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Westinghouse Astronuclear Laboratory

NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING
HELD WITH SNPO AT WANL ON OCTOBER 31, 1967
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by W.A.C. TIC, date SEP 10 1974

Westinghouse Astronuclear Laboratory
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SPECIAL REVIEW DETERMINATION	Revisors	Class	Date
	TR U	4-7-82	
Class: <u>U</u>			

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INFORMATION CATEGORY
CONFIDENTIAL-RD

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Authorized Classifier Date

GROUP - 1

Excluded From Automatic Downgrading
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NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW
MEETING HELD WITH SNPO AT WANL ON OCTOBER 31, 1967

ATTENDEES:

E. A. DeZubay	WANL	C. L. Meuche	WANL
R. N. Eichbauer	WANL	R. Muth	WANL
N. J. Ettenson	WANL	E. Pianka	WANL
H. J. Fix	WANL	R. Ramp	WANL
J. French	WANL	M. J. Rieb	AGC
W. J. Havener	WANL	W. J. Rowan	WANL
H. Hoffman	SNPO	L. Salvador	WANL
G. A. Kalvin	SNPO	F. G. Tauch	WANL
I. Kanter	WANL	E. Watjen	WANL

The Monthly Development Test Program Review Meeting was held on October 31, 1967.

This report is divided into two discrete sections. The first section covers the activities of the Thermal-Flow Laboratory and the second, those of the Engineering Mechanics Laboratory. Table I of each section lists the tests performed during the reporting period and those planned for the next period. Discussions of the individual tests follow.

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SECTION A

MONTHLY REVIEW OF THERMO-FLOW EXPERIMENTS

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TABLE 1
THERMO-FLOW LABORATORY TEST SCHEDULE

PERFORMED THIS PERIOD (October)	PLANNED NEXT PERIOD (November)
<p>Tests for NRX-A6</p> <p>TFL-1. b De-Pressurization Effects - Conducted tests.</p> <p>TFL-2. a Filler Strip Model - Performed following tasks for TFL-2. a. 0003 test:</p> <p>(1) Reduction of test data completed.</p> <p>(2) Preliminary data analysis and correlation completed.</p> <p>(3) Inspection of post-test hardware completed.</p> <p>(4) Released preliminary data to Advanced Reactor Design and Thermal & Nuclear Design.</p>	<p>Complete testing.</p> <p>Complete data analysis and publish summary report.</p>
<p>Tests for NR-1</p> <p>TFL-1. d Fuel Element Orifices - Flow Test - Zirconium orifices. High void channel effect.</p> <p>TFL-2. a Filler Strip Model - No activity.</p>	<p>Hydriding.</p> <p>Complete detailed design of NR-1 periphery model and initiate procurement of hardware.</p>
<p>General Development</p> <p>TFL-1. a Single Cluster Tests - Rebuilt CL-1 furnace insulator and shield assemblies.</p> <p>TFL-1. b Single Element Tests - Total Tests - 29</p>	<p>Conduct tests for coated cluster and composite support development.</p> <p>XE-1 Phase III Simulation Tests, tests of high void elements from Phase I-D, Phase IV-A, and Phase IV-B. Continuation of hot end chuck and furnace development tests.</p>
<p>Facilities</p> <p>Design, procurement, and installation of FS-1 (filler strip) furnace, flow loop, and auxiliary equipment continued.</p>	<p>Continue procurement and installation of FS-1 facility.</p>

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TESTS FOR NRX-A6

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TFL-1. b Single Element Process Development and Evaluation Tests

A test program was conducted to determine the effects of rapid de-pressurization of fuel elements on the integrity of the coating and the elements.

- (C-RD) Four elements were used for the tests: two (2) of Y-12 origin and two (2) of WNCO origin. Each element was cut into five (5) eight inch sections. All elements were weighed and incremental permeability data taken prior to testing.

