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Records

PRELIMINARY DATA REPORT

DOSIMETRY TEST

EXPERIMENT RE-I

AT PLUM BROOK REACTOR FACILITY

PBRF CYCLE 14 (PB NO. 4W)

MASTER

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1.0 INTRODUCTION

Dosimeters were irradiated to determine the spatial and energy distribution of the neutron flux density in the W-2 capsule, located in HT-1 of the Plum Brook Reactor. The test, Experiment RE-1, was conducted on March 17-18, 1964.

Design and hazards information for the loop is described in WANL-TNR-119¹, and for the experiment in WANL-TME-690, Revision 1².

2.0 TEST HISTORY

Thirteen dosimeter sets were irradiated in a static test in the W-2 facility of the Plum Brook Reactor. During this cycle (Cycle 14) the sample holder containing the dosimeters was exposed to an average water temperature of 125°F and an average water pressure of 128 psig. The sample holder was irradiated for 26.8 hours at an average reactor power of 33.5 Mw, acquiring an exposure of 898.5 Mw-hr.

Figure 1 is the reactor power profile, obtained from PBRF. The test was initiated at 1635 hours on March 17, 1964, and was terminated at 2133 hours on March 18, 1964.

A reactor scram occurred 3.67 hours after the beginning of the run. Reactor power was subsequently increased to 10 Mw.

A second, manual scram occurred 4.83 hours after the beginning of the run. Reactor power was again increased to 10 Mw, then subsequently to 20, 40 and 50 Mw. (The step-wise power rise was requested by another experimenter).

A third scram was inadvertently caused when the W-2 flow recorder was accidentally jarred (during routine maintenance), causing actuation of a mercury switch. The experiment sample holder was removed after this scram.

1. WANL-TNR-119, "Experiment Design Manual and Hazards Analysis, Plum Brook Reactor Facility, Exp. No. 63-05", Radiation Effects Program.
2. WANL-TME-690, Revision 1, "Design Manual and Hazards Analysis for Exp. RE-1, Dosimetry Test at PBRF (RFI, 63-05)", Radiation Effects Program.

Figure 1. Reactor Power Profile, Dosimetry Test

3.0 DESCRIPTION OF TEST

3.1 DESCRIPTION OF TEST SPECIMEN

Each of the thirteen dosimeter sets consisted of the following: a quartz-covered, bare aluminum-cobalt wire; a cadmium-covered, aluminum-cobalt wire; and a quartz-covered sulfur pellet. A set is illustrated in Figure 2.

Four grounded hot junction, copper-constantan thermocouples were used to determine water temperatures inside the capsule. These four experiment thermocouples were used in conjunction with the three system thermocouples to evaluate heat losses to the quadrant water, and heat transfer within and exterior to the capsule.

3.2 DESCRIPTION OF TEST FIXTURE

The dosimeter sets were placed at thirteen locations throughout the length of the W-2 capsule as shown in Figures 3 and 4. The flux density values across the diameter of the capsule at the core midplane and along the axial centerline of the capsule will be determined.

Two of the experiment thermocouples were located at the core midplane to detect a temperature difference across the diameter of the capsule at that vertical plane.

The other two experiment thermocouples were located near the sample holder backplate to determine a temperature difference between coolant entering and leaving the capsule.

3.3 TEST PROCEDURE

The test procedure consisted of monitoring temperatures and reactor power levels during irradiation. These were recorded at two hour intervals and at each change in reactor power.

The dosimeters will be evaluated and the flux densities determined.

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Figure 2 - W-2 Water Cooled Inpile Capsule Dosimeter Arrangement for PBRF

- 1 Tube
- 2 Spacer
- 3 Wire, quartz-covered
- 4 Pellet, quartz-covered
- 5 Wire, cadmium-covered

-5-

Figure 4. Photograph of Sample Fixture Showing Dosimeters

3.4 TEST RESULTS

Results of the evaluation of the dosimeters will be described in a future report.

Table 1 lists the temperatures recorded prior to the irradiation, and Table 2, the temperatures during irradiation. Note that the values obtained at point 5 are less accurate than those for the other locations. This was due to the necessity of using a miniature strip chart recorder for one thermocouple output. For the other readings a Daystrom multi-point recorder was used.

Points 1 through 7, indicated in Tables 1 and 2, and illustrated in Figure 5, refer to the following thermocouples:

<u>Point</u>	<u>Thermocouple</u>
1	*System Thermocouple 1
2	*System Thermocouple 2
3	**Experiment Thermocouple 1
4	**Experiment Thermocouple 3
5	**Experiment Thermocouple 4
6	**Experiment Thermocouple 2
7	*System Thermocouple 3

*Locations of system thermocouples 1, 2, 3, are also shown in Figure 6.

