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March 7, 1961
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FUELS PREPARATION
DEPARTMENT

MONTHLY REPORT
FEBRUARY
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HANFORD ATOMIC PRODUCTS
OPERATION

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FUELS PREPARATION DEPARTMENT
MONTHLY SUMMARY REPORT
FEBRUARY - 1961

PRODUCTION

Finished production for February was 628.6 tons, or 102% of forecast.

At month end the bare uranium inventory was 1,512 tons compared to 1,480 tons for January. Finished inventory was 725 tons at month end compared to 825 tons for the previous month.

ENGINEERING

Present Reactor Fuel Elements

Three natural and three enriched I&E fuel elements failed in reactors during February. This compares with 11 failures during the previous month and 18 in February of 1960. The severity index for reactor exposure conditions is about twice that of one year ago.

Radiometallurgical examination of three collapsible rail bumper fuel elements discharged after 1160 MWD/T has been completed. These fuel elements exhibited a high corrosion weight loss. The hydraulic resistance of the rails apparently contributed to broad shallow corrosion grooves and "ledging." Self-supported CIVN fuel elements, discharged after 900 MWD/T were examined in C basin. These showed further evidence of uniform corrosion and "ledging" attack. Hot areas between the rails suggest that flow irregularities contribute to higher surface temperature and corrosion. Flow restrictions resulting from fuel elements being 5 mills greater than nominal size and the resistance offered by "wide" spot welded rails also contributed to the increased corrosion. Projection rails are being redesigned and the fuel element design is being optimized. These two improvements are expected to sharply reduce the unusual corrosion patterns recently observed on projection fuel elements.

One of three columns of oversize self-supported fuel elements (PIP-1) was discharged after an exposure of 168 MWD/T. These had been under irradiation in C Reactor in overbored graphite channels and Zircaloy tubes. Preliminary visual examination show their general appearance to be similar to normal production fuel at the same exposure. IPD has received authorization to overbore 17 additional graphite channels in

C Reactor, increasing the facility for overbore evaluation to twenty channels. Two ribbed aluminum, five ribless Zircaloy, and ten ribless aluminum channels will be installed. The fuel for charging these columns has been prepared and is being measured prior to charging about March 6.

Approximately 210 tons of dingot uranium are currently being irradiated and 303 tons have been discharged. The irradiation performance of dingot uranium is comparable to ingot uranium.

Two completely untransformed cores were rejected by the UT-2 Testers this month. Improved surface inspection tests have been completed and are ready for installation on these testers. The first of NLO's UT-2 Testers (bare core) is being debugged in the Testing Methods Laboratory. The second and third units are essentially complete. Arrangements have been made for the onsite training of National Lead of Ohio (NLO) and Mallinckrodt Chemical Works (MCW) operating personnel to begin March 20, 1961.

Twenty thousand and three hundred OIIE bumper fuel elements were produced on 306 Pilot Plant ultrasonic welder. The yield through inspection was 90.7% as compared to 81.9% last month. A recently completed four-channel ultrasonic weld monitor is undergoing check-out prior to its application to the ultrasonic welder. Trial runs have been favorable and the instrument appears to reveal subtle changes in welder performance.

Fabrication of "Doe" fuel elements for surface film formation and corrosion studies is essentially complete.

The initial canning of 4500 four inch I&E fuel elements was carried out in the ALSi Pilot Plant. These elements are scheduled for charging into bowed tubes in the old reactors.

Evaluation of the irradiation test of nickel plated fuel elements is virtually complete. Summary results follow:

1. It is probable that 100% of the 0.5 mil nickel plate adhered up to 800 to 850 MWD/T.
2. Corrosion weight losses on unplated X-8001 clad control pieces were 6 to 15 times that of the plated pieces.
3. Crud formation on nickel plated pieces was significantly less.
4. Micro cracks in the nickel plate existent on about 15% of the fuel elements did not propagate into the underlying aluminum and resultant corrosion was insignificant.

5. Pitting corrosion of aluminum appears to result in the storage and basin examination water and not in the reactor process water.
6. Confirming results of earlier tests, the 0.5 mil nickel plate effectively protects the underlying aluminum from hot spot corrosion.

Ex-reactor corrosion testing of nickel plated fuels was continued in reactor process water at 120° and 165° C, with no accelerated corrosion apparent. Exploratory corrosion testing of nickel plated C-64 aluminum in 360° C pH 10 water continued with encouraging results. C-64 aluminum with a 0.5 mil coat survived 690 hours under these conditions in a refreshed autoclave.

HLO equipment for electroplating has been modified and improved to provide for the nickel plating of uranium fuel cores in preparation for the evaluation of fuel elements produced by the solid state diffusion process. A contract has been negotiated with the Savannah River du Pont Plant to utilize their high pressure autoclave for the diffusion bonding of fuel elements, using inert gas as a pressure media. Equipment for hot press die bonding of I&E fuel elements by the HAP0 hot press process is in the final stages of check-out. Procurement of 1,000 HAP0 I&E fuel elements produced by Sylcor hot press die process is proceeding.

Production testing of the prototype pressurized quench machine is complete and six production models have been ordered from Technical Shops for the 313 Building.

NPR Fuel Elements

All of the test elements in the KER loops operated satisfactorily during February. Four 1.6% enriched K single tube fuel elements were discharged after an exposure of 1,985 MWD/T. Examination in the viewing basin indicated no gross dimensional imperfections. Two elements, however, exhibited a greyish oxide on the end cap weld similar to that found on fuel elements previously rejected after autoclaving. Further examinations in Radio-metallurgy are planned.

KER Loop 2 was recharged with four 23" NPR inner tube fuel elements. A full range of models to simulate the operation of NPR fuels have now been charged. Additional test charges awaiting irradiation include: Six 0.947% enriched NPR inner tubes, six natural uranium NPR inner tubes, and four 1.6% enriched K single tubes.

Examination of a 1.6% enriched K single tube fuel element in the Radio-metallurgy facility showed that the weld was not cracked as was originally suspected. This fuel element was discharged during the previous month after an exposure of 1,193 MWD/T.

During the past two months, 27 tubes of K size I&E Zircaloy-2 clad fuel elements, including depleted, natural, and enriched uranium, have been extruded. Each of these tubes produces 33 fuel elements.

The metallurgical structure of enriched uranium billets has resulted in wrinkled zirconium cladding on the N inner tube and I&E extrusions. Since this problem primarily developed with the change to the purer enriched metal, it appears that the impurity level has a significant effect on the quality of subsequent extrusions. A series of tests are being carried out in conjunction with National Lead of Ohio (NLO) to resolve this problem. These will use up to 24 ingots and will involve the production and evaluation of billets with controlled higher impurity content (125 ppm iron and 100 ppm silicon) prepared by various fabrication techniques; pierced, core-cast and drilled. Previous billet preparation procedures, which were satisfactory for natural uranium, will also be reproduced. As an interim measure, beta heat treatment of finished billets will be continued at HAP0. Tests show that this treatment results in satisfactory, smooth outer cladding at some sacrifice of interface smoothness. Eighty-three uranium billets were checked with the grain size tester. The resultant data continued to correlate with extrusion results and accurately identified billets for rejection.

Approximately seventy 0.947% enriched I&E billets were received from Fernald. These will be beta heat treated to provide acceptable material for the I&E coextrusion program.

Harvey Aluminum Company is producing Zircaloy tubing for components by hot extruding of oversize material followed by cold drawing to size. Some machining is required on at least one of the diameters. The preliminary order of 100 ft of 7.3" O.D. tubing will be delivered by the Harvey Aluminum Company in the near future.

The following extrusions were made: 25 composites of zirconium clad enriched and natural uranium to provide I&E fuel elements, N inner and outer tubes, 15 Zircaloy billets to provide I&E end caps and inner clad, and 1.285" thin wall tubing for HLO. Six bare Zircaloy rod extrusions were also made at low reductions and temperatures. Because of the excellent results obtained development work on low reduction tube extrusions using some scrap Zircaloy-2 or Zircaloy-3 billets are planned.

An additional etch facility has been installed for bright etching of zirconium clad fuel elements prior to autoclave. Tests show the additional etch in "clean" solutions will result in bright weld bead surfaces and the desirable black oxide after autoclaving.

All coextruded fuel elements processed through the autoclaves during February had good black oxide films on all surfaces. Instances of voids and non-wetting in the zirconium-beryllium braze have been corrected by adjustment of the time-temperature cycle. In addition, recent test developments have very significantly improved the sensitivity with which braze closure defects may be detected. Techniques for brazing Zircaloy clad I&E pieces have been perfected to a point where satisfactory brazes can be routinely made.

The study of warp in NPR inner tubes geometry was continued in an effort to define the driving forces causing warp. This included double reverse bending in the plane of deformation followed by a second beta heat treatment; and further study of the interactions of grain orientation, wall thickness and warp during one or more heat treating cycles.

Final check-out of a chloride salt heat treating bath and a nitrate:nitrite quenching bath for K size I&E Zircaloy clad fuels was completed.

Experiments have revealed a heretofore unobserved effect in the behavior of an ultrasonic wave propagating in thin-wall tubing. Pulses reflecting from defects in zirconium tubes were observed to shift in frequency as the tube was rotated under the test head. At certain discrete positions, pulses were observed to contain two definite frequency bands. At other positions, only one band is observed. In terms of present knowledge, these effects are unexplainable. They do, however, closely agree with theoretical values predicted from Lamb's theory.

GENERAL

Manufacturing yield for eight-inch I&E was 88.7 per cent compared to 79.0 per cent for the previous month.

There were no autoclave failures during February. Total failures for the calendar year remain at two.

The February operating efficiency was 93.2 per cent compared to 91.5 per cent for January.

Both design and construction work on the new fuels facility is on schedule.

