HW--77787

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N - REACTOR DEPARTMENT

MONTHLY REPORT

MAY

1963

HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

GENERAL ELECTRIC

AEC-GE RICHLAND, WASH.

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HW-77787

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N-REACTOR DEPARTMENT

MONTHLY REPORT -- MAY 1963

Compiled by N-Reactor Department

June 7, 1963 - Richland, Washington

Work performed under Contract No. AT(45-1)-1350 between the Atomic Energy Commission and General Electric Company.

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TABLE OF CONTENTS

GENERAL SUMMARY

N REACTOR FUELS

Manufacturing

A total of 216 billets were extruded during May, a new record, of which 128 were outers and 88 were inners. Input at the extrusion press was 40 tons, bringing the total first load to date to 438 tons or 68 per cent of first load requirements.

Output through autoclave of 36 tons exceeded previous month total by ten tons with first load at 118 tons or 31 per cent of requirements.

Output to Finished Storage of 16.6 tons is significant in that it is the first month of more than token production. First load to date is 18 tons, 4.7 per cent of required tonnage.

Outer support fabrication problems are continuing to delay output production. Hanford Laboratories are currently fabricating all outer supports for production use.

Engineering

Four loop charges have been prepared during the month. Two were NIE heater element charges for Loops 1 or 2 and two were NOE-1 charges for Loops 3 or 4. The latter were specifically for studying irradiation behavior of uranium containing various amounts of phosphorus impurity.

A significant number of inner extrusions were found to be unbonded during the month. Investigation indicates that this is a result of cracked copper welds.

Charging machine tests in 314 Building have indicated that outer support damage may occur during fuel charging. These tests are not yet conclusive and charging conditions are being varied in an attempt to isolate the damage mechanism. Two charges per day are being provided for this study.

Testing Methods

Engineering assistance was provided NLO at their Cincinnati plant to initially check out the UT-2 testers recently supplied from Testing Methods. The equipment arrived in good condition and no unusual difficulties were encountered. As a result of the present capabilities for testing now in place at NLO, it was again recommended to Production Fuels, IPD, that fuel core listing be accomplished at feed site.

RESEARCH & ENGINEERING

A thorough literature investigation relative to tritium production, single tube elements, isotope production, plutonium burning and plutonium recycle has been initiated. Emphasis during the month has been on tritium production, and this part of the investigation is essentially complete.

A study of exposure versus cost, plutonium isotope content versus exposure, and maximum product versus exposure is being conducted at the request of the AEC.

Design Test No. 1160, which was conducted in the 189-D Laboratory to obtain comprehensive isothermal pressure drop data in connectors and process tubes, is now complete.

Document No. HW-76930, a six-volume N Reactor Hazards Summary Report for Phase I operation, was issued.

Installation and assembly drawings of the test model of the N Rupture Monitor System have been completed. Installation in KER Loop No. 1 will be completed in early June.

Analogue computer calculations of N Reactor kinetics have been completed and recommendations regarding N Reactor trip levels is being prepared. Analogue computer studies on the primary coolant injection system have been completed, and the results will be incorporated in a report on the pressurizer and its control system.

The second group of 14 N fuel assemblies was discharged from KER Loops at a goal exposure of 1815 MWD/T. No examination has been made.

Eight 12-inch single tube K size enriched fuel elements (KSE-5) were discharged at an exposure of 1250 MWD/T. This model was designed as a scaled down model of the single tube fuel for N Reactor. It is enriched to operate at the temperature distribution expected in the full size N single tube element. Preliminary examinations showed these elements to be in good condition. Swelling of from .8% to 2.2% occurred in these elements.

Multi-product target elements have been prepared for irradiation testing in KER Loops No. 1 and 2. These elements were fabricated from hollow aluminum rods containing 1 and 2% lithium and are clad with aluminum recanned in Zr-4 jackets.

N REACTOR PROJECT

The custody of the 105-N Building Zone V Ventilation System was transferred to General Electric May 15, 1963; the PAX Telephone System - May 31, 1963; the Right Rod Room - May 2, 1963; and the Pile Gas System - May 8, 1963. Testing work is now being performed on these systems.

The first modified river water pump motor is expected from Fairbanks-Morse on June 3, 1963.

All primary pipe work has been completed at the HUICO Shop and all fabrications shipped to the field.

Hydrostatic testing has been initiated on the primary piping in Cells 3, 4, and 5, with Cell 5 being completed.

A method for flushing and chemically cleaning the secondary loop condensate piping has been devised by representatives of Dow Industrial Service and General Electric.

No major difficulties have been encountered in the system testing of the Process Tube Flow Monitor at Avien as the testing passed the halfway mark of a 720-hour test.

Process requirements for instrument calibrations have been forwarded to the field for fifty per cent of the 105-N systems.

N REACTOR PLANT

Operating ownership responsibilities were accepted by N Reactor Plant Operation for Buildings 108, 151, 153, 166, 182, 183, 184, and 1100 on May 31. The right HCR room and the Zone 5 Ventilation System in 105 were received in provisional custody status.

The area service water systems test was the only major system or facility test completed although several are under way. Test procedure preparation is on schedule and well ahead of scheduled performance.

Training programs are on an accelerated schedule to assure completion in time to operate segments of the Plant as they become ready for tests.

PERSONNEL STATISTICS

Number of employees as of April 30, 1963	497
Number of employees as of May 31, 1963	518

	Exempt	Nonexempt	Total
General	3	2	5
Finance	16	7	23
N Reactor Fuels	55	116	171
Research & Engineering	39	7	46
N Reactor Plant	52	108	160
N Reactor Project	91	22	113
TOTAL	256	262	518

Employment

	Exempt	Nonexempt	Total
Additions	2	26	28
Reductions	1	6	7
Net Additions	1	20	21

SAFETY & SECURITY

Days without a disabling injury	182
Hours worked without a lost disabling injury	458,715
Medical treatment injuries (May)	14

There were 3 security violations in the Department during May, 1963.

SUGGESTION PLAN PARTICIPATION

	May	Year-to-Date
Number of eligible employees	262	228
Number of suggestions received	41	140
Number of suggestions acted upon	16	80
Number of suggestions adopted	10	39
Net annual savings	$ 4 052	$ 12 157
Amount of awards	$ 500	$ 1 650
Per cent of awards to savings	12.3	13.6
Average amount of awards	$ 50.00	$ 42.31

PATENT SUMMARY - MAY, 1963

All persons engaged in work that might reasonably be expected to result in inventions, or discoveries, advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during May. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

STAFF

General Manager	R. L. Dickeman
Manager, Employee Relations	C. O. Steinnagel
Manager, Finance	J. Milne
Manager, N Reactor Fuels	L. M. Loeb
Manager, N Reactor Plant	W. M. Mathis
Manager, N Reactor Project	J. S. McMahon
Manager, Research & Engineering	M. C. Leverett

R L Dickeman

General Manager
N-Reactor Department

RL Dickeman:skd

N-REACTOR FUELS OPERATION

MANUFACTURING

Production - Coextrusion Shop

Production input during May continued to increase with 216 extrusions, of which 128 were outers and 88 were inners. Input for the first time in five months did not meet the Official Forecast (89 per cent), however, the total input of 40 tons exceeded previous high for one month. Input to date of 438 tons is 68 per cent of first load requirements.

Production output through autoclaves of 3,325 pieces or 36 tons exceeded previous month by ten tons, bringing total first load to date to 118 tons or 31 per cent of requirements.

Output to Finished Storage during May established a milestone. This was the first month that significant quantities of assembled fuels were transferred to Finished Storage. The 16.6 tons produced brings the first load total to 18 tons or 4.7 per cent of requirements. An additional 22 tons of assembled fuels are ready for storage except for outer shoes.

Although considerable improvement in output production has been realized, outer support problems continue to limit output. As a result of difficulties with the outer support dies, outer support welding was discontinued early in the month and Hanford Laboratories was requested to resume production of outer supports.

Production Statistics

	Scheduled Tons	Actual Tons	Per Cent
Shop Input - Current Month	45	40	89
First Load	645	438	68
Autoclave Output - Current Month	40	36	91
First Load	385	118	31
Output to Finished Storage			
Current Month	40	16.6	42
First Load	385	18.1	4.7
		40.1*	10.8*

* Includes 22 tons completed except for shoes.

Station Throughput

Operation	Inners	Outers	Total	In-Process Inventory
Extrusion	88	128	216	---
Cutup First	1392	1576	2968	13
Cutup Rework	255	372	627	---
Chemical Milling (ends)	2232	4139	6371	270
Braze (ends)	1780	4486	6266	287
Heat Treat	1075	2115	3190	96
Machining (ends)	1741	3862	5603	245
Vacu-Blast	1041	2079	3120	70
Welding (ends)	2568	3546	6114	17
End Test (ends)	2070	4164	6234	44
Clad and Bond Test	1297	2166	3463	231
Support Weld	1696	1827	3523	9912
Autoclaves	1374	1668	3042	1377
Final Inspection	1548	1548	3096	6867

Oxide Burner - 39 batches burned = 926.08 lbs.
Thirty-one extrusions were made for Engineering.
Two-hundred and 41 pieces were welded for Engineering for the charging machine tests.

