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Westinghouse
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WANL-TME- 2736
SEPTEMBER 1970

MASTER

DATA ITEM T-119

FIVE INCH AXIAL LENGTH
CORE PERIPHERY EVALUATION
MODEL (U)

FINAL REPORT

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DATA ITEM T-119

FIVE INCH AXIAL LENGTH CORE PERIPHERY EVALUATION MODEL (U) FINAL REPORT

Approved By:

J. G. Gallagher, Manager
Design Engineering

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ABSTRACT

A series of hydraulic bundling, thermalizing, and depressurization tests was conducted on a short (5 inch long) model of the 64DT-031 Cyclic Strain Test to investigate the large pyrofoil expansion experienced at the relatively cool forward end of that test. These tests are used to verify corrective measures proposed for subsequent 64DT-211 and 212, "Corrosion Tests" to prevent excessive pyrofoil expansion.

Hydraulic bundling tests utilizing internal and external differential pressures on the pyrofoil wrapper have negligible effect on the wrapper growth. Thermalizing a pyrofoil wrapper in the test fixture results in less than 1.7% wrapper growth. Depressurization tests at reactor depressurization rates of 50 psi/sec cause a Petrolatum bonded unthermalized pyrofoil wrapper to grow 26% while thermalized pyrofoil wrappers with and without Petrolatum bonding grow only 4% to 6%.

It is concluded that thermalized pyrofoil assembled with or without Petrolatum would be acceptable for use in the 64DT-211 and 212 Corrosion Tests at nominal depressurization rates of 50 psi/sec.

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1.0 INTRODUCTION

1.1 TEST IDENTIFICATION

1.1.1 Type of Report

This report is a final report.

1.1.2 Scope of Test Document

The applicable Scope of Test Document is 66 DT-317-0 and Revision 1, "Five Inch Axial Length Core Periphery Evaluation Test".

1.1.3 Functional Category of Test

This is a development test.

1.1.4 Contractor

Westinghouse Astronuclear Laboratory (WANL/14683) under Subcontract Number-NP-1, CY-70

1.1.5 Test Facility

These tests were performed at the Westinghouse Astronuclear Laboratory at Large, Pennsylvania in the Thermal and Fluid Flow Laboratory during the period of June 1969 through April 1970.

1.2 PURPOSE OF TEST

The objective of these tests utilizing the five inch long core periphery model is to provide experimental information to be used in:

- a. Evaluating mechanisms that could have contributed to producing the pressure drop anomaly experienced in the 64DT-031 and 64DT-212 ambient flow tests, and to explain the wrapper growth at the inlet of the 64DT-031 model.
- b. Evaluating temperature and pressure/temperature effects that could explain the growth at the inlet of the 64DT-031 model.
- c. Evaluating any depressurization effects produced in the wrapper at the nominal reactor depressurization rate. (Includes effect on 64DT-211 Corrosion Test Model.)

d. Evaluating the feasibility of the process proposed for thermalizing the 64DT-212 corrosion test model.

Detailed documentation of the 64DT-211 and 64DT212 Corrosion Tests is contained in WANL TMEs 2742 and 2735, respectively. Detailed documentation of the 64DT-031 Cyclic Strain Test is contained in WANL DRM 51366.

2.0 REFERENCES AND ASSUMPTIONS

2.1 REFERENCES

2.1.1 Specification

EC-677564 Part I. Performance/Design and Qualification Requirements Core
Periphery for Nuclear Subsystem

2.1.2 Data Item Description

Form 9, Data Item Description, T-119, dated 4/2/69

2.1.3 Drawing List

The following drawings describe the model and details of components

<u>Drawing Number</u>	<u>Title</u>
100E752A	64DT-317 - 5" Thermalization Fixture
100E754B	Element & Spacer - 5" Model
100E762	5" Periphery Model 2
100E763	5" Periphery Model 2
100E764	Impedance Liner Subassembly Model 2
100E767A	5" Periphery Model 2
100E772B	Impedance Liner Subassembly Model 1, 3, 4 and 5
100E773	Details - 5" Periphery Models 3 and 4
100E775	5" Periphery Model 2
100E797A	Decompression Test Model EP-6 Assembly
100E798	Aluminum Reflector Layout
100E851A	5" Periphery Core Subassembly Models 1, 2, 3, 4 and 5
100E885	Stand - 5" Periphery Model 2
100E895	Aluminum Reflector Details
100E967	Spacer Assembly
100E968	Impedance Liner Assembly

<u>Drawing Number</u>	<u>Title</u>
101E087	5" Periphery Tests EP-1 and EP-5
101E088	5" Periphery Test EP-1 and EP-5
388D495	Details - 5" Periphery Models 3 and 4
388D650	Piping Schematic
576F823	5" Periphery - Model 2 - 64DT-317, 5" Thermalization Fixture Assembly
711J828	5" Periphery Assembly Models 3 and 4
711J843	5" Periphery Models 3 and 4

2.1.4

<u>Data Release Memorandums</u>	<u>Title</u>
51327	Thermalization Plan for the 64DT-317 Five Inch Long Core Assembly
51330	Operating Test Directive for 64DT-317 (EP-5) Five Inch Long Core Periphery Test Model
51325	Operating Test Directive for 64DT-317 (EP-1) Five Inch Long Core Periphery Test Model
51353	Operating Test Directive for 64DT-317 (EP-6) Five Inch Long Core Periphery Test Model

2.1.5

<u>Internal Documentation</u>	<u>Title</u>
CE-1192	Five Inch Low Pressure Core Periphery Model
TFL-1283	Five Inch Low Pressure Core Periphery Model
CE-1219	Operating Test Directive for 64DT-317 Core Periphery Test Model
CE-1237	Calculation of Bundling Load on Thermalization Specimens
CE-1309	Program Direction for EP-6 as Defined by Test Scope 64DT-317-1
NPE-1100	Priority Allocation of Pyrofoil

2.2 ASSUMPTIONS

2.2.1 Test Fixture

The effects of hydraulic and mechanical bundling on the 47 inch long model of the 64DT-031, "Core Periphery Model Test", can be simulated with a 5 inch long section loaded in a similar manner as the full length model.

2.2.2 Test Fluid

For an isothermal ambient test the hydraulic bundling or depressurization rate on the pyrofoil wrapper is independent of the fluid such that the use of helium produces results representative of hydrogen.

2.2.3 Thermal Environment

The effects of depressurization rate on the five inch long model of the 64DT-031, "Core Periphery Model Test", are similar to the effects of depressurization rate on the 47 inch long full length test fixture only at ambient temperatures.