**Locations of the experiment thermocouples (except Point 8) are also shown in Figure 3.

Note: Point 8 is Quadrant C Water Temperature Near W-2 Piping

Figure 5. W-2 Coolant Flow Path and Thermocouple Locations

Table 1

Pre-Irradiation Temperatures

<u>Date</u>	<u>Time</u>	<u>*Point 1</u>	<u>Point 2</u>	<u>Point 3</u>	<u>Point 4</u>	<u>Point 5</u>	<u>Point 6</u>	<u>Point 7</u>	<u>Remarks</u>
3/13	0900			76.5/75.5	76.5/75.5	73/74.0	76.5/75.5		Recorder/potentiometer readings; sample holder in air; air temperature 76.1°F.
3/13	1300	79.0/78.0	70.0/69.0					70.5/70.0	Recorder/potentiometer readings; system water temperature.
3/16	0100	99.0	98.0	99.0	99.0	96	98.5	95.0	Recorder readings; flow through sample holder in capsule.
3/16	0845	119.0	116.5	115.0	116.0	112	115.5	110.5	Recorder readings; flow through sample holder in capsule.
3/16	1933	121.0	119.0	117.5	118.5	104	118.0	113.0	Recorder readings; flow through sample holder in capsule. Pt. 5 pot. reading 114°F.
3/17	0145	121.0	119.0	118.5	119.5	115	118.0	113.0	Recorder readings; flow through sample holder in capsule.
3/17	0630	124.0	121.0	121.0	121.5	116	121.0	116.0	Recorder readings; flow through sample holder in capsule.
3/17	0830	123.0	121.0	120.0	120.0	116	120.0	115.0	Recorder readings; flow through sample holder in capsule.
3/17	1130	120.0	119.0	118.0	117.0	114	118.0	114.0	Recorder readings; flow through sample holder in capsule.
3/17	1430	118.0	117.0	116.5	115.5	112	117.0	113.0	Recorder readings; flow through sample holder in capsule.

*See Figure 5 for location of measuring points.

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Table 2
Temperatures, During Irradiation

<u>*Run-Time</u> (hr)	<u>Nominal Reactor</u> <u>Power</u> (Mw)	<u>**Point 1</u>	<u>Point 2</u>	<u>Point 3</u>	<u>Point 4</u>	<u>Point 5</u>	<u>Point 6</u>	<u>Point 7</u>	<u>Point 8</u>	<u>Remarks</u>
1.45	1	122.0	120.0	120.0	119.0	115	120.0	115.5	94.5	
2.00	1	121.0	120.0	119.0	119.0	116	119.5	115.0	95.0	
3.16	10	99.5	101.0	113.0	113.5	113	114.0	101.5	95.5	
3.66	0	91.0	90.0	93.0	92.0	86	92.5	91.0	94.5	Data taken after scram.
4.63	10	95.5	96.0	98.5	99.0	98	99.5	97.5	94.0	
4.92	0	92.0	92.0	94.0	94.0	90	94.0	92.0	94.0	Data taken after shutdown.
5.97	0	102.5	101.5	103.0	103.0	100	103.0	100.5	94.0	Startup initiated.
6.47	10	100.0	101.5	105.0	104.0	100	104.5	102.0	94.0	
7.12	10	98.0	98.0	100.5	101.0	99	101.5	99.0	94.0	
7.92	10	97.0	98.0	100.5	100.5	100	101.0	99.0	93.5	
9.17	20	99.5	101.5	102.5	104.0	105	104.5	101.5	94.0	
9.92	20	90.0	101.0	103.0	104.5	105	106.5	102.0	93.0	
12.00	20	109.5	111.0	111.5	113.5	112	114.0	110.0	93.0	
12.17	40	114.5	119.0	118.5	121.5	123	122.5	117.5	93.0	
13.92	40	110.5	113.5	114.5	117.5	120	119.0	114.5	94.0	

