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N-REACTOR DEPARTMENT

MONTHLY REPORT -- APRIL 1963

Compiled by N-Reactor Department

May 7, 1963 - Richland, Washington

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GENERAL SUMMARY

N-REACTOR FUELS

Manufacturing

A record 205 billets were extruded during April, consisting of 146 inners and 59 outers. Input at the extrusion press was 33 tons, bringing the total first load to date to 398 tons or 62 per cent of requirements. Output production through autoclaves increased significantly with 24 tons being processed. Total first load to date is 82 tons or 21 per cent of requirements.

In previous monthly reports, output through autoclaves has been shown as production output. With this report, all material processed through autoclaves will be so identified and an additional category, Output to Finished Storage, will be added which will include only those elements transferred to finished storage. During April, 144 pieces of 1.5 tons are included in this category.

A process problem in cleaning outer fuels for autoclaving reduced the throughput of these elements through autoclave, resulting in a high proportion of inners being autoclaved. The problem was alleviated, and at month end, outer elements were being processed. At month end, all 12 autoclaves were up to pressure with ten of the 12 loaded with outer elements.

Engineering

Billets containing up to 50 ppm phosphorus are being extruded routinely. Billets with up to 80 ppm are being received and will be processed if and when current studies indicate no serious fabrication or irradiation problems. Material above 80 ppm will not be accepted from the feed site.

All support hardware is in adequate supply with the exception of variable thickness shoes. Hanford Laboratories is being phased out of the support fabrication business as manufacturing equipment comes on the line in 333 Building.

Support and lock clip welding is now progressing satisfactorily. The locking clip welder has been re-calibrated and reproducible results are being obtained.

Testing Methods

Calibration of ultrasonic test results on billets are being made to increase the knowledge of N-fuel extrusion quality. Routine operation of the N-fuel testers was evaluated as to availability and throughput; capability exists for current production goals.

An enrichment tester for AlSi fuels was turned over to Production Fuels Operation for routine use. Routine operation of AlSi testers has been assigned to Quality Control and a Testing Methods engineer "loaned" for a six-month assignment to attempt to reduce tester biases.

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RESEARCH & ENGINEERING

A cost and production study for the operation of N-Reactor was made under two assumptions, i.e:

- a. Total HAPO reactors must produce a plutonium product containing an average plutonium-240 isotopic content of 6 per cent, and
- b. Present HAPO reactors must average a Pu-240 isotopic content of 6 per cent, but no restrictions are placed on the plutonium product from N-Reactor.

Cost and production data for exposure sufficient to produce about 15 per cent Pu-240 and for the highest feasible Pu-240 content were also included.

Four members of the General Electric Technological Hazards Council and one consultant visited N-RD to review the NPR design and preliminary plans for start-up and operation.

Preliminary arrangements for an in-reactor test of the fuel rupture monitor system have been completed. A test model, to be assembled from monitor spare parts, will be installed on Loop 1 of 1706-KER. The test will be run under closely simulated NPR conditions. The test is expected to provide fission product threshold sensitivity data for the monitor while it is subjected to normal background activity in a continuous sample of irradiated water from the loop. The spectral data collected during the test will be useful in determining optimum settings for maximum protection during NPR start-up.

Fourteen N-fuel elements in the KER Loops have reached 120 per cent of normal N-Reactor goal exposure. These fuels, which are representative of first-load production, will be discharged during the next reactor outage. Evaluations of a previous charge, which was discharged during February at 85 per cent of normal N-Reactor exposure, showed excellent performance.

Eight N-inner tube fuel elements with tapered end caps were discharged at an exposure of 1900 MWD/T. No cladding deformation in the cap area was seen during examinations in the KE basin. Selected elements from this group will be examined in the Radiometallurgy facility and large scale testing will be initiated if warranted.

Eight KSE-5 fuel elements were charged. This design is a scaled-down model of a single tube fuel element which is enriched so as to operate at temperature distributions characteristic of those which would be experienced by a full-sized single tube N-fuel.

N-REACTOR PROJECT

Repair work on the boiler in the 184-N facility was completed, and the boiler was placed back in service April 23, 1963.

Hydrostatic testing was performed on the primary loop piping in heat exchanger Cell No. 5. Except for minor adjustments of valve operations, the testing was acceptable.

Connector installation is nearing completion with slightly over a hundred remaining to be installed on the front face.

All horizontal rod drive units, with the exception of one being retained for testing, have been installed, and the pressure testing of the hydrostatic system has been initiated.

The studies of chemical cleaning of the secondary system of the N-Reactor have shown that it is economical to combine flushing with chemical cleaning. Approximately \$250,000 can be saved by this combination. Responsibility for flushing the secondary system has been transferred to General Electric and added to the responsibility for chemical cleaning. Dow Industrial Service was selected as the organization to provide consultation, chemicals, equipment, and services for the flushing and chemical cleaning.

Agreement was reached to transfer the detailed design responsibilities for the heat dissipation plant from Burns and Roe, Hempstead, New York to Burns and Roe, Richland, Washington, effective May 15, 1963, thereby permitting an economical closeout of the activities at Hempstead.

The contract with Beckman Instrument Company for monitoring equipment in the Hot Water Quality Laboratory has been approved and procurement of major components has been initiated.

Approximately 900 process tube flow monitor controllers have been completed and commencement of the 720-hour test has been forecast for the middle of May, 1963.

N-REACTOR PLANT

No facilities were placed in provisional custody this month. Boiler repairs were completed April 24, by the vendor and retesting initiated.

Preparation of test procedures is proceeding on schedule. Tests were run in 183-163 and 182, but no facility or system test was complete.

The various training programs were continued on schedule. Ten exempt people completed two weeks of off-site training on N-Reactor operating problems using the simulator at the U. S. Merchant Marine Academy at Kings Point, New York.

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PERSONNEL STATISTICS

Number of employees as of March 31, 1963 483
 Number of employees as of April 30, 1963 497

	<u>Exempt</u>	<u>Nonexempt</u>	<u>Total</u>
General	3	2	5
Financial	15	7	22
N-Reactor Fuels	55	113	168
Research & Engineering	39	9	48
N-Reactor Plant	52	87	139
N-Reactor Project	<u>91</u>	<u>24</u>	<u>115</u>
TOTAL	<u>255</u>	<u>242</u>	<u>497</u>

Employment

	<u>Exempt</u>	<u>Nonexempt</u>	<u>Total</u>
Additions	10	7	17
Reductions	<u>1</u>	<u>2</u>	<u>3</u>
Net Additions	<u>9</u>	<u>5</u>	<u>14</u>

SAFETY & SECURITY

Days without a disabling injury 151
 Hours worked without a lost disabling injury 372,708
 Medical treatment injuries (April) 9

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

SUGGESTION PLAN PARTICIPATION

	<u>April</u>	<u>Year-to-Date</u>
Number of eligible employees	242	221
Number of suggestions received	33	99
Number of suggestions acted upon	18	64
Number of suggestions adopted	12	29
Net annual savings	\$ 5 584	\$ 8 111
Amount of awards	\$ 720	\$ 1 150
Per cent of awards to savings	12.9	14.2
Average amount of awards	\$ 60.00	\$ 39.65

PATENT SUMMARY - APRIL 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 April, except as listed below. 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.

HW-SA-2938, N-Reactor Fuel Piece Charging Machine, dated March 25, 1963 by H. D. Lenkersdorfer, G. A. Newell, D. Marinos, J. R. Carrell, and G. H. Strong.

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

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N-REACTOR FUELS OPERATION

MANUFACTURING

Production - Coextrusion Shop

Coextrusion Shop input for April established a record of 205 extrusions consisting of 146 inners and 59 outers. Total extrusion input was 111 per cent of forecast and represents an input of 33 tons. Total input to date is 398 tons or 62 per cent of first load requirements.

Production output through autoclaves increased significantly during April with 3,018 pieces or 24 tons being processed. This brings total first load production to date to 82 tons or 21 per cent of requirements.

In previous monthly reports, output through autoclaves has been shown as production output. With this report, all material processed through autoclaves will be so identified and an additional category, Output to Finished Storage, will be added which will include only those elements transferred to finished storage. During April, 144 pieces or 1.5 tons are included in this category.

A process problem in cleaning outer fuels for autoclaving reduced the throughput of these elements through autoclave, resulting in a high proportion of inners being autoclaved. The problem was alleviated and at month end outer elements were being processed. At month end all 12 autoclaves were up to pressure with ten of the 12 loaded with outer elements.

