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WANL-TME-609

February 19, 1964

PRELIMINARY DATA REPORT

CONTROL DRUM BEARINGS, EXPERIMENT NO. 40/W004,

IRRADIATED AT PLUM BROOK REACTOR FACILITY

PBRF CYCLE 6 - (PB No. 2W)

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R 1 0 1964

MECHANICAL DESIGN

INFORMATION CATEGORY	
Unclassified	
<u>S. S. Stein</u>	2/26/64
Authorized Classifier	Date

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1.0 INTRODUCTION

Preliminary results of the irradiation of control drum bearings in a static test, conducted at the Plum Brook Reactor Facility in Sandusky, Ohio, on October 14-15, 1963, are described in this report. The test was designated Experiment No. 40/W004. The purpose of this experiment was to determine possible physical changes in the bearing resulting from the irradiation. This type of bearing is being considered for use with NERVA control drums. Background information for the loop is contained in WANL-TNR-119¹, for the bearing test in WANL-TNR-127², and in the Test Specifications.³

2.0 TEST HISTORY

The control drum bearings were irradiated in a static test in the W-2 facility of the Plum Brook Reactor and at a power level of approximately 40 Mw. During this cycle (Cycle 6), two control drum bearings and an additional retainer ring were irradiated. The sample fixture containing the bearings was exposed to an average water temperature of 118°F and an average pressure of 130 psig. The fixture was irradiated for 3.58 hours at an average reactor power of 34.14 Mw, acquiring an exposure of 122.31 Mw-hr.

1. WANL-TNR-119, "Experiment Design Manual and Hazards Analysis, Plum Brook Reactor Facility, Exp. No. 63-05", Radiation Effects Program, Westinghouse Astronuclear Laboratory.
2. WANL-TNR-127, "Design and Hazards Analysis for Experiment No. 40/W004, Control Drum Bearings at Plum Brook Reactor Facility (RFI, 63-05)", H. Cadoff and D. Newby, Radiation Effects Program, Westinghouse Astronuclear Laboratory.
3. "Final Test Specifications, Control Drum Bearings", Radiation Effects Program, Westinghouse Astronuclear Laboratory.

Figure 1 is the reactor power profile, obtained partly from the reactor log and partly from the experiment data sheets. The test was initiated at 2140 hours on October 14, 1963; the reactor power level was increased from critical to 40 Mw, during 2200 to 2245 hours. A power level of approximately 40 Mw was maintained for $2\frac{1}{2}$ hours. The reactor was shut down at the completion of the test at 0115 hours on October 15, 1963.

3.0 DESCRIPTION OF TEST

3.1 DESCRIPTION OF TEST SPECIMENS

Two control drum bearings and an additional retainer ring were housed in a sample fixture, as shown in Figure 2. The bearings were modified Marlin Rockwell Corp. products, size 206S. The inner and outer races and the balls were constructed of a stainless steel containing 14 percent chromium and 4 percent molybdenum. The retainer rings were constructed from a material containing 40 percent bronze, 40 percent polyimide; and, in one case, 20 percent tungsten diselenide, and in the other case, 20 percent molybdenum diselenide. (The extra retainer ring also contained the tungsten diselenide.)

3.2 DESCRIPTION OF TEST FIXTURE

A photograph of the test fixture and sample items before assembly is shown in Figure 2. Control drum bearings C and E, the extra retainer ring A, and the spacers B and D were mounted on the arm of the fixture. Dosimeters were inserted in spacers B and D. Details of the types of dosimeters and their placement are described in Figure 3. Likewise, the arrangement of the control drum bearings in the test fixture is illustrated in Figure 3. An aluminum crush ring (Figure 3, Item 113) was used as a water-tight seal for the housing to isolate the bearings from the primary coolant. An end cover, (Item 102), directed the coolant flow through the fixture.

Four thermocouples, used to monitor the approximate bearing temperatures, were embedded in the interior walls of the housing as shown in Figure 3.

3.3 TEST PROCEDURE

Since this was a static test, no actuating mechanism was involved.

Figure 1. Reactor Power Profile for Experiment No. 40/W004.

Figure 2. Unassembled Test Fixture and Control Drum Bearings.

Figure 3. Bearing Test Housing Water Cooled Inpile Capsule.

The thermocouples were embedded in fairly substantial masses of aluminum (as shown in Figure 3) in order to monitor more closely the bearing temperature as opposed to the coolant temperature. The approximate bearing temperatures were recorded every half hour during the run, and were read out on the multipoint recorder. The out-of-core coolant temperatures were also monitored for purposes of comparison.

Dosimeters were used to monitor the neutron fluxes.

3.4 TEST RESULTS

The irradiation was performed successfully and without incident. The usual small vibration due to the primary coolant pumps was noted. Reactor full power (at that part of the reactor cycle) was established quickly with respect to the length of the run, so that startup and shutdown time flux contributions should be suitably small, as desired. Approximate bearing temperatures, monitored throughout the run, were substantially below levels that might cause physical effects to the materials. Hence, temperature effects should not have to be considered in analyzing results. Results of the post-irradiation examination of the control drum bearings will be detailed in the Test Report.

Thermocouple 1 behaved erratically after 2.75 hours while other incore and out-of-core temperatures remained essentially constant. This thermocouple may have started to fail, or possibly, developed a leak causing the thermocouple to indicate a coolant rather than metal temperature. Apparently thermocouple 3 was exposed to coolant, since it is questionable that metal temperature gradients in the aluminum fixture would be as large as shown by the data (Table 1).

3.5 RAW DATA

Sample and coolant temperature data are listed in Table 1.

Table 1

Sample and Coolant Temperatures (Raw Data)

<u>Time</u>	<u>Run-Time</u> (hr)	<u>Nominal Reactor Power</u> (Mw)	<u>Thermocouple No.</u>				<u>HT-1 Temperature, °F</u>		<u>Capsule Outlet Temperature, °F</u>
			<u>1</u> (°F)	<u>2</u> (°F)	<u>3</u> (°F)	<u>4</u> (°F)	<u>Inlet</u>	<u>Outlet</u>	
2148	0.13	100*	115	120	120	120	121	121	117
2155	0.25	10	122	125	116	121	108	110	109
2330	1.83	40	142	143	131	140	122	123	122
0001	2.35	40	139	139	126	135	118	120	119
0030	2.83	40	138	136	126	136	116	119	118
0100	3.33	40	115	137	124.5	135	114	117	116
0113	3.55	40	115	137	123	132	113	117	117
0125	3.75	0	106.5	117	116	116	116	115	114

* Kilowatts