3.0 TEST ARTICLE CONFIGURATION

3.1 DESCRIPTION OF TEST CONFIGURATION

(U) Three five-inch axial length core periphery evaluation test models were assembled and tested. Cross-sectional illustration of these models are shown in Figures 3-1 and 3-2. The Build 1 model was used in conducting three tests; a simulated hydraulic bundling test, a thermalization process evaluation test, and the EP-5 depressurization tests. The Build 2 model was used to evaluate the effects of a non-thermalized (green) pyrofoil wrapper (EP-1 test) when subjected to nominal reactor depressurization rates. The Build 3 model was used to evaluate the effects of a thermalized rerolled pyrofoil wrapper (EP-6 tests) when subjected to nominal reactor depressurization rates. All models are dimensionally the same. Build 2 and 3 models have identical configurations. The Build 1 model differs from the Build 2 and 3 configuration in that it does not contain separate filler strip tiles. Table 3-1 defines the various 64DT-317 tests and lists the nomenclature used to identify each test.

A detailed description of the test articles follows.

3.2 TEST ARTICLE FOR SIMULATED HYDRAULIC BUNDLING TESTS

(U) The test article for simulated hydraulic tests of positive and negative pressure, Figure 3-3, consists of the Build 1 five-inch long core periphery test model and contains two plastic end plates retained by aluminum backup rings. Clear end plates are used to visually observe the core motion during the test. A LVDT positioned radially against the filler strips was used to measure relative displacement during the test. In Figure 3-4, a view of the test article is given showing the core photographed through the end plates. The Build 1 test model contained a core assembly, a reflector, and a lateral support system.

(CRD) The core was assembled utilizing parts salvaged from the 52-inch length pieces procured as an alternate design for the 64DT-031 and 212 test models. The core assembly contained a pyrofoil wrapper, an uncoated inner core, uncoated simulated elements, and uncoated cold periphery type filler strips without tile.

(CRD) The wrapper which is sandwiched between the elements and filler strips was assembled utilizing a prepared solution of Petrolatum and benzene. The wrapper, nominally 180 mils thick, was assembled with 30 layers of Z-liners. Each layer contained 12 Z-liners

Figure 3-1 Cross Sectional Illustration of the Build 1 (Simulated Hydraulic and EP-5) Test Model

Figure 3-2 Cross-Sectional Illustration of Build 2 (EP-1) and Build 3 (EP-6) Test Models

TABLE 3-1. 64DT-317 TEST DEFINITIONS

Type of Test and Test Plan Number	Test Description	Type of Wrapper and Condition	Build Model Description	Conducted For Information Concerning Test
<u>Hydraulic Bundling</u>				
Phase 1	Positive (External) Bundling Pressure	Unthermalized Pyrofoil (PDS 30182-2) Petrolatum Bonded	Build 1	64DT-031
Phase 2	Negative (Internal) Bundling Pressure	Unthermalized Pyrofoil (PDS 30182-2) Petrolatum Bonded	Build 1	64DT-031
EP-2 (Cancelled)	Negative (Internal F.E. Interstitial Bundling Pressure)	Unthermalized Pyrofoil (PDS 30182-2) Petrolatum Bonded	Not Assigned	64DT-031
Thermalization	Thermalize Pyrofoil in Test Fixture	Unthermalized Pyrofoil (PDS 3018212) Petrolatum Bonded	Build 1	64DT-212
<u>Depressurization</u>				
EP-1	Single Cycle Depressurization Rate	Unthermalized Pyrofoil (PDS 30182-2) Petrolatum Bonded	Build 2	64DT-031
EP-5	Single and Multiple Cycle Depressurization Rate	Thermalized in Test Fixture Pyrofoil (Initially PDS 30182-2) Assumed No Petrolatum	Build 1	64DT-212
EP-6	Single and Multiple Cycle Depressurization Rate	Thermalized Rerolled (PDS 30141-1) Petrolatum Bonded	Build 3	64DT-211

TABLE 3-1. 64DT-317 TEST DEFINITIONS (CONTINUED)

Type of Test and Test Plan Number	Test Description	Type of Wrapper and Condition	Build Model Description	Conducted For Information Concerning Test
<u>Pressure/Temperature Tests</u>				
EP-3 (Cancelled)	Constant Pressure Cyclic Temperature	Unthermalized Pyrofoil (PDS 30182-2) Petrolatum Bonded	Not Assigned	64DT-031 and 64DT-212
EP-4 (Cancelled)	Cyclic Pressure and Temperature	Unthermalized Pyrofoil (PDS 30182-2) Petrolatum Bonded	Not Assigned	64DT-031 and 64DT-212

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3-6

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Figure 3-3. Simulated Hydraulic Bundling Test Article

Figure 3-4. End View of Simulated Hydraulic Test Article Showing the Wrapper Through the Plastic End Plates

(CRD) which were preformed from strips of pyrofoil 1-1/8 inch wide at a nominal thickness of 5.5 mils. The pyrofoil used for the wrapper was non-thermalized (PDS-30182-2).

The five-inch long reflector was machined from a full length reflector which was discarded following the TFL-2.a-003 test. The reflector had two seal grooves.

The lateral support system was assembled utilizing spare parts which were procured for the 64DT-031 test model.

The test article contained valves and piping capable of providing either an internal or external pressure differential across the pyrofoil wrapper.

3.3 TEST ARTICLE FOR THERMALIZATION TESTS

(U) The fixturing required to thermalize the wrapper assembly is defined per Drawing 576F823. Figure 3-5 shows an axial cross-section of this fixture. The thermalization fixtures made from graphite included a five-inch long core assembly installed within a cylindrical can which was captured in place utilizing an end nut. The core assembly consisted of the Build 1 core assembly containing an unthermalized pyrofoil wrapper (PDS-30182-2) assembled with Petrolatum, a graphite felt lateral support and expansion cushion, two end plugs, and centering rod. The two end plugs are captured in place with a dowel pin at one end and a nut at the other.

The thermalizing furnace furnished by EML contained a cylindrical graphite heater element providing a hot zone with internal dimensions of 6" diameter by 10" long.

3.4 TEST ARTICLE FOR DEPRESSURIZATION TESTS

(U) The test article for depressurization tests contained the five-inch long core periphery test models consisting of a specific core assembly, a reflector, a lateral support system, and a reflector shroud. The test models are described in Sections 3.4.1 through 3.4.3.