Production Statistics

	<u>Scheduled Tons</u>	<u>Actual Tons</u>	<u>Per Cent</u>
Shop Input - Current Month	30	33	111
First Load	645	398	62
Autoclave Output - Current Mo.	35	24	70
First Load	385	82	21
Output to Finished Storage -			
Current Month	---	1.5	---
First Load	385	1.5	.4

<u>Station Throughput</u>	<u>Inners</u>	<u>Outers</u>	<u>Total</u>	<u>In Process Inventory</u>
<u>Operation</u>				
Extrusion	146	59	205	---
Cutup First	2543	827	3370	23
Cutup Rework	155	48	203	---
Chemical Milling (ends)	4769	918	5687	328
Braze (ends)	4537	1723	6260	174
Heat Treat	2264	958	3222	95
Machining (ends)	4038	1902	5940	137
Vacu-Blast	1860	1258	3118	16
Welding (ends)	2894	2596	5490	326
End Test (ends)	3884	1736	5620	85
Clad and Bond Test	1456	1622	3078	362
Support Weld	2278	526	2804	10,961
Autoclaves	2490	503	2993	1029
To Final Inspection	2515	503	3018	5512

Oxide Burner - 65 batches burned = 1361.92 lbs.

Twenty-nine extrusions were made for Engineering.

Shop Yield - First Run

	<u>Outer</u>	<u>Inner</u>	<u>Total</u>
Current Month	74%	82%	77%
First Load to Date*	42%	55%	46%

* All pieces with questionable locking clip welds and questionable inner supports were transferred to reprocess storage and the yields reduced accordingly. These elements will remain this category until evaluation of locking clip welds and support sizing has been completed.

Plant Operation

Forty-one inner extrusions were made using billets with a reamed ID and 1/2-inch end plates with only one rejected for peel test. Of the 73 extrusions using regular billets and 1/2-inch front end plates, peel test results were satisfactory. There were 32 inner extrusions using 1/4-inch front end plates of which four were lost due to peel test.

No billets were rejected during the month as a result of vacuum loss. The crimping process was redesigned for manually operating which provides a superior crimp.

The capacity of the inner tube in-process storage racks have been doubled by the use of Masonite spacer strips. Critical mass calculations were made to assure that double stacking of fuel elements would not result in a violation of the nuclear safety specifications.

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Increased productivity is evident in the following individual daily production records established during April: Vacu-blast, 226 inners; step cut, 482 inners (ends); copper strip, 306 inners; pre-braze etch, 241 inners; pre-weld etch, 229 inners; autoclave, four unloaded and reloaded.

As previously reported, considerable effort had been expended on the locking clip welder to eliminate double charging the "spike capacitors." The control circuitry has been modified to include a safety circuit which prevents initiating the weld current unless a locking clip is in the electrode and proper pressures are applied to the electrode and ground clamp. The welder is now producing satisfactory welds.

Availability of the autoclaves has increased as a result of a) modification to the body heater supports and vessel bottoms with work currently under way, b) reduction of down time due to cartridge failure by using heavy duty cartridge and calrods.

An increase to eight pieces in the capacity of the hangers at beta heat treat has been effected by redesign and fabrication of new "spiders." Quality Control is currently evaluating heating and cooling curves and will provide proper operating cycles during early May.

Reduction in the breakage and reduced cleaning time of the high cost bell jars has been effected by a redesigned cleaning basket.

Additional lag storage between final etch and autoclaving is being provided by the purchase of three carts and three polyethylene containers for deionized water.

A recent study indicates the noise level in the braze area enclosure is considerably above prescribed limits. Design of noise reduction enclosures for each generator is under way.

N-FUEL PRODUCT ENGINEERING

Phosphorus Impurity in Uranium

All material being cast at the feed site is being analyzed for phosphorus impurity. Prior to the detection of phosphorus impurity in material cast in January, 1963, this analysis had not been made. Billets machined from uranium containing less than 50 ppm phosphorus are being routinely coextruded. The feed site is continuing to process and ship billets containing up to 80 ppm of phosphorus. Plans are to accept the 80 ppm limit as a specification on new materials, if evaluation of fabrication characteristics show no significant problems. A limit of 80 ppm will be adopted on the basis that a continuing supply of uranium metal is possible under this limit. Billets containing phosphorus in excess of 80 ppm of phosphorus will not be accepted in order to minimize the risk of potentially unsatisfactory irradiation performance.

The feed site is still searching their production records and analyzing samples of old material in an attempt to characterize production prior to January of 1963 with respect to phosphorus impurity. To date, proof has been obtained that some phosphorus entered the production stream about September, 1962. Billets from three ingots contaminated with phosphorus to 295, 170 and 112 ppm have been shipped to HAP0 and coextruded. No unusual coextrusion results were obtained. Samples have been obtained from these coextrusions, and they are being examined metallographically by Hanford Laboratories. In addition, five NOE and five NIE billets containing 50 to 100 ppm of phosphorus have been coextruded in production under a process work request. These coextrusions have been processed past heat treat and no unusual difficulty has been encountered. The only differences in physical characteristics of uranium containing phosphorus impurity observed to date are a slight lowering of the melting point and a small decrease in the ductility of the uranium at room temperature.

Uranium Symmetry

Yield difficulties have been encountered at the feed site in attempting to machine uniform billets from extrusions made from eccentric hollow cast ingots. Some improvement has been made in primary extrusion concentricity by chamfering the end face of ingots with eccentricities of 60-80 mils and OD scalping of ingots with greater than 80 mils wall thickness wall variation. Work is under way at the feed sites to optimize the end shape contours and to determine minimum practical ingot diameters. The most recent primary extrusion campaign included test ingots with 60 degree, 55 degree and 35 degree chamfers, 1-1/4 inch end radii and diameters between 10.800 and 11.125 inch and ingot wall variations up to 100 mils.

Support Hardware

On-site fabrication of all support hardware items has been accomplished. The outer supports and locking clips are in routine production in the 333 Building facilities. Inner support production has started in the N-Fuels facility. The first proof lots have been accepted through inspection and are ready for proof testing through autoclave. Since a six-week inventory of inner supports has been obtained through the Hanford Laboratories fabrication, this source is being shut down. The last inner support should be delivered from Hanford Laboratories about May 15, 1963. They will have fabricated approximately 100,000 inner supports. The dies for fabricating steel shoes within the N-Fuels Section are not complete, but dies are available for fabrication of shoes on the Hanford Laboratories press, and a two month inventory is on hand. Hanford Laboratories' production of steel shoes is being discontinued.

Zircaloy strip supply is still being obtained from the Hanford Laboratories' facilities. Inner supports have been fabricated from sheet bar extruded by N-Fuels Product Engineering and rolled and slit

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in the Hanford Laboratories. Outer support and locking clip strip has been rolled in the Hanford Laboratories from slit cladding shells. Current efforts are concentrated on obtaining an off-site supply of strip. Manufacturing has ordered 250 pounds of rolled strip against a product specification for ductility. Hanford Laboratories is continuing development efforts to demonstrate the Turks Head process for strip fabrication. They have demonstrated that cold Turks Head rolling without precise control will produce an extremely ductile strip if a 0.3 inch round extruded stock is used for starting material. However, 0.3 inch extruded bar is not a commercial size. Some commercial one-inch diameter extruded bar has been purchased and will be hot swaged to 1/4 inch and Turks Head rolled in the Hanford Laboratories' facilities. It is expected that this will result in satisfactory strip. If so, attempts will be made to purchase large quantities from off-site sources.

Coextrusion Process

Engineering Development Extrusions

The following extrusions were made during the reporting month:

11.1 Inch Tooling - PU-88 & 89 and Z-183

PU-88	Primary extrusion to NOE billet stock. High phosphorus content.
PU-89	Same as 88, except NIE stock.
Z-183	Primary extrusion of Zircaloy-3 to 7.5 inch rod stock.

7.5 Inch Tooling

Two Zircaloy Billets - Z-205 and 206

Z-205 and 206	Billets extruded to 4.125 rod stock for HL.
---------------	---

6.0 Inch Tooling

Two Composite - X-87 and CZ-3

X-87	NIE extrusion using uranium billet with high phosphorus content for evaluation of clad thickness variation.
CZ-3	NIE geometry with copper billet core for final assembly development work.

Twenty-one Zircaloy Billets - Z-184 Through Z-204

Z-184 through Z-203	3/8 inch thick sheet bar extrusions for support fabrication.
Z-204	Shroud tube for KER loop testing.

Chemical Processing

Pre-Autoclave Etch

With the commencement of NOE fuel element etching and autoclaving in April, a surface smut appeared in the bores of about 27 per cent of the throughput in final bright etch. The surface smut is uniform in that it begins just below the braze heat affected zone and continues to the edge of the opposite heat affected zone. The smut is difficult to observe unless the fuel element is under water and a light beam focused down the bore. Concurrent with the incidence of the surface smut formation, a lighter, or slightly discolored, autoclave film was observed corresponding to the same area in the bore of the outer fuel element. Several inner fuel elements in the same autoclave load with the first group of stained outers exhibited a similar discoloration but on the outer clad. Prior to this time, clad discoloration of the particular type described above has not been observed on either inner or outer fuel elements.

There are at least two factors affecting the production of the etch smut-autoclave stain phenomena. First, the smut is being formed during the pre-autoclave etch treatment and is dependent upon the nitric acid concentration of the nitric HF etchant. Secondly, one vendor's Zircaloy appears more sensitive to the nitric concentration than does the other vendor's Zircaloy. The two variables are illustrated in Table I.