PERSONNEL STATISTICS

Number of employees as of January 31, 1961 847
 Number of employees as of February 28, 1961 851

	<u>Exempt</u>	<u>Nonexempt</u>	<u>Total</u>
General	1	1	2
Manufacturing	81	354	435
Engineering	37	27	64
Financial	12	6	18
Plant Facilities	43	280	323
Relations Practices	5	4	9
TOTAL	179	672	851

STAFF

General Manager, Fuels Preparation Department	R. L. Dickeman
Acting Manager, Manufacturing Operation	H. E. Berg
Manager, Engineering Operation	L. H. McEwen
Manager, Financial Operation	W. S. Roe
Manager, Plant Facilities Operation	E. Hilgeman
Manager, Relations Practices Operation	R. W. McCullugh
Special Studies Assignment	J. W. Talbott

Mr. W. N. Mobley was appointed Manager of the Manufacturing Operation, effective March 1, 1961.

PATENT SUMMARY - FEBRUARY 1961

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 February 1961 except as listed below. Such persons further advise that for the period therein covered by this report, notebook records, if any, in the course of their work have been examined for possible inventions or discoveries.

L. H. McEwen -- Magnetohydrodynamic Power from Electrically Conductive Boiling Liquids.

R L Dickeman

General Manager
 Fuels Preparation Department

RL Dickeman:mkm

MANUFACTURING OPERATION

February, 1961

CURRENT OPERATIONSProduction and ProductivityStatistics

	NORMAL					ENRICHED				Total
	8"	C	K	O		C	K	O		
	Solid			Reg.	Bumper			Reg.	Bumper	
<u>Current Month's Production</u>										
Acceptable Fuel Ele- ments Produced (Tons)	0	49.8	183.5	269.3	0	9.3	28.7	28.0	60.0	628.6
As % of Forecast Production	-	106	78	175	-	34	74	76	240	102
Cum. % of Forecast for Current Quarter	-	99	88	122	36	52	102	76	179	98
As % of Past 3 Month's Average Production	-	102	89	135	-	85	70	140	273	108
As % of Past 12 Month's Average Production	-	96	86	115	-	78	76	97	1000	99
% of Forecast Achieved Last Fiscal Quarter	-	86	107	107	49	64	98	36	136	98
% of Forecast Achieved Last 4 Fiscal Quarters	-	104	104	105	49	88	98	76	136	101

Operating Efficiency

Current Month (%)	93.2
Forecast (%)	93.0
Previous Month (%)	91.5

Manufacturing Yield

Current Month (%)	-	91	87	89	-	93	86	80	81
Forecast (%)	-	87	87	87	78	87	87	87	78
Previous Month (%)	-	78	78	81	-	77	81	77	-

Bare Uranium Available for Processing (Tons)	1512
Finished Products in Storage (Tons)	725
Special Products Finished (Pieces) Boll	1279
Uranium Utilization	97.5

ACTIVITIESProduction

Finished production for February was 628.6 tons or 102 per cent of forecast. One overtime day was forecast and two overtime days were worked, February 18, and February 25, 1961, to maintain inventories at desirable levels, part of which provided material for additional bumper fuel element fabrication.

Canning operations continued through the month at ten canning line shifts per day on a two-shift basis. A total of 217 canning line shifts were operated during the month.

The first production run of four-inch normal uranium I & E fuel elements (OVN) was completed in the 306 Pilot Plant during February. This material was processed in the Pilot Plant because extensive modifications would be required to fabricate four-inch pieces in the more mechanized 313 Building production lines. Some processing difficulties were experienced until the pre-heat time for the shorter cores was reduced. The shorter pieces were also difficult to process in the Pilot Plant facing lathes, and Special Products equipment was used to supplement the production efforts. The shorter fuel element is required for use in distorted tubes in two of the older reactors. If a continuing need exists for four-inch elements, necessary modifications will be required to permit processing in the 313 Building. Plant modifications necessary to permit the processing of the small elements in the 313 Building are under study.

An improvement was reported for six-inch enriched bumper fuel element welding during February. A total of 60 tons of enriched bumpers were produced with a 91 per cent welding yield. During the two previous months problems were experienced with "rail smashing" in the welding operation. This was determined to be caused from the softness of the rail alloy and the location of the node with respect to the weld. Harder aluminum sheet stock was obtained for rails and the node points were shifted so they aren't in the exact position where rails are attached, resulting in significant yield improvements.

Production of eight-inch bumper fuel elements was in process at the end of the month. The eight-inch run was delayed seven days while the welder crew was assigned to two-shift production of OVN fuel elements in the Pilot Plant and modifications were made to the prototype welder. In view of present finished inventory levels, it was not considered advisable to divert an excessive amount of regular production material for finished bumper inventories. A total of 13 tons of eight-inch OIIN fuel elements were welded but none reached finished storage by the end of February.

Since the ultrasonic welder was installed on November 1, 1960, a total of 128 tons of six-inch enriched OIIE bumpers and 89 tons

of eight-inch OIIIIN bumper fuel elements have been produced. Through the end of February, the reactors have charged 7 and 47 tons of OIIIIE-B and OIIIIN-B fuel elements respectively, leaving finished inventories of 121 tons of six-inch enriched and 57 tons of eight-inch normal bumper fuel elements. The high enriched inventory represents pre-production for the coming E-N demonstration load.

In addition to the 121 tons of enriched bumper material, almost enough for the first load of 130 tons to be charged in May, a total of 4041 four-inch "boll" pieces have been fabricated. This compares with the 5000 pieces required for the initial charge. A similar amount of both will comprise the second charge, now scheduled for September.

Yield Control

The manufacturing yield for eight-inch fuel elements of 88.7 per cent for February reflects a significant improvement over the January yield of 79.0 per cent. A comparable improvement in the manufacturing yield for six-inch fuel elements was attained. The February yield of 84.1 per cent compares to the January yield of 78.8 per cent for this model.

A revaluation of visual inspection criteria and standards for surface and inclusion rejects have provided a more stringent control at final inspection. This action plus the return to a higher degree of process control throughout the plant were the primary factors leading to the significant gains in yield.

There were no autoclave failures during February. Total failures for the calendar year remain at two.

Construction Projects

CAF-847 - New Fuel Cladding Facility

	<u>Scheduled</u>	<u>Actual</u>
Design	100	100
Construction	37	36

Work is proceeding on the assembly of the final package for outside painting, site work, etc.

The installation of chemical equipment has started. Most of the processing tanks are in place.

Requisitions are being issued on small equipment such as billet carts, braze vessels, and tooling fixtures.

Scope, preliminary design, and design criteria are complete.

CAF-894 - Increased Compressed Air Capacity

	<u>Scheduled</u>	<u>Actual</u>
Design	100	100
Construction	22	22

The vendor drawings on the compressor have been approved.

CGF-903 - Projection Fuel Element Modifications, 313 Building, Phase I

	<u>Scheduled</u>	<u>Actual</u>
Design	91	89
Construction	NS	5

The No. 3 etch machine has been relocated. The work was much simpler than expected.

Design of the conveyor system and soap tank has been completed.

The requisition has been issued for the autoclave baskets.

CAF-915 - Increased Warehouse Space, 303 Area

	<u>Scheduled</u>	<u>Actual</u>
Design	NS	30
Construction	NS	-

The scope drawings of the Architect-Engineer were reviewed and comments were sent to the AEC on February 9. The Architect-Engineer is now working on final design.

Other Activities

The following pieces were processed through the Fuel Recovery facilities during February:

8" Solid	172
8" I & E	29,648
6" Enriched	14,618
Total	44,438

PLANT CONDITIONS, INCIDENTS, AND IMPROVEMENTSGeneral

The operating efficiency of the A1Si Shop was 93.2 per cent during February compared to the scheduled 93.0 per cent. Equipment problems, most of which involved the bare core testers and the canning jacks,

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were responsible for 66 per cent of the lost time, while the remainder was due to operational outages.

Finished inventories at the end of February were 725 tons, 142 of which are bumper element models. This inventory represents an effective one month supply.

The month end bare uranium inventory was 1512 tons, a 2.4 month supply.

Two shipments of scrap were made during the month totalling 31,987 pounds of normal uranium, 9,944 pounds of enriched uranium, and 7,583 pounds of C-6. Additional enriched scrap remains to be returned due to restrictions imposed by existing nuclear safety standards.

The vendor evaluation program is progressing with some degree of success. Approximately 7,200 OIIIN cans were received from one vendor. Wettability of these components is questionable, resulting in their removal from the production line until an improvement can be made. Representatives from the company visited the plant on February 16 and 17, 1961, to review this condition. However, it was recommended that the vendor discontinue production until the wettability problem could be resolved.

A total of 88,500 OIIIN components have been received from a second vendor, approximately 45,000 of which were canned during February. The quality and yield of this vendor's components have been equal to or above the approved vendor. An additional 100,000 contour base component pairs have been ordered from this second vendor, 30,000 of which should be received about March 15, 1961.

The monitor charges from a production test of components from a third vendor have been discharged and sent to "C" basin for evaluation. The evaluation of the monitor charges and discharge of the remaining test material should be complete in March, at which time consideration must be given to placing further orders with this vendor.

The major portion of the downtime experienced on the UT-2 bare core testers during the past month seems to stem from the following two causes:

1. Surface Test Set-Up - Difficulty in the set-up of the surface test is due primarily to totally inadequate crystal manipulators. Replacement manipulators, which are now being fabricated, should be available within the next two weeks.
2. Stepping Switches - Malfunction of these components has become more and more frequent, and no improvement in this area can be expected until these switches can be replaced. New switches have been shipped, and as soon as they are received, a program will be initiated to replace the switches and revamp the readout panels on a tester by tester basis.

All thermocouples in the canning furnaces have been changed to the three wire safety type. This will assure that a broken couple will

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be detected immediately because the indicator on the recorder will go to the maximum limit causing the furnace to go on low power. This should solve the problem of unknowingly operating outside of process limits because the thermocouple was recording improperly.

