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September 1964

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Westinghouse
Astronuclear Laboratory

EML-8

PARTIAL LENGTH CORE ASSEMBLY STATIC TEST

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EML-8
PARTIAL LENGTH CORE ASSEMBLY STATIC TEST

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~~GROUP 1~~
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1.0 SUMMARY

Static tests are conducted to determine the physical characteristics of the reactor lateral support system by applying a load, laterally, to the core. These tests are conducted on partial length core specimens, with the results extrapolated to obtain values for a full length core. The test reported herein was conducted on a specimen of updated reactor components, including an impregnated inner reflector, for comparison with previous tests (B-5 program).

The full length core characteristics derived from the test data are spring rate, static friction force, static dead zone, static deflection, and natural frequency. These values with one exception, the natural frequency, are somewhat lower than those obtained from the previous test (B-5). The gouging of the seal segments by the plungers, at the locating holes in the previous B-5 test, resulted in higher values of friction force obtained from that test. Inspection during and after the completion of this test revealed no excessive wear or damage to the seals or plungers. Extrapolation from partial length core to full length values neglects effects of the tie rods.

2.0 INTRODUCTION

Previous static testing of a partial length core has been limited to tests with a non-impregnated inner reflector. A design modification of the seal segments, requirement for inner reflector impregnation

and use of PO3 plungers indicated the desirability of a test of a specimen containing these components for comparison with previous test results.

3.0 PURPOSE

3.1 This test was conducted to determine the system characteristics, under static load, of a partial length core with updated components and an impregnated inner reflector.

4.0 OBJECTIVES

- 4.1 To determine the amount of wear or damage to the seal segments and plungers as a result of static loading.
- 4.2 To determine the spring rate of the system.
- 4.3 To determine the static friction force of the system.
- 4.4 To determine the static dead zone of the system.
- 4.5 To determine the natural frequency of the system.
- 4.6 To determine the static deflection of the system.

5.0 CONCLUSIONS

From the following table it can be seen that all but one of the values determined from this test are lower than those obtained from the previous test (B-5). The higher values obtained from the B-5 tests can be attributed to the gouging of the seal segments, at the locating holes, by the plungers. This condition resulted in the

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highly curved shape of the load-deflection curves obtained from that test. The NRX-A2 design seal segments used in this test did not have locating holes. No seal segment gouging by the plungers occurred during this test.

Comparison of Test Results

Physical Characteristics	EML-8	B-5
Spring Rate (K)	44,160 lb./in.	44,760 lb./in.
Static Friction Force (P)	7230 lb.	9780 lb.
Static Dead Zone (From Curve)	0.162 in.	0.170 in.
Static Dead Zone (P/K)	0.164 in.	0.218 in.
Natural Frequency (fn)	11.8 cps	11.7 cps
Static Deflection (Δs)	0.070 in.	0.071 in.

6.0 TEST SPECIMEN

6.1 The test specimen consisted of the following components:

<u>Item</u>	<u>Dwg. No.</u>
Inner Reflector (Impregnated)	709J918
Seal Segments	977D843 977D844 977D845
Spring Assemblies	977D851 977D852 945C660
Screws	946C300
Graphite Plungers	963B984
Solid Core	945C533

6.2 The specimen was assembled in a support fixture (Dwg. No.

NT 701102) and the static test fixture (Dwg. No. NT 701035) as shown schematically in Figure 1.

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7.0 TEST EQUIPMENT AND PROCEDURE

- 7.1 All tests were conducted under laboratory ambient temperature and pressure.
- 7.2 Initially specimen weights were obtained.
- 7.3 The load was applied to the core by the static test fixture (Dwg. No. NT 701035). The core displacement, with respect to the inner reflector, was limited to a maximum of 0.19 in. in each direction. The core displacement was measured by a Research, Inc. Model 4046, 0 to 1 in. displacement transducer. The load applied to the core was measured by a WANL manufactured load cell. The transducer and load cell outputs were recorded on the X axis and Y axis, respectively, of a Electro Instruments Model 500 XY recorder. This arrangement provides an automatically plotted load-deflection loop (Figures 3 and 4). Figure 2 shows the instrumentation setup schematically. Actual test setup is shown in Figure 5.
- 7.4 The test was conducted with the longitudinal axis of the specimen in the horizontal position as shown in Figure 1. Two tests, of one cycle each, were conducted on the specimen with the following procedure.
- 7.4.1 The instrumentation was calibrated.
- 7.4.2 The core was centered within the inner reflector and the recording equipment started.
- 7.4.3 The load was applied to the core until a maximum displacement of 0.19 in. was recorded. The loading was

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reversed until a core displacement of 0.19 in. in the opposite direction was recorded. The loading was again reversed until the core was returned to the center position.

7.4.4 During the test loading was stopped four times, when core displacements of 0.10 in. and 0.19 in. from the center in each direction were recorded. At these times three lateral support springs, located at 0°, 90°, and 270° from the direction of loading, were removed and the plungers and seal segments were visually inspected for wear.

7.5 At the completion of the tests the specimen was disassembled and inspected for wear.

8.0 TEST RESULTS

8.1 The total weight of the specimens moving parts was 535 lb. with the core weighing 514 lb. and the seal segments weighing 21 lb. For a full length core, the weight of the moving parts would be 3095 lb. (Wc), based on partial core weight (Wc for B-5 test was 3078 lb). $Wc = \text{Partial Core Wt.} \left(\frac{\text{Full Core Lgth.}}{\text{Partial Core Lgth.}} \right) + \text{No. of Rows of Seals (Weight of Seals per Row)}.$

8.2 Inspection of the plungers and seal segment contact area during the test and after disassembly revealed only slight polishing which was not measurable, appreciable wear at any of the other component contact areas.

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8.3 The lateral support system characteristics were determined from the load-deflection curves, Figures 3 and 4. The spring rate is the slope of the curve and the static friction force is the intersection of the curve on the load axis at 0.0 in. displacement. The values obtained for the specimen are, spring rate 7360 lb./in. and static friction force 1205 lb. Extending these values to a full length core the following values are obtained.

Spring Rate (K) 44,160 lb./in.

Static Friction Force (P) 7230 lb.

8.4 The intercepts of the curve on the displacement axis determine the static dead zone, that is, the zone within which the static friction of the system will cause the core to remain in place on removal of the load applied to the core. This value determined directly from Figures 3 and 4 is 0.162 in. This is comparable to the value computed from the static friction force and the spring rate.

$$\frac{P}{K} = \frac{7230 \text{ lb.}}{44,160 \text{ lb./in.}} = 0.164 \text{ in.}$$

8.5 The natural frequency of the core as computed from the experimentally determined values is 11.8 cps.

$$f_n = \frac{1}{2\pi} \sqrt{\frac{kg}{W_c}} = \frac{1}{2\pi} \sqrt{\frac{44,160 \text{ lb./in.} (386.4 \text{ in./sec.}^2)}{3095 \text{ lb.}}} = 11.8 \text{ cps}$$

8.6 The static deflection of the system, or the distance the core moves due to gravity if friction is neglected is 0.070 in.

$$\Delta s = \frac{W_c}{K} = \frac{3095 \text{ lb.}}{44,160 \text{ lb./in.}} = 0.070 \text{ in.}$$

Figure 1

Static Load Test Set-Up

Figure 2

Schematic of Test Instrumentation

Figure 3

Load-Deflection Curve

Run 1

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Figure 5
Partial Length Core Static Test Set-Up

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