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WANL-TME-1104
February, 1965

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NOTES OF MONTHLY COMPONENT TEST PROGRAM REVIEW
MEETING HELD WITH SNPO AT WANL ON FEBRUARY 4, 1965

MASTER

(Title Unclassified)

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~~INFORMATION CATEGORY~~
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H. S. McCreary
H. S. McCreary, Manager
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Notes of Monthly Component Test Program Review Meeting

held with SNPO at WANL on February 4, 1965

Attendees:

DeZubay, E. A.	WANL	Miller, A. I.	WANL
Guzek, J. C.	WANL	Miller, D. F.	WANL
Helms, I.	SNPO-W	Pouchot, W. D.	WANL
Kalvin, G.	SNPO-C	Rowan, W. J.	WANL
Kees, F. R.	WANL	Tauch, F. G.	WANL
Larson, L.	AGC	Warner, P. C.	WANL
McCreary, H. S.	WANL		

Summaries of the present status of each Experimental Engineering Component Test were presented at the February 4, 1965, Monthly Component Test Review Meeting.

E. A. DeZubay described the Fluid Flow Program as follows:

HHT-2 Single Element Process and Evaluation Test

Testing continued on the two cycle (1B10 + 1B20) program for the purpose of obtaining data on the capability of elements to survive corrosion testing for 30 minutes duration. To date, eleven elements have been tested.

Approximately 50 per cent of these elements have successfully completed the 20 minute test after the initial 10 minute test. In those which failed, failure occurred in the mid-band range and exhibited weight losses of approximately 20 gms.

HHT-4 Single Cluster Development Test

A cluster with 30 mil orifices and unfueled elements is ready for test. The cluster was instrumented with a standard thermocapsule array on the end

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HHT-4 Single Cluster Development Test (cont'd)

cone and tie rod button. Parts are now available for the assembly of two additional clusters. The next cluster to be tested is a fully instrumented cluster.

HHT-5 Center Element Liner Corrosion Test

A test plan has been written and is being circulated for internal review. The heater and all necessary test parts are presently available. Testing will be conducted during the week of February 7 if a furnace is available.

HHT-6 Interstitial Corrosion Tests

Preparation is proceeding according to schedule and testing should be accomplished during the first week of March, 1965. The initial test inter-element gaps will be 0.001, 0.002, 0.004 and 0.006 inches.

HHT-7 Filler Strip Corrosion Tests

Assembly of the filler strip corrosion test model was completed. Installation of the model in the A-10 furnace was initiated. If no difficulties are encountered, testing should commence during the second week of February, 1965.

HHT-11 Small Scale Seal Test

This test has been indefinitely postponed due to program revision, no further reference will be made to this test.

HHT-13 Short Section Filler Strip Corrosion Test

As previously reported, all testing in this area has been completed. No further reference will be made to this test.

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FFL-6 Orifice Calibration and Testing

Testing of orifices clogged with debris has been completed. Pressures as low as 700 psi will clear a debris plugged orifice. Plugging of this nature is therefore not assumed to be problematic in nature. Further activity in this area has been suspended and will be applied to HHT-7, Filler Strip Corrosion Testing. Testing of the Diecraft preproduction orifices has been discontinued. Mr. Kalvin then questioned the whole of the Diecraft orifice test program -- i.e. Why was it done? WANL representatives stated that Diecraft's original quotation was considerably lower than the unit price of the presently used short tube orifice. However, they requoted at a much higher figure after actually attempting to meet our design specifications. WANL representatives further stated that if future designs require a long tube constant bore orifice, the unit price will increase above present levels. This is due to the inherent production difficulty in maintaining a constant bore in a long tube orifice.

FFL-17 Plugged Core Flow Test

A tracer gas test was successfully conducted in the plugged core flow test rig. A test was performed with gaseous hydrogen at an inlet pressure of 300 psia. Methane was injected at one point near the top of the core and sampled at 22 points downstream on the 45° core radius. All systems functioned as planned and all test goals were achieved. Analysis of a given bomb was time dependent in that it is low at the beginning and high at the end of the analysis. This could be due to methane absorption and desorption in the sample cylinders.

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FFL-18 Single Seal NRX-A5 Tests

All test rig and specimen drawings have been released and fabrication initiated.

FFL-19 Inner Reflector Exit Plenum

Activity in this area has been temporarily suspended.

FFL-20 Inner-Outer Reflector Impedance Ring

Activity in this area has been reduced and part of this effort reapplied to corrosion tests.

