~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
Atomic Energy Act

MAR 31 1965
SNPO-C
Astronuclear
Laboratory

WANL-TME-1131

March, 1965

12
RECORD COPY

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

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

MASTER

Westinghouse Astronuclear Laboratory
Astronuclear Laboratory
P. O. Box 10864
Pittsburgh, Pennsylvania 15236

Classification cancelled (or changed to)

by authority of Doc

H.F.C. TIC, date SEP 10 1973

SPECIAL REREVIEW FINAL DETERMINATION	Reviewer	Class.	Date
	<u>KAW</u>	<u>U</u>	<u>2-20-82</u>
Class: <u>U</u>			

INFORMATION CATEGORY
Confidential-Restricted Data

Authorized Classifier

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

RECORD COPY

H. S. McCreary, Manager
Experimental Engineering

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
Atomic Energy Act

Group 1
Excluded from automatic Downgrading
and Declassification

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~

~~Atomic Energy Act, 1954~~

WANL-TME-1131

Notes of Monthly Component Test Program Review Meeting

held with SNPO at WANL on March 4, 1965

Attendees:

Bifano, N. J.	WANL	Miller, A. I.	WANL
DeZubay, E. A.	WANL	Miller, D. F.	WANL
Helms, I.	SNPO-W	Pouchot, W. D.	WANL
Kalvin, G.	SNPO-C	Scheib, W.	SNPO-W
Kees, F. R.	WANL	Sheppard, D.	AGC
Larson, L.	AGC	Warner, P. C.	WANL
Lowe, B. J.	SNPO, Pgh. Res.	Watjen, E. A.	WANL
McCreary, H. S.	WANL	Wisniewski, E.	WANL

Summaries of the present status of each Experimental Engineering Component Test were presented at the March 4, 1965, Monthly Component Test Review Meeting. The following material was presented by Engineering Mechanics.

EML-60 Core Effective Gap Tests

The inner core support structure has been fabricated and the core completely assembled in this structure. The input flow piping and pressure scanning valves were received. System checkout runs were performed at various test pressures with the scanning valve. The valve performs excellently with no transient or pressure oscillations at the full scanning speed of twenty-four (24) measurements per second. All elements to be used for the test have been capped and pressure checked individually. Porosity measurements were made on several elements at twenty-five (25) psi bore pressure with helium. Mechanical bundling bands have been designed and are now being fabricated. The six (6) bundling bands will be controlled externally by hydraulic pressure. During the test, interstitial pressures will be measured at four (4) axial

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~

~~CONFIDENTIAL~~

~~RESTRICTED DATA~~

~~Atomic Energy Act of 1954~~

Astronuclear
Laboratory

WANL-TME-1131

EML-60 Core Effective Gap Tests (cont'd)

locations on three (3) radii. Mr. Helms questioned the use of the flat-bottom plate on the pressure vessel. WANL representatives replied that the vessel was designed and will be tested to the ASME Pressure Vessel Code for 150 psi pressure. The first phase of the test to be run will be measurement of core diameter under various banding pressures. Tests with helium will begin shortly thereafter.

EML-61 Tie Rod Fatigue Properties

The tie rod work on Inconel-718 tie rods that has been performed to date was described. An S-N curve for a steady load of 810 lbs. has been completed. This curve shows that these tie rods have a fatigue life of 2×10^6 cycles for an alternating load of ± 200 lbs. This value is only 40 per cent of the value predicted on the basis of bar stock data for the material given in the WANL Materials Manual. Photos of the fatigue failures were shown. All failures had occurred within the body of the tie rod. Mr. Larson inquired how this data compared with that of the Inconel-750 tie rods. WANL representatives stated that sufficient fatigue tests have not run on Inconel-750 material to define an S-N curve. It is believed, however, that the strength of all tie rods is more than sufficient based on the stresses measured to date. Fatigue tests at temperatures other than ambient will be delayed indefinitely. The only tests planned are those at 500 lbs. mean load and are scheduled for completion in March. Tensile tests of advanced design counterflow tie tubes will be performed when specimens become available.