- (C-RD) The tests were conducted in three phases. The first phase consisted of testing 12 fuel element segments, three from each Y-12 element and three from each WNCO element. The chamber into which the segments were placed was de-pressurized from 750 psig hydrogen at the rate of 400 psi per second. All of the element segments were held at 750 psig for 15 minutes before decompression. There was no weight loss and no change in incremental permeability on any of the element segments. Phase II was conducted with two element segments, one from a Y-12 element and one from a WNCO element. The test chamber was decompressed from 750 psig hydrogen to 350 psig in 0.020 seconds. There was no damage to either element produced from this rapid decompression. Phase III was conducted with two element segments, one Y-12 and one WNCO. These segments were sealed so that the flow could only pass through the element webs enroute to the bore. There were no adverse effects to the element segments; however, it was noticed during the test that the seal was not perfect. Attempts are being made to seal the ends more effectively for future tests. The results thus far have shown that the elements are capable of withstanding rapid decompression with no damaging effects. Figure 1 is a schematic of the element de-pressurization test model.

TFL-2. a Filler Strip Corrosion Tests

- (C-RD) Preliminary information on flow, temperature, pressure, and electrical data from test TFL-2. a. 0003 of the NRX-A6 periphery model was released for

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FIGURE 1

ELEMENT DEPRESSURIZATION TEST MODEL

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(C-RD) analysis by the Advanced Reactor Design and Thermal and Nuclear Design departments. This data included: axial temperature profiles in all the model components, axial seal system pressure profiles, axial tile and filler gaps, mass flow rate, and time-temperature history of the wrapper and other components. Figure 2 is a time-temperature history for the filler strips at Station 26 and for the grafoil at Station 36. The latter curves are calculated minimum and maximum values for the wrapper outside diameter. Figures 3 and 4 are axial profiles, for two periods of the test, representing peak and steady-state temperatures. Figure 5 charts the cumulative operating time versus temperature for the grafoil wrapper outside diameter.

(U) In addition to the test data reduction, post-test inspection of test hardware was essentially completed. This included the tabulation of dimensional and weight changes for all components, photography, and graphic mapping of corrosion areas on all components. Figures 6 through 10 show representative views of the various model components after the test.

FIGURE 2
STATION 36.0 GRAFOIL O.D. TEMPERATURE-TIME HISTORY
(TFL-2.a.0003)

FIGURE 3
 PEAK TEMPERATURE PROFILES (TFL-2.a. 0003)

FIGURE 4
 R_o - TEMPERATURE $^{\circ}R$

STEADY-STATE TEMPERATURE PROFILES (TFL-2.a.0003)

FIGURE 5
TEMPERATURE EXPOSURE TIME OF GRAFOIL O.D.
(STATION 36.0)

FIGURE 6
SIMULATED CORE FROM TEST TFL-2. α . 0003

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FIGURE 7

ANTI-FRICTION LINERS FROM TEST TFL-2.α.0003

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FIGURE 8

FILLER STRIPS FROM TEST TFL-2.a.0003

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FIGURE 9
GRAFOIL WRAPPER (9 LAYERS) FROM TEST TFL-2.a. 0003

FIGURE 10
PYROLYTIC GRAPHITE TILE FROM TEST TFL-2, α.0003

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TESTS FOR NR-1

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TFL-1. d Orifice Calibration and Test

(U) Tests were conducted on twenty 30 mil and fourteen 36 mil diameter bore orifices which were machined out of zirconium. These tests were conducted in order to evaluate the machinability of zirconium. The orifices were flow tested on the quality control production orifice tester. The dimensional tolerances and surface finishes of these orifices were below the standards set for the stainless steel orifices. The measurements of the bores of the orifices resulted in two of them being in the bore dimensional tolerances set for the stainless steel orifices. All of the others being too large. Other bore deficiencies were; elliptical cross section, axial taper, and lack of concentricity with envelopes. There were also scratches on the inlet and/or the outlet faces of the orifices. The test results showed that all of the orifices were within the flow acceptance band. Tests are planned on additional zirconium orifices in a hydrogen atmosphere in order to evaluate the hydriding qualities.

(C-RD) The outlet of the test assembly which corresponded to the fuel element channel of the NRX reactors was 0.094 inches in diameter. The NR-1 reactor design designates a fuel element coolant channel diameter of 0.108 inches. An experiment was performed to determine the effect of this outlet channel diameter on the orifice calibration. Ten orifices ranging in bore diameter from 0.0255 inches to 0.070 inches were selected for the test. Each of the ten orifices were tested in the 0.094 inch diameter test assembly twice. The same ten orifices were then tested twice in the 0.108 inch diameter test assembly. Thus, a total of 20 tests were performed in this sequence. Test conditions for both cases were as follows:

Flow Media	Hydrogen
Inlet Plenum Pressure	691 psig
Temperature	Ambient
Differential Pressure Settings	5 to 150 psid

The results were as expected. Figure 11 shows the loss coefficients for orifices from 0.0255 to 0.045 inch diameter bores to be nearly the same (within the limit of the accuracy of the test) for the 0.108 and the 0.094 inch diameter outlet.