Since its installation, 2-A automatic welder has consistently produced a slightly higher number of weld rejects than the other machines. These rejects could be classified into two types -- either arc strike or arc decay "blowouts". The times during which this machine malfunctioned were so infrequent that determination of the trouble has been very difficult. It had been surmised that the trouble was either in the current programming or the cubed root sine wave transformer. On several occasions slight programming modifications were made but with little improvement. Recently the transformer was exchanged with one on another of the machines and still the sporadic malfunctions persisted. Because of the unreliability of this welder, it has been used as a spare to be put in service only when one of the other four welders was inoperative.

Due to the increasing demands being made on all production equipment, it was agreed this machine should be made fully operative if at all possible. On January 13, 1961 (during a Class "A" overhaul), it was found that the transient suppression resistor controlling the impedance in this circuit during the arc strike and arc decay portions of the weld cycle had been incorrectly wired. The wiring fault was corrected, and the welder has been restored to full service with a performance equal to the other four machines.

An evaluation has been made of the effect of the spire pulse preheating technique on radiograph and welding reject rates. This could not be done during the production test for evaluating the spire pulse preheating technique since data for welding and radiograph rejects are kept by lot and not by canning line. To obtain this information, lots of the same product models canned in January, 1961, using the spire pulse preheating technique. The results of these data are as follows:

1. A reduction of radiograph rejects by a factor of 2.0 on lots canned using the spire pulse preheating technique (difference significant at 0.01 level).
2. No significant difference in welding rejects.

The ultrasonic welding yield for February was 93 per cent as compared to a yield of 81.7 per cent for January. The ultrasonic welding yield is the yield from weld pre-cleaning through welding, weld testing and de-soaping. The first major step in improving the welding yield was the solution of the rail smashing problem. Rail smashing was eliminated by brazing steel washers in the welder collets in place of the rubber pads. It had been

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demonstrated that the relative positions of the vibration node and the weld had a considerable effect upon rail smashing.

Another improvement in yield resulted from better positioning of the rail on the fuel element. When the rubber collet pads were replaced with steel, a pointer was installed in one end of each collet to extend into the fuel element base and prevent the piece from rotating during welding. Increasing the pointer depth by approximately 0.005 inches reduced fuel element movement and resulted in less misalignment rejects. Improvements in the rail feeding mechanism also resulted in a more accurate rail positioning and less misalignment rejects.

Improvements were also made during the month in the methods of controlling the concentration of the soap solution (improved temperature control and development of a more rapid analytical technique) and in the procedure for monitoring the tensile strength of the welds.

No enriched I & E fuel elements were completed during February. Progress through the process has been slow, with significant delays at heat treatment and vapor blast. Heat treatment was delayed awaiting startup of furnaces in the 313 Building. Vapor blast has caused some delay in processing initial material because of poor nozzle design and other maintenance problems. Although the operation was improved with a new nozzle, the throughput rate is very slow - six to eight pieces per hour - this will be a "bottleneck" operation.

The combined technical and operating problems which have delayed the startup of I & E production have not been completely solved and another full month of debugging will be required before maximum production is attained.

306 Pilot Plant

In addition to production of CVIN, OIIW and OVN fuel elements in the 306 Pilot Plant, five development tests were conducted during February. Included in the schedule were wetting tests to evaluate aluminum component shipments, D.C. welding studies, pressure quenching, a thermocouple test, and optimization of the O.N.P. (nickel plated) fuel element canning cycle.

305 Test Reactor

Routine testing continued to remain in a relatively current status in 305 Test Reactor with a testing back log of approximately 8 days. During February, approximately 22 per cent of the reactor operating time was devoted to graphite testing. Shipments of NPR graphite are still being received and will continue for about another month, but at a decreasing rate. Approximately one-third of the graphite for the Oak Ridge EGCR has also been received and tested.

OPERATING PLANSCoextrusion Billet Quality

The major process problem in the coextrusion operation is that of uranium billet quality. Uranium core structure is such that during coextrusion, the zircaloy clad is deformed resulting in a wrinkled clad on the outer surface. As a result of meetings held with representatives from NLO on 2-15-61 and 2-16-61, a program has been initiated to develop a satisfactory fabrication technique. The primary emphasis of this program is placed on the use of silicon-iron additives to effect grain refinement and reduce "ingotism".

Fuel Recovery Facilities

A study of the fuel recovery process has revealed a means of increasing filter press throughput. A design concept for automatic pressure control of the press is being proposed. This can be accomplished by placing a flow meter on the waste solutions and coupling it to an automatic regulator of pressure input on the press. By so doing, the pressure will be automatically increased whenever there is a significant drop in the flow of waste solutions. Currently the pressure is increased manually at irregular intervals with a consequent loss in filter press throughput due to the fact that the press loses efficiency constantly as the cake builds up.

Beryllium Hazard Control

Beryllium monitoring of the Pilot Plant operations is being planned and coordinated with concerned personnel. The information provided from this program will be applied to the beryllium control problems of the shop operation. However, a peak effort will be necessary during the first months of plant operation to insure that control procedures are adequate for the equipment and operating procedures used in the plant.

Detailed control procedures to be used by the shop operation will be completed by March 1, 1961. These are tentative procedures based on present knowledge of the problem, but they will be of some assistance in planning monitoring procedures and outlining areas in which additional test data is required.

EMPLOYEE RELATIONSSafety Performance

Members of the Manufacturing Operation were treated for 25 medical treatment injuries during February, a frequency rate of 3.46.

Radiation Control

The four week badge results for the period ending January 27, 1961 has not yet been received. One employee received what appeared to

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be a significant dose (435 mr) of low energy X-ray radiation. Careful investigation of the incident revealed that the man had in all probability worn his badge during a series of diagnostic neck X-rays, and had obtained the exposure in this manner.

Security Violations

None

Training

Four two-hour classes were held for instrument technicians on the UT-2 digital voltmeter circuitry during this reporting period and classes on the 25 megacycle bond test modifications are currently in session.

Reports of Invention

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 February.

WN Mobley
Manager - Manufacturing

WN Mobley:HFT:gl

STATISTICS

1960 - 61

ENGINEERING OPERATION

February, 1961

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
CE Bussert JE Blasdel CE Polson JF Schiltz	National Lead of Ohio	SM Gill GW Riedeman CH Shaw AE Guay	2/14-16/61	Discuss uranium billet technology.
E Meyer H Watts	Sylcor	JT Stringer CA Burgess DC Worlton	2/8-9/61 2/10/61	Discuss fuel technology. Discuss nondestructive testing.
JA Fellows	Mallinckrodt	JT Stringer	2/15-16/61	Discuss uranium technology.

TRIPS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
WA Hendricksen	U.S. Chemical Milling Corp.	DC Atkins CJ Vinton	2/2-3/61	To close out R&D contract CA-264.
GW Riedeman	Bridgeport Brass	LL Becker	2/5/61	Technical liaison - N-Reactor fuel cladding components; Zr-2 pilot orders and copper can alloy development.
	Airline Welding	HL Meredith	2/6/61	
	Harvey Aluminum	GA Moudry	2/7/61	

PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Reason</u>	<u>Date</u>
WK Alexander	Engr. Proc. & Dev.	Transfer from IPD	2/1/61
PD Lockwood	Secretary	Deactivate-personal illness	2/10/61
TR Groupman	Engr., Proc. & Dev.	New Hire	2/20/61
EF Perrizo	Technician	Transfer from FPD-Mfg.	2/20/61

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INVENTIONS

All Engineering Operation personnel engaged in work that might reasonably be expected to result in inventions or discoveries advised that to the best of their knowledge and belief no inventions or discoveries were made in the course of their work during February, 1961, except as listed below. Such persons further advise that for the period therein covered by this report, notebook records, if any, in the course of their work have been examined for possible inventions or discoveries.

L. H. McEwen

MAGNETOHYDRODYNAMIC POWER FROM ELECTRICALLY
CONDUCTIVE BOILING LIQUIDS

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ALSI PRODUCT ENGINEERINGFuel Performance & Requirements

Three natural and three enriched I & E fuel elements failed in the reactors during February. These ruptures are summarized as follows:

<u>Fuel Element Type</u>	<u>Reactor</u>	<u>Exposure (MWD/T)</u>	<u>Rupture Classification</u>	<u>Canning Date</u>	<u>Cladding Alloy</u>
I & E Natural*	B	774	Side Hot Spot	9 - 2-60	X-8001
**	C	706	Internal	2 - 4-60	C-64
	C	702	Side Hot Spot	10-14-60	X-8001
I & E Enriched	D	638	Unclassified	6 -15-60	X-8001
	H	825	Side Hot Spot	8 -22-60	X-8001
	KW	583	Side Hot Spot	11-10-60	X-8001

* Dingot uranium

** Six-inch watermixer

All ruptures occurred in high power factor tubes of the reactors and at exposures more closely approaching variable goal. Side hot spot failures attributed to localized corrosion attack as a result of fuel misalignment and warp were the major rupture category.

The six ruptures occurring this month compare with 11 ruptures last month and with 18 ruptures occurring in February 1960. The severity index of reactor service is about twice that of one year ago.

Further Radiometallurgical examination of a natural I & E internal rupture sustained in KE Reactor during November has failed to establish the point of coolant entry. The sectioning of a subsequent internal rupture from the same reactor has revealed a coolant path in the outer braze layer leading toward the cap end. Both of these ruptures were from production lots (KR-277-D and KR-279-D) suspected of containing cores with a high iron content. Surface quench cracks typical of cores with a high iron content were observed only on the first core (lot KR-279-D) examined, and there is no evidence that the surface cracks contributed to failure.

A fourth natural alloyed dingot I & E rupture (side hot spot) was sustained this period. Neither this rupture nor previous ruptures involving dingot material can be associated with uranium quality. The rupture rate for approximately 3000 tons of dingot fuel elements discharged at goal to date is 1/20,000 or essentially equivalent to ingot fuel elements.