~~CONFIDENTIAL~~

~~RESTRICTED DATA~~

~~Atomic Energy Act of 1954~~

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~

WANL-TME-1131

EML-62 Lateral Support System Test

The needs for the tests on the NRX-A5 design are not critical until the end of the year. This program will be delayed until about July to make manpower available for other more urgent programs.

EML-65 Mechanical Test of Instrumented NRX Reactor Components

A report, WANL-TME-1107, summarizing the calibrations and proof tests for the NRX-A3 reactor lateral support springs and tie rods, has been completed. Tests of leaf springs for the NRX-A4 reactor have been initiated and are over half completed.

Tests have been run on several support blocks which were modified to receive thermocouple lead wires. The test results showed a static strength at room temperature of approximately 4,350 lbs. and indicated that the modification did not affect the strength adversely. Photos were shown of characteristic support block failures. The NRX-A4 leaf spring tests will be completed in March. The tests on the NRX-A4 tie rods will be initiated when these components become available for testing.

EML-66 Fuel Element High Temperature Static and Fatigue Testing

During February, a check of furnace alignment was conducted at room temperature. Three-inch long fuel elements with strain gage bridges at the midpoint of the element were used in this checkout run. The test showed that the specimen was subjected to excessive bending during compressive loading. These tests were followed by detailed inspections of each component in the loading train. The inspection indicated that most of the components were not according to print.

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~APR 1954~~

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~Atomic Energy Act - 1954~~

WANL-TME-1131

EML-66 Fuel Element High Temperature Static and Fatigue Testing (cont'd)

Despite the excessive bending, the parts were assembled in the furnace with an unfueled element to check the integrity of the hardware under load at 5,000° R. This test showed that the components were structurally adequate.

During March, no major work has been scheduled on fuel elements because of the greater urgency on support blocks and short clusters. Procurement of reworked hardware and some redesign of element fixtures will be undertaken, and testing will resume as soon as schedules permit.

EML-67 Fuel Element Cluster High Temperature Testing

During February, short cluster tests were concentrated on additional flaking studies. These tests were conducted by maintaining a positive furnace pressure of five (5) psi to eliminate entry of contaminants through sight-ports. This technique eliminated all of the discoloration seen previously on the test specimens, but flaking of the coating still occurred.

A hydrogen atmosphere system is now being installed in the furnace. This system has been reviewed with the Safety Committee, and their requirements will be met. Their requirements will limit flow to one SCFM of hydrogen and will not permit storage of more than two bottles in the hot room.

EML-68 Core Insulation Development Testing

During February, the test rig was checked out at temperature. This test was limited to 1,000 amps because the D.C. power supplies had not been paralleled. The test confirmed the initial calculations and showed that everything is ready for the high power tests.

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~Atomic Energy Act - 1954~~

CONFIDENTIAL
RESTRICTED DATA

WANL-TME-1131

EML-69 Support Block Mechanical and Thermal Tests

Tests were conducted on support blocks at temperatures of 4,000° R, 4,500° R and 5,000° R. Five (5) tests were taken to failure, and two (2) were conducted as creep tests. Testing is scheduled on six virgin support blocks and six (6) of the NRX-A2 blocks at 4,300° R. We received eleven (11) of the twelve (12) NRX-A2 blocks we had originally requested. Five (5) of these will also be crush tested at room temperature for comparison with previous results.

A recent addition to the program was a test to determine the energy required to chip the support block coating. This test employs a 100 gram rod that is dropped from a known height onto the edge of a support block. The test shows that as little as .03 in.-lb. will cause chipping of the coating and parent graphite. The test has also evaluated supplementary coatings provided by the Materials Department. However, only one (1) of these has shown any positive result, but it is too thick to be acceptable.

Support blocks have also been bored out in the center-hole area to simulate advanced stages of center-hole corrosion. These tests showed that a minimum load of 2,550 lbs. was required to fail a block bored out to .600 in. in the seat area.

