	0	28.0	16.9 Ω	17.3	11 meg	29 meg
4/20/64	1000	0	28.0	16.4 Ω	16.9 Ω	13.8 meg	27.5 meg
4/20/64	1508	0	28.0	16.8	17.1	14.5 meg	27.0 meg
4/20/64	1645	0	28.0	16.57 Ω	16.98	11 meg	25 meg
4/21/64	1230	0	28.0	16.60	17.02	16 meg	28 meg
4/21/64	1532	0	28.0	16.90	17.35	8.5 meg	22 meg
4/21/64	1600	100 KW	28.0				
4/21/64	1617	1 MW	28.0				
4/21/64	1700	10 MW	28.0	20.50	21.47	4.0 meg	10 meg
4/21/64	1850	25 MW	28.0	24.60	26.51	3 meg	5 meg
4/21/64	1845	25 MW	28.0				
4/21/64	2130	47.6 MW	28.0	29.69	33.34	4.9 K	4.7 K
4/21/64	2230	47.6 MW	27.8				
4/21/64	2330	47.9 MW	28.0	28.99 Ω	32.50 Ω	6.5 K Ω	7 K Ω
4/22/64	0030	48.1 MW	28.0				
4/22/64	0130	48.1 MW	28.0	30 Ω	34 Ω	7.5 K Ω	7.5 K Ω
4/22/64	0230	48.1 MW	27.8				
4/22/64	0330	49.1 MW	28.2	30 Ω	35 Ω	7 K	7.5 K
4/22/64	0430	49.1 MW	28.0				
4/22/64	0530	49.5 MW	28.0	30 Ω	34 Ω	7 K	7 K
4/22/64	0630	49.5 MW	28.0				
4/22/64	0730	49.5 MW	28.0	30 Ω	34 Ω	70 K	6.8 K
4/22/64	0830	50.7 MW	28.0	28.29	32.26	7.5 K	7.5 K
4/22/64	1035	0	28.0	17.29	18.27	1.9 meg	2.1 meg
4/22/64	1230	0	28.0				
4/22/64	1300	0	28.0	17.05	17.98	2.8 meg	2.8 meg

Table 11. Coil and Insulation Resistances,
CCC Transducer -3

DATE	TIME	POWER	SUPPLY VOLTAGE	COIL RESISTANCE		INSULATION RESISTANCE	
				A-C	E-F	A-Gnd	F-Gnd
4/17/64	1000	0	28.0	16.6	17.0	16.4 meg	7.1 meg
4/17/64	1630	0	28.0	16.6	17.0	810 K	30 K
4/19/64	2000	0	28.0	17.0	17.2	35 meg	3 meg
4/19/64	2315	0	28.0	16.9	17.3	7.7 meg	6.5 meg
4/20/64	1000	0	28.0	16.4 Ω	17.0 Ω	8.2 meg	7.2 meg
4/20/64	1508	0	28.0	16.8	17.2	7.6 meg	7.2 meg
4/20/64	1645	0	28.0	16.66 Ω	17.07 Ω	7.9 meg	7.2 meg
4/21/64	1230	0	28.0	16.69	17.10	23 meg	10 meg
4/21/64	1532	0	28.0	16.96	17.38	5.4 meg	5.4 meg
4/21/64	1600	100 KW	28.0				
4/21/64	1617	1 MW	28.0				
4/21/64	1700	10 MW	28.0	21.33	22.27	0.8 meg	7.3 meg
4/21/64	1815	25 MW	28.0	27.75	30.35	94 K	.2 meg
4/21/64	1845	25 MW	28.0				
4/21/64	2130	47.6 MW	28.0	39.44	55.0	3.8 K	7 K
4/21/64	2230	47.6 MW	27.8				
4/21/64	2330	47.9 MW	28.0	41.60 Ω	56.60 Ω	Erratic	6 K
4/22/64	0030	48.1 MW	28.0				
4/22/64	0130	48.1 MW	28.0	40 Ω	60 Ω	14 K Ω	5 K Ω
4/22/64	0230	48.1 MW	27.8				
4/22/64	0330	49.1 MW	28.2	45 Ω	65 Ω	15 K	5 K
4/22/64	0430	49.1 MW	28.0				
4/22/64	0530	49.5 MW	28.0	48 Ω	62 Ω	14 K	25 K
4/22/64	0630	49.5 MW	28.0				
4/22/64	0730	49.5 MW	28.0	48 Ω	62 Ω	11 K	9 K
4/22/64	0830	50.7 MW	28.0	46.56	60.39	19 K	3.0 K
4/22/64	1035	0	28.0	26.11	(unstable) >10 K		
4/22/64	1230	0	28.0				
4/22/64	1300	0	28.0	25.75	1600 Ω		