Radiometallurgical examination of three high-weight loss, collapsible (20 mils thick), bumper I & E fuel elements exposed to approximately 1160 MWD/T

in D Reactor is essentially complete. Maximum weight losses occurred in broad shallow grooves adjacent to the top rails at the base (downstream) end of the pieces and in the form of general ledge-type attack over 30% of the surface on both sides of the elements extending from the cap end to the bumpers on the base end. The deepest corrosion penetration was in a shallow groove where the residual can-wall measured 20 mils. In the area of ledge-type attack the minimum residual wall was 23 mils. The corrosion of these and other bumper elements included in the same production test was two-fold greater than for the control material. About a 5% reduction in coolant flow and associated higher surface temperatures resulting from the increased hydraulic resistance of the rails contributed to increased corrosion of the bumper fuel. Further refinements of fuel and bumper rail design are expected to alleviate this problem.

Recent C Basin examination of self-supported (CIVN) fuel elements discharged from C Reactor at exposures of about 900 MWD/T has shown further evidence of uniform corrosion and general ledging attack. Hot areas observed between the upstream and downstream rails suggests flow anomalies are contributing to higher surface temperatures between the rails. Flow reductions resulting from the fuel diameter being 5 mils oversize, including flow resistance offered by the wider (tab width 5/8 inch, rail width 3/16 inch) spot-welded rails, has contributed to elevated surface temperature and increased surface corrosion.

One of three columns of oversize self-supported fuel elements (PIP-1) being irradiated in overbored graphite channels and zircaloy tubes in C Reactor was discharged at about 168 MWD/T exposure. The remaining columns are continuing to operate at an average tube power of about 1225 KW and a maximum specific power of 72 KW/ft. Maximum surface temperatures are in the order of 110 C. Preliminary visual examination of the discharged pieces shows the general appearance of the pieces is not significantly different from normal production fuel discharged at the same exposure. No hot spots or hot areas were observed and only slight ledging attack was noted on one piece. Abrasion of the bearing surface on all of the rails on some pieces suggests the rails were too high (69 mils) or the process tube was undersize making insufficient allowance for thermal swelling of the pieces, or a combination of thermal and irradiation-induced swelling. Post-irradiation measurements are expected to verify whether permanent deformation of the pieces occurred.

IPD has received authorization from the AEC to overbore 17 additional graphite channels in C Reactor, increasing the total facility for evaluating oversize fuels to 20 columns. Ribbed aluminum tubes will be installed in two of the channels, ribless zircaloy tubes in five channels, and ribless aluminum tubes in the remainder. The necessary fuel elements for these columns have been prepared and measured for charging on or about March 6.

Uranium Technology

Approximately 210 tons of dingot uranium are currently being irradiated and 303 tons had been discharged by mid-February. One side-hot-spot failure

occurred this month in un-outgassed dingot uranium at 774 MWD/T: 4 failures in dingot have occurred to date in un-outgassed uranium. The irradiation performance of dingot uranium is comparable to normal ingot uranium. About 113 and 57 tons of regular and vacuum-outgassed-before-heat-treatment virgin dingot cores were canned this month. In addition, 41 tons of virgin dingot cores were canned as large-grained material. The large-grained cores include cores with a UT-2 minimum voltage range of between 0.3 and 0.1 volt and false rejects due to instrument problems. The bond test reject rate for dingot and ingot OIIIN cores remains low--1.7% for dingot and 0.5% for ingot.

The reject rates for the OD surface test circuit on the UT-2 testers for normal ingot, enriched ingot, and normal dingot virgin cores were 1.4, 1.0, and 0.7%, respectively. This is approximately 1/2 the January reject rate.

Two completely untransformed cores were rejected by the UT-2 testers this month from a production lot of vacuum-outgassed-before-heat-treated dingot cores supposedly heat treated by NLO.

The segregation of large-grained cores in OIIIN and KIVN models is continuing. At a setting of 0.3 minimum voltage, 11.0% of the ingot and 12.7% of the dingot cores were segregated this month into large grain lots. However, this includes false rejects due to instrumentation difficulties. When the large-grain uranium lots were retested at a setting of 0.1 minimum voltage, only 0.03% of the ingot and 0.04% of the dingot cores retested were rejected for large grains.

By routine sampling of incoming core lots, an enriched core was found that analyzed 265 ppm iron (exceeding the specification of 150 ppm maximum iron) but did not contain quench cracks. Unfortunately, the lot containing the majority of the cores (about 100 pieces) from this high iron ingot had already been canned and bumpers attached. A waiver was issued limiting the use of the suspected lot to low power factor tubes.

The 1739 CVIN rolled ingot cores for PIP-1 (oversize fuel) were UT-2 tested for grain size and internal and external surface defects. The same reject limits were used for the ingot cores as were used previously for the CVIN extruded dingot cores. The reject rates for large grains, external surface defects, and internal surface defects were 5.0, 2.2, and 0.7%, respectively. There were no small grain or difference (large-grain variation) rejects. In addition, 175 CVIN rolled ingot cores with iron and silicon adjusted to an average of 139 and 106 ppm for grain size control were received and UT-2 tested. The grain size on these high iron and silicon cores was much finer than for the regular cores which contained an average of 72 ppm iron and 20 ppm silicon. Test quantities of the additive ingot cores will be irradiated if the Met. Lab examinations are favorable.

Fifty (50) completely alpha-recrystallized dingot cores and 70 control cores from the same rods have been received for examination. Alpha recrystallization

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produces an equiaxed grain structure with very little residual stress and may reduce the tendency for cores to warp during irradiation. The alpha-recrystallized cores attenuated the ultrasonic energy more than the normally heat-treated control cores. Whether this difference in attenuation is due to grain size, grain shape, or a combination of both is unknown. Orders for large quantities of alpha-recrystallized dingot cores are awaiting Met. Lab. results.

Process Development

An initial canning of 4422 four-inch I & E fuel elements by the AlSi process was completed in the pilot plant during the month. The yield on the first 1368 pieces through non-destructive testing was 70.2%. Rejects were as follows:

<u>Reject Type</u>	<u>Percent</u>
Canning Assembly	5.6
Facing	2.9
Female Weld	5.0
Male Weld	2.6
Mandrel	2.3
External Bond	1.4
External Penetration	3.1
Internal Bond	0.2
Internal Penetration	1.8
Marred Surface	

Although some problems were experienced in assembling fuel of different dimensions and according to modified process cycles, further refinement of both process equipment and techniques is expected to achieve yields comparable to regular production material without sacrificing fuel quality. Because of some evidence of component non-wetting, the fuel elements are being tested on a 25-megacycle bond tester to detect and reject any pieces with non-wet areas. The non-wetting appears to have resulted from the components being unusually dirty and the pH of the Diversey deoxidizing solution being slightly high (2.5).

Approximately 500 oversize I & E fuel elements were also assembled in the pilot plant. Based on destructive and non-destructive tests, these fuel elements were of comparable quality to those previously produced, except for a minor incidence of component non-wetting. Part of the finished fuel elements canned this period, including those remaining from a previous run, have been measured and assembled into charges to be loaded into an additional 17 overbored channels in C Reactor early next month. Collapsible bumper rails (60 mils high) were attached to two columns scheduled to be charged in ribbed aluminum process tubes. Collapsible self-support rails (69 mils high) were attached to the remainder for charging in ribless zircaloy and aluminum tubes.

Examination of fuel elements and evaluation of data from the irradiation test of nickel-plated fuel elements (PT-263) is virtually complete, with the following results:

1. It is very probable that 100% of the 0.5-mil thick nickel plate adhered throughout the irradiation up to 800-850 MWD/T. Possible flaking of the nickel was initially reported on 11 out of the 136 fuel elements in areas approximately 1/4-inch diameter or less. A second look at some of these revealed that the nickel was probably still present. A third visual examination after 4 1/2 months in the storage and examination basin water revealed very obvious nickel sloughing on approximately 20% of the fuel elements, most of which was not observed on the original examination. It is concluded that exposure to basin water causes nickel sloughing, probably by undercutting corrosion at plate discontinuities caused by mechanical damage. Exposure to basin water and mechanical damage well may have caused or enhanced the possible flaking observed on the initial visual examination which was carried out six weeks after discharge from the reactor.
2. In the region of maximum in-reactor corrosion, weight losses on the X-8001 jacket, unplated controls were at least six to fifteen fold higher than for the nickel-plated fuel elements. In this region the weight loss for the nickel-plated fuel elements ranged from 0.6 to -0.3 grams with an average of approximately zero.
3. The crud film accumulated on nickel-plated fuel elements weighs significantly less (by 2-1/2 fold average) than that on X-8001 jacketed, unplated fuel elements. This may be beneficial in reducing surface temperatures; however, no data exists at present.
4. Macro-cracks observed in the nickel plate of approximately 15% of the fuel elements did not propagate into the underlying aluminum and aluminum corrosion was insignificant (< 1/2-mil depth).
5. Pitting corrosion of the aluminum appears to result from exposure to storage and examination basin water, as revealed by metallographic examination of an irradiated and an un-irradiated fuel element exposed to examination basin water for approximately the same length of time. It should be pointed out that the examination basin water does not contain sodium dichromate, which inhibits pitting attack in reactor process water. It does contain other solutes including aluminum deoxidizing and etching compounds, which may be excellent media for galvanic corrosion.
6. Confirming results of an earlier irradiation test (PT-207), a 0.5-mil thick nickel plate effectively protects the underlying aluminum from hot-spot corrosion. With a normal incidence of hot spots,

visual examination indicated no in-reactor corrosion of aluminum had taken place--the hot spots were merely film patterns with sound nickel and aluminum underneath the boiler scale. These results were confirmed by metallographic examination of a single fuel element. It is noteworthy too, that macrocracks in the nickel plate (Item 4 above) were not observed in any of the hot-spot regions.

Corrosion testing of nickel-plated fuel elements in ex-reactor process water flow tubes at 120 and 165 C continued, but no examinations were carried out this month. As reported last month, tests of up to 5-1/2 months duration revealed no accelerated attack of aluminum at discontinuities in the nickel plate, and in general, corrosion rates were less than expected for unplated aluminum.