(C-RD) For orifices with greater than the 0.045 inch diameter bore, the loss coefficient in the 0.108 inch diameter channel is larger than the 0.094 inch diameter channel. The results of these tests indicate that the orifices used for the NR-1 must be re-calibrated with the 0.108 inch diameter outlet at reactor temperature. There are no further tests planned in this area.

TFL-2. a Filler Strip Corrosion Tests

The detailed design of the NR-1 periphery model is almost complete and hardware procurement will be initiated in the near future. This model was presented at the previous meeting and is included here for reference in Figure 12.

(U) The design provides for the maximum number of standardized parts which can effectively be used in a series of developmental tests. Slight alterations to the basic design of the inner core, peripheral elements, filler strips, tile or wrapper arrangement can be made from the standardized parts to suit the requirements of any specific test.

FIGURE 11

LOSS COEFFICIENT VS ORIFICE BORE DIAMETER
0.108 AND 0.094 INCH DIAMETER OUTLET CHANNELS

FIGURE 12
 PROPOSED COOL PERIPHERY WRAPPER MODEL

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GENERAL DEVELOPMENT TESTS

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TFL-1.a Single Cluster Development Tests

(U) During the period the furnace insulators and shield assemblies were completely rebuilt. This is a major maintenance item which is performed once each year.

(U) The procurement of hardware for the composite support development tests continues. The hardware is expected to be available for testing next month.

(U) A cluster was built from externally coated elements and will be tested next month to determine the feasibility of testing bundled, coated elements in the electrical test model.

TFL-1.b Single Element Process Development and Evaluation Tests

(C-RD) There were twenty-nine single element experiments conducted at WANL during this period. One test was conducted as part of Phase I-D, high void elements with LTRM coating. Sixteen tests were conducted as part of Phases I-Eb and I-Ec, A-6 elements at NR conditions. Two tests were conducted as part of Phase I-4B, A-4, A-5, and A-6 Build 1 elements at A-6 screening test conditions.

(U) Five furnace development tests were conducted to evaluate longer molybdenum shields, 26 inches compared to standard 15 inch length. A flatter surface temperature profile, more like the NR curve, was achieved with A-6 elements and with one high void element.

(U) Four hot end chuck development tests were conducted; three with high void elements and one with an A-6 element. One chuck test was conducted with a low void A-6 element with a 7.5 inch long chuck with a thin nose and a 3.5 inch long contact area. A reasonably good profile was obtained. Arcing occurred on the down power ramp due to more rapid cooling of the element as compared to the hot end chuck.

(U) Tests for the next period include XE-1 Phase III simulation tests, tests of high void elements from Phase I-D, Phase IV-A and Phase IV-B. The NRX-A6 Fuel Characterization program plant will be finished. The hot end chuck and furnace development tests will also be continued.

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FACILITIES and ACTION ITEMS

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FACILITIES

The design, procurement, and installation of the filler strip test facility (FS-1) continues. This furnace, including the flow systems, controls, and data acquisition system is being installed at WANL in the Cell 1 area. At present, the furnace stand and furnace are on hand and the cell has been partially prepared to receive them. Primary sensors (pressure transmitters, transducers, and thermocouples) have been received and partially installed. The flow system, calibration equipment, control console, bus bar and auxiliary equipment have been designed and will be procured as soon as possible.

An engineering effort to develop water injection for complete cooling of the hydrogen gas is under-way. This will eliminate heat exchanger and striker plate problems. If single element furnace tests are successful, this cooling system would be scaled up for the 9 MW cluster furnace making it possible to eliminate the heat exchanger equipment.

The 20,000 gallon dewar has been set on the pad. Work is progressing in preparing it for service.

ACTION ITEMS

Analysis of the resistance of elements as related to corrosion test results is not complete at this time.