Table 2 (Cont'd)
Temperatures, During Irradiation

<u>*Run-Time</u> (hr)	Nominal Reactor <u>Power</u> (Mw)	<u>**Point 1</u>	<u>Point 2</u>	<u>Point 3</u>	<u>Point 4</u>	<u>Point 5</u>	<u>Point 6</u>	<u>Point 7</u>	<u>Point 8</u>	<u>Remarks</u>
14.92	50	111.5	115.0	117.5	119.0	124	120.0	116.0	94.0	
15.92	50	115.0	119.0	119.0	123.0	126	124.5	119.0	94.5	
18.00	50	121.0	125.0	124.0	128.5	131	130.0	124.0	94.5	
20.00	50	121.0	126.0	124.0	129.0	131	130.0	124.0	96.0	
22.00	50	121.0	125.0	123.5	129.0	131	130.0	123.5	95.5	
24.00	50	120.0	125.0	124.0	130.0	130	130.0	124.0	96.0	
26.00	50	116.5	121.0	120.5	125.5	130	126.5	121.0	95.5	
28.00	50	115.5	120.0	120.0	126.0	129	125.5	121.0	96.0	
29.20	0	90.5	90.0	92.5	93.5	90	92.5	91.0	95.0	
30.00	0	81.0	81.0	84.0	85.0	81	84.0	83.0	95.0	

*Reactor critical at 1635 hr on March 17, 1964 = 0.00 hr run-time.

**See Figure 5 for location of measuring points.

REVISIONS			
SYN	ZONE	DESCRIPTION	DATE
A		REVISED IN TITRATION ZONE C-4 C-3 B-4 CORRECTED LEGEND PER ENGINEERING REQUEST ADDED NOTES 5 & 6 D SPEC 751323-J 11 MARKS - 31 63 ADDED 3-WAY VALVE & ACCUMULATOR 3" LINE WAS 1 1/2" IN ZONE S-B, S-C & S-D ADDED 3 X 1" REDUCERS ADDED PB15V37, PB15V38, & PB15V39 VALVES D SPEC 751323-J D SPEC HARDT 6-1-63	5/31/63
B		REVISED TO AS BUILT CONDITION D SPEC 751323-S J REED 9/27/63	10/1/63
C		REVISED TO AS BUILT CONDITION D-SPEC 751323-AB H MARKS 12-3-63	12/4/63
D	B-4	REMOVED CHECK VALVE EC-VI-11 D SPEC 751323 AF A DANIELS 4-10-64	4/10/64

LEGEND	
	Y-STRAINER FLANGED
	VALVE 3-WAY
	GATE VALVE, FLANGED, MANUALLY OPERATED
	GLOBE VALVE, MANUAL REACH ROD OPERATED
	CHECK VALVE
	NEEDLE VALVE
	NEEDLE VALVE, PRESSURE REGULATED
	SPRING LOADED RELIEF VALVE
	REDUCER
	FLOW MEASURING DEVICE
	BALL VALVE FLANGED MANUALLY OPERATED
	FLANGED CONNECTION
	INSTRUMENT ON EXPERIMENT CONTROL PANEL
	LOCALLY MOUNTED INSTRUMENT
	HORN AND LIGHTED PANEL (ANNUNCIATOR)
	STAINLESS STEEL FLEXIBLE ALL METAL HOSE
	1/2 NOMINAL FLEXIBLE HOSE
	ELECTRICAL CONTROL
	ELECTRICAL LEADS IN TYGON TUBING

INSTRUMENTATION SYMBOLS		
SYMBOL	1ST POSITION PROCESS VARIABLE	2ND & 3RD POSITION INSTRUMENT FUNCTION
A	AUDIBLE	ALARM
C		CONTROL
D		DIFFERENTIAL
E		PRIMARY ELEMENT
F	FLOW	
I		INDICATOR
M	MANUAL	
P	PRESSURE	
R		RECORDER
S		SWITCH
T	TEMPERATURE	
X	POSITION	VALVE TRANSMITTER

PIPING LEGEND & MATERIAL SPECIFICATION		
SYMBOL	SERVICE	MATERIAL SPEC
PC	PRIMARY COOLANT 105-145 PSIG 100-140°F	P1-304 L CRES SCH 10 S
P	PURGE 80 PSIG 90°F	P2-316 CRES FLEXIBLE HOSE EQUIV TO SCH 40
N (NOZZLE)	SAME AS PC	P3-1/4" 304 CRES TUBING
EC	EMERGENCY COOLANT 80 PSIG 90°F	
VO	VENT & DRAIN 10-15 PSIG 90-165°F	P1A-304 CRES SCH 40 S
SA	SAMPLE ACTUATING GAS 0-295 PSIG	

4- INCLUDES 1/2 4 6 7 & 8
3- PRI AND TR2 ARE ON SEPARATE PENS BUT ON A SINGLE RECORDER
2- REFERENCE DRAWINGS - 1 OF 114407 REV D1 REVISED AS BUILT 5-15-64
2 OF 122146 REV A1 FIELD CHECKED AND REVISED
AS BUILT 3-13-62
1- SAMPLE CONNECTIONS & INSTRUMENTATION VARY WITH EACH
EXPERIMENT

Figure 6. W-2 Water-Cooled Inpile Capsule Engineering Flow Diagram