Exploratory corrosion testing nickel-plated C-64 alloy aluminum in 360 C, pH 10 water continued with encouraging results. Material having a 0.5-mil thick nickel plate survived 690 hours in a refreshed autoclave, with the nickel defecting at identifying scribe marks and 340 hours with macrocracks made by severely deforming the sample. Samples having 0.1-0.3 mils thick nickel exhibited severe aluminum corrosion after 160, 300, 520, 690 hours. Comparatively, unplated aluminum is totally reduced to oxide in 40 hours or less. Samples having 1/2-mil thick plate exposed in 290 C, pH 10 flow tubes exhibited aluminum corrosion at sharp corners of the sample after only one week exposure, but the remainder of the surface was not attacked. These tests are continuing.

Efforts to obtain a low-phosphorous, chemically deposited nickel plate on aluminum have been moderately successful, in that material with a 2-3 weight percent phosphorous has been produced by commercial plater. Reproducibility of these results is being checked at present. Reduction of the normal 8-10 weight percent phosphorous is of interest since the ductility of the plate would probably be improved.

A second small-scale test of canning in nickel-plated components was carried out, aimed at the AlSi-uranium bond strength and wetting of the cap by the AlSi. Analysis of preceding test data indicated the following at the best conditions tested. (Values are in pounds of force required to pull a 1/4-inch drain stud.)

Average	600
Minimum	475
Maximum	640

These values are about the same and better as have been established for large segments of standard production, but the trend of the data indicated that maxima have not yet been achieved.

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Progress on electron-beam closure welding of fuel elements canned in nickel-plated aluminum components was impaired by deposition of vaporized aluminum on the glass porthole and other components within the vacuum chamber during the welding process. Several vapor collection devices were fabricated and tested, and it is believed the problem has been alleviated.

Work in the 304 Bldg. nickel-plating facility included final shakedown tests under actual plating conditions, and an initial test of plate adhesion. Control of the plating process conditions during equilibrium operation was highly satisfactory as follows:

Solution pH - $\pm .025$ pH units,
Plating Tank Temperature - ± 0.5 C,
Solution Composition (Nickel & Reducing Agent -
 $\pm 5\%$ of nominal,
Plating Rate - 0.5-0.7 mils/hour.

The electrolytic protection system was found to be probably 100% effective in preventing plate deposition on the stainless steel plating tank and heat exchanger surfaces. Initial results on plate adhesion testing indicate the material produced is grossly inferior to that produced in earlier laboratory experiments and by most commercial platers. Studies to improve the plate adhesion are underway.

Laboratory equipment for electroplating has been modified and improved to provide a facility for electroplating of nickel on uranium fuel cores in preparation for evaluation of fuel elements produced by solid state diffusion bonding processes. New plating racks utilizing platinum-gold alloy contact points and designed to alternate between two contact points are undergoing test. Spray equipment for de-ionized water rinsing also has been incorporated in the plating line.

A contract has been negotiated with Savannah River to utilize their high pressure autoclave to diffusion bond fuel elements using inert gas as a pressure media. Techniques for pre-assembling the components and vacuum welding prior to autoclaving have been worked out. Final assembly of the test pieces awaits satisfactory preparation of the nickel-plated fuel cores.

Equipment for hot-press die bonding of I & E fuel elements by the HAPO hot-press process is in final stages of checkout. The four-hole furnace block assembly has been rebuilt and is undergoing final checkout. Delivery of the specially designed spire-can components is expected the first week of March.

Preparations for procuring 1000 HAPO I & E fuel elements produced by the Sylcor hot press die process are proceeding. Two changes in the Sylcor process will be incorporated in making the test pieces: the components will be die sized onto the uranium core and the aluminum components used will be of the integral spire-can type.

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Process Technology

Several revisions were made to the process specifications for the Lead-Dip Canning Process (HW-47029). Some of the major changes were as follows:

1. Specifications for the components and assembly of solid fuel elements were deleted.
2. An alternate I & E core length 0.053 inch longer than the standard core length was added to increase uranium content of finished fuel elements without changing length specifications or altering nominal cap and base thickness.
3. Specifications for contoured base components to improve can-base preheating rates were added.
4. Specifications for use of cap-spire pulsers to improve wetting and remove oxides and gases trapped underneath the cap wafer were added.
5. Specifications were added for four-inch I & E fuel components and assembly.

Production testing of the prototype pressurized quench machine has been essentially completed and a work order has been issued to Tech Shops for fabrication of six production model machines for 313 Bldg. Fabrication of a prototype adjustable quench basket, designed to accommodate any sleeve size from 1-3/4 inches to 2-5/16 inches in diameter, is complete and it is expected that this design will be used on the production model machines.

A canning line mechanization feasibility study, carried out jointly with engineers from Facilities Engineering and Methods Engineering, has been completed. Results of the study are reported in HW-68658.

It has been found that direct current is superior to alternating current for welding AlSi-bonded fuel elements in that the direct current process eliminates more braze voids and results in less weld cracking. As a result, all of the AC welding power supplies in the 313 manufacturing process are scheduled to be replaced with DC power supplies. However, current tests have revealed that there are significant differences in the DC power supplies currently available on the market. One of the primary differences is in the amount of ripple in the welding current supplied by the power supply, which varies from 70% to less than 3%, depending on the design of the power supply. Recent laboratory scale tests have revealed that, with low-current ripple, a much better weld is obtained, less ozone is produced, less shielding gas is required and less electrode erosion is experienced. As a result, the low-ripple power supplies have been recommended for the DC conversion of the 313 Bldg. machines. One machine (a semi-automatic on line 1) has been converted for DC welding and has been operated since February 15 with very few operating problems.

Since porous areas in the brazed closure are known to be a factor in fuel element failures, work is continuing in the area of void elimination and void detection. Some initial work was done to determine the possibility of detecting braze voids by monitoring the welding variables during the closure welding process. Work thus far showed that a signal is reflected in the arc voltage when a large braze defect is encountered. During the course of these tests it was noted that any ripple in the welding current produces a corresponding ripple in the arc voltage which will make the problem of void detection at this point more difficult if not impractical.

306 AlSi Pilot Plant Activities

Approximately 7260 uranium cores were dip brazed in the pilot plant for process development purposes. The number of fuel elements for reactor use was 6540. Major items of development were:

1. Aluminum component cleaning and wettability tests in molten AlSi for component vendor evaluation.
2. Investigation of tube distortion by pressure quench technique.
3. Fabrication of CVIN fuel elements for IPD reactor testing.
4. Fabrication of OVN four-inch I & E fuel elements for evaluation of improved cycle and to provide elements for reactor use.
5. Fabrication of OII watermix fuel elements for bumper production test.
6. Caustic etching of welded fuel elements for evaluation of improved welding techniques.

The installation of the non-corrosive fume exhaust system has been completed. The pilot plant cleaning and dip-canning facilities were out of service for six days to allow for installation.

During the month, 20,286 OIIE bumper fuel elements were produced on the automatic ultrasonic welder in the 306 pilot plant facility. The yield through the inspection station was 90.7% compared to 81.9% last month for this element model. The designed capacity of the welder has been demonstrated by the production of 2321 completed elements in two continuous shifts.

The ultrasonic rail welder was taken out of service for seven days this month for maintenance, modification, and product change. About 24 items of work were accomplished, including modification of the chucks to eliminate the smashed rail problem experienced with six-inch elements.

Offsite procurement of bumper design rails has been delayed until early March. Stoker Engineering of Tacoma, who was awarded the contract, was late

in receiving the X-8001 alloy material and they have had difficulties with their dies.

A warm-up period may be required on the automatic ultrasonic welder. The average weld strength of the first 100 elements is below the daily average. A testing program has been initiated to determine if an electrical or mechanical warm-up period is required.

An additional variable in the ultrasonic welding process has been determined. The temperature of the fuel element at the time of welding affects the welding characteristics. The transduced reed is more efficient, in that greater tip displacement and power is obtained, when welding on elements hot from the soaping operation. Additional development is required to capitalize on this welding characteristic.

The following special products have been produced on the manual ultrasonic welder:

1. Five charges of KVN s/s for reactor use.
2. Ten charges of CVIN s/s for reactor use.
3. Two charges of CVINB for reactor use.
4. Four CVINB watermix fuel elements.
5. Three hundred (300) CVIN s/s perforated tubular dummies.
6. Sixty (60) CVINB solid aluminum dummies for the short bumper charged tubes.

Fabrication of "doe" fuel elements for the crud and corrosion studies by IPD is complete except for autoclaving.

The first large-scale evaluation of the automatic pressure quench machine has been completed. A factor of two improvement in the average bond count was obtained, compared to a factor of four during the feasibility testing. The lower improvement factor was due to extreme tube distortion during quenching. Tests proved that the tube distortion can be eliminated by not introducing the pressurization air down the bore of the element. Since the modification of the quench machine to indirect inlet air, the CVIN elements have been pressure quenched, resulting in very low bond counts and no bond rejects.

COEXTRUDED PRODUCT ENGINEERING

N-Reactor Fuel Development

KER Testing

Visual examination in the Radiometallurgical facility of one of the 1.6% enriched K-single tube fuel elements from the first discharge of this design, indicated the weld was not cracked as originally suspected. The fuel element had been discharged from Loop 4 at an exposure of 1193 MWD/T.

Four 1.6% enriched K-single tube fuel elements were discharged from Loop 2 at an exposure of 1985 MWD/T. Visual examination in the viewing basin indicates no gross dimensional imperfections. Two of the elements have a greyish white oxide on the end cap in the vicinity of the braze welded end closure. The appearance of this oxide is similar to that observed on fuel elements rejected after autoclaving due to white oxide. Photographs will be taken and the fuel elements will be examined in the Radiometallurgical facility.