The pressure vessel is a modified filter housing made from 8" diameter 300 lb. stainless pipe fittings. The body is made from a weld neck flange and cap. A blind flange is bolted to the weld neck flange to complete the pressure vessel assembly. The blind flange and cap contain 1/2 inch pipe taps to allow for pressurizing and venting the pressure vessel.

Figure 3-5. 64DT-317 Five Inch Thermalization Fixture Assembly

(U) Figure 3-6 shows an axial section illustration of the test article used for the 64DT-137 EP-5 and EP-1 depressurization tests. Figure 3-7 shows an axial cross section of the test article for EP-6. Figure 3-8 is a schematic illustration of the test loop and instrumentation locations. Instrumentation requirements included two 0-1000 psi pressure transducers and one 0-500 psi pressure gauge. Loop requirements are listed in Table 3-2.

3.4.1 Build 1 Model for EP-5 Test

(U) The primary purpose of the EP-5 test was to provide qualitative screening information to define adequacy of a thermalized wrapper assembly (thermalized as an assembly) when subjected to depressurization rates that could be representative of future tests.

(CRD) The build for the EP-5 test was made to simulate the 64DT-212 test configuration. Following the thermalization cycle on Build 1, the model was reassembled utilizing all of the Build 1 components with the exception of the outer four (4) layers of Z-liners. These four layers were removed and replaced with Z-liners made from thermalized rerolled pyrofoil strips (PDS-30141-1). The Z-liners were bonded together utilizing a Physical Science Laboratory preparation of a saturated solution of Petrolatum and benzene.

3.4.2 Build 2 Model for the EP-1 Test

(U) The primary purpose of the EP-1 test was to provide qualitative information of depressurization wrapper effects in an attempt to understand in its entirety, or in part, the unexpected high growth that was noted at the inlet end of the unthermalized wrapper following the 64DT-031 Core Periphery Model Test.

(CRD) This build was made to simulate the 64DT-031 test configuration. The new wrapper was assembled utilizing a prepared Petrolatum-benzene solution. The wrapper, nominally 180 mils thick, contained 31 layers of Z-liners. Each layer had 12 Z-liners which are preformed from strips of pyrofoil 1-1/8 inch wide at a nominal thickness of 5.5 mils. The pyrofoil used for the wrapper was unthermalized (PDS-30182-2).

Figure 3-6. 64DT-317 (EP-1) and (EP-5) Decompression Test Article

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101E087

Figure 3-7. 64DT-317 (EP-6) Decompression Test Article

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Figure 3-8. 64DT-317 (EP-X) Depressurization Test Loop Schematic

TABLE 3-2
TEST LOOP REQUIREMENTS

<u>Valve No.</u>	<u>Type</u>	<u>Requirement</u>
V-1	1/4 inch Imperial Needle Valve	Supply shut off
V-2	1/4 inch Imperial Needle Valve	Supply vent
V-3	1/4 inch Imperial Needle Valve	Supply shut off
V-4	1/4 inch Hoke Micrometering Valve	Decompression rate control
V-5	1/2 inch Hoke Ball Valve	Pressure dump valve
V-6	1/4 inch Imperial Needle Valve	Vacuum shut off
V-7	1/4 inch Imperial Needle Valve	Vacuum shut off
V-8	1/4 inch Imperial Needle Valve	Supply vent
<u>Instrumentation No.</u>	<u>Type</u>	<u>Requirement</u>
P1	0-1000 PSIA BLH Transducer	Chamber inlet pressure
P2	0-1000 PSIA BLH Transducer	Chamber outlet pressure
P3	0-1000 PSIG USG Gage	Chamber outlet pressure
P4	0-30 in. of Hg USG Gage	Vacuum system pressure

3.4.3 Build 3 Model for the EP-6 Test

(U) The primary purpose of the EP-6 test was to provide qualitative screening information to define the adequacy of a thermalized and rerolled wrapper assembly when subjected to depressurization rates representative of future tests.

(CRD) This build was made to simulate the 64DT-211 test configuration. The core assembly was fabricated from parts rejected for use in the 64DT-211 assembly which could be salvaged by cutting away the defective area. This particular hardware was used to insure a material match between models. The core assembly contained a NbC coated SX-5 graphite inner core, uncoated SX-5 simulated elements, and uncoated Graphitite "G" cold periphery type filler strips with tile.

(CRD) The wrapper consisted of 32 layers of Z-liners assembled with Petrolatum. Each layer had 12 Z-liners which are preformed from strips of 1-1/8" wide pyrofoil tape with a nominal thickness of 5 mils. The pyrofoil used for the wrapper was thermalized and rerolled (PDS-30141-1).

(U) The lateral support system was assembled utilizing spare parts which were procured for the 64DT-031 test model.

(U) The reflector was a 5-inch long copy of the 64DT-212 reflector fabricated of graphite and had two rows of lateral support seals. The reflector was previously used in the 64DT-317-(EP-1) test.

(U) The containment hardware consisted of a stainless steel top plate, a lower tile insulating plate, a lower support pad and the tie down rod. These items hold the model in position in the pressure vessel and insure that the direction of blow down flow is through the model rather than through open areas between the model and the vessel wall. The tie down rod which also simulates the heater element contains an "O" ring groove which can be used to seal the metering plug orifice if desired.

3.5 Test Articles for Canceled Tests

(U) EP-2, EP-3, and EP-4 test models were designed and partially procured before being cancelled. Figure 3-9 shows the EP-2 test model and Figure 3-10 shows the EP-3 and EP-4 models.

(U) EP-2 was proposed as a hydraulic bundling effects model with the purpose of investigating what effects can be produced under forced pressure differences across the wrapper by pressuring fuel interstitial areas. EP-3 and EP-4 were proposed as cyclic temperature/pressure

Figure 3-9. 64DT-317 (EP-2) Hydraulic Bundling Test Article

Figure 3-10. 64DT-317 (EP-3) and (EP-4) Temperature/Pressure Test Article

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test models to simulate the test inlet conditions of 64DT-031 and proposed test conditions for the 64DT-212 full length core periphery test model. These tests were cancelled as a result of the Core Periphery meeting with SNPO-C in Cleveland on April 2, 1970 where WANL was directed to reduce the effort level on the pyrofoil wrapper.

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4.0 SUMMARY OF TESTS

4.1 NARRATIVE

In April of 1969, the results of the first R-1 Core Periphery Model Test, 64DT-031, showed a high radial growth of the wrapper had occurred during the heated helium strain test. Of particular interest was the wrapper growth at the inlet end where the temperature level reached a maximum temperature of about 1100°R . Post test thermal expansion data performed with small pyrofoil test samples at temperature up to 1000°R , did not provide results which could explain this high growth.