EML-70 Strip Supported Cluster Test

This program has grown appreciably during February. The test description has been rewritten and the title changed. The new title, "Self-Supported Cluster Tests", permits the combining of all of the work on new designs in one program. Configurations now being tested are the strip supported cluster, the fully bonded, the diverted flow, and the non-diverted flow designs. Cold end designs will be added to the test effort along with specimen tests on keys, graphite threads, and tie rod seat areas.

CONFIDENTIAL
RESTRICTED DATA

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

During March, high temperature tests will be conducted on the strip supported design and the fully bonded cluster design. Fatigue tests of the strip supported element have shown that the element is generally stronger and that the failures do not follow the glue joint. Much of the available manpower will be working on tests of new cluster designs during March.

EML-72 Test of Fuel Elements in their Transportation Container

Work on this test has been completed, and WANL-TME-1094 was published in February, 1965.

EML-73 Inner Reflector Testing

During February, a major addition was made to this program in the form of additional sub-scale tests of stave barrel designs. These tests are intended to provide early answers as to whether or not the stave barrel is as good as the solid barrel. Three solid barrel specimens will be used for comparison tests with 6 inches diameter x 5 inches long stave specimens. A special pressure vessel has been designed, and testing is expected to begin during early March.

EML-75 Friction Tests of Reactor Components

Preliminary bonding and friction testing of NbC coated fuel element wafer and support block specimens with and without additional interface coatings has been completed. The tests were performed in hydrogen at temperatures from 4,000 to 4,800° R with a 250 psi contact pressure. Screening tests at 4,500° R, in which the test specimens were separated

~~CONFIDENTIAL~~

~~RESTRICTED DATA~~

~~Atomic Energy Act - 1954~~

Astronuclear
Laboratory

WANL-TME-1131

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

with plasma sprayed ZrC, neolube, pyro carbon, tungsten foil, rhenium foil and TaC foil, indicated that TaC was the most promising separator material for minimizing breakaway friction. Tests of specimens, without a separator and with TaC foil between them at temperatures from 4,000 to 4,800° R, indicated that a TaC foil separator reduced the breakaway friction force forty (40) to seventy (70) per cent and prevented bonding of the specimens throughout the temperature range. Additional specimen tests will be performed to further investigate the bonding of NbC coated fuel elements and support blocks and evaluate the effects of a TaC separator. Exposures of twenty (20) minutes to the test temperatures and the effects of pimples on the coating surfaces will be investigated. Friction and wear tests of NbC coated fuel elements sliding on pyro tiles will be performed in March at reactor operating temperatures. This testing could not be started in February as planned, because all the available friction testing capability was concentrated on fuel element support block work.

EML-76 Reactor Hardware Static and Dynamic Tests

A test was performed to determine the variation of the instrumentation block seal preload with the locking nut assembly torque at room temperature. The results indicated that the thread coefficient of friction was lower than had been assumed when the assembly torque was established. Additional tests will be performed to determine the seal preload obtained at 140 to 620° R with the minimum and maximum assembly torques. A test rig was designed for evaluating a new lateral support spring concept in which the aluminum cylinder around the inner reflector will contribute to the lateral support spring force.

~~CONFIDENTIAL~~

~~RESTRICTED DATA~~

~~Atomic Energy Act - 1954~~

EML-82 Outer Reflector Sector Test

Manufacturing of test rig components was continued in February and is expected to be completed next month. Testing is currently planned to begin the middle of May.

EML-88 Insulated Control Drum Bow Tests

A control drum bow test was performed with the etched thermal barrier installed to determine the effect of preheating the drum to about 250° F. The maximum bow with a flow ramp of approximately 1 lb/sec² was found to be about 0.034 inch. Additional bow tests with helium will be performed at various flow ramps from 0.4 to 5.0 lb/sec² with and without drum preheat. A study was made to determine the equipment requirements and schedule involved in performing bow tests with gaseous and liquid hydrogen at the Waltz Mills Hydrogen Facility.