FFL-21 Tie Rod Hardware Flow Tests

The special reactor design O-ring was tested in full element and on a short fixture at both ambient and cryogenic conditions. Testing has been completed on the short fixture. Short fixture cryogenic testing indicated that the O-ring is as effective at cryogenic conditions as at ambient conditions. A small difference in leakage rates noted is due to the high gas density at low temperatures. The O-ring was also found to be equally effective when compressed against a pyro tile with and without a chamfer. Tapered foil seals are now being tested in the full element fixture and will shortly be tested in a fixture where the pyrofoil is wedged between two metal rings.

Waltz Mills Facility

Construction details of the corrosion facility were discussed.

E. A. DeZubay circulated several photographs illustrating the state of completion of the facility. The initial test date is estimated to be March 15.

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A short discussion of the direction of the present program followed E. A. DeZubay's remarks. During this discussion, Mr. H. S. McCreary stated that the emphasis of our program has been altered to place more effort in the following areas:

1. Support block bonding and corrosion
2. Fabrication of a rig to expedite the acquisition of information concerning small gap corrosion
3. Single cluster corrosion testing
4. A center hex element corrosion test program
5. Filler strip corrosion tests

Due to conflicting schedules of both SNPO and WANL personnel, the Monthly Component Test Review Meeting was adjourned at the conclusion of H. S. McCreary's remarks.

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The following are notes prepared but not presented by W. J. Rowan for the discussion of Engineering Mechanics' component tests:

EML-60 Core Effective Gap Test

During the month of January, all of the flow channels in the elements which are to be used in this test were sealed with thin hexagonal aluminum plates. The elements are now being pressure tested to insure a perfect seal. A core band system to obtain various bundling loads with remote control was developed and tested. The inlet flow orifices and pressure transducers have been received. Fabrication of the inner support structure and pressure vessel is underway. Core buildup will be performed during the next two weeks. Testing will commence as soon as the core is installed in the pressure vessel and should occur late in February or early in March.

EML-61 Tie Rod Fatigue Properties

Four axial fatigue tests on Inconel 718 tie rods were completed in January. In each of the tests, the tie rods failed in the body of the rod; consequently, the fact that they were rejected on the basis of material defects in the head has no bearing on the test. Ambient axial fatigue tests should be completed during the month of February. Cryogenic condition testing at 140° R will then begin.

EML-62 Lateral Support System Test

Test rig drawing modifications are being made to accept NRX-A5 inner reflector sections. Test planning and rig design work will continue during the month of February.

EML-65 Mechanical Test of Instrumented NRX Reactor Components

A report summarizing the results of the NRX-A3 tie rod and lateral support spring calibration and proof test is now being written. No further testing was conducted during the month of January. Similar calibration of instrumented components for the NRX-A4 reactor will begin during the month of February.

EML-66 Fuel Element Tests

The redesign fixture parts for fuel element tests were recently received. The initial tests will be performed at room temperature on strain gaged sections of elements to evaluate the concentricity of the compressive loads.

EML-67 Fuel Element Cluster Tests

Considerable testing was conducted on short cluster assemblies of fuel elements in a helium atmosphere. The primary objective in these particular tests was to investigate bonding characteristics between the support block and the wafer tips of the elements. No evidence of bonding was found in any of these tests, however, considerable flaking of the niobium carbide coating did occur. Approximately two thirds of the elements tested showed some degree of flaking. A number of tests will be conducted during the month of February to further investigate this flaking phenomena. Steps are now being taken to supply a hydrogen atmosphere in the small furnace as the results of EML-75, Friction Tests of Reactor Components, indicate some bonding may occur in hydrogen. Investigations are also being conducted to correlate our test results with coating runs, batch numbers, and the results of previous Fluid Flow Laboratory testing. The effect of different temperatures will also be evaluated in future testing. During the latter part of January, the full length cluster furnace facility was used to test thermocouples installed in a single fuel element.

EML-67 Fuel Element Cluster Tests (cont'd)

Complete activation of the full length furnace will require additional high pressure piping to supply helium to the test chamber.

EML-68 Core Insulation Development Testing

All test rig parts for the tile bow test have been received and are being assembled in the pressure vessel. Checkout runs of the test hardware are expected to be conducted during the first half of February, and actual high temperature testing is scheduled for the second half of February.

EML-69 Support Block Mechanical and Thermal Test

Two support blocks were compression tested to failure during the month of January. In both blocks, failure occurred at approximately 5,000 lbs. The block tested at 3500° R failed in a typical brittle fracture mode. A block tested at 4500° R failed in a similar mode but did show some evidence of plastic failure. Additional support block tests are to be conducted late in February. Several support blocks which were part of the NRX-A2 reactor during its hot test are being shipped to the Engineering Mechanics Laboratory. When they are received, compressive strength tests will be conducted at both room temperature and 4300° R.