Loop 2 was recharged with five NPR inner tube fuel elements, 23 inches in length. Test material now being irradiated in the KER loops include ten NPR inner tube fuel elements, 15 inches in length; nine NPR inner tube fuel elements, 23 inches in length; and four K-single tube, 1.6% enriched. Additional test charges awaiting irradiation include six NPR inner tube, .947% enriched; six NPR inner tube natural uranium, and four K-single tube 1.6% enriched.

Coextruded I&E Program

In the past two months, twenty-seven tubes of I&E fuel elements, including depleted, natural and enriched uranium have been extruded. Each extruded tube produces thirty-three fuel elements. Of the 200 depleted uranium fuel elements, twenty-five have been processed through welding, the remainder have been processed through brazing or chemical milling and discarded when acceptable material was available for processing. All the depleted uranium extrusions had excessive clad wrinkling due to a metallurgical problem in the uranium billet. 130 fuel elements fabricated with natural uranium are in process, and approximately 50 will be autoclaved the first week in March.

The clad surface on these fuel elements is typical of acceptable material extruded in the past. The enriched uranium fuel elements are at various stations throughout the process, with the first group to be finished approximately March 15. Equipment breakdown has prevented processing this material as rapidly as initially planned. The major problem has been with the abrasive blasting equipment which is distinctly a marginal operation for this program insofar as the pilot plant is concerned.

A design problem on the cap of the I&E enriched piece has presented a problem unique to the I&E geometry. This is due to the tru-line feature which results in having to cut the caps thinner on either the inside or the outside in order to make the appropriate step for this design. This left a residual cap thickness which may be too thin and subsequent welding produced a product where the heat effected zone touched the uranium. The question of reactor charging is under study.

Materials Development and Procurement

Uranium Billets

The recent serious problem with uranium billets has been one of metallurgical structure which, upon coextrusion, results in wrinkled zircaloy cladding on the outside of the N-inner tube design and on the I&E design. A thorough examination of all the data indicates several variables are involved in the change from previous, apparently satisfactory, material. A previous base point order of billets which worked well in three different designs was one which was pierced from heat treated ingots of natural uranium containing somewhat high levels of impurities. A series of tests involving up to twenty-four ingots is being worked on in conjunction with NLO, and an attempt is being made to resolve the current problem. Much of this material will have iron and silicon added in the respective amounts of approximately 125 ppm and 100 ppm. In addition, some material will be pierced to recheck whether this is really introducing working effects. Another possible variable, that of the effect of the cast-in hole upon stresses residual after beta heat treating, will also be evaluated. Plans are to have an evaluation on one of the more likely improvements in technique by about the end of March.

Two shipments of I&E .947% enriched billets have been received this month from Fernald. A total of approximately seventy billets is involved, and these will be once beta heat treated here at HAP0 in order that they can be used to make acceptable product for the I&E² program.

Zircaloy-2 Cladding Shells - Vendor Development

Harvey Aluminum is currently producing zircaloy tubing for components for the coextrusion process by hot extruding oversize and cold drawing to size, followed by some machining on at least one of the diameters. A problem of some concern developed when it appeared they would be unable to draw the 8-1/2 inch diameter tubing down to its approximately 7.3 inch OD size. However, adjustment of lubricating conditions permitted the original drawing scheduled to be achieved. It is anticipated that this preliminary order of 100 feet of 7.3 inch OD tubing will be delivered by Harvey shortly.

During the month, several items of inner cladding were extruded on the Loewy press in the 333 Building. These are itemized under the section on "coextrusion".

Copper Cans

A large quantity of 6 inch and 7-1/2 inch copper tubing was received onsite late in the month, relieving a bottleneck in this material.

Billet Preparation

Copper Cleaning

A continuation of the tests begun in December indicates the source of problems in copper cleaning. The cleaning difficulty is dependent upon the type and composition of the copper.

TABLE I

<u>Type Copper</u>	<u>Etchant</u>	<u>Resultant Surface</u>
OF/ASTM B224-48	Brightner ⁽¹⁾	Good
" "	Nitric ⁽²⁾	Good
DLP/ASTM B224-48	Brightner	Good
" "	Nitric	Fair
DHP/ASTM B224-48	Brightner	Good
" "	Nitric	Unsatisfactory

(1) Brass Dip and Zinctone (30 sec., 25°C) gave equal results.

(2) (45% HNO₃, 30 sec., 25°C)

The data in Table I indicates that the DHP copper may not be cleaned with nitric acid. A black heavy oxide forms immediately as the part is brought out of the etchant. The two brightner solutions work equally satisfactorily for all three types of copper that are presently used for copper components.

Uranium Billet Cleanup

The amount of metal that must be removed to clean up the uranium depends upon the surface condition. Some billets clean up nicely by removing only a half a mil, while others require a removal of 2 mils. Various acids and combinations of acids have been used to remove the surface. The manner in which the metal is removed is not important providing the final step is a cold nitric acid etch followed by a cold water rinse.

Copper Welding

Vacuum tight welds are being produced routinely. There is foreign material rising out of the weld some of the time that makes welding a little difficult. Some evidence indicates that it is worse with the copper brightener. A modified cold pressure closure method for sealing the evacuation tube has been modified and should be ready for trial by March 6, 1961.

Crimping Device for Evacuation Tubes

A four inch hydraulic cylinder with a "C" clamp attachment will be used to seal the evacuation tubes on billets after evacuation. On the "C" clamp are two punches shaped in such a manner as to pinch the cross section of the tube. These punches are insulated from each other in order to apply 125 amps at 3 volts to the copper tube. The punches have a 1/8 inch radius on the tips, as the tips come in contact with the 3/8 inch copper tube, the high current is applied heating the small section of tube to approximately 200°C in 20 seconds. When the tube is approximately 200°C, the hydraulic pressure is applied squeezing the tube flat. After the tube is pinched, the free end of the tube is broken off with a few side motions. The pressure is released, and the end of the evacuation is then TIG welded for final closure. If the tube becomes too hot for the hose, there will be a 1" x 1" water cooled quench block just below the rubber hose connection to prevent the hose from getting hot.

Extrusion Process

N-Inner Tube and I&E OD Surface Roughness

The OD surface finishes of N-inner tube and I&E coextrusions as effected by uranium billet quality is essentially identical. The present problem of roughness is exaggerated in the I&E extrusions due to thinner clad, and therefore evaluation of uranium billet quality is best made on the I&E design.

Ten I&E extrusions were made during the month. These extrusions were made to make a preliminary evaluation of the effect of ingot heat treatments, various charge makeups of the ingot, and final beta heat treatment of the finished billet on the extruded tubing. The results of this evaluation are as follows:

100% Derby vs Composite Charge Make-up

Billets extruded which were composites (15-35-50 and 15-15-70) produced better OD surface finishes than all-derby billets with identical billet tester results. Although these surfaces were better, the material is all borderline and some portions of the extrusions were rejected.

Short Beta Treat vs Long Beta Treat

Evaluation of the two types of ingot heat treatment is difficult because the change in heat treatment occurred on the same material that the charge make-up was changed from all-derby to composite. However, from four N-inner tube extrusions and primarily from the billet tester, it is believed that the short beta heat treatment of the ingot has improved billet quality.

Beta Heat Treatment of Finished Billets

Single beta heat treatment of finished billets has proven to be very successful in 90% of the material extruded. Extrusion results and billet tester results on the latest billet shipments indicate that 9 out of 10 billets received will produce satisfactory material if the billets are beta heat treated.

Coextrusion

The following extrusions were made during the month:

1. 6.0 Inch Tooling

23 Composites - T-120 through T-138 and T-141 through T-144

T-120 through 129	I&E Enriched
T-132 through 135	"
T-141 through 144	"
T-130, 131, 136, 137 & 138	NIT Enriched

4 Zircaloy Billets - Zr-44, 56, 57 and 58

Zr-44	I&E End Caps
Zr-56, 57 & 58	" " "

2. 7.6 Inch Tooling

2 Composites - T-139 and 140

T-139	NOT Enriched
T-140	NOT Normal

6 Zircaloy Billets - Zr-45 through 50

Zr-45, 46 & 47	4.850 OD Rod
Zr-48, 49 & 50	5.850 OD Rod

1 Copper Billet

3. 5.0 Inch Tooling

3 Zircaloy Billets - Zr-51, 52 and 53

All billets extruded to I&E inner clad.

4. 4.0 Inch Tooling

2 Zircaloy Billets - Zr-54 and 55

Both billets extruded to 1.285" x 0.142" wall for HLO.
Stalled Zr-55.

Bare Zircaloy Extrusions

Six bare zircaloy rod extrusions were made during the month. These extrusions were all very low reductions at low temperatures. From the excellent results and experience obtained from these extrusions, some low reduction tube extrusions will be made with scrap zircaloy-2 or zircaloy-3.

Copper Removal

The problem of complete copper removal through the copper and zircaloy stripping processes is well under control. Very few tubes have copper residues after stripping.

Zircaloy Etching

An additional etch facility has been installed for final bright etching prior to autoclave. This etch will be free of copper and uranium contamination. When copper concentration in the etch bath builds up, a thin copper film has been observed to plate out on the clad surfaces. The additional bath will provide closer control over highly sensitive etchant variables which contribute to autoclave corrosion film properties. The additional bath will be equipped shortly with a mechanical agitator which will provide the necessary agitation to provide bright weld bead surface which will corrode black in the autoclave. The agitator is now being fabricated.

Chemical Milling

The chemical composition of the etchant has been fixed at:

Cu - .160 - .200 #/Gal.
 $\text{SO}_4^{=}$ - 4.9 - 5.1 #/Gal.
 NO_3^- - 0.85 - 0.90 #/Gal.⁽¹⁾
U - .10 - .70 #/Gal.

(1) It appears that the tolerance is improved if the $\text{NO}_3^-/\text{SO}_4^{=}$ is kept between .17 and .18.

There may be slight refinement in the solution to counteract anticipated higher Fe content or any other changes which may occur in other steps of the process that would effect the milling operation. The changes would be small. Efforts are now directed toward the physical method of milling.