TABLE I - FINAL BRIGHT ETCHING OF NOE FUEL ELEMENTS

Nitric Acid Conc. (lbs/gal)	Vendor X Zircaloy					Vendor Y Zircaloy				
	Etch	Smut	None	Auto	Stain	None	Etch	Smut	None	Auto
3.0 - 3.2			X			X			X	
3.2 - 3.4			X			X	X ¹			
3.4 - 3.6			X			X	X			X
3.6 - 3.9	X				X		X			X

¹ Very light smut.

An investigation is in progress to determine the nature of the smut, its cause, and its effects.

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Nitric Acid Fume Control

Assistance to Manufacturing in nitrogen oxide fume control was provided during the past two months. The work performed was to recommend operating control techniques designed to reduce peak concentrations of fumes. A procedure was recommended for the copper removal process that would reduce the fuel load per basket and increase basket throughput. This required additional baskets which have been procured by Manufacturing. Initial processing by this method will be made shortly and air samples will be taken to compare fume levels for both operating conditions. It has also been proposed that air sparging of the chemical milling solution be performed during the coverage shift to minimize fume condition during the daytime when other fume producing operations such as copper removal are down.

Chemical Milling

Masking plugs are being used in production chemical milling process to control surface variation. These are being applied during the last part of the milling cycle on fuels having surface variation greater than specified in the limits. Previously, the masking plugs were used to salvage reject fuels accumulated as a reprocess lot. Occasionally this will occur, depending on availability of operator time during the regular cycle. Daily station reports will indicate the number that required masking application. Since masking plugs were supplied, approximately 1,000 fuel elements have been reclaimed without resorting to refacing.

Autoclave Processes

White Welds - Water Cycle Autoclaving

Tests have been completed to compare the effects of the following variables on water cycle autoclaving:

1. Uranium contaminated weld beads vs. uncontaminated weld beads. (Approximately 45 Mg U/end)
2. Bright etching prior to autoclaving vs. no Zircaloy etching after end welding.
3. Standard TIG welding vs. electron beam welding.

The visual appearance of the weld beads after three-day steam autoclaving and after 14-day water autoclaving was similar in that all the weld beads were an acceptable gray to gray-black in color. These same fuels, when vacu-blasted, re-etched and re-autoclaved 14 days in water with a full autoclave load exhibited spalling white weld beads. Evidence to date suggests that etchant entrapment and carry-over into the water cycle autoclave may have an effect

on the formation of white weld beads. Thus far, three loads of production fuel elements subjected to the water autoclave cycle have exhibited white weld beads. Additional pilot plant autoclave studies are in progress to determine the nature of this phenomenon.

Elimination of Pre-Autoclave Etch

A pilot plant Process Work Request (E-62) eliminating the final bright etch step prior to autoclaving is being evaluated. The last Zircaloy etch used in the PWR is the preweld etch. After this etch, the four fuel elements were end welded, support welded, cleaned, and autoclaved. The cleaning techniques were an Alconox wash, a vapo-degrease, and an ethanol rinse. After three days exposure to 1500 psig steam at 400 C, the fuel elements exhibited black film, metallic black weld beads, and black spot welds. There were several light scratch marks on all the fuels from the handling after the final preweld etch, but these appeared minor. The fuel element cleaned using perchlorethylene vapor degreasing evidenced light clad staining, but the other two techniques provided sufficient cleaning to produce black autoclave films. These fuels will be exposed to 360 C pH 10 water for several weeks to determine the effects of longer corrosion testing on the cladding and weld bead corrosion rates. Additional testing and evaluation will be performed as necessary.

Corrosion Studies

Ex-Reactor Fretting Corrosion Studies

Three short-term tests have been run in TF-7 ex-reactor loop located in 1706-KE Building. The tests involved the charging of two 23-inch fuel element assemblies into a six-foot section of Zircaloy process tubing. An air driven vibrator was attached in a vertical position near the center of the tube. Loop operating conditions are similar to anticipated NPR conditions with high purity deionized, deoxygenated water with the pH adjusted to 10 ± 0.1 with lithium hydroxide recirculated past the fuel elements. The loop operates with a water temperature of 276 C and at 1200-1300 psig. The flow rate through the process tube is approximately 15-25 gpm. The vibrating conditions and type supports for the three tests are illustrated in Table II.

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TABLE II

<u>Test No.</u>	<u>Type Fuel Elements</u>	<u>Exposure Time and Conditions</u>	<u>Remarks</u>
1	2 NAE-1, 23" long, soft sized buggy spring supports(1)	48 hrs.-f = 41 cps; a = 1.9-3.5 mils 120 " f = 54 cps; a = 1.8 mils	Fretting wear marks were observed on the buggy spring supports, locking clips, and in the bore of the outer fuel where buggy spring supports contacted outer fuel. Penetration of wear marks ranged from 1 to 16 mils.
2	2 NAE-1, 23" long, hard sized buggy spring supports(2)	72 hrs.-f = 54 cps; a = 1.8 mils	No visual signs of fretting
3	2 NAE-1, 23" long, hard sized buggy spring supports(2)	Ap.336 hrs - f = 54 cps; a = 1.8 mils	No visual signs of fretting Inner fuel spring constant approximately same as before vibration testing.

- (1) The soft sized buggy supports spring constants are estimated at one lb/mil.
 (2) The hard sized buggy supports spring constants are determined as 25 lbs/mil.

The first charge of soft sized material, after one week's exposure, had sustained wear marks in the inner cladding of the outer fuel of up to 16 mils penetration. Subsequent testing has been on current material. Future testing will involve test conditions designed to enhance fretting corrosion within the N-fuel complex and yet remain within the possibilities of the N-Reactor system.

Gas Pressure Bonded End Closure Development

Lot Nos. XVI Through XXI

All of these lots have been gas pressure bonded at Battelle Memorial Institute and returned to HAP0. A preliminary investigation of the cladding to closure ring bonds indicates that a pressure of 20,000 psi at either 650 C or 750 C is not sufficient to eliminate the cladding striations when the closure ring is Zircaloy-2. Preliminary investigations also indicate that a pressure of 46,000 psi at 650 C with a Zircaloy-2 closure ring results in residual striations while a temperature of 750 C at this pressure apparently eliminates all striations. A preliminary investigation of the cladding to closure ring bond using a Zircaloy-2 closure ring at 45,700 psi, 650 C indicates

no residual striations. In both cases the bond area at 600X showed a very fine grain growth across the interface. The bonding time for all lots was one hour. Evaluation of the specimens is continuing.

The specimens in the above lots having a niobium washer between the Zircaloy-2 closure ring and the uranium core are being prepared for examination.

Lot No. XXII

This lot was prepared to obtain additional corrosion data on using copper as a diffuser between the Zircaloy-2 closure ring and the cladding. Closure rings coated on DDR-139 were used. At the time of receipt of the coated rings, the vendor was notified that the Zircaloy was oxidized and that the oxygen content of the copper was too high, judging from its color. No evidence of diffusion was found between either the copper coating and the cladding or seal ring. The only information gained from the test was a substantiation of previous work that the metal surfaces must be clean or diffusion will not take place.

Fuel Element Supports

Charge Machine Testing

Charge machine testing was resumed during the last week in the month. Under the current series of tests, charging is accomplished under full column load pressure. To date, four charges have been provided for these tests. In many cases, outer supports have been damaged severely in this test. Evaluation of the cause of this damage is under way and additional tests will be performed in May to confirm preliminary results.

Locking Clips

The first two batches of improved locking clips were fabricated and followed until cleared. Subsequent production is being processed through more normal channels.

A study was performed to determine proper locking clip spacing. The data were given to Quality Control for modifying the Quality Control Standards.

Outer Supports

It is expected that outer support circle diameter control will be difficult. A report has been issued outlining the requirements at final assembly for shoes of varying thicknesses and explaining how these shoes are to be used.

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Welding of outer fuels has resumed. Initial data on outer support circle control were accumulated. The data were analyzed and the results reported. Some additional data are being accumulated in this area, although primary control is being provided by Quality Control Engineering.

A compression test device has been fabricated for determining the deflection strength of outer supports at Final Assembly. The tester is designed for production use. Currently the tester is being used to determine tester characteristics and to determine deflection strength differences between shod and non-shod supports, 30 degree and 45 degree supports, and autoclaved and non-autoclaved supports.

Inner Supports

The inner support deflection tester was modified to improve operation and was turned over to Quality Control for routine deflection testing at final assembly.

A sizing test to determine inner support material thickness limits is now in process.

Final Assembly

The final assembly operation has been audited for process flow, new equipment and materials ordered, and minor modifications made to existing tools. The responsibility for this work will be transferred to Quality Control in the near future.

Support Welding

The locking clip welding process has been firmly established and complete operating procedures have been prepared for shop usage.

Equipment Development

Projects Completed

Outer Support Fabrication

The new outer support die was installed in the eight-ton mechanical press. Proof supports were fabricated, inspected and found satisfactory. The press, with tooling, was turned over to Manufacturing on April 17, five days ahead of schedule.