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SECTION B

ENGINEERING MECHANICS TESTS

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ENGINEERING MECHANICS TESTING

Performed This Period (October 1967)

Planned Next Period (November 1967)

Tests for NRX-A6			
EML-B.2	XE-1 Support Tests		
EML-B.3	A-6 Transportation Tests		
EML-G.2	Lateral Support System Tests		
Tests for NR-1			
EML-A.4	Ganged Drive Band Fatigue	EML-A.4	Continue Ganged Drive Band Fatigue
EML-C.1	Support Pedestal Thermal Shock	EML-C.1	Continue Support Pedestal Thermal Shock
EML-E.4	Core Wrapper Leakage Tests		
EML-F.1	Plenum Stem Thread Sealing	EML-F.1	Continue Plenum Stem Thread Sealing
		EML-F.2	Shield Thermal Shock Material
		EML-J.1	Poison Wire
		EML-L.2	Stem Components
General Development			
EML-A.2	Beryllium Properties Thermal Shock		
EML-C.1	Thermal Gradient Test of Peripheral Support Blocks		
FACILITIES			
EML-H.1	XECF Resonant Survey	EML-H.1	Conduct Resonant Survey

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NRX-A6

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EML-B.2

XE-1 Support Tests

Dome End Cleanup

The ND-201 reactor was used as a test article to develop cleanup procedures, tools and inspection devices to be used on XE-1 at NRDS.

The core support plate was removed and simulated reactor debris having a particle size distribution the same as the XE-1 debris was inserted over a 90° sector of the core cluster plates. The support plate was then installed and Quality Control personnel charted the location of debris in the 90° sector. During the charting, inspection techniques and viewing devices were developed.

The 90° sector was then cleaned using a Black and Decker 1-1/4 HP vacuum fitted with a .3 micron absolute filter and an Aerotec separator. Special cleaning tools were developed and a cleaning procedure was written.

After cleaning of the 90° sector and before removal of the core support plate, Quality Control personnel inspected the cleaned area. Several locations were observed where a small amount of debris still existed. These areas were then cleaned while Quality Control personnel viewed the cleaning process through the special viewing equipment. The core support plate was then removed and a visual examination revealed that all debris had been successfully removed.

The vacuum equipment and special viewing devices were then sent to NRDS for use in XE-1 dome end cleanup. Personnel who performed cleanup and inspection on ND201 will also do those operations on XE-1.

XE-1 Aft End Cleaning Procedure Verification

Several tests were conducted in the Engineering Mechanics Laboratory to verify that the cleaning procedure used at NRDS for debris removal through the aft end of the XE-1 core was satisfactory.

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Debris was inserted into two elements of a cluster fitted with .0255 mil orifices. With the cluster at 2 degrees from horizontal, nozzle end elevated, and with the standard vacuum hose fitted with 3/8 inch I.D. tygon tubing, all debris was removed and all orifices were clear. This was demonstrated by sighting through the elements and then by holding them vertical, nozzle end down and tapping them gently on white paper.

Three tests were conducted on a 48 inch long glass tube (.085 I.D.) fitted with a .0253 dia. orifice. In the first test, debris was inserted into the tube to a depth of about 3 inches with the tube held vertical, nozzle end up. The tube was then laid horizontal and the vacuum applied by inserting the tube end into the 3/8 I.D. tygon tube. Dirt removal was almost faster than the eye could perceive with a vacuum of approximately 2" Hg. No orifice blockage existed after cleaning.

The second test was identical to the first except the debris was distributed along the length of the tube, laying on the bottom with the tube horizontal. Results were the same as in the first test.

The third test consisted of inserting debris into the glass tube, locating the glass tube nozzle end adjacent to a support block but purposely misaligning the tube with the support block hole. Application of the 3/8 I.D. tygon tube to the support block aft end successfully removed all debris from the glass tube. This simulated a worst XE-1 condition and demonstrated that nozzle end debris removal techniques used on XE-1 were satisfactory.

EML-B.3

Simulated NRX-A6 Leak Check and Transportation Tests

Tests were conducted to determine the effects on NRX-A6 fuel elements when subjected to simulated NRX-A6 core leak check procedures and a transportation environment simulating the worst conditions generated during shipment of an assembled reactor.

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The test specimens consisted of three reactor grade regular fueled clusters with 42 poison wires. The clusters were supported at their ends by graphite fixturing which in turn was placed in a pressure tight aluminum container.