EML-70 Strip Supported Cluster Tests

Fatigue tests of strip supported unfueled elements were conducted during the month of January. Similar tests of fueled specimens will be conducted during February to complete this phase of the program. Compressive tests utilizing unfueled specimens were also conducted on a fully bonded design and deflected flow designs. The results of these tests are as follows:

EML-70 Strip Supported Cluster Tests (cont'd)

Fully Bonded Design (six inch cluster) 3,995 lb. average compressive strength,

Deflected Flow Design (six inch cluster) 2,465 lb. average compressive strength,

Strip Supported Cluster 2,500 lb. average compressive strength.

These results are comparable to a support block capability of about 4,000 lbs. The reactor operating load expected at this point is approximately 500 lbs. In the bonded arrangement testing, it appears that bundling force applied to the assembly is a very important factor in that the failures that occurred show indications of a peeling or tearing type of action along the joint and not shear type of failure.

EML-72 Transportation of Elements in their Shipping Containers

All scheduled testing in this area was completed. A report describing the test and giving recommendations will be issued shortly.

EML-75 Friction Tests of Reactor Components

Friction tests were performed on specimens machined from coated fuel element wafers and support blocks. These tests were performed in a hydrogen atmosphere with various materials between the specimens to determine the effect of these materials on fuel element-support block bonding and friction. The specimens were held at a temperature of 4500° R for 10 minutes before determining friction force. A contact pressure of 250 psi was maintained throughout the test by applying a normal force of 20 lbs. on specimens which had a net area of 0.08 sq. in. The following results were obtained:

EML-75 Friction Tests of Reactor Components (cont'd)

<u>Test Conditions</u>	<u>Breakaway Friction Force (lb)</u>
No Additional Coating at Interface	65
Tungsten Foil Between Specimens	65
Neolube Coating on Support Block Specimen	55
Pyro Carbon Coating on Support Block Specimen	35
TaC Foil Between Specimens	20

Additional friction and wear tests of fuel element wafers on support blocks will be performed during the month of February. Friction and wear tests of niobium carbide coated fuel elements on pyrotiles will be performed at reactor temperature conditions.

EML-76 Reactor Hardware Static and Dynamic Tests

A fixture was manufactured for testing support plate-support ring bolts and instrumentation tubes and nuts. Tests on instrumented threaded tubes and nuts will be performed during February. If present conditions continue, support plate-support ring bolts will not be available for test until March. A test was performed to determine the load-deflection characteristics of the core support ring-core assembly barrel connecting tabs. Three specimens were tested simulating the extreme and nominal tolerance conditions of the tab assembly. The results indicated that for all tolerance conditions, a maximum load of about 2,600 lbs. per tab would be developed with about 1/4 in. of movement.

EML-82 Outer Reflector Sector Tests

Test design and procurement work on test rig components was continued during the month of January.

EML-85 Control Drum Bearing Test

Vibration tests of the control drum bearing were concluded. Tests at higher levels than those previously reported were performed to evaluate the performance of the bearings. The test conditions were as follows:

<u>Frequency (cps)</u>	<u>Input (G's)</u>	<u>Dwell Time (min)</u>
1844	20	30
1844	10	30
733	20	60
494	20	60
328	20	60
14	2.2	60

The input for the 1844 cps dwell tests was reduced to 10 G's after 30 minutes because it was not possible to continue to maintain proper control of the shaker system at 20 G's.

Post-test friction measurements at both room temperature and cryogenic conditions revealed that the bearing friction torque had not changed during the vibration tests as previously reported. The actuator torque change reported last month was due to frictional changes in the drive system. The combined friction of both of the control drum bearings, before and after vibration testing, was about 4 in. lbs. at room temperature and 15 in. lbs. at cryogenic conditions. Inspection of the bearings after test revealed no increase in radial or axial clearances or damage to the balls and grooves.

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EML-86 NRX-A5 Lateral Support System Component Tests

Drawings of the pin and seal cycling rig have been completed.
Fabrication of the rig parts should be completed during February.

EML-88 Insulated Control Drum Bow Tests

Control drum bow tests were performed with a thermal barrier installed between the beryllium cylinder and control vanes. With a thermal barrier with a chemically etched 0.010 gap, a very steep flow ramp of about 5 lbs./sec² resulted in a maximum bow of 0.017 in. and a ramp of about 1 lb./sec² resulted in a maximum bow of 0.021 in. In previous tests without a thermal barrier, similar ramps resulted in maximum bows of 0.038 and 0.031 in. respectively. A test run with a less effective but cheaper thermal barrier resulted in a maximum bow of 0.032 in. with a ramp of about 5 lbs./sec². Apparently, these barriers tend to significantly reduce control drum distortion during simulated reactor conditions.

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