End Closure Brazing

All fuel elements reaching the braze station were closed as required. The techniques for brazing I&E pieces have been perfected to where satisfactory brazes can be made routinely. Some instances of voids and non-wetting of the uranium were experienced early in the month but were corrected by adjustment of the time-temperature cycles. Attempts to "wide braze lines" to facilitate welding have been only partially successful. It is quite apparent that the use of a wide braze between the cap and clad will be a serious complication to the brazing operation and should be used only if clearly justified.

MMI has been able to keep us supplied with brazing alloy, and it is expected there will be no problem from now on.

The new 3000 cycle M-G induction heater is being installed. It is anticipated that this unit will do a better job of heating on the inside of the inner piece.

Beta Heat Treating

Warp in NPR Fuels

The study of warp in the NPR inner tube geometry was continued. The earlier concept that warp could be a function of variable preferred orientation was studied on the basis that the shift of the zircaloy surface might be related to a variation in preferred orientation. However, neither the position of the lead nor the lag of the shift appears to be significantly related to the plane of the first beta heat treated warp. Thus, shift is not a single cause of warp.

Many fuel lengths were given a second beta heat treatment to determine if wall thickness variation might be related to the plane of the warp of that second treatment. No correlation was found.

In both of the above studies, the vector quantities that describe the change in the magnitude and the direction of warp from:

- (1) as-received to first beta heat treated,
- (2) first beta heat treated to second beta heat treated were determined.

These driving forces again could not be related to the shift positions and to the variability in wall thickness.

The most disturbing facts that have arisen from this work is that a large change in warp (its direction and magnitude) occurs when pieces that have been beta heat treated are re-beta heat treated. This implies that a once-beta heat treated condition may not be

stable enough to be a basis for a reverse bending:re-beta heat treating to achieve straightness. The second fact is that there were 19 warp rejects out of 64 N-inner fuel elements heat treated during the month. Thirdly, the distribution of the angle of the plane of warp has become more random than was previously noted.

There remains only to examine a possible interaction of effects whereby:

- (1) Warp from a first beta heat treatment might be a function of both (i.e. an interaction) of shift and wall thickness,
- (2) Warp from a second beta heat treatment might have some function of both the first warp and wall thickness.

Straightening

Pieces that were out of specification for warp after a single beta heat treatment have been re-beta heat treated in the vector analysis work on the warp mechanism (rather than reverse bowed and re-beta heat treated). Some double beta heat treated pieces have been reverse bowed and re-beta heat treated, and they have behaved differently from those having a single beta heat treatment. In general, straightness was not obtained.

Fuels have been supplied to HLO for hot-roll straightening. Both N-outer and N-inner geometries have been straightened to within 4 mils total indicator reading. However, these pieces have not been evaluated by either an autoclave treatment or an additional beta heat treatment.

Heat Treatment of K, I&E² Fuels

A chloride salt heat treating bath and a nitrate:nitrite quenching bath have been prepared in the 313 Building. This equipment will be used to heat treat K, I&E² fuels using an automated merry-go-round to transport the fuels in both baths. Final check-out of the operation was completed on 2/27/61.

Vapor Blasting

Modification of the inner nozzle to balance abrasive slurry and air flow and relocation of the air jet in an upward position has increased throughput rates. The addition of 100 mesh to 220 mesh aluminum oxide has also had a beneficial effect.

End Closure Machining

During the month, approximately 130 I&E pieces and approximately 30 N-inner pieces were machined. The machining results showed that the I&E contour forming tools had a life of over 130 cuts before regrinding was required. The step-cutting tools used had a life of approximately 50 cuts. After 50 cuts, a burr (0.002 inch to 0.005 inch high) formed on the edges of the step-cut. This burr interferes to some degree with cleaning prior to welding. Different types of tool design will be tried to eliminate this burr.

To determine beryllium concentrations, air samples were taken at the cutting tool with and without ventilation. Further, air samples were taken in the exhaust duct of the ventilation system. The results of the air sampling are not yet available.

During the first week of March, the first beryllium swipes will be taken from the shoes issued to the three operators.

Braze Closure Welding

It appears that the spikes in the weld are caused by the superheating of the braze metal as zircaloy dissolves into the weld and thus raises its melting point. As the braze metal is superheated, its pressure increases until it cannot be restrained by the fluid weld metal and thus a column penetrates the fluid weld until the pressures are in equilibrium.

The grain structure of the wide brazes is not of a uniform size, showing areas of rather coarse grains. In addition, there is an occasional fine spike that extends to the throat of the weld. The throat of the weld is the region between the tops of the unmelted cladding and unmelted cap. One very fine spike, in 72 welds examined, was found to penetrate approximately one-half the way through the weld proper toward the surface.

The problem of "spikes" on the I&E² fuel elements has been virtually eliminated by increasing the outer braze width to 0.030 inch by 0.100 inch deep and the inner braze width to 0.030 inch by 0.100 inch deep. In addition, the thin sections of both end caps has been increased from 0.100 inch to 0.170 inch to assure that the braze metal fusion does not penetrate to the uranium during welding.

The problem of "spikes" on the N-fuel design has been virtually eliminated by increasing the outer braze to 0.020 inch maximum and the inner to 0.040 inch minimum. There is evidence from the I&E² work to indicate that a 0.030 inch minimum inner braze will be satisfactory. This is being investigated.

Solid State Diffusion Bonding

The specimens processed at 600°C and 6 hours have been prepared for metallographic examination as follows:

- (1) Control specimen as received,
- (2) Beta heat treated once,
- (3) Beta heat treated twice.

Metallographic examination is to start on 2/28/61.

Spot checking of mounted specimens has disclosed the following:

- (1) Outer clad to cap and part of inner clad to cap on one control specimen was not bonded, but a good bond existed between the uranium and the cap.
- (2) Clad to cap bonding was better than 70%; the unbonded areas being small and widely separated.
- (3) Ultrasonic test showed one unbonded area all the way around in the middle of the cap. No evidence of this has been found in the spot checks.
- (4) Uranium to cap bond is excellent.

Specimens are being prepared by the chemical milling process for hot die pressure bonding by HLO and gas pressure autoclaving by BMI.

The specimens to be autoclaved at BMI at 650°C and one hour at temperature have been completed but are not on site.

Welding Equipment

The TIG welding chamber for I&E² welding was completely sealed off to prevent the operator from coming in contact with any beryllium contamination. A large lucite shield is being fabricated to cover the entire I&E² welding machine. The lucite shield will have a 22" x 48" opening for the operator to work through. This shield will be connected to the main exhaust system. The existing exhaust system on the TIG welding chamber will remain intact.

Provisions are being made to locate the prototype production welder in the first welding booth (NPR horizontal welding booth). The chuck assembly on the NPR welder will be moved to the I&E² welding table, the spindle on the I&E² chuck assembly will be removed and the balance of the assembly will be stored. The I&E² spindle will be chucked into the NPR chuck; this will make it possible to weld either NPR or I&E² fuel elements on the one welder. After debugging, the production welder will be used for NPR material.

Fuel Element Support Attachment

Tooling for the resistance spot welder for the attachment of supports to the N-fuel element is being prepared and should be ready by early in March. This is for spot welding either inner or outer supports to NPR fuel elements. The air cylinder clamping device has been installed on the spot welder and the electrical work is complete. As soon as the tooling is completed, it will be installed and the machine will be ready for support welding.

Another design was sent to White Bluffs on a small chucking device to compress the supports, making the support OD concentric with the tube OD. The chuck and associated support blocks will fit on the same air cylinder clamping device. It is only a matter of removing four bolts to change from one tool to another.

Autoclave

All fuel processed through the autoclave during the month has had good black films on all surfaces. White oxide corrosion on the braze closed weld beads has been eliminated by an etching technique of rapid agitation to remove etch reaction residues formed when etching zircaloy:beryllium alloys.

Nondestructive Testing

A new probe was built during the month by Testing Methods for the I&E fuel elements. This new design was needed because of the bulge at the ends of the fuels. The old probe was not properly aligned in the I&E size fuel until all of the probe was clear of the bulge. The new probe will not go into the I&E fuel elements now in the process because they have a smaller ID at the ends than originally planned. A smaller probe with a Lamb wave clad thickness test cannot be built until new crystals are obtained from offsite. Until a new probe can be built, pieces can be tested with the old probe. This will give a good bond test and should detect a large change in clad thickness.

Eighty-three billets have been checked with the grain size tester during February. The tester is being used to determine the billets that need to be heat treated before extrusion.

The end closure tests have detected unbonds between the zircaloy clad and the uranium in the braze closure heat effected zone below the cap. Destructive examination of tester rejects has been delayed because of a shortage of personnel.

Interface Cleanliness

There has been a drop in the interface cleanliness rating of tubes extruded during the last two months. This drop occurred about the same time the Analytical Laboratory started making the interface cleanliness rating, and it is thought the laboratory might be rating lower than the personnel of CPE had been making the ratings. However, the samples have been reinspected by the personnel of CPE and there has been a definite drop in the interface cleanliness.

A series of tests have been conducted to increase the interfacial cleanliness.

- (1) Zr-2: bright etched vs unetched;
- (2) Uranium: hot nitric vs cold nitric;
- (3) Copper: nitric vs brightener.

A comparison of the tests with the interfacial cleanliness ratings reveals:

- (1) The above steps do not effect the interfacial cleanliness, or
- (2) The interfacial cleanliness test is not able to depict the difference.

One interesting fact is noticed in checking the chemical composition of the billets. Tubes No. 53-56 were rated very high on our interfacial cleanliness test.

TABLE II

<u>Tube No.</u>	<u>Interfacial Cleanliness</u>		<u>Carbon Content</u>
	<u>OD</u>	<u>ID</u>	<u>PPM</u>
53	6.6	7.0	237
54	7.5	7.0	234
55	5.9	6.0	224
56	6.9	6.6	237

The cleanliness ratings on the tubes recently have been lower, and yet the appearance of the component has been consistently better. Correspondingly, the carbon content on all of our recent uranium material is consistently higher (250-450 PPM^C). There are no tubes with a carbon content above 250 ppm that have a cleanliness rating above 6.