In order to further investigate the cause of the anomaly experienced during the 64DT-031 test, a five inch long core periphery model test program, 64DT-317, was initiated. Five (5) series of tests were conducted, a series of hydraulic bundling tests, a wrapper thermalization test and three (3) depressurization tests with three different wrapper configurations; thermalized as an assembly, unthermalized pyrofoil Petrolatum bonded, and thermalized-erolled pyrofoil Petrolatum bonded.

Early in June of 1969 the first of a series of test called the Phase I Positive Bundling Mode Test and the Phase II Negative Bundling Mode Test were conducted using the Build 1 five-inch long model described in Section 3.1. This model was assembled and tested to investigate the effects of a positive or negative bundling condition that could possibly have existed between the heater and seal cavities during the 64DT-031 Core Periphery Model Test. Details of these tests are summarized in Sections 4.2.1 and 4.3.2.1 below.

In mid June of 1969, Phase I of the second full length R-1 Core Periphery Model Test, 64DT-212, was conducted utilizing ambient temperature hydrogen as the fluid medium. The results of this test showed that the core diameter had grown, an average of 0.3% at the inlet and 0.8% at the aft end, identifying some inability of the wrapper to maintain its assembled geometry. At this time a decision was made to attempt to stabilize the pyrofoil by thermalizing the wrapper in the assembly.

To provide information for defining the thermalization requirements for the full length 64DT-212 Core Periphery Model, the initial five-inch long core assembly from the 64DT-317 Build 1 model was reassembled for processing. In August 1969 the thermalization process was completed as defined by Test Plan DRM 51330.

Following the thermalization process the Build 1 model was prepared for the subsequent depressurization tests, 64DT-317 (EP-5) - 1AHE-1. The wrapper utilized in these tests consisted of all of the original pyrofoil Z-liners with the exception of the outer four layers. On reassembling the wrapper, the outer four layers were removed and were replaced with Z-liners made from thermalized rerolled pyrofoil strips (PDS 30141-1) which were bonded together with the saturated solution of Petrolatum and benzene.

Concurrently, 64DT-317 (EP-1) or Build 2 model was assembled which incorporated a "un-thermalized pyrofoil wrapper (PDS 30182-2). In September 1969 depressurization tests were conducted on both EP-1 and EP-5 models.

To complete the depressurization test series, a model containing a thermalized rerolled pyrofoil wrapper assembly was tested in April of 1969. The test (64DT-317 (EP-6)) was a prerequisite for the subsequent 64DT-211 full length core periphery test.

4.2 TEST CONDITIONS

4.2.1 Simulated Hydraulic Bundling Tests

A five inch (5") low pressure core periphery model was tested in two phases to determine what effect hydraulic pressure loading has on the test hardware. The Phase I experiments investigated the effects of a positive seal cavity to heater cavity pressure differential, simulating a positive hydraulic bundling mode condition. The Phase II experiments investigated the affects of a positive heater cavity to seal cavity pressure differential, simulating a possible negative bundling mode condition.

Regulated low pressure gas flow from a standard helium supply cylinder was induced at ambient temperature and at a constant pressure level through both the heater and seal cavity flow systems form a common supply line by adjusting the needle valves in each outlet line. The impedance in each parallel system could be changed, resulting in a change of

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pressure levels prescribed for each test point by adjusting each of these valves independently. Adjustments were made to produce both positive and negative bundling loads on the wrapper considering the permeability of the heater as a communication path to the wrapper I.D.

4.2.2 Thermalization Tests

The thermalization fixture assembly was heated to a temperature of approximately 5000°R in a helium atmosphere of 2 ± 1 psig pressure. The process temperature was obtained at a ramp rate of about 7 degrees per minute. After reaching process temperature the outer surface of the can was maintained at $5000^{\circ}\text{R} \pm 200^{\circ}$ for 60 minutes prior to cool down. No controlled cooling cycle was required other than that dictated by furnace requirements. Pyrometer and thermocouple temperature measurements were continuously recorded through the entire cycle.

4.2.3 Depressurization Tests

Each series of depressurization test points is identified by the following notation:

All depressurization tests were conducted utilizing ambient temperature helium as the fluid medium. In each of the tests the system was first purged and then evacuated prior to pressurization. The test article was then pressurized slowly to 500 psig and stabilized for a period of time. During stabilization the system was checked for leaks. The test article was then depressurized at the prescribed rate for the test. Detailed operating procedures are described in Appendix A of DRM 51389.

The pressure decay measured by the inlet and outlet transducers was recorded on an oscillograph at 1 in/sec. A typical pressure decay trace is reproduced in Figure 4-1.

Figure 4-1. Typical Pressure Decay Trace

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The depressurization rate is defined by the equation:

$$R = \frac{0.63 P_i}{t - t_i}$$

where

R = depressurization rate - $\frac{\text{psi}}{\text{sec}}$

P_i = initial pressure t = t_i - PSIG

t_i = initial reference time - sec.

t = time graphically determined at P = 0.37 P_i - sec.

At the end of each test series, the model was removed from the pressure chamber and inspected per requirements outlined in Table 4-1. If no adverse effects were detected at the end of each series, the subsequent series of tests were conducted.

4.3 TEST RESULTS

4.3.1 Recorded Data

The data recorded for each of the tests are presented in the following sections.

4.3.1.1 Simulated Hydraulic Bundling Tests

The summary of 54DT-317 Phase I and II test data is presented in Table 4-2 and Table 4-3, respectively.

4.3.1.2 Thermalization Test

The average radial change of the core (3.500 inch nominal diameter) attributed to the thermalization process was measured to be .003 inch. The average filler strip gap change varied from .7 to 1.7 mils.

4.3.1.3 Depressurization Tests

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TABLE 4-1

INSPECTION REQUIREMENTS FOR 64DT-317(EP-5)-1 HE TEST

1. Photographs of inlet and outlet face of the model assembly. Pre-and post test.
2. Reflector to plunger depth measurements. Pre-and post test.
3. Filler gap dimension utilizing rubber bands to bundle assembly. Post test.
4. Core diameter dimension utilizing rubber bands to bundle assembly. Post test.
5. Maximum and minimum Z-liner gap measurements (outer layer only), at the same axial stations determined by pre test measurements. Pre-and post test.
6. Repeat filler gap and core diameter measurements after banding seal segments to core assembly with hose clamps and torquing to six (6) in-lbs. Pre and post test.