Shop Yield - First Run

	Outer	Inner	Total
Current Month	76%	88%	80%
First Load to Date	45%	58%	49%

The 80 per cent yield for May is a record for a full month operation. First load yields to date are still below the 50 per cent level, however, they increased three per cent over previous month.

Plant Operation

Autoclave operating efficiency has been significantly improved by the following modifications:

1. Two autoclave preheaters have been replaced with a preheater design in which the heating elements are cast in aluminum plate to provide better heat transfer and eliminate problems with electrically insulating the heating units. To date, the new preheaters have shown improved operating characteristics with no electrical failures. All old style heaters will be replaced with the new design.

2. Modification of the strip heater support system was completed on eleven of the twelve autoclaves. There have been no heater element failures on any of the modified vessels.

A potentially serious shortage of braze rings has been overcome by authorization of expedited delivery of these components. Contact with AEC Procurement personnel resulted in the placing of a revised delivery schedule effective May 29, 1963. The expedited procurement will result in an increase in cost, but will preclude a production shutdown.

Twenty tubes were lost during May due to non-bond. Investigation has shown that the majority of these non-bonds probably resulted from two causes: a) failure of weld seams around the I.D. copper tube, and b) use of quarter inch end plates on PWR material. The use of thin end plates has been discontinued and evaluation of the weld process is under way.

Failure of a second Heraeus Type VPR 152A high vacuum pump on the billet evacuation system required the call-in of a service engineer from the manufacturer. Two of the units were returned for examination to determine the cause of failure. A new unit was obtained and placed in service.

Autoclave locking pressure has been reduced from 500 to 350 foot pounds as an aid in alleviating stuck autoclave set screws. Techniques for cleaning, lubricating and locking these nuts have been revised. Operating procedures, component quality, and material changes are currently being reviewed with the vendor. There were no stuck screws during the latter half of the month.

The following significant jobs were completed in the 306 Building by Manufacturing Maintenance:

1. Completed 400 ampere dual feed to salt bath furnaces.

2. Relocated 200 ton Logan press and associated controls.

3. Relocated 110/220 power feeders to laboratory in Room 104.

4. Completed modification to autoclave for fuel fabrication development.

N-FUEL PRODUCT ENGINEERING

Phosphorus Impurity in Uranium

The presence of phosphorus impurity in the uranium used to fabricate NPR billets was reported in February, 1963. The source of the phosphorus was the UAP (Uranyl Ammonium Phosphate) recovery processes used to reclaim enriched uranium residues. Prior to the use of this recovery process, the phosphorus contamination was less than 35 ppm. Since September, 1962, billets have been received containing up to 296 ppm phosphorus.

No fabrication or irradiation experience had been obtained with this type of material. The following tentative limits were adopted March 22, 1963:

1. Billets containing up to 50 ppm phosphorus would be routinely coextruded.

2. Billets containing up to 80 ppm phosphorus would be shipped to HAPO.

The bases for these limits were:

1. Analytical data below the spectrochemical sensitivity limit of 50 ppm were not available at that time on uranium cast prior to the introduction of the UAP process.

2. It would probably be necessary to accept phosphorus up to 80 ppm in order to maintain a supply of billets.

The evaluation of coextruded fuels fabricated from uranium containing up to about 80 ppm of phosphorus has been essentially completed. No major changes in fabrication characteristics were detected and routine extrusion of billets containing up to 80 ppm of phosphorus was authorized on May 10, 1963.

Test fuels have been prepared and the irradiation testing of uranium contaminated with phosphorus will begin in June, 1963 and will be completed in approximately six months.

The AEC has been requested to transmit a specification for phosphorus impurity in uranium used for NPR billets of 75 ppm until August 1, 1963 and of 35 ppm after August 1, 1963. The reasons for selecting two limits are as follows:

1. Use of the UAP process for recovery of enriched uranium for NPR billets has been discontinued.

2. Much of the uranium now in process at NLO is contaminated above 35 ppm.

3. The 35 ppm limit should approximate the maximum levels obtained before the introduction of material from the UAP process.

4. The limit for phosphorus should be set as low as practical to minimize the risk if unsatisfactory performance is obtained from irradiation testing.

The AEC was requested to instruct the billet supplier that when process changes are made at the feed sites, thorough tests for any changes in the physical or chemical characteristics of the uranium must be made and reported before production material is committed.

Support Hardware

An on-site capability for fabricating all items of support hardware has been demonstrated. Zircaloy-2 ingot and commerical steel sheet are used as starting materials. Inner tube supports and locking clips are being routinely produced within the N-Fuels facility. Outer supports have been produced by N-Fuels, but damage to the die has temporarily necessitated the fabrication of outer tube supports in the Hanford Laboratories facilities. Supplies of steel shoes fabricated by Hanford Laboratories are adequate, and additional dies are being obtained to resume fabrication of this item within N-Fuels.

Rolling of the Zircaloy strip has been done entirely by Hanford Laboratories. Efforts are being concentrated on obtaining a satisfactory off-site supply of strip. An order has been placed for 300 pounds of 0.040 inch strip using a product specification for ductility. Samples of this material have been received and are currently being evaluated.

Development work by Hanford Laboratories has demonstrated that the Turks Head rolling process will produce extremely ductile strip, if 0.300 inch round extruded stock is used as a starting material. Inner supports fabricated from Turks Head rolled strip have been fabricated and successfully tested through final assembly operations. Experimental orders have been placed with commercial sources for one inch and 1/4 inch extruded rod for Turks Head rolled by an off-site source. It is expected that all of these tests will result in very satisfactory strip. If so, orders for large quantities of strip fabricated by these processes will be recommended.

Extrusion Process

Extrusion - Engineering extrusions performed during the reporting month were as follows:

11.1 Inch Tooling

2 Zircaloy Billets - Z-207 and 208

To 5.875 inch bar stock for sheet bar fabrication.

7.5 Inch Tooling

3 Composites - X-88, 89 and 90

X-88	NOE for evaluation of high phosphorus content on extrusion quality.
X-89 and 90	NOE for evaluation of uranium billet material fabricated from 13 inch diameter ingot on clad thickness variation.

[redacted]

7 Zircaloy Billets - Z-216 through Z-222

To 5.875 inch bar stock for sheet bar fabrication.

1 Uranium Billet - U-117

To produce uranium billet required for fabrication of nondestructive tester thin-clad standards.

1 Copper Billet

For tooling conditioning.

6.0 Inch Tooling

7 Zircaloy Billets - Z-209 through Z-215

To 3/8 inch x 3.75 inch sheet bar for support fabrication.

Inner Tube - I.D. Bonding

A problem with clad bonding on inner tube extrusions occurred during the month. However, it appears that this problem differs from the previous bonding problem experienced with inners last December and January. One major process problem was weld cracking on the inner billet assembly which did not appear until billets were preheated to extrusion temperature. The exact cause for this welding problem is unknown and work is now in progress to evaluate weld process and material changes that have occurred during the past few weeks which could effect weld quality. There is still some doubt if weld cracking is the only cause for unbonding during the month, however, until reliable welds can be made, testing for other causes is severely limited.

Chemical Processing

Chemical Milling

A test of horizontal chemical milling has been completed for both inner and outer fuel sections. Approximately 200 inner and 100 outer sections were chemically milled using a prototype horizontal basket. Although the use of masking plugs has improved the present vertical milling process, a significant increase in production throughput could be accomplished with the horizontal process. A summary of the work performed is being prepared.

Pre-Braze Etch

A preliminary audit on this process disclosed several problem areas.

1. Inadequate volume of rinse water.

2. Excessive immersion time in high acidity rinse water,

3. High drying temperature.

These deficiencies have been corrected with a resultant improvement in cleanliness of the product. Additional study of this process is being made to detect and correct other variables which reduce process capabilities.

Pre-Autoclave Etch

The smut formation on the surfaces of the Zircaloy clad fuel elements during nitric-hydrofluoric etching has been reduced by maintaining a nitric acid concentration of 2.5 to 3.0 lbs/gal. The correlation of particular lots of Zircaloy with the susceptibility to smut formation at particular nitric acid concentrations has been verified with a larger sample size. Attempts to analyze the smut, or film, by X-ray diffraction or spectrographic techniques has been unsuccessful. Metallographic cross sections of Zircaloy component stock and extruded cladding indicates a larger amount of second phase compounds in the Zircaloy lots that produce the worst surface smutting. Evaluation of this effect is continuing.