EML-93 Pyrofoil Wrapper Tests

Pyrolytic graphite foil has been considered as a core wrapper for advanced designs. Room temperature ductility tests were run to determine the percent elongation at failure and failure stress. Testing of several 1/2 in. x 0.006 in. thick strips indicated fracture strain of from 0.3 to 0.5 percent and tensile strengths between 800-1200 psi. Additional tests will be run on ten (10) mil material at room temperature and at high temperature. Cyclic tests will be run to determine the hysteresis characteristics of the material.

E. A. DeZubay presented the Fluid Flow Laboratory Program as follows:

HHT-2 Single Element Development Test

A second checkout run was performed in the new corrosion furnace at the Waltz Mills site. During the test, an unfueled coated element achieved a surface temperature of $4,315^{\circ}$. This checkout run consisted of a test from 100 volts at 19 amps to 1,900 volts at 160 amps with hydrogen flow of 20 scfm. Further checkout runs will be performed to correlate test results from the Waltz Mills and Large corrosion test facilities. Quality Control testing is scheduled to begin at the Waltz Mills site on or about April 1. Cold end chucks which grip the element 6 inches, 8 inches and 10 inches closer to the hot end have been designed and tested. As expected, this changed the axial temperature profile to a point where the cold end temperature had dropped 100° below the average element temperature.

HHT-4 Single Cluster Tests

Boron nitride insulators have been designed which will electrically insulate cluster tube liners without requiring alteration of the unfueled center element. Such a cluster has been assembled and installed in the furnace. Testing will be performed as soon as time permits.

HHT-5 Center Hex Test

A center hex element, complete with A2 reactor grade hardware, was tested at power levels ranging from 90 kw to 220 kw. Power levels were increased in four (4) steps with an approximate 8 minute hold at each level. Hydrogen gas at a flow rate of 170 scfm was passed continuously through the center hex during the test. The external temperature of the unfueled

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~

~~Atomic Energy Act, 1954~~

Astronuclear
Laboratory

WANL-TME-1131

HHT-5 Center Hex Test (cont'd)

element reached approximately 4,500° R with the cold end at approximately 700° R. Tested for a period of 32 minutes, the element experienced a weight loss of 20 grams. The element was sectioned to determine the location of this weight loss. The location and appearance of the corrosion was identical to that observed during the NRX-A2 Postmortem Test. An A3 configuration is scheduled for testing during the week of March 8.

HHT-7 Filler Strip Corrosion Tests

Build No. 1 was completed and installed in the A10 furnace. A helium checkout run was made to functionally check the operational characteristics of the model at both ambient and intermediate temperature conditions. Unexpected temperature oscillations caused the abortion of the planned test after a power run of 13 1/2 minutes. Partial disassembly of the cold end of the furnace showed that two thermocouples were shorted against the arc suppressor. These damaged thermocouples have been replaced, and a second helium checkout run will be conducted in the imminent future. Interstitial corrosion tests are scheduled to begin the week of March 6.

FFL-17 Plugged Core Tests

The instability in analysis of methane-hydrogen mixtures indicated that selective adsorption of the methane on the walls of the sample container was responsible for the erroneous results. The Beckman hydrocarbon analyzer showed a progressive increase in hydrocarbon concentration as the sample bottle was deleted. This adsorption phenomena was found to occur on only

~~CONFIDENTIAL~~

~~RESTRICTED DATA~~

~~Atomic Energy Act, 1954~~

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~Atomic Energy Act, 1954~~

Astronuclear
Laboratory

WANL-TME-1131

FFL-17 Plugged Core Tests (cont'd)

a fresh surface such as in a new unused container or a container held for a long period at very high vacuum. Apparently, once adsorbed, the methane passivates the surface and no additional adsorption takes place. Future test samples will be accumulated in containers which have experienced several nitrogen purges to eliminate air from the system. In addition, filters will be installed in the analyzer lines to prevent graphite dust from entering the sampling system. A computer program for the reduction of test data has been completed.

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~Atomic Energy Act, 1954~~