Locking Clip Fabrication

The tooling was used by Manufacturing to produce locking clips on April 4, one week ahead of schedule. A design change of the locking clip necessitated that new die inserts be made. The press, with tooling, was turned back to Manufacturing on April 18. An additional change will be made the week of April 29 or May 6 to improve the centerline location of the weld projections. The timing of this change is dependent on backlog of parts available for production.

Projects in Progress

Outer Support Shoe Fabrication

The shoe fabrication die for 0.010 inch thick shoes was completed. Problems were encountered in stripping the part out of the die. It appears that a major modification will be required to correct the problem. Since .010 inch shoes are being produced by Hanford Labs and since there is an immediate need for 0.015 inch thick shoes, the majority of effort is being placed on obtaining the dies to produce the 0.015 inch shoes and on obtaining the shoe crimping pliers. The target date for producing 0.015 inch shoes is June 3. No target date is set for producing 0.010 inch shoes.

Inner Support Fabrication

All equipment was installed and some test parts (inner supports) were produced April 12. Some minor equipment modifications were made to the tooling and additional test parts were made, inspected, and found to meet dimensional specifications. Two operators were trained in the operation of the equipment.

About 500 to 1,000 inner supports will be made the week of April 29. These parts will be inspected for dimensional properties and then some will be welded on inner fuels and autoclaved. These fuels with supports will be subjected to the normal compression and vibration tests. If adequate manpower and material are available, and all test results are favorable, the inner support fabrication equipment can be turned over to Manufacturing the week of May 13.

Sizing and Assembly Tools

In general, some of the accessory tools that were to be fabricated and tested this month were delayed due to priorities of the locking clip problem.

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The new hydraulic sizing fixture should be ready for prototype testing about May 10.

The prototype rotary locking clip bending tool should be ready for testing May 1.

Support Welding Fixtures

The NOT support welding fixture was disassembled, the base and knee modified to mount new parts, and the fixture re-assembled. This work was completed one day ahead of Manufacturing's allowable time to do the work. The new parts to be mounted on the NOT weld fixture to accommodate various lengths of fuel tubes are fabricated. These parts will be installed when a time, convenient to Manufacturing, can be arranged to have the welder down.

The electrode alignment problem on both support welders has not been resolved.

Design work has started on modifying both support welder fixtures to locate and index unenriched fuel tubes.

Final Inspection and Assembly Room

Additional dust sampling tests were made in the subject room at our request and under our supervision. The results indicate 1) that "dusty" air is coming into the room over the top of the existing partial partitions which should be corrected, and 2) that one inexpensive type of air filter will remove about 60 per cent of the dust coming in through the ventilator. Corrective action will be discussed with Quality Control and a decision made as to what action will be taken.

TESTING METHODS OPERATION

N-Fuel Testing

Component Testing

1. Correlation of Billet Extrusion Performance with Pre-Extrusion Test Data: Work was initiated in conjunction with Quality Control to better define the results of the ultrasonic billet test. Among the objectives are: definition of the shape and analog chart values of standards; direct calibration in terms of grain; and effects on product quality. Realization of these objectives will permit Manufacturing to routinely adjust the equipment and will permit pre-selection of billets for control of product quality.

2. Uranium Billet Grain Size Tester - UT-8: The production unit has been delivered to 333 Building. With completion of the maintenance manual, due in May, all adjustments and maintenance will be routinely performed by production personnel.

Process Control

1. Braze Station Operation: Assembled instrumentation for integrating total power used in a brazing operation. This instrumentation will be used to detect and record changes in power usage reflecting variations in braze operation. Such information will assist in the evaluation of present and future braze control systems.

Product Certification

1. Alpha Surface Contamination Testers - AC1 and 2: Unstable operation of the alpha contamination counters recently encountered was traced to line voltage variations and a relatively low building supply voltage. The counters were reset out of the critical voltage range (a five per cent voltage change was giving a 50 per cent counting change), and more effective voltage stabilizers are being used. Two modifications were made to the inner contamination tester (AC-1) to improve its operation. Provision was made for testing clad and end cap simultaneously to reduce counting time. Standards were also permanently mounted in a holder, improving the handling problem and reducing calibration time by allowing simultaneous test head calibration.
2. Bore Camera: A bore camera has been located in excess at Frankfort Arsenal at considerable cost savings. This camera designed to photograph rifle bores will be used for photographic inspection of the inner surface of the fuel elements.

Post-Irradiation Testing

1. Irradiated Fuels Tester - UT-10: The UT-10 station has not been put into operation because of a delay resulting from higher priority of 105-KE operations work. In the interim, all as-built circuit drawings were completed and tracings were about 25 per cent completed. A rough draft write-up on operation of the UT-10 station was about 50 per cent completed. Beneficial use of the station is expected momentarily, and is dependent upon availability of time at the KE basin.

AlSi Fuel TestingComponent Testing

1. Enrichment Tester - ERT-1: The ERT-1 enrichment tester, complete with instructions and standards, was turned over to Production Fuels and assistance given on startup and an operator trained. Routine operation of the unit will provide valuable supplementary information in AlSi operations.

Process Control

1. Ultrasonic Welding Monitors: The weld monitor system developed by Testing Methods was evaluated and used in the 306 Pilot Plant prototypical welder for several months. The production model of this unit has not yet been evaluated on the 313 Building welders. The system was designed to control the welding time for each weld to compensate for other welder variances. Other systems have potential for control, and being less complex, they will be evaluated by Production Fuels first. Two such systems are automatic temperature compensating oscillators, and automatic frequency control. The first attempts to compensate for shift in the resonant frequency of the vibration system while cold, and the second strives to match the driver current frequency to the resonant frequency of the system. A commercial development is being evaluated for temperature compensating and Testing Methods is responsible for design and construction of a prototypical unit for the frequency control system. This system consists of a hunt-and-seek oscillator which will sweep a frequency band and lock-in on the frequency which obtains the maximum tip amplitude. A circuit was designed and construction started of a proposed device. Development of the foregoing systems will aid or eliminate the job of the monitor system.

Product Certification

1. Hot Die Sized Fuel Element Tester - UE-3: The electronic console of the UE-3 was moved from the 328 Building Electronic Shop to the Testing Methods laboratory for check out. Debugging of the can wall thickness testers was completed and they are operating in a stable, trouble-free manner. The original probe design (made interchangeable with 313 Building testers) has large probe travel, reducing precision. In line with proposed modifications for the 313 probes (use of pulse echo ultrasonic transducers), a direct riding eddy current probe will be investigated for both AlSi and N-fuel. Laboratory tests were made on approximately 100 hot die sized production test fuel elements for internal and external cladding thickness and end bonding. All elements were found to be acceptable.

2. Routine Tester Operation: The operation of the nondestructive testers in Production -uels, Irradiation Processing Department, has recently been the source of considerable discussion and consideration. It appears that there has been an appreciable loss of effort and accomplishment as a result of the need to coordinate and integrate the approaches of the several organizations which have been involved in the nondestructive testing work. As a means of pinpointing responsibility, the direction of the nondestructive testing program (UT-2, UE-1, and UT-4 equipment) for the next six months will be placed in the hands of one component - Quality Control; assistance will be provided by other organizations as requested by Quality Control. Testing Methods has been asked and will make available the services of Mr. C. J. Denton for an "on-loan" assignment for the six-month period. Mr. Denton will function in the capacity of a Technical Specialist and will report to the Manager, Quality Control, for the duration of the assignment. The primary objective of the program will be to reduce the biases of the equipment so that the data obtained is reliable.

Post-Irradiation Testing

1. Irradiated Fuels Tester - UT-11: Two new transducers for the 105-C, UT-11 station were received and installed. Tests on standards gave a fuzzy surface echo, hinting at incorrect transducer aiming. However, before corrective action could be taken the viewing basin was shut down for maintenance work.

PRTR Fuels Testing

Plutonium Distribution Uniformity in Developmental Fuels

Ceramic Fuels reports that the Pu homogeneity tester can readily measure concentrations down to 0.1 per cent. They are quite satisfied with the unit and are taking steps to acquire a permanent installation.

Reactor Testing

Ultrasonic Detection of Hydriding in Zircaloy Process Tubes

NPR process tube samples have been hydrided and the ultrasonic hydride test was able to detect hydriding down to 400 ppm. Previous work had been done on KER size tubing samples having a thinner wall. Additional NPR samples are being prepared and Zr-analysis will be used for obtaining exact correlations. An inside probe with a rotating mirror for tube scanning is being evaluated. Preliminary results with this technique also show detection down to approximately 400 ppm. Further work will be done to determine effects of variables.

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Separations Testing

Assistance was given CPD in the evaluation of an eddy current test being used by the Dow Chemical Company at Rocky Flats on Hanford components.