Table 12. System Hourly Data Sheet W-2 Inpile Loop

DATE	TIME	INLET FLOW	OUTLET FLOW	HT-1 PRESS	SAMPLE TEMP.	SAMPLE TEMP.	SAMPLE TEMP.	SAMPLE TEMP.	HT-1 INLET TEMP.	HT-1 OUTLET TEMP.	CAPSULE OUTLET TEMP.	CAPSULE PRESS	REACTOR POWER	QUADRANT CHECK	INITIAL
		FR-1	FR-2	PR-1	TR-2	TR-1	TR-1	TR-1	TE-1	TE-2	TE-3	PI-1			
4/21/64	1525	79	75	142	103	116	108	107	107	106	101	130	0	OK	RCA
4/21/64	1600	79	75	143	105	117	109	109	109	107.5	102	130	100 KW	OK	MC
4/21/64	1618	79	75	142	105	118	110.5	110.5	110	109	103	130	1 MW	OK	MC
4/21/64	1636	79.5	75	142	110	121	113.5	113.5	108	109.5	107	130	10 MW	OK	MC
4/21/64	1830	79	75	142	107	118.5	114.5	113.5	103	105	103.5	130	25 MW	OK	MC
4/21/64	1858	79	75	140	117	129	126.5	126	110	114	111.5	128	50 MW	OK	PMT
4/21/64	1930	79	75	140	122	133	131	129.5	114	118.5	115	128	50 MW	OK	PMT
4/21/64	2030	79	75	140	124	133.5	132	131.5	116	119.5	116	128	50 MW	OK	MC
4/21/64	2135	79	75	140	124	133	133	132	115.5	119.5	117	128	50 MW	OK	PMT
4/21/64	2230	79	75	140	123.5	132.5	133	132	115.5	120	117	128	47.6 MW	OK	PMT
4/21/64	2330	79	75	140	125	134.5	133.5	133	116	120	117	129	47.9 MW	OK	PMT
4/22/64	0030	79.5	75	140	125	135.5	135.5	134	118	120.5	118.5	128	48.1 MW	OK	MC

Table 12. System Hourly Data Sheet W-2 Inpile Loop

DATE	TIME	INLET FLOW	OUTLET FLOW	HT-1 PRESS	SAMPLE TEMP.	SAMPLE TEMP.	SAMPLE TEMP.	SAMPLE TEMP.	HT-1 INLET TEMP.	HT-1 OUTLET TEMP.	CAPSULE OUTLET TEMP.	CAPSULE PRESS	REACTOR POWER	QUADRANT CHECK	INITIAL
		FR-1	FR-2	PR-1	TR-2	TR-1	TR-1	TR-1	TE-1	TE-2	TE-3	PI-1			
4/22/64	0130	79	75	139	126	134	136	133	116	120	118.5	128	48.1 MW	OK	PMT
4/22/64	0230	79.5	75	140	126	135	136	133.5	116	120.5	118.5	128	48.1 MW	OK	PMT
4/22/64	0330	79.5	75	140	126	135	136.5	135	116	121	119	128	49.1 MW	OK	MC
4/22/64	0430	79.5	75	140	126	136	136.5	134.5	116	121	119	128	49.1 MW	OK	RCA
4/22/64	0530	79.5	75	139	126	136	138	135	117	122	119.5	128	49.5 MW	OK	LP
4/22/64	0630	79.5	75	140	127	136	138	136	118	122	120	128	49.5 MW	OK	LP
4/22/64	0730	79.5	75	140	129	137	138.5	137	118	122.5	120.5	129	49.5 MW	OK	LP
4/22/64	0830	79.5	75	140	129	137	139.5	136	118	122	120.5	129	50.7 MW	OK	RCA
Reactor shutdown at 0911.															
4/22/64	0920	79.5	75	140	86	98	96	92	86	86	86	128	0	OK	RCA