TABLE 4-2. SUMMARY OF 64DT-317 PHASE I TEST DATA
(SIMULATED POSITIVE HYDRAULIC BUNDLING EXPERIMENTS)

<u>Test No.</u>	<u>Seal Cavity Pressure (psig)</u>	<u>Heater Cavity Pressure (psig)</u>	<u>Differential Cavity Pressures P Seal - Heater</u>	<u>Radial Displacement * LVDT</u>	<u>Test Observations</u>
1	5.2	0	5.2	0	No Apparent Movements
2	10.0	0	10.0	0	No Apparent Movements
3	20.4	0	20.4	0	No Apparent Movements
4	31.0	0	31.0	0	No Apparent Movements
5	10.0	5.2	4.8	0	No Apparent Movements
6	20.4	9.4	11.0	0	No Apparent Movements
7	31.0	15.2	15.8	0	No Apparent Movements

TABLE 4-3. SUMMARY OF 64DT-317 PHASE II TEST DATA
 (SIMULATED NEGATIVE HYDRAULIC BUNDLING EXPERIMENTS)

<u>Test No.</u>	<u>Seal Cavity Pressure (psig)</u>	<u>Heater Cavity Pressure (psig)</u>	<u>Differential Cavity Pressure P Seal - Heater</u>	<u>Radial Displacement * LVDT</u>	<u>Test Observations</u>
1	0	3.6	- 3.6	0	No Apparent Movement
2	0	5.2	- 5.2	0	No Apparent Movement
3	4.2	5.2	- 1.0	0	No Apparent Movement
4	5.0	10.1	- 5.1	0	No Apparent Movement
5	10.0	10.1	- 0.1	0	No Apparent Movement
6	10.0	15.2	- 5.2	0	No Apparent Movement
7	9.8	20.2	- 10.4	0	No Apparent Movement
8	15.4	20.4	- 5.4	0	No Apparent Movement
9	15.8	30.8	- 15.0	0	No Apparent Movement
** 10	16.0	31.0	- 15.0	0	No Apparent Movement
** 11	18.8	32.2	- 13.4	0	No Apparent Movement
12	3.6	20.1	- 16.5	0	No Apparent Movement
13.	3.8	25.2	- 21.4	0	No Apparent Movement
14	3.8	30.0	- 26.2	0	No Apparent Movement
15	3.6	35.0	- 31.4	0	No Apparent Movement
16	3.8	40.0	- 36.2	0	No Apparent Movement
17	2.4	44.6	- 42.2	0	No Apparent Movement
** During readjustment of pressure levels between 11-9 and 11-10 test point aft end seal had failed. Repair of seal was made before continuing with test point 11-12.					
* Displacement sensor					

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4.3.1.3.1 64DT-317 (EP-5) - Build 1 (Thermalized as an Assembly Wrapper)

The summary of 64DT-317 (EP-5) Build 1 depressurization test data is presented in Table 4-4.

4.3.1.3.2 64DT-317 (EP-1) - Build 2 (Unthermalized Wrapper)

The summary of 64DT-217 (EP-1) Build 2 depressurization test data is presented in Table 4-5.

Figure 4-2 shows a view of the aft end of the model before and after the test. Figure 4-3 shows post test view of both the forward and aft ends of the mode. Seven (7) out of the twelve (12) plunger caps had failed during the depressurization test. In Figure 4-4 the condition of the typical unfailed and failed plunger caps are shown which identically resembles the type of failure experiences on the 64DT-031 test. In Figure 4-5 the pre-and post test core diameter along the axial length of the assembly are presented.

Blistering of the outer pyrofoil surface was observed and was concentrated in the region under the filler strip gaps location. In Figure 4-6 pre-and post test views of the outer wrapper surface are shown comparing the blistered surface after the test with the final-as assembled-surface.

Hammocking of the wrapper was observed. Dimensional inspection measurements illustrating this condition are shown dimensionally in Figure 4-3. Filler strip gaps had opened up to an average of 23 mils.

4.3.1.3.3 64DT-317 (EP-6) - Build 3 (Thermalized Rerolled Wrapper)

The summary data of the 64DT-317 (EP-6) Build 3 depressurization test data are presented in Table 4-6.

In test 3, a single cycle test a nominal depressurization rate of 100 psi/sec., two spring plunger caps failed, one in seal row 1 ($\theta = 300^\circ$) and one in seal row 2 ($\theta = 60^\circ$). Surface blistering was observed in areas closest to the filler strip gaps.

In test 4, a 10 cycle test at an average depressurization rate of 129.5 psi/sec., three spring plunger caps failed, but no significant change in blistering of the surface could be noted.

TABLE 4-4. SUMMARY OF 64DT-317-(EP-5) TEST DATA
(THERMALIZED AS ASSEMBLED DEPETROLATED WRAPPER*)

Cycle No.	Chamber Pressure: P _i (psig)	Time to 0.37 pi: t (sec)	Depressurization Rate: R (psi/sec)	Diameter ¹ (As Assembled) D _o (Inches)	Diameter ¹ (Post Test) D _f (Inches)	ΔD^2 D _f - D _o (Inches ²)	ΔR $\Delta D/2$ (Inches)
1A	500	5.12	61.5	3.5049	3.5130	.0081	.0041
1B	500	6.78	46.5	X	3.5170	.0121	.0061
2A	500	6.08	51.8	X	X	-	-
2B	500	5.85	53.3	X	X	-	-
2C	500	6.2	50.8	X	X	-	-
2D	500	6.09	51.6	X	X	-	-
2E	500	6.05	51.7	X	X	-	-
2F	500	6.2	50.8	X	X	-	-
2G	500	6.25	50.4	X	X	-	-
2H	500	6.2	50.8	X	X	-	-
2I	500	6.1	51.4	X	X	-	-
2J	500	6.2	50.8	X	3.5182	.0133	.0067

X Measurements not taken.

¹ Average of the inlet and outlet diameters measured at the end planes of the core with the core supported by the lateral support - seal-reflector system

² ΔD based on the difference between the measured post test average and the initial as assembled average diameter measurement

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TABLE 4-5. SUMMARY OF 64DT-317-(EP-1) TEST DATA
(NON-THERMALIZED REROLLED PYROFOIL PETROLATUM BONDED WRAPPER)

Cycle No.	Chamber Pressure: P _i (psig)	Time to 0.37 p _i : t (sec)	Decompression Rate: R (psi/sec)	Diameter ¹ (As Assembled) D _o (Inches)	Diameter ¹ (Post Test) D _f (Inches)	ΔD^2 D _f - D _o (Inches)	ΔR $\Delta D/2$ (Inches)
1	500	6.08	51.8	3.511	3.605	.094	.047
1	Average of the inlet and outlet diameters measured at the end planes of the core with the core supported by the lateral support - seal-reflector system.						
2	ΔD based on the difference between the measured post test average and the initial as assembled average diameter measurements.