Elimination of Pre-Autoclave Etch

The pilot plant Process Work Request (E-62) to study elimination of the final bright etch continues to be evaluated. Test elements after being autoclaved for one week in 360 C water, adjusted to pH 10 with LiOH, had black cladding and support surfaces, but the end welds had turned a brownish-white with some spalling. Exposure on the four fuel elements in 360 C water is continuing.

Autoclaving of Assemblies

A PWR to evaluate autoclaving fuel element assemblies as opposed to the individual inner and outer elements was completed. In summary, a technique involving 1) gaging and sizing the inner supports to 1.740 inch support circle diameter after welding, 2) etching and loading vertically into outer fuel elements under water, 3) autoclaving, and 4) disassembling horizontally using a protective insert between supports and inner surface of outer fuel has provided minimal to no scratches in the bore of the outer fuel.

Coextrusion Studies

Ex-Reactor Fretting

The fifth of a series of short term tests is currently in progress at TF-7 ex-reactor loop located in 1706 Building, K-East. Two prototypic 24 inch fuel element assemblies are being vibrated in a six foot section of NPR process tube under simulated reactor conditions of flow, temperature, and pressure. The vibrating conditions for this test have been determined by substituting the measured fuel element spring constants into a computer program designed to yield amplification factors for various two degrees of freedom systems. As a result, the process tube vibrating frequency is being maintained as close to 60.7 cps as possible. The resulting process tube amplitude is approximately one mil.

End Closure Development

Brazing

Brazing of production fuels with the beveled top cap design was performed during the month under PWR No. 54. Fifty-six outer fuels were processed, together with an equal number of control fuels with standard production caps. Fuels were brazed on No. 3 station alternating four test fuels and four control fuels. The test was discontinued when residual braze material was observed on the caps after facing and step cut. However, these fuels were later faced an additional ten mils which removed all residual braze alloy, but still left adequate cap thickness. Defective brazes found for both the test and control fuels are detailed as follows:

Process Step	Beveled Cap Rejects	Normal Cap Rejects
Braze Station	5	6
Braze Voids	1	2
Weld	1	5
End Closure Bond	0	2

Rejects at the braze station with the beveled cap design were higher than anticipated. However, three of the five station rejects obtained were caused by foreign contamination introduced in the recess prior to brazing which resulted in a blow-out of molten braze during melting.

Results of the above preliminary testing is encouraging to the point that an extension of the test will be initiated to braze approximately 500 outer fuels using the beveled cap design.

Gas Pressure Bonded End Closure Development

Lot No. XV - This lot consists of six each inner and outer fuel sections which were brazed by the standard production process and were end faced, but not welded. Half of these elements have been autoclaved in 360 C water, while the other half have been exposed to 400 C steam. This test has been completed after six months exposure of each group without failure or significant corrosion. A final report on this study is being prepared by BMI, who conducted the test.

Lots XVI through XXI - These six lots were recently gas pressure bonded at Battelle Memorial Institute to study the effects of higher temperatures and pressures when using Zircaloy-2 and Zircaloy-3 caps. The evaluation o this material is not yet complete, but the following table indicates the degree to which a metallurgical bond was formed between the cap and the cladding.

Lot No.	Pressure In PSI	Temperature °C	Temperature °F	Time in Hours	Closure Ring Metal	Per Cent Bonded Cladding to Closure Ring
XVI	20,000	650	1202	1	Zircaloy-2	75
XVII	20,000	750	1382	1	Zircaloy-2	95
XVIII	46,000	650	1202	1	Zircaloy-2	90
XIX	46,000	750	1382	1	Zircaloy-2	100
XX	20,000	650	1202	1	Zircaloy-3	99
XXI	46,000	650	1202	1	Zircaloy-3	100

It is tentatively concluded from the examinations made to date on this material that if the pressure-temperature relationship is adequate to give complete and intimate contact between the surface bonding,will be complete and probably occurs almost instantaneously. Additional material is being prepared for processing in an attempt to more closely define the required time-temperature-pressure parameters required for complete bonding.

Fuel Element Supports

Charging Machine Test

Support damage was experienced last month under Part "B" of "Charging Machine Design Test No. 22." Under Part "B" of this test, fuels are charged through a prototype nozzle and roll-joint

assembly into a magazine against back pressure. During this test, back-pressure was varied to simulate varied charging conditions, i.e., simultaneous charge-discharge, discharging stuck columns, etc. The nozzle assembly used was a simulated "worst case." When damage in form of flattening of the supports of 20-22 mils occurred, it was impossible to determine whether it was due to the nozzle and/or the roll-joint assembly, the magazine which received the fuels, defective mock-up equipment, or the charging parameters of speed or back pressure. The test program was revised in May to try to determine the mechanism and cause of damage. Charging speed and pressure were reduced, but supports were still damaged. At this point, there was concern about whether or not it would be possible to charge the first load of fuel assemblies. A process tube was substituted for the magazine which received the fuels and ten fuel element charges were tested under simulated charging conditions. The same "worst case" nozzle assembly was used for this testing. The test was essentially that described under "Part C," Charging Machine Design Test No. 22. Five charges were made on a test in which one column of fuels was loaded into the empty process tube and another column of fuels was used to discharge the first column during loading. Only a few units of support flattening and surface scratching of shoes occurred during these ten charges indicating that fuel element performance in the reactor would not be impaired under these conditions.

It is still possible that damage to the supports might result from increased pressures which would occasionally be required during charge-discharge operations. Four charges of fuels have been provided for charging into the "process tube, Part C, Assembly" at varied charging pressures. To date, results have been inconclusive, and it may be found that the mock-up for providing back-pressure will have to be modified.

Scratching damage to the process tubes also occurred under the conditions of simulated charging.

Testing is to continue until the mock-up for providing back-pressure is considered satisfactory and then various nozzle assemblies are to be tested, warped process tubes are to be evaluated, and methods are to be examined for minimizing process tube scratching. Tests are also to be conducted using various sized fuels and autoclaved outer supports when test conditions have been thoroughly defined.

Nineteen charges of fuels have been provided for charge machine testing this month. Measurements on one fuel element charge were repeated to provide data for measurement error analysis.

Equipment Development

Projects Completed

Support Welding Fixtures

The NOT support welder fixture was modified to accommodate all lengths of enriched outer fuel tubes.

Inner Support Fabrication

The inner support fabrication equipment is operating successfully and is producing supports within specifications. A fabrication error in one of the die sets was found and corrected.

Outer Support Shoe Tool

The 0.015 inch outer support shoe crimping tool was completed. While checking out the tool, it was discovered that the tool could be used to raise the height of low outer supports. This would eliminate the need for 0.015 inch shoes if approved for process use. Process Engineering is performing tests to determine if there are any detrimental effects on quality.

Projects in Progress

Support Fabrication and Welding Tooling

The outer support dies have been rebuilt. These dies are being tested with various strip material to determine how closely dimensions can be held. Testing should be complete the week of June 3.

The modified locking clip dies have been fabricated, but will not be installed in the press until sufficient parts have been made and back-logged for manufacturing.

The outer support shoe fabricating dies are about 80 per cent complete. The hydraulic sizing device for inner supports is about 90 per cent complete.

The design of NOT and NIT support welder parts to facilitate welding of 20 inch natural enriched fuel tubes is 80 per cent complete.

Design was started on locking clip and support welder tooling for the 306 Pilot Plant welders.

Chemical Area Exhaust System

It was decided to raise the existing 333 Building fume exhaust stack about 60 feet and repack the scrubbers with a new scrubbing media. The new scrubbing media is on order.

A continuous type stack monitoring system was installed to determine the peak emission rates of stack gases. Knowing the peak rates will facilitate accurate evaluation of proposed equipment revisions.

TESTING METHODS

N-Fuels Testing

Component Testing

Ultrasonic Tests on Billets

Recent extrusions of uranium billets that had previously been tested for grain size afforded an opportunity to compare inner clad variation with uranium grain size. No apparent correlation was found; however, because of the time lapse between testing and extrusion, the testing represented the initial efforts in grain size measurement and were known to be relatively insensitive to the I.D. structure. Subsequently, additional readouts have been provided that should be more sensitive to I.D. variations. Additional correlations will be available when material tested by such methods is extruded.

Eddy Current Tests on Zircaloy Cans

Fifteen Zircaloy cans (inner clad of the outer tube) were eddy current tested in February with fairly uniform results. To date, ten of the pieces tested have been extruded. It appears that a "no correlation" conclusion is indicated. The extrusions ranged from no rejects to all rejects due to clad variations while the eddy current charts of the pre-extruded components were uniform. An ultrasonic angle beam test will be conducted to determine if any anomalous condition may be related to extrusion performance.