Each test was composed of three parts, a plumbing leak check, a simulated core leak check and a simulated transportation test consisting of vibrating the containers at 1, 2, and 4 cps at accelerations of 0.5, 0.4 and 0.35 g's, respectively. These levels represent motions in excess of those which were recorded during shipment of reactors to NRDS.

Two tests were run. In the first test the cluster container was pressurized with bottled breathing air to two (2) psig with gas samples taken and air changes made every 12 hours commencing with the start of the vibration. For the second test the cluster container was continuously purged with Helium at 3 psig with samples taken every 24 hours for 108 hours. Sampling frequency was later changed to every 12 hours and the test duration to 90 hours.

The test setup designed to produce sinusoidal motions at the desired frequencies consisted of suspending the cluster container from an I-Beam structure with elastic rope and driving with an eccentric lever mounted on the shaft of an electric motor. The associated gas supply system consisted of:

- 1) vacuum pump, air and Helium supply
- 2) .3 micron particle filter
- 3) 25 mm particle filter mounted on the inlet to the container
- 4) flow meter, pressure gages
- 5) metering valves necessary to insure proper sampling and flow rates through the container of not greater than 100 cubic inches per min.

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The combined test setup is shown in Figure 1.

Instrumentation consisted of accelerometers mounted triaxially on the top and bottom flanges of the cluster containers with output indicated on an oscilloscope and recorded with a camera.

After testing the cluster-container assemblies were returned to Reactor Assembly for disassembly and analysis by the appropriate WANL groups. This analysis, made by the Fuel Evaluation and Analysis and the Physical Sciences groups showed that neither of the two simulated leak check and shipping tests produce any detrimental effects on the cluster elements.

EML-G.2

Lateral Support System Tests

Vibration tests were performed on A6 type seal segments. Dwell frequencies were selected between 10 and 400 cps which avoided the effects of fixture resonances and the driving motion was increased in 1/2 g increments to the design level of 4 g's. (the initial series of tests in this program were performed to the operating level of 2 g's.) During the dwell at 25 cps and 4 g's the A6 type displacement transducers showed a relative motion between the reflector and the core of 15 mils. At the completion of the test series a disassembly revealed that no damage had occurred as a result of the 4 g testing.

Measurements made during reassembly showed that the core was not concentric and parallel to the center line of the reflector. The data indicated there was an approximate misalignment in one plane of 1/200 of a degree. This misalignment in no way detracts from usefulness of the design information previously obtained. However, since the partial length core fixture will be used for future development tests, a complete evaluation of the condition will be made and corrective action taken.

FIGURE 1
SIMULATED LEAK CHECK AND SHIPPING TEST SETUP
EML-B.3

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NR-1

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EML-A.4

Ganged Drive Band Fatigue

Failure of several bands in previous tests at the cable clamp location indicated that spot welding doubler plates to the band did not provide a satisfactory load distribution from the cable clamp into the band. Several band tensile specimens were prepared with doubler plates cemented to the band with epoxy and clamp bolt holes were punched through the doubler plates and band after cement curing. These specimens were then loaded in tension on the Wiedemann using cable clamps for load application. The bands failed in the band section which indicated a satisfactory load distribution and bands are currently being prepared in this manner for fatigue tests on the multiple band test rig.

Installation of the 3 drum drive test fixture is progressing. A set of the decoupler-ganging mechanism parts had been ordered per preliminary prints to provide parts for fixture checkout. A review of latest drawings however, revealed that these parts would in most instances meet the drawing requirement. These parts will now be inspected to the current drawings and will be upgraded as required to meet important dimensional requirements i.e. concentricities, perpendicularity, parallelism, true position, etc. These parts will now be able to be used for fixture checkout as well as ganged drive development work resulting in a cost savings to the program.

EML-C.1

Support Pedestal Thermal Shock Tests

The first batch of development pedestals were machined from the Carborundum Company material purchased for development testing. This yielded a total of nine (9) pedestal specimens and related washers. Eight (8) of the pedestals were sent to Cheswick for coat-

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ing and have been returned. One (1) of the pedestals was used for thermal shock tests in an uncoated configuration. This uncoated pedestal was subjected to a total of three (3) tests in the single element thermal shock fixture that has been used for development of the thermal shock technique.