General

Ultrasound Imaging Techniques

Examination of the near field cross section of an ultrasonic beam by the method of sectional analysis was accomplished. This method consists of reflecting a section of the beam at right angles to the original, and examining the section with the Schlieren imaging system. A mechanical positioning apparatus is being constructed which will permit more accurate and extensive analysis of beam geometries utilizing this simple method. A complimentary system using the disturbance at the surface of a liquid resulting from ultrasonic energy impinging upon it is being investigated by means of interferometry and surface Schlieren techniques.

GENERAL

The presentation of a paper on ultrasonic techniques to determine defect growth, by the Manager, Testing Methods, invoked interest on the part of the Bureau of Ships and additional information is being transmitted to the interested individuals.

During April, employees of the Section attained the highest suggestion rate at Hanford. Nine awards were presented in April for an annualized adoption rate of 702 per 1,000 eligible employees. Annual savings totaled \$5,578.00.

Several major tours of the 333 Building were conducted during the month. The individuals in each tour were generally quite impressed and indicated complete satisfaction with the tours.

The program for automated yield and activity reports has been completed and a test run performed April 29 using the new master file. A sideline benefit of this system is the use of the system for personnel records and organization charts.

The Section continues to reduce the document inventory with a nine per cent reduction by Manufacturing during April.

N-REACTOR FUELS OPERATION
APRIL, 1963

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
R Graham	Wah Chang Albany, Oregon	DW Darsow	4/3 - 4/4/63	Zircaloy-2 end caps and supports.
CA Brown	Rem, Inc. Portland, Oregon	DW Darsow	4/4/63	Zircaloy-2 end caps and supports.
J Foss	Bridgeport Brass Seattle, Wash.	DW Darsow	4/18/63	Cu-Si, Zr-2.
CD Spurrier	Torrance Brass Torrance, Calif.	DW Darsow	4/18/63	Seamless Cu-Si tubes.

TRIPS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
HP Kraemer	Crotonville, N.Y.	- - - - -	4/8 - 4/10/63	Attend Inventory Management Cour:
HP Kraemer	Nuclear Metals Concord, Mass.	P Loewenstein	4/11/63	Closure ring procurement.
HP Kraemer	Metals & Control Attleboro, Mass.	G Howland W Payton	4/12/63	Zircaloy supports.

ORGANIZATION AND PERSONNEL

	<u>3/31/63</u>	<u>4/30/63</u>
Exempt	54*	55
Non-Exempt	<u>109</u>	<u>113</u>
	<u>163</u>	<u>168</u>
Tech Grads Assigned to N-Reactor Fuels		<u>2</u>

* Includes two MTP's

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Transfers

<u>Name</u>	<u>From</u>	<u>To</u>	<u>Effective Date</u>
J. R. Samuel (exempt)	CE&UO	N-Fuel Prod. Engrg. •	4/1/63
H. R. Perkins (non-exempt)	IPD	Manufacturing	4/1/63
A. R. Nichols (non-exempt)	IPD	Manufacturing	4/1/63
J. R. Payne (non-exempt)	IPD	Manufacturing	4/1/63
A. W. Davis (non-exempt)	IPD	Manufacturing	4/1/63
D. C. Wyatt (non-exempt)	IPD	Manufacturing	4/1/63
E. E. Reip (non-exempt)	Manufacturing	IPD	4/22/63

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 April, 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-77225 Pallet Test, J. P. Keenan, 4/9/63, Confidential.

HW-76948 Processing Data for KSE-5 and 2 W/o XT-Uranium Fuel Element Charges for K-East Reactor, R. K. Robinson and R. D. Dudley, 4/10/63, Confidential.

 Target Schedule for December 1, 1963 Completion, J. W. Nickolaus, 4/25/63, Confidential-Undocumented.

HW-77220 Ultrasonic Testing, Detection Tool for NPR Cap-to-Clad Voids, G. L. Wilfert, 4/9/63, Unclassified.

SECURITY VIOLATIONS

There were three security violations in the N-Reactor Fuels Operation during April. Total CYTD - 4.

Manager, N-Reactor Fuels

LM Loeb:mf

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RESEARCH AND ENGINEERING

ADVANCE TECHNOLOGY

A cost and production study for the operation of N-Reactor was made under two assumptions, i.e.:

- A. Total HAPD reactors must produce a plutonium product containing an average plutonium-240 isotopic content of 6 per cent, and
- B. Present HAPD reactors must average a plutonium-240 isotopic content of 6 per cent but no restrictions are placed on the plutonium product from N-Reactor.

Cost and production data for exposure sufficient to produce about 15 per cent Pu-240, or, if not physically possible, for the highest feasible Pu-240 content was also included.

Revised O2 Research and Development and Supplemental Programs were completed and transmitted to the AEC.

REACTOR ENGINEERING

All Reactor Engineering contributions to the revision of the Hazards Review were completed in April.

Work has begun on the preparation of technical bases for Process Standards in support of the standards and records unit of Process Evaluation and Control. One of the most immediate needs in this area appears to be establishment of procedures, which will be in keeping with safety criteria requirements, related to removal of electrical or cooling backup levels for maintenance or repair. Initial study is directed towards identification of requirements for adequate cooling in such cases.

A study was initiated in April to determine the release of steam occurring from a process tube nozzle end cap failure during operation.

Contributions to the Research and Development 189 Technical Backup Document have been submitted to Advance Technology covering program R-2, "Fluid Flow and Heat Transfer Studies."

Support for the NPR testing and startup program continues on schedule.

REACTOR PHYSICS

A supplemental project proposal (189) has been prepared for additional reactor physics research and development work needed in support of N-Reactor. The proposal is entitled "N-Reactor Advanced Physics Research."

A description of the problems, technical approaches, and expected results have been prepared in support of the three project proposals for reactor physics research and development work.

Work has been in progress during the month on the following problem areas:

- a) Most efficient utilization of a small quantity of some additional fuel of a slightly higher enrichment which may be useful in reaching full operating conditions.
- b) The production and utilization of non-fissionable and fissionable heavy isotopes in N-Reactor.
- c) The development of a computer code for reactor analysis.
- d) The establishment of technical bases for N-Reactor upon which operating standards are to be based.

CONTROLS, INSTRUMENTS AND SYSTEMS ANALYSIS

A Supplemental 189 R&D program was prepared for a proposed "N-Reactor Plant Integrated Data System Feasibility Study and Development." A technical write-up for the back-up document was also prepared.

Detailed technical write-ups have been prepared for inclusion in the R&D program back-up document being prepared by Advance Technology. This material covers the following proposed programs:

- a) Heat Exchanger Interface Control Development
- b) N-Reactor Instrument Development and Systems Analysis.

Fuel Rupture Monitor System

Preliminary arrangements for an on-reactor test of the fuel rupture monitor system has been completed.

A test model, to be assembled from monitor spare parts, will be installed on Loop 1 of 1706-KER. The test will be run under closely simulated NPR conditions. The test is expected to provide fission product threshold sensitivity data for the monitor while it is subjected to normal back-ground activity in a continuous sample of irradiated water from the loop.

The spectral data collected during the test will be useful in determining optimum settings for maximum protection during NPR startup.

Reactor Simulations

Analog computer runs for studies on N-Reactor trip settings are about 90 per cent complete.

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A dump condenser digital computer code for determining steady-state operating conditions is approximately 75 per cent complete.

The translation of a pressurizer digital code from Philco-2000 computer language to IBM 7090 Fortran language is near completion. Debug runs will start in the near future.

Acceptance Test Procedure Assistance

Technical assistance is being provided in the review of Acceptance Test Procedures before the technical writers prepare the Operational Test Program documents. During the month of April assistance was given in reviewing the following N-Reactor Plant systems:

- a) Raw Water System
- b) Flow Monitor
- c) Secondary System.

CHEMISTRY AND METALLURGY

Evaluation of "First Load" N Fuel Elements

The discharge of a second group of 14 assemblies of N fuel elements that has reached goal exposure is scheduled for the next reactor outage. The first group incurred approximately 85 per cent of normal N-Reactor goal exposure. The current group reached 120 per cent (1676 MWD/T) of normal N-Reactor goal exposure on April 30. A charge of 13 assemblies reached 207 MWD/T on April 30.

The first charge showed excellent performance. Swelling in the outer tube pieces was measured at the theoretical minimum value. The swelling in the inner tubes was less, indicating that considerable restraint of swelling was accomplished by the 40 mil thick outer clad. Radiometallurgical examination confirmed that end closure performance, core integrity, and clad performance was satisfactory. There was no indication of fretting corrosion of the inner clad of the outer tube at the contact surfaces of clad and buggy springs.

Advanced Fuel Development

Eight 17-inch N inner fuel elements with tapered end caps (PT-IP-536-A, Supplement A) were discharged March 26, 1963, at an exposure of 1900 MWD/T. Four of the elements had unbonded closures and the other four were identical except that the end caps were brazed. This end cap design is regarded as an improvement over the flat end cap design for either the bonded case or the unbonded case. No evidence of deformation of the cladding in the area of the cap-to-fuel juncture was seen during examination in the KE basin. An earlier test of unbonded tubular elements

with flush, flat caps and 20 mil cladding failed at 1700 MWD/T by shear of the cladding at the cap-to-fuel juncture. A similar group of elements with 35 mil cladding survived irradiation to 1200 MWD/T with no evidence of cladding deformation.