Figure 4-2. 64DT-317 (EP-1) Pre and Post Test Photographs of the Core Sub Assembly

MEASURED DIMENSIONS

	<u>DESIGN</u> <u>(INCHES)</u>	<u>POST TEST</u> <u>(INCHES)</u>
--	----------------------------------	-------------------------------------

A	0.235	0.270
---	-------	-------

B	0.180	0.227
---	-------	-------

C	0.199	0.241
---	-------	-------

POST TEST
(INLET END)

POST TEST
(AFT END)

Figure 4-3 64DT-317 (EP-1) Post Test Photographs of the Core in the As Assembled Reflector

Figure 4-4. 64DT-317 (EP-1) Post Test Photographs Showing Failed and Unfailed Plunger Caps

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Figure 4-5. 64DT-317 (EP-1) Core Diameter Measurements

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PRE TEST SURFACE
CONDITION

SURFACE BLISTERS

POST TEST SURFACE
CONDITION

Figure 4-6. 64DT-317 (EP-1) Wrapper O.D. Surface Condition

TABLE 4-6
 SUMMARY OF 64DT-317-(EP-6) TEST DATA
 (THERMALIZED REROLLED PYROFOIL PETROLATUM BONDED WRAPPER)

Cycle No.	Chamber Pressure : Pi (psig)	Time to 0.37 Pi: t (sec)	Depressurization Rate: R (psi/sec)	Diameter ¹ (As Assembled) D _o (inches)	Diameter ¹ (Post Test) D _f (Inches)	ΔD^2 D _f - D _o (Inches)	ΔR $\Delta D/2$ (Inches)
1	500	10.1	31.2	3.5038	3.5250	.0212	.0106
2A	500	9.44	33.3	3.5195	X	-	-
2B	500	10.70	29.4	X	X	-	-
2C	500	9.72	32.4	X	X	-	-
2D	500	9.23	34.1	X	X	-	-
2E	500	9.56	32.9	X	X	-	-
2F	500	9.00	35.0	X	X	-	-
2G	500	8.60	36.6	X	X	-	-
2H	500	8.64	36.4	X	X	-	-
2I	500	8.52	36.9	X	X	-	-
2J	500	8.38	34.5	X	3.5256	.0218	.0109

X Measurement Not taken

1 Average of the inlet and outlet diameters measured at the end planes of the core with the core supported by the lateral support - seal-reflector system.

2 ΔD based on the difference between the measured post test average and the initial as-assembled average diameter measurements.

TABLE 4-6
 SUMMARY OF 64DT-317-(EP-6) TEST DATA (CONTINUED)
 (THERMALIZED REROLLED PYROFOIL PETROLATUM BONDED WRAPPER)

Cycle No.	Chamber Pressure: P _i (psig)	Time to 0.37 P _i : t (sec)	Depressurization Rate: R (psi/sec)	Diameter ¹ (As assembled) D _a (Inches)	Diameter ¹ (Post Test) D _f (Inches)	ΔD^2 D _f - D _a (Inches)	ΔR $\Delta D/2$ (Inches)
3	500	3.30	95.5	3.5193	3.5401	.0363	.0182
4A	500	2.40	131.2	3.528	X	-	-
4B	500	2.43	139.6	X	X	-	-
4C	500	2.40	131.2	X	X	-	-
4D	500	2.43	129.6	X	X	-	-
4E	500	2.45	128.5	X	X	-	-
4F	500	2.48	127.0	X	X	-	-
4G	500	2.50	126.0	X	X	-	-
4H	500	2.43	129.6	X	X	-	-
4I	500	2.38	132.3	X	X	-	-
4J	500	2.42	130.1	X	3.5515	.0477	.0239

X

Measurements not taken

1

Average of the inlet and outlet diameters measured at the end planes of the core with the core supported by the lateral support - seal-reflector system.

2

ΔD based on the difference between the measured post test average and the initial as-assembled average diameter measurements.

4.3.2 Discussion of Data

(U) The discussion of data reported herein will be primarily directed to summarizing the results of each test conducted. Assembly and Post Test inspection information for each test are reported in Appendix B, C, and D of DRM 51389. A photographic survey of each test is presented in Appendix E of this same DRM.

4.3.2.1 Simulated Hydraulic Bundling Tests

(U) From visual observation of the core inlet face and displacement measurement information recorded no movement of the core and/or components were detected for seal cavity to heater cavity pressure differentials of +31 to -42 psi.

4.3.2.2 Thermalization Test

(U) The thermocouple used to measure the element temperature had formed a carbide and became fused in the instrumentation hole. Melting of the thermocouple formed a braze joint between the element and end plate. As a result of this experience, the location of the thermocouple in 64DT-212 model was changed.

(U) The $\pm 1^{\circ}\text{R}/\text{min}$ ramp rate of the heat-up cycle was specified. The maximum deviation from the tolerance band of $+2.1^{\circ}\text{R}/\text{min}$ was considered satisfactory. The thermocouple data showed that the I.D. side of the wrapper lagged the surface temperature of the O.D. of cylindrical container by approximately 115° .

(CRD) Four layers of Z-liners from the thermalized wrapper were removed with little difficulty. Observations of the sublayer surfaces indicated that additional layers could be removed without difficulty. No difficulty was encountered replacing the outer four layers with the thermalized rerolled pyrofoil assembled with Petrolatum. Detailed test information is entered in test record book on page K2305700.

4.3.2.3 Depressurization Tests (U)

(U) The results of all the depressurization tests are presented graphically in Figure 4-7 showing the average measured radial growth of the core. A detailed discussion of the data from each of the three types of depressurization tests is given below in Sections 4.3.2.3.1 through 4.3.2.3.3.

Figure 4-7. 64DT-317 Decompression Test Summary

Average Radial Growth of the Core Inlet and Outlet Ends
In the-As-Assembled-Lateral Support and Reflector System

4.3.2.3.1 64DT-317 (EP-1) - Build 2
(Non-Thermalized Pyrofoil Petrolatum Bonded Wrapper)

(CRD) Test 1, a single cycle test at a nominal 50 psi/sec depressurization rate, showed only one cycle depressurization at a rate of 51.8 psi/sec was required to produce a significant change in the wrapper geometry: The core diameter expanded an average of .092 inches, equivalent to a 26% wrapper growth. The remaining tests specified in the operating directives were waived following this first cycle test because of the growth obtained.