The uncoated specimen conformed to Drawing Number 576F878, and was instrumented with thermocouples located at the I.D., outer flowhole and outside slot. The test conditions and startup transients are shown in Table I. After Test No. 1, which consisted of one (1) cycle, the pedestal was inspected in the suspected high stress area between the alignment pin holes & the pedestal ID and no cracks were found. Data from the 1st test is shown in Figure 2. This data indicates a startup ramp of $200^{\circ}/\text{sec}$ and shows a maximum ΔT of 900°R . Data from the second and third tests have not been plotted at this time. The fourth run of the final test was at a condition well beyond that which was expected in a reactor. This gave a startup transient of $750^{\circ}/\text{sec}$ to a maximum temperature of 3900°R . After completion of this test, a small circumferential crack was observed between the thermocouple flowhole and an adjacent flowhole, indicating a cold spot in the hole plugged by the thermocouple. No cracks were found in the alignment hole area that was suspected of high stresses during the startup transient.

EML-E.4

Core Wrapper Leakage Tests

The last in the series of four tests was completed to evaluate the various joint configurations which are being considered for use on the core periphery. For each test nine layers of 5 mil thick pyrofoil using the joint condition to be evaluated were assembled on the

TABLE I
PEDESTAL THERMAL SHOCK TEST SUMMARY

<u>Test Number</u>	<u>Cycles</u>	<u>Transient * °R/Second</u>	<u>Max. Temp. * °R</u>	<u>Specimen Condition</u>
1	1	200	3470	Undamaged
2	4 A)	150	3400	
	B)	150	3400	
	C)	170	3400	Undamaged
	D)	200	3400	
3	4 A)	250	3940	
	B)	290	3940	Crack between
	C)	325	3800	TC flowholes
	D)	750	3900	and
				adjacent flowhole

* Conditions achieved during composite pedestal thermal shock tests.

FIGURE 2
 TEMPERATURE TRANSIENTS DEVELOPED DURING
 UNCOATED PEDESTAL THERMAL SHOCK TESTS - CYCLE 1
 EML-C.1

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flat surfaces between the two halves of the cylinder shown in Figure 3. Figure 4 shows the test arrangement inside the pressure vessel and the manner in which loads are applied by the bundling bladder. The vessel and auxiliary equipment are seen in Figure 5. Axial leakage of helium was measured for various bundling pressures and pressure drops. Room temperature type tests were performed on both butt and lap joints but subsequent tests in other test rigs will be performed at operating conditions on the selected design.

Data at a bundling pressure of 50 psi are shown in Figure 6. The butt joint with zero gap was added to the curve presented in last months report.

The results of the tests show the greatest joint impedance against leakage is achieved with butt joints and zero gap.

EML-F.1

Plenum Stem Thread Sealing Test

An NR-1 stem thread sealing test has been initiated to evaluate silastic RTV 891 sealant as an effective pressure seal on the threads of the NR-1 cluster assembly. Testing of unirradiated hardware is in work and favorable test results will lead to tests of irradiated specimens. All tests are to be carried out with the components shown in Figure 7 at ambient and 140°R temperatures while testing the seal configuration from 0 - 1200 psid.

Assembly procedures for the seal configuration follows:

All parts are thoroughly cleaned with grain alcohol and dried so as to render parts free of dirt, oil, grease, and other foreign material. Silastic RTV 891 sealant is applied to the threaded end of the bolt (Figure 7) and worked into the threads for a distance of 1/2 inch minimum from the bolt end. Excess sealant is removed from the bolt

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FIGURE 3
LEAKAGE SEALS EMPLOYED IN THE CORE WRAPPER IMPEDANCE TEST
EML-C.1

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FIGURE 4
TEST SETUP INSIDE THE PRESSURE VESSEL
EML-C.1

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FIGURE 5
CORE WRAPPER IMPEDANCE TEST SETUP
EML-C.1

FIGURE 6
 EVALUATION OF JOINT CONFIGURATION FOR CORE WRAPPER
 EML-C.1

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FIGURE 7
STEM THREAD SEALING TEST ASSEMBLY
EML-F.1

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by a wiping action, so that sealant is present only in the threads. The nut (Figure 8) is assembled so that the length of thread engagement is $.500 \pm .020$. Any excess sealant remaining is removed. Assemblies remain undisturbed for a period of 48 hours to allow sufficient time for cure of sealant material. Figure 8 shows a cross section of the test fixture with the test specimen in place.