Selected elements from the tapered end cap test will be examined carefully in the Radiometallurgy Laboratory later. Information bearing on the behavior of this end cap design will be sought by sectioning several closures. If the results are encouraging, larger scale testing of modified end caps will be initiated.

Eight KSE5 elements were charged on March 25 under PT-IP-544-A. This element is designed as a scaled-down model of a single tube element for N reactor. It is sized for use in the small loops and enriched so that it operates with the same temperature distribution (maximum uranium temperature - 575° C) as is expected in the N single tube element. The purpose of the test is to evaluate the behavior of tubular uranium fuel operating at these temperatures.

SIGNIFICANT REPORTS ISSUED

HW-77363, "Production and Cost Studies at Varying MWD/T - N-Reactor," by R. L. Dickeman, dated April 23, 1963.

HW-77149, "N-Reactor Department 02 Research and Development Program for FY-1964 - FY-1965," compiled by E. D. Sayre, dated April 1, 1963 (SECRET).

HW-77342, "Supplemental 02 Research and Development Program for FY-1964 - FY-1965 N-Reactor Department," compiled by E. D. Sayre, dated April 15, 1963, (SECRET).

HW-69000 Vol. 1, "100-N Technical Manual" was revised, completed and reissued on the basis of the N-Department organization.

HW-77274, "Burial of Hanford Radioactive Wastes," G. E. Backman, P. D. Jerman, R. E. Roberts all of HL and J. W. Vanderbeek of Nrd, dated April 15, 1963, (Unclassified).

HW-77205, "Bases for Recent Cost Studies on NPR," K. W. Norwood, dated April 1, 1963, (SECRET).

HW-77305, "NPR Unit Costs," K. W. Norwood, April 15, 1963, (SECRET).

Three papers were presented at the Electro-Nuclear Conference in Richland, April 29, 30 and May 1, as follows:

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Paper No. CPA63-5127, "Instrumentation and Control of An In-Reactor Test Facility," by J. R. Bolliger.

Paper No. CPA63-5134, "The NPR Maintenance Communication System," by A. A. Maupin, Jr.

Paper No. CPA63-5144, "Special Requirements of Electrical Supply Systems for Nuclear Reactors," by R. E. Trumble.

TRIPS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
A. E. Guay	National Lead Company Cincinnati, Ohio	April 3,4,& 5	Attend meeting on Effects on Phosphorus and Uranium.
J. W. Riches	National Lead Company Cincinnati, Ohio	April 23, 24 & 25	Attend Working Com- mittee Mtg. of FEDC.
M.C. Leverett	Bonneville Power Authority Portland, Oregon	April 5	Meeting with BPA representatives.

VISITORS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
W.R. Kanne	General Electric Company San Jose, California	April 30 - May 1	Attend Mtg. of GETHC Subcouncil
R.B. Richards	" "	"	" "
F.W. Mezger	" "	"	" "
B.O. Buckland	" "	"	" "
J. A. Haaga	" "	"	" "

PERSONNEL

Additions

	<u>From</u>	<u>To</u>	<u>Date</u>
H. Wayne Slater	New Hire	Advance Technology	4-1-63
D. H. Curtiss	IPD, R&E	Chemistry & Metallurgy	4-1-63
Duane Allred	HL, Nuclear Program	Controls, Instruments & Systems Analysis	4-1-63
A. A. Maupin	CE&UO, DEO	" "	4-1-63
G. W. Morrow	CE&UO, DEO	" "	4-1-63

PERSONNEL (Continued)

Transfers

	<u>From</u>	<u>To</u>	<u>Date</u>
K. W. Norwood	NRD, R&E, Reactor Engineering	GE Capacitor Dept. Hudson Falls, N.Y.	4-15-63

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 April, 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:mlk

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N-REACTOR PROJECTPROCESS DESIGN OPERATIONProcess Research and Development

Studies have indicated that air will not have to be evacuated from the tube side of the NPR dump condensers as a prerequisite to placing them in service. Such a possibility was foreseen because of the requirement for air removal that appeared in the Burns and Roe Acceptance Test Procedure. However, the circulating raw water system has been calculated to have the necessary head to lift the water to the high point of the condenser system and to create a water flow that should sweep out any entrapped air.

Bases have been developed for performing a computer analysis of the heat dissipation plant primary piping in Cell 5, and contacts have been made with Electric Boat to do the work. The results of this computer program will provide firm values of reactions and pipe stresses and will be useful in auditing the piping support system.

Presentations were made to various engineering and management personnel of the General Electric Company and the Atomic Energy Commission supporting the need for and analyses of two hot dumps (440F and 500F) of the primary coolant system. These hot dumps of the primary loop are included in Acceptance Test Procedure 2405 to test the emergency cooling system close to operating conditions.

Conversion

The design criteria covering instrumentation requirements of the primary and secondary coolant systems of the NPR when converted have been prepared. In addition to defining the instrumentation performance requirements, the document includes necessary additions and modifications to system components, available space, and optimum location of equipment.

Stresses in the NPR steam generators under Phase II operating conditions have been evaluated and found to be generally less than under the originally specified Phase I conditions.

Project CAI-816Close-out of Hempstead Activities - Burns and Roe

Agreement was reached to transfer the detailed design responsibilities for the heat dissipation plant from Burns and Roe - Hempstead, New York, to Burns and Roe - Richland, Washington, effective May 15, 1963, thereby permitting an economical close-out of the activities at Hempstead. All design activities will be funneled through the field resident project manager, who will have the authority to call upon responsible engineers at Hempstead for assistance as required.

Hot Water Quality Laboratory

The contract with Beckman Instrument Company for monitoring equipment in the Hot Water Quality Laboratory has been approved and procurement of major components has been initiated. Preliminary design drawings (38) have been received from Beckman and have been reviewed and returned with relatively minor comments.

Chemical Cleaning

The studies of chemical cleaning of the secondary system of the N-Reactor have shown that it is economical to combine flushing with chemical cleaning. Approximately \$250,000 can be saved by this combination. Responsibility for flushing the secondary system has been transferred to General Electric and added to the responsibility for chemical cleaning. Dow Industrial Service was selected as the organization to provide consultation, chemicals, equipment, and services for the flushing and chemical cleaning. The selection was based upon a review of the Dow Industrial Service proposal, on-site tests, the specific chemicals and procedures proposed, and past experience and technical knowledge.

Process Tube Nozzle Caps

Fabrication of process tube nozzle caps, which was started in March by Bruce Industries, has progressed favorably. The nut forging being performed by Reisner Metals Incorporated was 30 per cent complete by April 30, 1963. The nut material appears to be very good with all tensile and impact test results of the first ten lots being within specification requirements. Additional material was ordered for plug fabrication when less footage than originally ordered was received. Marking requirements for the plugs were conditionally waived at the request of the vendor. Questions on nut machining sequence and ACME thread dimensioning were resolved.

Process Tube Flow Monitor Controllers

Approximately 900 process tube flow monitor controllers (1,004 required) have been completed and commencement of the 720-hour test has been forecast for the middle of May, 1963. While controllers are being manufactured, the supplier, Avien, has been using the available time to "de-bug" the system and its wiring.

Traveling Wire Flux Mapping System

At the request of the Atomic Energy Commission, the procurement responsibility for the traveling wire flux mapping system was transferred from Kaiser Engineers to General Electric. The order has been placed with the low bidder, Eanco, Inc.

Resistance Temperature Detector Cable Plating

Nickel plating of the resistance temperature detector cable and gland assemblies by Heath Plating, Inc. has been successfully completed and the final shipment made.

Rupture Monitor Valve Rack

The last rupture monitor valve rack was completed by Western Piping and Engineering and shipped on April 11, 1963.

Gamma Energy Monitor - Rupture Detection System

Hanford engineers visited San Jose, California, to check on progress on the Gamma Energy Monitor of the Rupture Detection System. In preliminary tests the count-rate circuit did not meet the specified linearity and temperature drift requirements; modifications are in progress. Tests conducted on other components and sub-systems in the Gamma Energy Monitor have shown that specified requirements are being met. Electrical and operational tests of the spectrometer (linear amplifier and high voltage supply) and temperature testing of two differential alarm modules were performed satisfactorily. Functional tests on portions of two zones (turrets) of Panel D, which included the differential alarm modules and the logic and light circuitry, demonstrated that the components tested meet the functional requirements of the specification. A simulated operational test of one channel (system) was satisfactorily completed, including scintillation detector, preamplifier, spectrometer, differential alarm module, and position identification circuitry. Interconnection wiring diagrams were reviewed and corrected so that this information can be transmitted to the field for use in wiring at the N-Reactor plant site.