Billet Integrity

Partial results have been obtained in the metallographic examination of billets previously ultrasonically tested for discontinuities at the I.D. surfaces of the billet. So far only very small discontinuities have been discovered. Though the anomalies observed ultrasonically gave a low return energy, positive correlation is in doubt. A better "standard" has been machined and will be used to give a more accurate estimation of discontinuity location.

Process Control

Braze Station Operation

Eddy current tests to check braze ring identification have indicated some variations. A spectrochemical check showed a corresponding difference in beryllium content; as much as 3.5 per cent below the specified five per cent. A production run will be conducted using braze rings that have been sorted by eddy current.

Support and Clip Welding

A four-pronged attack is being made on the locking clip welding problem involving some 2,000 suspect fuel. Tests are being sought that will detect either uranium in the weld nugget or establish the existence or non-existence of the Zircaloy-uranium interface below the weld nugget. Under current investigation are beta counting techniques, utilization of the Hall effect, X-ray diffraction techniques, and ultrasonic tests. The first three are being studied to determine if uranium exists in the weld nugget. Ultrasound methods are being investigated to show the presence of the Zircaloy-uranium interface.

Product Certification

Routine Tester Operation

Full production testing of N-fuel elements has pointed up certain difficulties with the 333 Building testers. A drift problem arose that initially appeared related to ambient temperature changes. However, subsequent checking revealed harmonics in the oscillator circuit which were corrected. Measurement of temperature changes will be made to evaluate temperature sensitivity. Transducer variations inherent in manufacture are giving erratic results. More definitive specifications and possible design changes are being studied to correct this problem. Use of improved standards has indicated a variabilities difference between testers and subsequent investigation of tester differences pointed out defective and weak tubes, and a faulty transducer. The new standards should be more sensitive to tester malfunction and will be put into operation when the transducer operation is characterized.

Alpha Surface Contamination Testers (AC-1 and 2)

Standardization procedures for the alpha contamination testers (AC-1 and 2) have been developed using printers that permit overnight checking. Automatic cycling equipment permits ten-minute counts to be repeated throughout swing and graveyard

shifts. The counts are printed out and control charts can be made up the following morning. Use of this procedure has defined the precision of the testers more precisely and results on production pieces are more meaningful.

Bore Camera

The excess bore camera from Frankfort Arsenal was received and will be set up in the laboratory for preliminary evaluation on fuel element examination.

Post-Irradiation Testing

Irradiated Fuels Tester (UT-10)

A rupture at KE extensively contaminated the N-Fuels irradiation testing station along with other major basin installations. Fortunately, it was possible to clean up the fuel examination basin and work is proceeding. Improvements to the recorder and tester monitor circuits were made during downtime. Testing of irradiated fuels is scheduled to start during June.

AlSi Fuel Testing

Component Testing

Uranium Grain Size Testers (UT-2) for NLO

Engineering assistance was provided National Lead Company of Ohio at their Cincinnati plant to initial check out the testers recently supplied from HAPO. The equipment arrived in good condition and no unusual difficulties were encountered in the initial set-up and operation. Observation of the capabilities in the operation and maintenance of the two other testers at this location led to the recommendation that Production Fuels, IPD, again consider the testing of all fuel cores at the feed site. With the addition of the new testers, capability for full production testing is good. Demonstration of sustained operation and the availability of definitive standards should be established before a final decision is contemplated.

Product Certification

Hot Die Sized Fuel Element Tester (UE-3)

Work continued on the check out of the electronic consoles including: alignment and adjusting of a 120 KC oscillator; correction of an interaction between the high and low reject circuits of the external and internal nickel thickness testers; modification of the recorder to allow

trace intensity to be individually controlled for each channel; and study of the ultrasonic pulse shape to sharpen response in the unbond test. Approximately 200 hot die sized fuel were tested in the laboratory for cladding thickness (internal and external) and for cap and base unbond. Partially unbonded end caps were indicated on two fuel; destructive confirmation tests have not yet been performed. Additional samples will be run in the laboratory before installation of the equipment in the pilot plant which is tentatively scheduled for mid-June.

Routine Tester Operation

The program for reducing biases of the nondestructive testing equipment in Production Fuels of IPD appears to be well in place and functioning. Definitive standards for the uranium grain size test are being selected to cover the range of material encountered. On the closure test, emphasis is being placed on preparation of operating standards, modification of existing standards, and operating procedures. Significant reduction in reject rates have already been realized. Total count standards have been established for four product models on the bond and penetration test.

Improvement of Production Testers

Previous preliminary tests comparing Lamb wave and longitudinal wave ultrasonic tests for internal bond indicated comparable sensitivity with slightly better reproducibility for the longitudinal wave. Use of the longitudinal wave techniques for internal unbond would also simplify the AlSi element testing since a longitudinal wave transducer is already used for the O.D. surface bond test. A program was initiated to compare longitudinal wave transducer operation with Lamb wave transducers. Characteristic curves, total count versus video gain curves, and hi-lo percent deviation curves were plotted for four longitudinal wave transducers and five Lamb wave transducers. Alternating the two types of probes, nine AlSi fuel elements containing natural discontinuities were examined, using an Aquadag standard as a base. Results to date show no clear-cut comparison between transducer types or even transducers of the same type. Testing will be continued using a small void in contrast to the large Aquadag standard (lacking discrimination) and alternately, using one of the nine test specimens as the set-up standard.

Detection of internal unbonds may be possible by introducing ultrasound from the outside of the fuel element. By passing wide band ultrasound from the outside through the uranium, low frequency components are reflected back from the internal bond layers as well as the external bond layers. If the pulses are short enough all interface reflections are seen; thus, both internal and external bonds can be detected with the same system. In testing various grain size bare cores the method was relatively insensitive to uranium grain size. Unbond standards will be developed using various grain size cores to more thoroughly evaluate this variable.

Post-Irradiation Testing

Irradiated Fuels Tester (UT-11)

Set-up of the station was completed, and it was checked out on a group of irradiated fuel elements. Reproducibility of the tester was good. Testing of PTs is scheduled to commence by June 29, 1963.

Ultrasonic Detection of Hydriding in Zircaloy Process Tubes

A phase or velocity shift in the signal from hydrided areas has been found to provide the most reliable hydride information free from other variables effects. A read out to utilize this effect is being developed. The reflector rotation system is being redesigned to provide better angular precision as the first design had angular error causing excessive signal variations.

N-REACTOR FUELS OPERATION
MAY 1963

VISITORS

Name	Company	Contact	Date	Reason
AM Weis	Nuclear Materials & Equip. Corp. Apollo, Pennsylvania	HP Kraemer	5/27	Closure rings.
RW Clark	GE, Schenectady	TB Correy	5/14-5/15	Support attachment.

TRIPS

HP Kraemer TD Naylor	National Lead Co. Cincinnati, Ohio	C Bussert	5/16 & 5/17	Uranium billets.
HP Kraemer LM Loeb TD Naylor	Nuclear Materials & Equip. Corp. Apollo, Pa.	AM Weis	5/20	Closure rings.
HP Kraemer LM Loeb TD Naylor	Nuclear Metals, Inc. Concord, Mass.	P Loewenstein	5/21	Closure rings.
HP Kraemer LM Loeb	Brush Beryllium Cleveland, Ohio	H Piper	5/22 & 5/23	Closure rings.
LM Loeb	National Lead Co. Cincinnati, Ohio	S Marshall	5/22	FEDC meeting.
GL Waldkoetter	National Lead Co. Cincinnati, Ohio	W Adams	4/30 - 5/3	Assist NLO personnel in check-out of UT-2 equipment.
TD Naylor SM Gill	Bridgeport Brass Ashtabula, Ohio	JF Puterbaugh	5/13-5/14	Monitor primary extrusions.
SM Gill	National Lead Co. Cincinnati, Ohio	CE Bussert	5/15-5/17	Uranium billets.
TR Groupman	American Welding Society, Seattle, Washington		5/9	Speak at May
TR Groupman	Linde Company Seattle, Wash.	J Dickinson	5/10	Witness plasma-arc demonstration.

ORGANIZATION AND PERSONNEL

	4/30/63	5/31/63
Exempt	55	57
Non-Exempt	113	113
	168	170
Tech Grads Assigned to N-Reactor Fuels	2	3

Transfers

Name	From	To	Effective Date
DE Blahnik (Exempt)	IPD	N-Fuel Product Engineering	5/1/63
ST Field (Exempt)	Tech Grad Program	N-Fuel Product Engineering	5/1/63
RR Studer (Exempt)	New Hire	N-Fuel Product Engineering	5/1/63
JR Goggin (Non-Exempt)	Manufacturing	N-Fuel Product Engineering	5/20/63
GW Riedeman (Exempt)	N-Fuel Product Engineering	IPD	5/1/63
CF Allen (Non-Exempt)	New Hire	Manufacturing	5/6/63
ML Stratton (Non-Exempt)	Manufacturing	N-Reactor Project	5/24/63

INVENTIONS

All Engineering personnel engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during May, 1963. Such persons further advise that for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

SIGNIFICANT REPORTS

HW Number	Classification	Author	Date	Title
Undoc.	Confidential	JW Nickolaus	5/7/63	Target Schedule for December 1, 1963 Completion. Revision I-May 3, 1963
Undoc.	Confidential	JW Nickolaus	5/29/63	Shop Capacity
HW-77577	Unclassified	DH Walker	5/8/63	Measurement Error - Coextrusion Shop, Non-Destructive Testers - First Quarter, 1963.
Undoc.	Confidential	DH Walker	5/1/63	Measurement Error - Coextrusion Shop Central Inspection - First Quarter, 1963.