To date, four seals have been tested at room temperature and four at 140°R . Slight leaks were detected in one seal at ambient temperature and in one seal at cryogenic temperature. The remaining six seals did not leak. Data are being reduced at this time.

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High Pressure Inlet

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FIGURE 8
STEM THREAD SEAL TEST FIXTURE
EML-F.1

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GENERAL DEVELOPMENT

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EML-A.2

Beryllium Properties

Thermal Shock Test

A thermal shock test was conducted on a specimen machined from a beryllium block pressing. The cross section of the specimen was .75 x 1.50 inch and a .625 inch diameter hole was located at the center of the cross section and penetrated the 5 inch specimen length. A flow sleeve inserted in this hole guides the flow along the thin sides of the specimen during test. Three .010 inch deep notches are located on each thin side of the specimen. See Figure 9.

Gaseous helium cooled by a liquid helium heat exchanger was passed through the specimen at high pressure in the test setup shown in Figure 10. Test conditions were as follows:

Specimen bulk temperature = 310°R

Helium pressure = 1100 psig

A thermal gradient of approximately 130 degrees was achieved during the test, however no thermal shock cracks developed.

Further tests will be conducted with specimen bulk temperatures to 350°R . This then will bracket the anticipated reactor reflector operating temperature of approximately 330°R .

EML-C.1

Thermal Gradient Test of Peripheral Support Blocks

Last month a test was described in which an unsymmetrical thermal gradient was obtained on XE-1 type graphite support blocks in an effort to simulate side-wall cracks observed during post-test reactor inspections. This test resulted in a gradient of 2000° across the block. Subsequent analysis has shown this to be a linear gradient; therefore, high stresses were not to be expected and further testing of the same type would be of no value.

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FIGURE 9
THERMAL SHOCK SPECIMEN
EML- A.2

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FIGURE 10
THERMAL SHOCK FACILITY
EML- A.2

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Another technique was employed during the past month using fixturing that permits room temperature gas to be directed at the hot side of a support block to simulate a radial in-flow leakage on peripheral blocks. The fixturing consisted of a retractable tube mounted on one of the furnace side ports. In this test, the support block was heated to 4500°R with a load of 750 lbs applied at temperature. The gas blast consisted of hydrogen flowing through a one quarter inch ($1/4''$) tube at a rate of 35 scfm. The first test of a coated support block produced a network of cracks in the coating in the area of gas impingement. The block was sectioned and polished and it was found that no penetration of cracks into the graphite substrate had occurred.

A second test, using an uncoated graphite block was run under identical conditions and did not result in any cracking or damage to the block. Thermocouple data was obtained from two (2) thermocouples located in flowholes near the outer surface with one of each on opposite sides of the block and a third in the center of the block to confirm the slope of the gradient. A fourth thermocouple was brought through the tube used to direct the gas stream on the block. Uncorrected data from this thermocouple indicated a temperature of 400°F at the point where the gas impinged on the block; while the thermocouple on the opposite side of the block indicated 3400°F , giving a gradient of approximately 3000° .

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FACILITIES

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EML-H.1

XECF Resonant Survey

The instrumentation trailer containing the vibration and data acquisition equipment was delivered to NRDS. WANL personnel went to the Site to setup the equipment and mate the AGC System to the WANL Data Acquisition System and coordinated the remaining work with the Site personnel. During the checkout of the equipment the socket of a power amplifier output tube was found cracked but this was the only problem resulting from the shipping that required a correction.

Since the XECF reactor was moved to E-MAD Building causing a delay in schedule, the Engineering Mechanics personnel returned to Pittsburgh. As soon as the reactor is installed in ETS-1, the men will return to NRDS for the completion of checkout and testing.

The approved document NTO-I-0345, "NTO Procedure For Vibration Testing of XECF at ETS-1" was received. Work sheets, instrumentation forms and data reduction procedures were developed.

The work sheets will be used to note significant details of setting up and calibrating the many transducers and to summarize the information for each transducer immediately following the sweep tests. The outputs from selected transducers will enable the Data Review Team to select the significant dwell frequencies.