Equipment Development and Testing

Vibrational characteristics of the NPR nozzle-to-header connectors have been studied in hot tests in the Component Test Loop. The test connector specimens corresponded to the central inlet and outlet connectors adjacent to the process unit. Under conditions of normal fuel loading and maximum tube flow, a maximum movement of 0.170 inch (peak-to-peak amplitude) was recorded for the outlet connector between the first two supports in the straight-run portion. Under other sets of conditions in excess of normal operation, the maximum amplitude was 0.230 inch. Neither values should encroach upon the physical limits of the actual installation.

Environmental flow testing of a section of an NPR process tube containing a column of fuel element spacers, or dummies, was performed at 189-D Building. After approximately 80 days of high temperature flow exposure, the tube was inspected by borescope and found to have sustained no damage. The dummies appeared undamaged also.

Design tests on inlet barrier wall seal plugs have demonstrated superior holding characteristics of the production-run plugs over the originally tested prototypes. The plugs have successfully resisted attempted blow-outs at reverse pressure differentials up to 5 psig, considerably in excess of the criteria of 2 psig negative pressure. Testing will be continued under simulated environmental conditions.

FIELD ENGINEERING OPERATIONConstruction105-N and 109-N Buildings

The installation of duct work in both inlet pipe spaces and the left outlet pipe space has been completed with the exception of punch list items. The installation is continuing in the right outlet pipe space. The 105-N Control Room duct work is now nearly completed.

The pre-start checkout of the brine chiller for the pile gas system has been nearly completed. The equipment should be ready to operate as soon as the control circuit has been completed. A final punch list of the mechanical, electrical and instrumentation for the pile gas system has been completed.

The safety circuit panel has been received and is installed in the 105 Control Room. All panels in the 105 Control Room have now been installed with the exception of three (3) console sections which are yet to be received from Bailey Meter, and the process flow monitor controllers which are yet to be received from Avien.

The testing of the video communication system has been interrupted due to failure of a vendor supplied component. This has been returned to the factory for correction and is expected to be returned about the middle of June.

Instrument cable work has continued on both the flow monitor system and rupture monitor system. The tube welding on the rupture monitor system is now about 85 per cent complete. The weld production rate on the work varies from about 500 to 900 welds per week.

All of the rupture monitor system valve racks have now been installed and tubing is being placed in both rupture monitor turret rooms. The slip-ring wiring harnesses in the turrets were found to be damaged and it is intended that all of these assemblies shall be returned to the vendor for repair.

117-N Building

Painting work has been in progress in this building during the past month. Most of the painting of the filter cells has been completed.

1310-N Facility

Concrete placement is underway by both Kaiser Engineers and their sub-contractor Frank Lohse. Kaiser Engineers has completed the pouring of the storage tank foundation and Frank Lohse has poured the pump house foundation and the first lift on the walls. Shop fabrication of piping is underway by Kaiser Engineers.

The installation of underground conduit to this facility is nearly completed.

181-N Building

The pressure transmitter panel has been received from Bailey Meter and is now being installed.

Operational tests have been run on the screen wash system.

108-N Building

All work inside this building has been completed.

163-183-N Buildings

The subcontractor has resumed testing of the demineralization system in the 163-N Building.

All work has now been completed on the clear-well overflow crib.

182-N Building

Work is underway in this building on most of the punch list items included in the Custody Agreement. The following pumps have been run-in: the high and low pressure injection pumps, the high pressure raw water pumps, the high and low pressure filter water pumps, the afterheat removal fill pump No. 3 and the lube and fuel oil transfer pumps.

184-N Building

The repair work on the boiler has been completed, including satisfactory completion of hydrostatic tests. The boiler was returned to service April 23, 1963.

Numerous revisions and corrective work was accomplished on the 184-N Building during the boiler outage. De-bugging is underway in preparation for going on automatic control.

1900-N Building

A new routing has been established for the area fire protection piping in the area west and north of the 105-N Building to clear the temporary construction ramp. The encasement for this pipe for the railroad crossing is now in place and the excavation for the lines has been completed.

Primary Piping

Primary pipe work in the HUICO Shop is essentially completed. The last load of material is expected to be shipped from the shop to the field by May 3, 1963.

In the field, erection of primary pipe is approximately 81 per cent complete. Hydrostatic testing has been performed for that portion of primary pipe in heat exchanger Cell No. 5.

Pipe Erection

Connector installation has been completed in the rear pipe spaces and 859 connectors have been installed on the front face. Considerable rework of Grayloc surfaces has been required on these, both at the HUICO Shop and in the field.

The major effort for diversion valve installation in the rear pipe spaces is underway. The tooling is no longer a limiting factor and the completion of this work should meet primary loop hydrostatic test schedules.

All rod drive units, except for one held at the 189-D Building for testing, are now installed. Hydrostatic testing of the hydraulic system is underway in the right rod room.

The Ball X System is now basically complete with the exception of instrumentation.

NPR Testing Program

The overall progress on test procedure preparation has continued to improve. Essentially no progress was made on actual test performance due to incomplete construction and punch list activity. Overall progress may be summarized as follows:

	<u>Procedure Preparation</u>		<u>Test Performance</u>	
	<u>Scheduled</u>	<u>Actual</u>	<u>Scheduled</u>	<u>Actual</u>
Last Month	28.4	10.6	7.5	0.6
This Month	33.5	24.1	12.0	0.6

Administration

The following material has been processed during the period of March 18, 1963 through April 14, 1963.

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Drawings	286
Criteria	0
Specifications	0
Requisitions	61
ATP's	17
Other	<u>8</u>
Total	372

Bailey Meter material processed as of April 14, 1963 is as follows:

Released as Noted for Fabrication Drawings	85
Released for Information	95
Released for Fabrication Drawings	247
Not Released for Fabrication Drawings (B&R)	1
Approved without Exceptions (GE)	<u>6</u>
Total	424

Following is the status of Subcontract KE-11252 (HUTCO) data as of April 15, 1963.

Total Number Received	2807 (Includes 2007 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
Number Received for Information Only	0
No Approval Required	2007

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PROGRAM EVALUATIONDesign 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 March 31, 1963 Cost Estimate displays an estimate \$4,629,700 higher than the Official Estimate. This is an indicated decrease of \$2,416,900 since the February 28, 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 May 1, 1963, based on Revision # 5 to the AEC construction schedule, dated February 1, 1963, is as follows:

	<u>Scheduled</u>	<u>Actual</u>
Temporary Construction	88	88
General Area Systems	90	91.7
105-N Building	87	88
109-N Heat Exchanger Building	77	81
163N-183N Water Treat. Facilities	100	99.1
181-N River Water Pump House	99	99.8
182-N High Lift Pump House	100	99.7
184-N Standby Power House	99	99.9
153-N Switchgear Building	100	100
NPR Project (CAI-816)	85	87

RESPONSIBILITY

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

ORGANIZATION AND PERSONNEL

	<u>3-31-63</u>	<u>4-30-63</u>
<u>Exempt</u>		
Permanent	92	93
Tech. Grad.	1	1
<u>Non-Exempt</u>	<u>23</u>	<u>24</u>
<u>Total Personnel</u>	116	118

<u>Transfers</u>	<u>From</u>	<u>To</u>	<u>Effective Date</u>
Duncan, WO (exempt)	CE&UO	Field Eng'g.	4-1-63
Fitch, MH (nonexempt)	N-Reactor Project	N-Reactor Fuels	4-1-63
Sturgis, MB (nonexempt)	N-Reactor Fuels	N-Reactor Project	4-1-63
Getz, DW (nonexempt)	Prod. Fuels, IPD	Drawing, Specifica- tion & Material Control	4-8-63

SAFETY AND SECURITY

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

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 except as listed below. 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.

HW-SA-2938, N-Reactor Fuel Piece Charging Machine, dated March 25, 1963
by H.D. Lenkersdorfer, G.A. Newell, D. Marinos,
J.R. Carrell, and G.H. Strong

TRIPS

<u>Name</u>	<u>Firm and Location</u>	<u>Date</u>	<u>Purpose</u>
Fastabend, JH	Bruce Industries, Inc. Gardena, California	3-26 to 3-29-63	To review nozzle cap production progress
Rohrbacher, RA	APED San Jose, California	4-1 to 4-5-63	To witness tests - Gamma Energy Monitor
McCullough, JD	Avien, Inc. Woodside, N. Y.	4-1 to 4-15-63	To assist in resolving engineering, production and testing problems delaying completion of the Flow Monitor System
McCullough, JD	General Electric Pittsfield, Mass.	4-4-63	To discuss required modifications to the Inductrol units of the Flow Monitor System
Rohrbacher, RA	Western Piping & Engr'g San Francisco, Calif.	4-4-63	To review status of order - Rupture Monitor Valve Racks
Swezea, GL	Bailey Meter Company Wickliffe, Ohio	4-15 to 4-18-63	To discuss instrumentation problems relating to the Bailey Panels and Controls
Harty, WM	Bailey Meter Company Wickliffe, Ohio.	4-18-63	To discuss instrumentation problems relating to the Bailey Panels and Controls
GL Swezea WM Harty	Avien, Inc. Woodside, N. Y.	4-19-63	To assist in resolving engineering production and testing problems delaying completion of the Flow Monitor System
Mundt, WJ	Burns and Roe, Inc. Hempstead, N. Y.	4-24 and 4-25-63	To discuss remaining design items and closeout of Hempstead activities
Mollerus, FJ, Jr.	Burns and Roe, Inc. Hempstead, N. Y.	4-24 to 4-26-63	To discuss remaining design requirements and to review Secondary Coolant System requirements for the Conversion project.
Fastabend, JH	Bruce Industries, Inc. Gardena, California	4-23 to 4-26-63	To review nozzle cap production progress and witness testing of first nut forging
Reinig, LP	Bruce Industries, Inc. Gardena, California	4-23 and 4-24-63	To determine conformance of materials being procured to NPR specifications
Reinig, LP	IEEE Conference Los Angeles, California	4-25 and 4-26-63	To attend meeting of IEEE Regional Officers

TRIPS (cont'd.)