SECURITY VIOLATIONS

There were three security violations in the N-Reactor Fuels Operation during May. Total CYTD - 7.*

* A vigorous program is under way to reduce to zero the incidents of security violations.

Manager, N-Reactor Fuels

LM Loeb:mf

RESEARCH AND ENGINEERING

ADVANCED TECHNOLOGY

A thorough investigation of literature relative to tritium production, single tube elements, isotope production, and plutonium burning and plutonium recycle has been started. Emphasis during this month has been upon tritium production and it is about complete. This investigation will serve as a background for the advanced fuel technology program. All literature is carefully abstracted and all abstracts are placed on ASM Literature Classification Cards which are coded and can be used in future literature searches.

Work began on the study of the AEC Projected Needs and Technology advancements for N-Reactor over the next ten years. This study will include a definition of the needs, Department objectives and capabilities and action plans. The plan will consider opportunities, incentives in the market for isotopes, steam for electrical power, new types of fuels, the Department's capabilities for fuel cycle manufacture and effect of private ownership of fuel and government buyback policies on reactor economics.

An AEC-N Reactor Department meeting was held for the purpose of reviewing the 02 R&D Program. All material presented is available for AEC utilization.

Computer techniques have been originated for technical-economic studies of N-Reactor. The (PANACEA) program was first used in a neptunium production study. Preliminary computer runs, which were performed to determine the optimum percent U-235 in blend stock versus successive fuel recycles, have been made as a basis for future computer runs that will more firmly establish an accurate optimum blend stock. These computer programs will allow us a broader range of analysis of the economic and engineering studies and a much greater ability for optimization with considerably reduced cost.

A study of exposure versus cost, Pu-240 isotope content versus exposure, and maximum production versus exposure is being conducted at the request of the AEC.

REACTOR ENGINEERING

Design Test 1160 is now complete. These tests, which were made with the NPR Prototype Concept Evaluation Facility in the 189-D Equipment Laboratory, were conducted to obtain comprehensive isothermal pressure drop data in connectors and process tubes. The data have been made available to the Thermal Hydraulics Laboratory for their use in relation to programmed experiments with the half column electrically heated test section. Copies of data sheets also have been submitted to Design Analysis for their information. Processing of the data by Reactor Engineering has begun.

The Thermal Hydraulics electrically heated test section is nearly complete. It is expected that testing will begin in mid-June.

REACTOR PHYSICS

Enriched Fuel (1.25% U^{235})

The use of 1.25 enrichment as either a spike material or as a target support in the NPR has been studied. A document is being issued which concludes that the enriched material can be used either way if extruded as the outer fuel tube with the inner fuel containing either .947 enrichment of 1 per cent lithium in aluminum. Its use as a reactivity booster will create conditions bordering on nucleate boiling on the outer jacket.

Code Development

Flex 2 has been completely converted from Fortran to FAP, but only a few of the possible paths through the program have been debugged. The conversion has resulted in a savings of about 7000 core locations and a reduction in execution time of about 20 per cent. Debugging of options other than the fixed geometry, fixed enrichment ore, have been postponed while changes in isotope buildup-burnout formulations are being made. Previously Np-239 hold up was ignored and a correction applied to Pu-239 afterward. However, for short irradiations an error resulted in Pu-240 and Pu-241 concentrations. The best method of overcoming this defect is being sought. Other changes to the program have been the inclusion of Sm-151 and recognition that the fission yields of xenon are different for U-235 and Pu.

The current operating deck of Flex 2 has developed two sources of trouble. Neutron temperature calculations failed to work for D_2O moderation, and cases seeking the required enrichment occasionally blew up. These two troubles have been tracked down and are in the process of being fixed.

Pu Burning and Recycle

The study of the use of plutonium as a fuel in the NPR required some appropriate fuel dimensions to start the study by the Applied Physics Operation in Hanford Laboratories. Two sets of dimensions have been found corresponding to a target element (in this case LiAl) being either inside or outside the plutonium fuel element. The dimensions given below are suitable for plutonium concentrations in aluminum of about 4 per cent by weight for the plutonium driver element and natural lithium concentrations of 1 per cent by weight in LiAl in the target elements.

OUTSIDE DRIVER

Material	Outside Diameter (inches)
Zr	2.406
Pu-Al	2.354
Zr	1.819
H_2O	1.764
Zr	1.380
Li-Al	1.294
Void	.409

INTERIOR DRIVER

Material	Outside Diameter (inches)
Zr	2.640
Li-Al	2.590
Zr	2.316
H_2O	2.251
Zr	1.819
Pu-Al	1.736
Zr	.890
H_2O	.835

The fuel element dimensions have been given to the Applied Physics Operation so that they can begin work on the project. They will attempt to generate information yielding estimates of long-term reactivity changes, temperature coefficients and isotopic compositions of the fuel as a function of exposure.

N-Reactor Operator Certification Lectures

Considerable effort was devoted to preparing and presenting lectures to the N-Reactor operators as part of the certification training program. The lectures covered the subjects of nuclear safety external to the reactor and in-reactor heat generation sources.

Bases for Control and Nuclear Instrumentation

Preparation of required input for various transient conditions has received limited attention. The input desired are tables of control rod and ball system strengths versus time after scram, and reactivity input functions versus time for various events causing positive increases in reactivity. Definition of input functions for incidents such as cold water injection and stack flooding which spread throughout the system are proving to be the most difficult to handle. The code CLUMSY I may be quite useful for this problem. Actual investigations with the code must be made before it is known how accurately these inputs must be defined.

Shield Plug

There is a shield plug in the top of the N-Reactor shield which was designed for use in obtaining experimental data on attenuation of neutrons and gammas through the shield. Access is also provided into the graphite reflector.

At our request, the Engineering Development Operation, Hanford Laboratories, has prepared a proposal for the use of the plug facility during the startup program in order to evaluate the N-Reactor shield performance.

CONTROLS, INSTRUMENTS AND SYSTEMS ANALYSIS

Fuel Rupture Monitor System

Installation and assembly drawings have been completed. Construction of the monitor mock-up is also complete. Mechanical installation will proceed June 3 and final instrumentation should be completed by June 7. Testing will commence June 10 and will probably run through October, 1963.

Non-destructive Testing of Fuel Rupture Monitor Sample Chambers

Twenty-five sample chambers were radiographed to determine if crud pockets or serious tube closures exist where the tubing is welded into the chambers.

Sample tube closure was present only to a minor degree in twelve of the chambers. None of the chambers showed crud pockets on the inside adjacent to the inlet tube penetration. However, all of the chambers showed defects at one or more of the four welding sites. The most frequent defect noted was gas porosity in the circumferential welds around the end caps.

The gas porosity in the end cap weld could weaken them to the point of failure at high pressures. It is noted, however, that all chambers were tested at twice operating pressure at room temperature at the vendor's factory prior to shipment. Representative samples from the shipment were pressure tested to destruction at the factory. These burst at approximately five times operating pressure.

Simulation Studies

a. Analog computer calculations on N-Reactor kinetics are finished. A report on recommended reactor trip levels, based on the kinetics studies, is now being prepared. Target date for completion of the report is July, 1963.

b. N-Reactor pressurizer programs both for digital and analog computers are being "debugged." Pressurizer studies should commence about the middle of June.

c. Primary coolant injection system investigations supplementary to a previous injection system study have been completed. The results will be a part of the report on the pressurizer and its control system.

CHEMISTRY AND METALLURGY

Evaluation of "First Load" N Fuel Elements

The second group of 14 assemblies of N fuel elements to reach goal exposure was discharged on May 13, 1963. The exposure was 1815 MWD/T. No post-irradiation examinations and measurements have been made.

A third group of 13 assemblies reached 330 MWD/T on May 12, 1963. No further exposure has been accumulated as the KE Reactor was shut down for retubing operations on that date.