(CRD) From the diameter difference measurements, a taper was found to exist from the inlet to the outlet end where the inlet growth varied from .005 to .007 inches greater than the outlet. Growth variation was dependent on bundling.

4.3.2.3.2 64DT-317 (EP-5) - Build 1
(Wrapper Thermalized as an Assembly)

(CRD) Test 1, a single cycle test at a depressurization rate of 61.6 psi/sec, showed the core diameter increased an average of .0081 inch. Attributing this to the wrapper, the wrapper growth is about .0041 inch or about 2.3% based on the .180 inch nominal wrapper thickness. The diameter growth showed a trend that the inlet grew more than the outlet. However, the accuracy of measurement is not adequate to conclude that this trend is factual. The outer layer Z-liner buttjoint gaps showed an average gap change of 7.5 mils ranging from +5 to -20 mils but the accuracy of this measurement is ± 5 mils.

(CRD) Test 1B, a single cycle test at a depressurization rate of 46.5 psi/sec, shows the core diameter showed an increase of .0121 inch from the original assembly diameter measurements. Again attributing this growth to the wrapper, the wrapper growth is .0061 inch or about 3.4%.

(CRD) Tests 2A through 2J, 10 cycle tests at an average depressurization rate of 51.3 psi/sec, showed the core diameter increased an average of .0133 inch from the original assembly diameter measurement. Attributing this growth to the wrapper, the wrapper growth is .0067 inch or about 3.7%.

(CRD) Tests 3 and 4, single and 10 cycle depressurization test, respectively, had been planned to test the thermalized wrapper at a depressurization rate of 100 psi/sec. These tests were not conducted due to an assembly mishap during the reassembly of the EP-5 test fixture

following tests 2A through 2J. During this reassembly, the inner layers of Z-liners slipped out of the wrapper assembly and as a consequence tests 3 and 4 were waived.

4.3.2.3.3 64DT-317 (EP-6) - Build 3
(Thermalized Rerolled Pyrofoil Petrolatum Bonded Wrapper)

(CRD) Test 1, a single cycle depressurization test at nominal rate of 50 psi/sec, was conducted at a depressurization rate of 31 psi/sec which did not meet the 50 ± 5 psi/sec requirement defined in the test plan. This discrepancy in depressurization rate was attributed to utilizing a spare micrometering valve identical to the one previously used. Apparently, identical valves do not have the same pressure flow characteristics. In the assembled configuration the core diameter of the inlet end expanded an average of .020 inch and outlet end about .023 inch. The wrapper (nominally .180 inch thick) grew approximately 6%.

(CRD) Test 2, a ten cycle test at average depressurization rate of 34.5 psi/sec, was conducted with test cycle 2A through 2J at depressurization rates ranging from 29.4 to 36.9 psi/sec. The core diameter was found to expand a total of .0218 inch with an average wrapper thickness growth of .0109 or again about 6%.

(CRD) Test 3, a single cycle test at a nominal depressurization rate of 100 psi/sec was conducted at a decompression rate of 95.5 psi/sec due to the valve calibration, the wrapper had expanded a total of .0182 inches or 10% of the original thickness. The results of the test defined a problem area for the as assembled 64DT-211 test model where the first three inlet seal rows were assembled with allowable spring compression limit of .015 inch.

(CRD) Test 4, a ten cycle test at an average depressurization rate of 129.5 psi/sec, conducted to obtain an additional point at a higher depressurization rate, showed the wrapper had expanded a total of .0239 inch or 13% of the original thickness.

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5.0 ANALYSIS

5.1 INTRODUCTION

This section evaluates and states the significance of the experimental results relative to the physical changes to the five-inch core assembly and their effects on the full length test configuration. An analytical model was not formulated to provide calculated information for post test comparisons since this test was conducted to verify the behavior of the wrapper in support of the full length 64DT-211 and 64DT-212 Corrosion Tests. Analytical models of these full length core periphery tests were made in which experimental and calculated results were compared. This evaluation is made for each phase of testing emphasizing its significance relative to the 64DT-211 and 64DT-212 full length test configuration.

5.2 COMPARISON OF RESULTS

5.2.1 Simulated Hydraulic Bundling Tests

The first series of 64DT-317 tests were the hydraulic bundling tests designed to investigate whether or not possible positive and negative radial bundling pressures on the wrapper could cause a radial growth of the core sufficient to damage the plunger spring caps as experienced in the 64DT-031, Cyclic Strain Test. The Phase I Positive Bundling Model Test (i.e., seal cavity pressure greater than the heater cavity pressure) simulating positive external pressure differentials on the wrapper from 4.8 psi to 31.0 psi displayed no measurable growth of the core. The Phase II Negative Bundling Model Test (i.e., seal cavity pressure less than the heater cavity pressure) simulating negative external pressure differentials on the wrapper from -0.1 psi to -42.2 psi also displayed no measurable growth of the core.

5.2.2 Thermalization Test

The second 64DT-317 test was the pyrofoil wrapper thermalization test. This test performed on the Build 1 Model consisted of heating the model to 5000°R and soaking for one hour prior to cooldown. The thermalization process produced negligible growth in the Build 1 Model, hence further heating or analysis was not conducted.

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5.2.3 Depressurization Tests

(CRD) The third of the 64DT-317 tests was the (EP-1) - 1AHE-1 depressurization test conducted on an unthermalized pyrofoil wrapper assembled with Petrolatum. The average permanent growth for the single cycle test is tabulated in Table 5-1. Based on having a nominal radial clearance of 0.030 inch in the 64DT-317 test model, it is seen that the growth in the case of the (EP-1)-1AHE-1 test is beyond that which would produce breakage of the test components.

(CRD) The major mechanism causing this high growth and subsequent failure of the spring plunger caps was attributed to the outgassing of the entrapped gas in the pyrofoil wrapper. High pressure, ambient temperature gas occupying the voids in the pyrofoil material and between the wrapper layers was subjected to sudden depressurization of the external wrapper pressure at the rate of 50 psi/sec causing the entrapped gas to outgas. This outgassing produced a radial growth of the wrapper assembly in the direction of the seal segments which resulted in failure of the plunger spring caps. Further support to this theory was given by the increase in filler strip gaps to an average of 0.023 inch. Both the plunger spring cap breakage and the increase in filler strip gaps can be attributed to the radial growth of the wrapper.