<u>Name</u>	<u>Firm and Location</u>	<u>Date</u>	<u>Purpose</u>
Johnson, VV	U.S. Merchant Marine Academy	4-1 thru 4-12	Evaluating the N.S. Savannah control simulators
Rediske, AC	Avien, New York	4-8 thru 4-12	Observe vendor testing of components.
Stice, JE	APED, San Jose, California	4-11/12	Consult on hydraulic fluid containment in connection with horizontal rods and hydraulic elevators.
Kratz, EM	Portland, Oregon	4-4/5	Meeting with BPA on N-Reactor conversion
Kratz, EM	Burns & Roe, New York, N.Y.	4-24 thru 4-27	Conversion design

VISITORS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
Gazda, W	ATL, Schenectady, N.Y.	4-22 thru 4-24	Perform services on N-Reactor control rod drive under contract GEL-ATM-1-63
Jens, W	APDA, Detroit, Mich.	3-27	Discuss serpentine concrete
McCormick, HV Lonn, J	Ingersoll Rand Co., Portland, Oregon	4-9/10	Discuss control of air motors as used in magazine loader
Zahn, R	Rush S. Drake Associates, Inc., Seattle, Wn.	4-11	Discuss weldable strain gages and instrumentation for use with hot ATP
Oldham, W Rowe, R	Consolidated American Services, Inc., Los Angeles, California	4-19	Discuss chemical cleaning of secondary piping system

SIGNIFICANT REPORTS ISSUED

<u>HW Number</u>	<u>Classification</u>	<u>Author</u>	<u>Date</u>	<u>Title</u>
HW-77223 PT1	Unclassified	EM Kratz	4-9-63	N-Reactor Conversion - Project Representatives Meeting No. 3, March 29, 1963
HW-77223 PT2	Confidential	EM Kratz	4-9-63	" " " "
HW-77277	Unclassified	EM Kratz	4-15-63	N-Reactor Conversion - Project Representatives Meeting No. 4, April 11, 1963

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SIGNIFICANT REPORTS ISSUED (cont'd.)

<u>HW Number</u>	<u>Classification</u>	<u>Author</u>	<u>Date</u>	<u>Title</u>
HW-76668 RD	Unclassified	Mollerus, FJ, Jr.	4-9-63	NPR Conversion Criteria, Process Instrumentation and Control, Secondary Cooling System
HW-77027	Unclassified	Robinson, RK Taylor, GR	4-29-63	N-Reactor, Pressurizer - High Pressure Injection Pump Simulation Study
HW-77166	Confidential	Goss, CL	4-2-63	NPR Circulating River Water System Transient Performance Following a Loss of Power
HW-77391	Confidential	Muraoka, J	4-25-63	NPR Dump Condenser Boiling Analysis
HW-77467	Secret	Condotta, DL	4-29-63	Reactor Design Analysis Monthly Report - March, 1963
HW-77468	Confidential	Muraoka, J	4-29-63	Analysis of Phase II Operating Conditions for NPR

Manager, N-Reactor Project

JS McMahon:mbs

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N REACTOR PLANT OPERATIONPROVISIONAL CUSTODY OF FACILITIES

Repair of the 184 boiler was completed on April 24. Testing for acceptance was initiated on April 22 with the vendor and third-party representatives in attendance. Shift personnel was increased to provide sufficient manpower for required plant operation.

TRAININGPlanning & Scheduling

Twelve pile operators finished the ten day training in the N Plant planning and scheduling system use and participation on April 3.

Orientation

Group VI, 31 people, completed the course May 3. Ten of the group who were returned to shift work on April 27 will have final review and tests in the field. Group VII, 22 people, are scheduled to start on May 13.

Maintenance

Twenty-four instrument oriented personnel completed a two-week digital transistor training class on April 5. Maintenance training on the plant nuclear instrumentation was given by an APED Engineer to 24 employees. The classes were held daily, in four-hour sessions April 15 through April 26. Instruction on the boiler light-off system was conducted by a Bailey Meter Company Instrument Engineer, April 29 through May 3.

Certification

Formal training with twelve operators and thirteen supervisors was started April 8. A two-hour minimum class is scheduled each day. Length of the course is not definite due to progress made as measured by frequent testing. Rework of presentation material and units of study is being done to increase the efficiency of the program and instruction. Instructors, expert in their fields, are being drawn from Research, Engineering, Design, and Operations groups.

Off-Site

Ten exempt people completed two weeks of process operation training on the simulator at the U. S. Merchant Marine Academy, Kings Point, New York on April 13. Regular Academy instructors presented the training using N Reactor problems as the basis of instruction.

TESTING

Retesting of the 184 boiler and associated equipment was initiated on April 24. Testing work continued but no test fully completed.

PROCEDURE PREPARATION

Building of the mechanics of the planning and scheduling system is progressing on a new schedule to meet the earlier fuel loading date. The feasibility study for use of ADP equipment was completed. A plan for plant-wide use resulted to assure N Plant efforts would be compatible. Cost information and a schedule for procurement were completed.

Detailed procedures for ATP and Operation Tests are about 50% completed. Other procedure preparation is on schedule.

SIGNIFICANT REPORTS ISSUED

None

TRIPS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
R. C. Knop J. C. Clausing K. L. Fowler	Consolidated Edison Indian Point, New York	4/8 to 4/14	Observe ramp power level changes.
L. T. Sneddon	Avien Incorporated New York	4/8 to 4/14	Inspection of equipment
R. A. True	Bailey Meter Co. Cleveland, Ohio	4/15 to 4/21	Observe test and check-out of equipment
E. W. Wilson	Bailey Meter Co. Cleveland, Ohio	4/15 to 4/18	Discuss instrument- ation
E. W. Wilson	Burns & Roe Hempstead, New York	4/19 and 4/25 to 4/29	Discuss NPR design

VISITORS

<u>Name</u>	<u>Firm & Location</u>	<u>Date</u>	<u>Purpose</u>
J. A. Haaga	APED, San Jose, Calif.	4/29	Consult on startup problems

PERSONNEL

No Changes

WM Mathis:GVRs:ds

Manager - N Reactor Plant

FINANCIAL OPERATION
APRIL, 1963

The following were the principal activities of the N-RD Financial Operation during April, 1963, other than those activities of a routine and continuing nature.

N-Reactor Business Information Project

The work on the Business Information Project for N-Reactor continued during the month. A revised schedule for the study was prepared, based on completion of the system by December 1, 1963. During the month, an evaluation of input equipment was completed, as well as a system justification. Work on definition of inputs and outputs and study of programing requirements was continued during the month. The most critical item presently in the schedule for completion of the system is the procurement of input equipment.

N-Reactor Production Study

The study of N-Reactor costs and capabilities mentioned in last month's report was furnished to RLOC-AEC on April 4, 1963, in Document HW-77198 - "Production Studies." This study forecasts production and costs associated with N-Reactor at more favorable levels than those forecasted at the time N-Reactor was authorized to be built as a convertible reactor.

Department Budgets

All budget work associated with the Revised Budget for FY 1964 and the Budget for FY 1965 was completed during April, 1963, and required reports were furnished to Contract & Accounting Operation. Amounts budgeted for FY 1965 are compatible with costs reported in the Production Study mentioned above.

Paper Work Reduction

The work of the Financial Operation associated with the reduction of Department paper work was accelerated during the month of April. Certain substantial contributions to this effort have already been made. These include:

1. Reduction of frequency and quantity of certain Personnel Accounting reports.
2. Initiation of a new reporting system for N-Reactor Fuels Section which provides for more easily understood reports and a decreased number of reports which are to be maintained.
3. Improved reporting systems for N-Reactor Plant, N-Reactor Project, and Research & Engineering Sections which will more nearly fit the needs of those businesses.

In addition, certain clerical functions are being transferred to Contract & Accounting Operation.

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HAP0 Overhead

The question of method to be used for allocation of the HAP0 Overhead Pool and the composition of the pool is still being studied. A final N-Reactor Department report will be issued on May 24, 1963.

A. B. Stenquist
For
Manager - Finance

J. Milne:skd

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END

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