Single Tube Fuel Development

Eight 12-inch KSE5 test elements were charged March 26, under PT-IP-544-A and discharged May 12, 1963, at an exposure level of 1250 MWD/T after an uneventful irradiation. This element was designed as a scaled-down model of the single tube fuel element for N-Reactor. It is sized for use in the small loops and is enriched so that it operates with approximately the same uranium temperature distribution as is expected in the N-Reactor single tube element (575 C maximum temperature). The purpose of the test was to evaluate the behavior of tubular uranium fuel with brazed closures operating at these temperatures and power. The swelling rate of uranium and the cladding response to swelling were of particular interest.

The elements looked good on basin examination. That is, the outer cladding showed no striations, the inner cladding was smooth and there was no deformation of the cladding visible at the fuel-to-cap juncture. The elements were weighed under water and the amount of swelling found to be 0.8 to 2.2 per cent, varying smoothly along the column.

Multiproduct Target Element Testing

Prototype target elements will be irradiated next in KER-1 and 2. Hollow rods of aluminum - 1 and 2 per cent lithium have been clad with aluminum and recanned in Zr-4 jackets. They will be irradiated to gas-volume-ratios (GVR) of 10 and 20 (in KER-1 and 2 respectively) at expected N reactor water temperatures to determine whether swelling, tritium migration or lithium thermal diffusion occur. Discharge dates are approximately September 1 and December 1.

Zircaloy Pressure Tubes

The zirconium process tubes in KER Loops 1 and 2 were removed and replaced. The tubes were cut in predetermined lengths to facilitiate maximum utilization of the center portions of the tube. The service age of these tubes is three and four years for Loops 1 and 2 respectively.

SIGNIFICANT REPORTS ISSUED

HW-77597, "Technical Discussion of N-Reactor Department 02 R&D Program," Compiled by E. D. Sayre, dated May 20, 1963 (SECRET).

HW-76930, "N-Reactor Hazards Summary Report (Phase I - Production Only)," dated April 15, 1963 (SECRET), was issued and released to the RLOO-AEC on May 29, 1963. The volumes and their editors are as follows:

Volume 1, "Summary and Safety Analysis," N. R. Miller and R. E. Trumble.
Volume 2, "Reactor and Reactor Auxiliary Systems," N. R. Miller and R. E. Trumble.
Volume 3, "Heat Dissipation Plant and Auxiliary Systems," N. R. Miller and R. E. Trumble.
Volume 4, "Operations," J. R. Bolliger and R. E. Trumble.
Volume 5, "Appendixes," R. E. Trumble, R. E. Hall and J. W. Vanderbeek.

A paper entitled "Effective Resonance Integral for Pu-240 in Pu-Al Alloy Rods," written by P. F. Nichols on work done in Hanford Laboratories, was revised and resubmitted to NUCLEAR SCIENCE AND ENGINEERING during the month. We have received notification that the paper has been accepted for publication.

TRIPS

Name	Firm & Location	Date	Purpose
R. E. Trumble	General Electric Co. Charlevoix, Michigan	May 15	Attend 11th meeting of GE-THC
M. C. Leverett	"	May 15 - 17	" " "
B. S. Kosut	AEC Corrosion Symposium Vallecitos Atomic Lab. Pleasanton, Calif.	May 20 - 22	Attend meeting
A. E. Guay	Los Alamos Scientific Lab. Los Alamos, New Mexico	May 21 - 23	Attend Metallography Meeting
M. C. Leverett	Nuclear Metals, Inc. Boston, Mass.	May 27	Visit Plant
M. C. Leverett	MIT, Boston, Mass.	May 28, 29	Visiting Committee Meeting

VISITORS

	Firm & Location	Date	Purpose
A. J. Mooradian J. Howieson	AECL, Chalk River	May 22, 1963	Discuss support design & mat'ls on charging damage on process tubes.

PERSONNEL

Additions - None

Removals

	From	To	Date
D. H. Cook	Process Eval. & Control	N-Reactor Plant	5-20-63
M. D. Gnoza	Process Eval. & Control	Leave of Absence	5-31-63

SECURITY VIOLATIONS

None

INVENTIONS

All Research and Engineering personnel engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during May, 1963. Such persons further advise that for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

M. C. Leverett

Manager
Research and Engineering

MC Leverett:LCC:mk

N-REACTOR PROJECT

PROCESS DESIGN OPERATION

Process Research and Development

Listings have been made of the process requirements for calibration of instruments and control systems of the N-Reactor. Typical of the information presented for each instrument are input and output signals, controller settings, high and low trip points (and reset, if any), and allowable instrument variations. This work for 105-N is 50 per cent complete. Emphasis has been directed to defining the calibration requirements of those systems that must be operable prior to the early scheduled fuel loading date.

The analog simulation of the NPR pressurizer high-pressure injection system has been analyzed. A few minor design changes in the heat dissipation plant control system have been recommended to Burns and Roe to insure safe, reliable, and stable operation during all operating conditions.

An analysis of N-Reactor reactivity transients has been made and shows that the reactivity effect of the graphite temperature is somewhat less than previously evaluated. This reduces the control requirements predicated upon the cold-water injection type of accident in a hot reactor. It underlines the conservatism of the original design approach.

Conversion

An engineering study of the secondary cooling system during Phase II operation has been completed and a report prepared. Among the items considered were the transient effects of turbine tripoff events, the transfer of steam flow to standby dump condensers, the control of condensate return to the condensate pump suction header, and the control of steam flow to the generating plant. There appeared to be sufficient flexibility in the system to achieve the necessary control precision. However, it was concluded that the surge tank system volume should be increased to provide surge volume for generating plant turbine tripoff events.

Project CAI-816

Flushing and Chemical Cleaning

A method for flushing and chemical cleaning of the secondary loop condensate system has been devised by representatives of Dow Industrial Service and General Electric. The flushing and chemical cleaning would be accomplished in three closely related steps: (1) a high volume, cold water, single-pass flush; (2) a hot water recirculating flush; (3) a chemically treated, hot water recirculating flush (Dow solution at 170F to 220F), followed by draining and passivating, after which the system can either be left full or drained and dried as desired.

Process Tube Flow Monitor Controllers

The 720-hour system test for the process tube flow monitor has passed the halfway point and no major problems have been encountered. A Hanford design engineer has been in residence at Avien during the testing to evaluate test results as they become available, to assist in the correction of problems as they arise, and to help expedite completion of the testing.

Reactor Nuclear Instrumentation

Dynamic tests were conducted on the operational spare Log CRM Start-up Range chassis and associated recorder in the 305 test reactor, to check the log CRM performance over true reactor periods and to substantiate vendor test data. The data are being evaluated.

Primary Loop Pressure Relief Valves (RV-2)

Fabrication of the pilot-operated, primary loop pressure relief valves has been completed by DeVar Kinetics, and hot and cold water tests have commenced at the test loop facility of Combustion Engineering in Windsor, Connecticut. At the specified test conditions of 1495 psig and 500F, the hot water seat leakage of the pilot valve exceeded specifications. The leakage rate diminished as the line fluid temperature was reduced, until at 365F and below, the leakage was acceptable. The vendor was informed that General Electric would accept pilot valves which were leak-tight at 300F in lieu of the originally specified 500F, and the erection drawings have been released with the insulation deleted from the static pressure sensing lines which connect the RV-2 pilot valves to the primary loop so that the actual operating temperature will remain below 300F.

Process Tube Nozzle Caps

One hundred fourteen complete nozzle cap assemblies have been received to date from the vendor, Bruce Industries. The nuts of fourteen were installed on rear-face nozzles at N-Reactor and the thread fit was confirmed to be very good. Six of these assemblies have been scheduled for installation in the 189-D Environmental Test Facility. Because of the critical schedule relationship of primary loop hydrotesting to completed nozzle cap fabrication, close liaison has been maintained with the vendor, and a continuing review has been made of requested deviations. Specifically, a machining deviation has been approved to eliminate crack indications introduced during broaching of the female hex in the nut. The deviation consisted of a peripheral recess machined at the base of the hex. The finish requirements of certain portions of the nut and the plug have been relaxed on the basis of experience gained during nozzle cap development.

A material deviation was accepted on plug material received by Bruce Industries from Republic Steel with no record of heat treatment. The acceptance followed a study by Hanford metallurgists of 250X photomicrographs of representative bar stock samples. The review indicated that the

material structure did not appear to have complete transformation and the grain size was not as reported, but the material was concluded to be marginally usable.

A fabrication deviation has been accepted permitting exploration to a depth of 1/8 inch (instead of 1/16 inch maximum) as a means of cleaning up magnetic particle indications which were found in the thick portion of the nozzle cap nut on 54 of the first 150 nuts checked. A similar problem has arisen with the magnetic particle testing of the plugs and is being studied to insure scheduled delivery.