(CRD) A fourth series of 64DT-317 tests were depressurization tests performed at ambient temperature using the EP-5 configuration with the thermalized pyrofoil. As a result of thermalization, the entrapped gases in the pyrofoil and the Petrolatum bonding material were expected to have been purged. The average radial growth of the wrapper due to thermalization was 0.003 inch and this model was used for cycle depressurization tests at depressurization rates of 62 psia/sec and 47 psia/sec. This resulted in average radial growth from the original model size of 0.004 inch and 0.006 inch, respectively. A ten cycle test was then conducted for a depressurization rate of 52 psia/sec and resulted in a core growth of 0.0075 inch, slightly higher than one of the single cycle tests. These results of these three tests, (EP-5-1AHE-1 (2 runs) and (EP-5)-1AHE-2 are listed on Table 5-1. It appears from this series of tests that the stabilization of the thermalized pyrofoil was indicated by the small change in radial growth for the single and ten cycle depressurization tests. This indicated that the 64DT-212 configuration should not be damaged by depressurization after thermalization.

TABLE 5-1
 64DT-317 DECOMPRESSION TESTS
 AVERAGE RADIAL GROWTH OF CORE END FACES
 AT-AS-ASSEMBLED-BUNDLING LOADS

Build No.	Test Model	Simulated Test	No. Cycles	No. Layers Pyrofoil	Petrolatum Bonded	Nominal Total Insulation Thickness-Inch	Decompression Rate - psi/sec	Radial Growth (from initial Build Size) Inch
1	(EP-5)-IAHE-I	64DT-212	1	30	No	0.180	62	0.004
1	(EP-5)-IAHE-I	64DT-212	1	30	No	0.180	47	0.006
1	(EP-5)-IAHE-2	64DT-212	10	30	No	0.180	52	0.0075
2	(EP-1)-IAHE-I	64DT-031	1	31	Yes	0.180	51.8	0.047
3	(EP-6)-IAHE-I	64DT-211	1	32	Yes	0.180	31	0.011
3	(EP-6)-IAHE-2	64DT-211	10	32	Yes	0.180	35	0.011
3	(EP-6)-IAHE-3	64DT-211	1	32	Yes	0.180	95	0.018
3	(EP-6)-IAHE-4	64DT-211	10	32	Yes	0.180	132	0.023

(CRD) The fifth series of tests, EP-6, were also depressurization tests performed at ambient temperature with a Build 3 model consisting of thermalized rerolled pyrofoil with Petrolatum bonded layers. Similar to EP-5, but at the lower depressurization rates (approximately 35 psi/sec), negligible differences were observed in the core growth between a one cycle and ten cycle test. This is indicated on Table 5-1 for (EP-6)-1 AHE-1 and 2 as 0.011 inch of radial growth for each test. However, an increase of .005 inch in growth exists between (EP-6)-1 AHE-3 the 1 cycle, 95 psi/sec depressurization test and (EP-6)-1 AHE-4 the ten cycle, 132 psi/sec depressurization test. For one cycle the growth was 0.018 inch and for ten cycles the growth was 0.023 inch. Table 5-1 indicates that a linear relationship exists for this series of tests exhibiting an increase in growth with increasing depressurization rate. In addition, a comparison with the EP-5 results indicated an increase in growth for the Petrolatum bonded assembly which infers that not only outgassing is a contributing factor to core growth but in addition the Petrolatum bond could be contributing factor. The Petrolatum bond in combination with the outgassing associated with depressurization of unthermalized pyrofoil could be a significant factor in contributing to the high growth exhibited in the EP-1 test.

5.3 SIGNIFICANCE OF RESULTS

(U) The test results for EP-1 show a high radial growth of the core assembly for the non-thermalized, Petrolatum bonded core assembly for a nominal reactor decompression rate of 50 psia/sec. In addition, large filler strip gaps resulted from the core radial growth. It was concluded that these results assisted in confirming the observation of high growth at the inlet end of the 64DT-031 model, and in part, the pressure drop anomaly experienced in the 64DT-031 and 64DT-212 ambient flow tests. These results were significant in that they demonstrated the instability of the non-thermalized Petrolatum bonded core assembly imposed a risk in running the 64DT-212 test at temperature without first thermalizing it. The results also showed that thermalization of the wrapper on the test assembly is not detrimental to the core dimensions.

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6.0 CONCLUSIONS

The test results of the 64DT-317 Core Periphery Decompression Tests lead to the following conclusions:

- 1) Positive and negative hydraulic pressure effects in the range of possible pressure drops estimated for the 64DT-031 Core Periphery Model Test would not have caused the excessive radial growth experienced in that test.
- 2) Depressurization rate effects of a 51.8 psi/sec pressure drop on an unthermalized pyrofoil wrapper assembled with Petrolatum caused sufficiently large radial growth to have damaged the plunger spring caps in the (EP-1)-1AHE-1 test. This same phenomenon could have contributed to the radial growth which caused similar plunger spring cap damage and the excessive axial flow experienced in the 64DT-031 Core Periphery Model Test.
- 3) Thermalizing, in the test fixture, an unthermalized pyrofoil wrapper assembled with Petrolatum can effectively be done without jeopardizing the build for future tests. Repeating the same process in the 64DT-212 Core Periphery Model Test should produce an acceptable build for corrosion testing.
- 4) Depressurization rates of approximately 50 psi/sec on thermalized pyrofoil without Petrolatum have negligible effects on the radial growth of the pyrofoil wrapper.
- 5) Depressurization rates of 30 to 132 psi/sec on a thermalized rerolled pyrofoil wrapper assembled with Petrolatum have a small but significant effect in increasing the radial growth of this type of wrapper. The increased radial growth over the thermalized pyrofoil without Petrolatum is probably due to the addition of the Petrolatum.

The results of the 64DT-317 Depressurization Tests, therefore, indicate that the pyrofoil wrapper for the 64DT-212 and 211 Core Periphery Model Tests should be thermalized.

Table 6-1 lists the EC 677564 requirements and compares these with the test results.

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TABLE 6-1. 64DT-317 TEST -EC-REQUIREMENTS VS. RESULTS

E.C. Specification and Paragraph Requirement	Comments
EC-677564 Part I	Supplied data for use in Test Scopes 64DT-211, 64DT-212 and 64DT-031

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TITLE	
		Five Inch Axial Length Core Periphery Evaluation	
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ABSTRACT			
<p>A series of hydraulic bundling, thermalizing and depressurization tests was conducted to investigate the large pyrofoil expansion experienced at the cold end of the 64DT-031 Cyclic Strain Test. Corrective measures were investigated and it was concluded that thermalized pyrofoil assembled with or without Petrolatum would be acceptable for the 64DT-211 and 212 Corrosion Tests of nominal depressurization rates of 50 psi/sec.</p>			
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