Charging Machine

The charging machine was successfully tested with an end thrust of approximately 20,000 pounds, which is the maximum that can be encountered in actual charging. To simulate the axial loading of a column of fuel in a process tube, the fuel was discharged into a magazine filled with water with pressure regulated behind a piston in the magazine. A short section of process tube connected the magazine to the nozzle assembly and provided a rolled joint protypical of the worst condition that might be encountered in the reactor (0.036 inch step-up). In charging a column of fuel elements into this arrangement, the fuel element self-supports were damaged. The test facility was then modified by removing the magazine and installing a full-length process tube in its place. A column of fuel was charged into this arrangement and subsequently discharged using a second column of fuel. No appreciable self-support damage was found. The test was repeated four times with similar results.

Equipment Development and Testing

A back-up seal concept for the horizontal rod drives was tested at the 189-D Laboratory using chevron-type seal rings made from a thermoplastic material and impregnated with molybdenum disulphide. Oil leakage beyond the specified maximum was noted on all but two of the forty operations. On the basis of these results, further modifications have been planned for subsequent testing.

Solenoid control valves for the horizontal rod drives were evaluated to determine the cause of burn-outs experienced during testing. It has been demonstrated that the failures can be eliminated by replacing the original diodes with higher rated units to suppress the adverse effects of the relatively high switching transient voltage produced by the control circuit.

The full-length process tube test facility at 189-D was used to evaluate pressure drops for various fuel column loadings and to provide associated measurement data. In the Environmental Test Facility at 189-D, production-run header-to-header components were operated at design temperatures almost continuously. The loop has since been shut down to install three production-run diversion valves and to permit inspection of components previously tested.

An isotope producing horizontal rod assembly has been installed in the drive test setup for scram testing. It has been successfully scrammed over 100 times in a graphite channel distorted to simulate ten years of reactor life. The tip section contained 45 solid aluminum dummy slugs to represent target slugs.

FIELD ENGINEERING OPERATION

Construction

105-N and 109-N Buildings

The custody of the 105-N Building Zone V Ventilation System was transferred to General Electric on May 15, 1963, with minor punch list items remaining. Contractor testing of the Zone II and III exhaust fans has been initiated.

As of May 26, 1963, the installation of electrical cable for the 105-N and 109-N Buildings was about 72 per cent complete. About 49 per cent of the conductor terminations of the two buildings have been made.

The XX Console Section arrived from Bailey Meter and has been installed in the 105-N control room.

The contractor testing of the PAX telephone and paging system for the area has been completed and the transfer of custody to General Electric accomplished May 31, 1963. There are minor punch list items remaining to be completed.

The continuity checking and purging and flow testing work is in progress on the flow monitor system tubing. The cables for the Flow Monitor System have been pulled from the transducers to room 6 and the terminations are approximately 90 per cent complete. Cable for this system to the data logger is also in place and termination work is in progress.

The installation of tubing for the rupture monitor system is continuing in both the right and left side rupture monitoring rooms. The right side installation is nearly completed. Installation of the coaxial cable to the turrets is completed.

The purging and continuity checking of the tubing for graphite flow monitor and rod cooling flow monitor systems have been completed. Pressure testing of both these systems has been started.

117-N Building

The painting in this building is nearly completed. Tubing and wire installation nearing completion.

1310-N Facility

Concrete placement for the pump house walls has been completed. Field fabrication of the waste storage tank has been started by Chicago Bridge and Iron. The installation of the 10" and 24" fill lines from the pump house to the storage tank is in progress.

181-N Building

The electrical work in conjunction with the pressure transmitter panel is being performed. All tubing work has been completed for this panel.

The rebuilding of the first electric motor for the primary river pumps has been completed and the motor was received from Fairbanks-Morse on June 3, 1963.

163-N and 183-N Buildings

The testing work being done by the subcontractor in 163-N on the demineralizer equipment has continued throughout the last month. This system is still not functioning properly.

Testing of the filters in the 183-N Building shows that the walls in each filter section must be increased at least 6' in height to prevent damaging the filter beds at designed flow rates.

182-N Building

The contractor testing of all the electric motor driven pumps has been completed. The test run-in of the diesel engine driven pumps has been delayed pending delivery of governors for the engines. These have been received and are now being installed.

184-N Building

The boiler has been in operation throughout the past month and work has continued on completion of punch list items. The Bergen representative visited the job site during the week of May 20th to review the pipe line vibration problems of the feed water piping and the compressed air piping and is to recommend corrective action.

1900-N Building

The installation of piping for the fire line loop for the area has been completed; however, two breaks in this line have held up the completion of testing. Also, a portion of the line has been removed to permit the installation of other piping systems.

Primary Piping

Primary pipe work in the HUICO Shop has been completed. All shop fabrications have been shipped to the field.

In the field, erection of primary pipe is approximately 92 per cent complete. Hydrostatic testing has been completed for that portion of primary pipe within heat exchanger Cell No. 5. Hydrostatic

testing of primary pipe within heat exchanger Cells No.'s 3 and 4 is currently under way.

Pile Erection

The installation of all the front and rear face connectors has been completed.

Seven hundred diversion valves have been installed for the rear face connector assemblies as of the end of the month.

Custody of the right rod room was transferred to General Electric May 2, 1963. Hydrostatic testing of the horizontal rod hydraulic drive systems is now in progress. Two rod tip assemblies have been installed to permit run-in tests on the completed rod assemblies.

Continuity checking of the wiring for the Ball-X System has been initiated.

Custody of the Pile Gas System was transferred to General Electric May 8, 1963. Instrument calibration and equipment run-in has been initiated and the air test has been completed on the process unit and the supply and return Gas Piping System.

The erection of the inlet barrier wall has been initiated and this work is proceeding without difficulty although it has interferred with work progress on the 'C' and 'W' elevators.

NPR Testing Program

Additional improvement in over-all progress on test procedure preparation was made during the month. Test performance remains behind schedule pending completion of construction items, principally the boiler and demineralization plants. Tests on the Water Treatment Facility and the Service Water Supply System are completed.

Preparation		Performance	
Scheduled	Actual	Scheduled	Actual
41.0%	38.5%	15.5%	2.0%

Administration

The following material has been processed during the period of April 15 through May 19, 1963.

Drawings	339
Criteria	1
Specifications	1
Requisitions	53
ATP's	1
Other	10
Total	405

Bailey Meter material processed as of May 19, 1963 is as follows.

Released as Noted for Fabrication Drawings	58
Released for Information	115
Released for Fabrication Drawings	254
Not Released for Fabrication Drawings (B&R)	1
Approved without Exceptions (GE)	6
Total	434

Following is the status of Subcontract KE-11252 (HUICO) data as of May 19, 1963.

Total Number Received	2809	(Includes 2009 received for information only).
Number Approved	750	
Number Approved with Exceptions	27	
Number Not Approved	23	
Number Currently Being Reviewed	0	
By GE & B&R Jointly	0	
By B&R (109-N)	0	
Number Received for Information Only - No Approval Required	2009	

CONVERSION

Design Criteria for conversion to Phase II, approved by the Design Council, have been transmitted to the Commission for approval. The Criteria provide design requirements for the sixth primary loop, the secondary steam and condensate system process and control, Phase II confinement, injection and auxiliary water systems, Phase II operating parameters and construction and tie-ins to the Phase I reactor plant.

General Electric representatives of Field Engineering and Vendor Inspection, CE&UO, spent two days at the Ladish plant at Cudahy, Wisconsin, reviewing records to establish the present status of excess primary piping material. Representatives of the Commission, Burns and Roe, and HUICO also participated. It has been proposed that this material in various stages of manufacture and testing which was not used for Project CAI-816 be made available to the Supply System to make primary pipe for the sixth loop.

PROGRAM EVALUATION

Design Status

Title I - 100 per cent complete.

Title II - 100 per cent complete.

Costs

No change has been made in the Official Budget Estimate during this reporting period. The current estimate for Project CAI-816 remains at $188,320,000. The Kaiser Engineers April 28, 1963 Cost Estimate displays an estimate $4,445,000 higher than the Official Estimate. This is an indicated decrease of $184,700 since the March 31, 1963 report.

Schedules

On February 1, 1963, RLOO-AEC issued Revision # 5 to the Certified Construction Schedule. This schedule shows a construction completion of March 15, 1964.

The construction status as of June 1, 1963, based on Revision # 5 to the AEC construction schedule, dated February 1, 1963, is as follows:

	Scheduled	Actual
Temporary Construction	89	91
General Area Systems	91	92
105-N Reactor Building	90	91
109-N Heat Exchanger Building	81	83
163N-183N Water Treat. Facilities	100	99.1
181-N River Water Pump House	100	99.8
182-N High Lift Pump House	100	99.7
184-N Standby Power House	100	99.9
153-N Switchgear Building	100	100
NPR Project (CAI-816)	88	89.6

RESPONSIBILITY

There was no change of responsibility since last month's report.

ORGANIZATION AND PERSONNEL

	4-30-63	5-31-63
Exempt		
Permanent	93	93
Tech. Grad.	1	1
Non-Exempt	24	23
Total Personnel	118	117

Personnel Changes

Name	From	To	Effective Date
RF Small (nonexempt)	Drawing, Specification & Material Control	Terminated	5-10-63
GA Sheard, Jr. (nonexempt)	Drawing, Specification & Material Control	Terminated	5-31-63
M Stratton (nonexempt)	N-Reactor Fuels	N-Reactor Project (General)	5-27-63

SAFETY AND SECURITY

There were no disabling injuries or security violations reported during May.

INVENTIONS OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during the period covered by this report. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

TRIPS

Name	Firm and Location	Date	Purpose
McCullough, JD	Avien, Inc. Woodside, New York	4-15 to 4-26-63	To assist in resolving engineering production and testing problems delaying completion of the Flow Monitor System.
McCullough, JD	Chatham Electronics Div.of Tung-Sol Electric Livingston, New Jersey	4-24-63	To discuss thyratron indicator problems.
Fastabend, JH	Bruce Industries, Inc. Gardena, California	5-2 to 5-4-63	Resolve nozzle cap nut production problems.
Davis, HS	Running Wolf Iron Deposits Stanford, Montana	5-6 & 5-7-63	To consult with ORNL engineers.
Richards, WA	Physical Sciences Arcadia, California	5-8-63	Discuss engineering problems in production of headers for RTD's being manufactured by RdF.
Richards, WA	Triad Transformer Co. Venice, California	5-9-63	Check reason for delay in production of final units.
Richards, WA	ISI Los Angeles, California	5-9-63	Discuss training and check details of tape punch.
McCullough, JD	Avien, Inc. Woodside, New York	5-14 to 5-29-63	To assist in resolving engineering production and testing problems delaying completion of the Flow Monitor System.
Shadinger, CD	Ladish Plant Cudahy, Wisconsin	5-20 to 5-23-63	Evaluate status of primary pipe.
Love, WJ	General Electric Co., Schenectady and N.Y., N.Y.	5-26 to 5-30-63	Reviewed the control seal progress and discussed reliability position.

VISITORS

Marquis, DH	Engineering Services, General Electric Co., Schenectady, N.Y.	5-13 to 5-17-63	Consult on design review practices
Harris, JT	Avien, Inc. Woodside, N. Y.	4-30 to 5-1-63	Discussions and visit to N site related to installation of Flow Monitor System.

VISITORS (cont'd.)

Name	Firm & Location	Date	Purpose
Ingolfsrud, LJ	AECL, Toronto, Ontario Canada	5-13/14	Discuss couplings and development and testing aspects of primary loop components
Knoedler, EL	Sheppard T. Powell Baltimore, Md.	5-13/15	Water quality instrumentation and operation of 163-N demineralization plant.
Moore, SS	S.S. Moore & Associates	5-16-63	Discuss instrument air package for 189-D testing.

SIGNIFICANT REPORTS ISSUED

HW Number	Classification	Author	Date	Title
HW-77029	Unclassified	Robinson, RK	5-17-63	N-Reactor, Pressurizer-High Injection Pump Simulation Study, Part III, System Response during Scram
HW-77512	Confidential	Mollerus, FJ,Jr.	5-3-63	An Analysis of K Reactor Zirconium Tubes under Graphite Stack Distortion
HW-77625	Secret	Bailey, GF	5-14-63	Effect of Fuel Weight on Phase II Operating Parameters
HW-77673	Secret	Condotta, DL	5-20-63	Reactor Design Analysis Monthly Report - April, 1963
HW-SA-3018	Unclassified	Demmitt, TF Bainard, WD	5-20-63	Automated Water Quality Monitoring System for the New Production Reactor
HW-77558	Unclassified	Kratz, EM	5-7-63	N-Reactor Conversion - Project Representative Meeting No. 5 - May 3, 1963.
HW-77737	Unclassified	Kratz, EM	5-27-63	N-Reactor Conversion - Project Representative Meeting No. 6 - May 17, 1963
HW-77738	Unclassified	Kratz, EM	5-27-63	N-Reactor Conversion - Project Representative Meeting No. 7 - May 20, 1963

for Manager, N-Reactor Project

JS McMahon:mbs

N REACTOR PLANT OPERATION

TRANSFER OF FACILITIES

Final acceptance of responsibility for custodianship and maintenance was accomplished as of May 31 for Buildings 108, 151, 153, 166, 182, 183, 184 and 1100.

Provisional custody of the ventilation system for Zone 5, 105 Building and the right HCR room were placed in this status.

TRAINING

Orientation

Group VII started orientation class on May 13. Group VIII is scheduled for June 10 and Group IX for July 1, which should complete the extended seven week, orientation classes.

Planning & Scheduling

No class in May. For economy of instructor time, these will be resumed when larger classes are available.

Maintenance

Eighteen instrument technicians and supervision attended eight, four-hour classes on the Central Data Logger System and miscellaneous associated equipment presented by two Engineers from Information Systems Incorporated, the vendor.

Six electricians started training on N electrical systems and maintenance on May 6 for 17 weeks. Classes are 20 hours/week with the other 20 hours on study and field checkout on material presented in class. Instructors are engineers from design and specialists in their fields.

Certification

The minimum two-hour/day theory classes for 12 operators and 13 exempt personnel continued throughout May. These classes are scheduled to be completed early in June, when field instruction and testing will be started.

TESTING

The area service water system test was completed. Testing of the 105 gas system was begun. Planning for doing the testing including writing of detail procedures continued on schedule.

PROCEDURE PREPARATION

On schedule. ADP equipment for preparation of the processing and maintenance procedures and data in the form for the planning and scheduling system operation was ordered for delivery in June.

SIGNIFICANT REPORTS ISSUED

None

TRIPS

Name	Firm & Location	Date	Purpose
E. W. Wilson	Burns & Roe Hempstead, New York	5/31 - 6/6	Conversion

VISITORS

None

PERSONNEL

Additions	From	To	Date
R. M. Smithers (E)	IPD	Maintenance	5/13/63
E. L. Alexander	IPD	Maintenance	5/13/63
K. F. Dean	CE&UO	Maintenance	5/13/63
C. W. Drake	IPD	Maintenance	5/13/63
J. J. Gibson	HL	Maintenance	5/13/63
W. J. Gurtisen	IPD	Maintenance	5/13/63
D. L. Helgerson	IPD	Maintenance	5/13/63
F. J. Kelley	IPD	Maintenance	5/13/63
G. Liddell	IPD	Maintenance	5/13/63
H. A. Raymond	IPD	Maintenance	5/13/63
R. H. VerSteeg	IPD	Maintenance	5/13/63
L. D. Campfield	CPD	N Shift Operation	5/13/63
A. F. Elberg	CPD	N Shift Operation	5/13/63
L. E. Tompkins	CPD	N Shift Operation	5/13/63
W. J. Nelson	HL	N Shift Operation	5/13/63
L. L. Champoux	IPD	N Shift Operation	5/13/63
D. G. Edgar	IPD	N Shift Operation	5/13/63
G. G. Gilmour	IPD	N Shift Operation	5/13/63
O. L. Hill, Jr.	IPD	N Shift Operation	5/13/63
F. Trent	IPD	N Shift Operation	5/13/63
G. F. Neth	IPD	N Shift Operation	5/13/63
R. E. Weaver	IPD	N Shift Operation	5/13/63
Dorothy Cook	NRD, R&E	Operations	5/20/63

Transfers	From	TO	Date
F. J. Billings	N Shift Operation	IPD	5/13/63

W M Mathis
Manager - N Reactor Plant

WM Mathis:GVRS:ds

FINANCIAL OPERATION
MAY, 1963

The following were the principal activities of the NRD Financial Operation during May, 1963 other than those activities of routine and continuing nature.

N-Reactor Business Information Project

The work on the Business Information Project for N-Reactor continued during the month. System definition and programming work are proceeding on schedule. Requisition for the necessary equipment has been prepared and is currently under review. The over-all feasibility study has not yet been approved by the Richland Operations Office of the Atomic Energy Commission.

N-Reactor Production Study

A new study of N-Reactor costs and capabilities under revised guide lines furnished by the Atomic Energy Commission has been initiated and will be completed prior to the end of June.

Fuels Accounting System

Work on a revised fuels end function accounting system is proceeding. This system will be based on establishing end function centers for the process and relating all effort to these functional stations. The system will be implemented on July 1, 1963.

Program Milestones

Preparation of program milestone sheets for Finance objectives was initiated. These sheets will be used to chart the progress of the Finance Section.

Project CAI-816 Funding Requirements

During May a review of all responsibilities assigned to the General Electric Company under Project CAI-816 was made and funding requirements for these responsibilities were analyzed. A revised expenditure pattern for General Electric incurred costs under the Project will be submitted to the Atomic Energy Commission during June.

J Milne
Manager-Finance

J Milne:pw

END

DATE
FILMED
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