TESTING METHODS

Process Fuel Element Inspection

Bare Core Station

Concerted efforts to pin-point the source of UT2 large grain rejects have located three principle causes. Circuit modifications have been developed and put into place which greatly reduces the seriousness of two of these; installation of new stepping switches now on-site is expected to alleviate the third.

Improved surface inspection test heads have been completed and made ready for installation.

Bond-Pen Stations

Operating difficulties which have impaired the effectiveness of the external bond test over the past few months has been discovered, isolated and corrected.

New Methods Development

UT4 Project

Techniques for applying UT4 closure tests to the base weld are under development. A new probe design incorporating a one-quarter inch diameter lithium sulphate transducer appears particularly effective. Mounted on a fixture which allows it to be inserted in the spire, the probe clearly resolves braze porosity as small as 0.050 inches in diameter.

Approximately 1500 pieces of various sizes have been tested with the prototype UT4 tester during the month. Of sixty "K" size elements tested with the inside probe, three were found with objectionable closure defects.

Work orders have been placed for the fabrication of a complete UT4 station for 306 Building. The order includes the purchase of electronic components for the base end closure test which, hopefully, will be developed in time to be incorporated in the station. Shop fabrication of 313 test equipment will commence immediately upon approval of a project proposal.

Ultrasonic Weld Monitor

A recently completed four-channel ultrasonic weld monitor is undergoing check-out prior to its application to the automatic welder. Preliminary trial runs appear favorable. The instrument appears to reveal subtle changes in welder performance. At least on one morning start-up, for example, it was found that 40-50 pieces were run through the machine before

consistent welds were produced. It is anticipated that these evaluation tests will demonstrate the feasibility of applying this principle of weld integrity determination as a production tool.

N Reactor Fuel Testing

Closure Test

Recent test developments have very significantly improved the sensitivity with which braze closure defects may be detected, particularly in the internal clad-cap and clad-core regions. Numerous instances of unbonds and braze porosity have been found, some defects being as small as 0.030 by about 0.060 inches.

Destructive examinations being carried on with this work has revealed frequent instances of what appears to be small (about 0.020 inch) diameter holes in the uranium core. In some cases these "holes" seem to be clustered together to give certain regions of the core a porous appearance. This condition has been noticed only in regions adjacent to the closure.

Billet Testing

Some eighty-three billets were tested in the laboratory the past month. The ultrasonic data continues to correlate with extrusion data.

The equipment is being made ready for transfer to the 333 area. Production type instrumentation is under development for use in the production facility.

333 Testers

Four nondestructive test tanks and two electronic consoles which are scheduled for 333 installation have been received from the vendors and are now in the laboratory undergoing check-out. Two additional consoles being fabricated on-site are now under fabrication.

Present Reactor Fuel Testing

Off-Site UT-2 Program

The first of NLO's UT2 stations has been completed and is in the laboratory for de-bugging. The second and third off-site units are essentially completed. It appears that all equipment will be ready for shipment close to the scheduled dates. Arrangements have been made for on-site training of NLO and MCW operating personnel to begin March 20th.

Lamb Wave Research

Experiments have revealed an here-to-fore unobserved effect in the behavior of ultrasonic waves propagating thin-wall tubing. Two, five and ten MC pulses reflecting from artificial defects in 0.020 inch thick wall zirconium tubes are observed to undergo a shift in frequency

as the tube is rotated under the test head. At certain discrete positions of the tube with respect to the test head received pulses are observed to contain two definite frequency bands. At other positions, only one band is observed. In terms of present knowledge these effects are unexplainable. However, it seems probable that they are related to Lamb's theory in that in each case the frequencies observed closely agree with values predicted from the theory. These studies have also shown that the 2.25 MC frequency gives as good sensitivity to defects, with a better signal to noise ratio, than does the higher test frequencies.

Sam Gie
for
Manager, Engineering

LH McEwen:dl

FINANCIAL OPERATION

FEBRUARY, 1961

Tentative accounting procedures have been developed for accumulation of NPR fuel cladding costs, including specific cost coding instructions for the coextrusion shop. It is expected that these instructions will be formalized in March.

The formats for the Department's "Production Cost" and "Monthly Unit Cost Information" reports have been revised. The revised formats provide unit cost information on projection fuels as well as more detailed information on manufacturing cost.

Conversion cost and unit cost per gram of Pu for fiscal years 1960 and 1961 (Midyear Budget) were broken down by HAPO Level 2 component. This information was developed for use in the study of HAPO general overheads.

A comparison was made of HAPO and Savannah River unit cost per gram of Pu nitrate generated during the second quarter with the first quarter FY 1961. The report included pertinent comments and explanations of unit cost variances between the two quarters. In addition, unit cost data were compiled for the Department Manager for use in the Annual Report which compared unit cost performance between the two plants over the past four years.

A statement will be prepared as soon as possible after the close of each month, showing the relationship between FPD's Financial Plan and fiscal year-to-date actual cost plus current best estimates for the subsequent months in FY 1961. By reporting monthly, it is expected that trouble areas may be detected early and necessary action taken to prevent overruns of available funds.

In view of the fact that funds available in the various Engineering programs are very "tight," procedures were established this month to provide for better financial control on all expenditures in this area. Under the new procedure, all source documents committing Engineering program funds are being reviewed and logged by Financial personnel in order to maintain expenditure and commitment records as up to date as possible. A monthly fund status report is being issued for Engineering to assist them in future planning.

New distribution percentages for HAPO Direct Assessments were established in connection with the preparation of FY 1962 and FY 1963 budgets.

Preparation of the annual budget is proceeding on schedule. Schedules covering personnel, overtime, end function personnel, contributions to HAPO pool, and services to other Departments have been completed and copies forwarded to Contract and Accounting. Basic information of cost and

distribution is currently being accumulated in order to prepare final schedules, including unit cost schedules and inventory forecasts, which are due on April 1, 1961.

Audit of FPD suggestion award administration has been completed and report issued.

Audit of equipment assigned FPD and FPD motor pool utilization has been completed. Report is being prepared.

Audit of FPD periodical subscriptions and assigned reference works is in progress.

Subjects for audit activity during the month of March, in addition to those previously listed, include personnel administration and payroll and the FPD safety award.

Three miscellaneous capital work orders covering the balance of the Department's FY 1961 allocation were issued during February. These include the PRTR Access Road - \$17,300; 10" water line from the 382 Pump House to 300 Area grid system - \$6,800; and ventilation and heating for the 303-J Building - \$9,400.

Six appropriation requests totalling \$50,000 were issued during February. The total number of AR's issued thus far in FY 1961 now stands at 50 and represents a dollar expenditure in excess of \$560,000.

A Property Accounting task force has been established to review and recommend changes in the HAPO depreciation policy. Presently, HAPO is charging proportionately more depreciation expense to product cost than is the Savannah River operation. Since the differences are primarily attributable to interpretation of AEC capitalization policy, the objective of the task force is to re-evaluate our position and recommend changes comparable to the depreciation and capitalization basis at Savannah River.

An instruction for use by operating management concerning capital expenditure procedures is being prepared. The object of the instruction is to provide management with a source of information and references concerning general policies, procedures and requirements in this area.

The Plant Acquisition and Construction and the Equipment Not Included in Construction Projects Budgets are currently being prepared and will be submitted to C&AO during March.

Two spot audits of uninstalled equipment control procedures and records were conducted during the month. In both instances minor discrepancies were noted and appropriate recommendations made for improving the effectiveness of the control of this equipment.

Travel for February amounted to \$5,400 - about average for the Department.
FY 1961 to date cost of \$37,627 represents 91% of the same period in FY 1960.

A concentration of effort is being placed on the OPG system with approximately fifteen guides undergoing revision. OPG on procurement procedure is complete and ready for review by the Department Manager; the guide on research and development is being reviewed by the Engineering Section prior to final draft and "Reporting of Accidents or Special Incidents" is being revised to comply with HAP0 1.4.

Manager - Finance

WSRoe:mh

PLANT FACILITIES OPERATION

FEBRUARY 1961

I. RESPONSIBILITY CHANGES

None.

II. ACHIEVEMENTS

A. Statistics

1. Duplicating

<u>Process</u>	<u>No. of Impressions</u>
Multilith	602,613
Verifax	11,296
Ozalid	13,610
Total	<u>627,519</u>

2. Utilities

	<u>Feb.</u>	<u>March</u>
Average steam generated (M lbs/hr)	82	95
Maximum steam generated (M lbs/hr)	101	129
Total steam generated (M lbs)	55,026	70,491
Coal consumed (Tons)	2,605.65	3,298.05
Evaporation rate (Steam/#Coal)	10.56	10.68
Efficiency - Actual	69.2	72.0
Efficiency - Theoretical	72.5	73.6
No. of Boilers on: 3		
Sanitary water from 3000 Area (M Gals.)	109.53	121.06
Total water from 3000 Area (Avg. rate GPM)	2,722	2,712
Total water from #3 & #4 wells (M Gals.)	12.12	11.14
Total water from #2 well (M Gals.)	.30	.30
Peak water consumption for 24 hours (M Gals.)	4.7	4.4

B. Operating Experience

Numbers 4, 5 and 6 Boilers were in service for the entire month with No. 3 as first reserve. Hand-cleaning of the ashes from the left hand grate of No. 6 Boiler continues until the scheduled overhaul can be completed later in the year.

Sanitary water loads have been met without difficulty even though the engine driver for the No. 5 Pump remains uncoupled.

The rough draft of the Manual on the UT-2 Tester is scheduled for issue March 20, in time for the training of personnel from Mallinckrodt.

C. Equipment Experience

Several revisions to the air supply units in the 306 Building, which are to eliminate the flooding experienced in the equipment room and provide more operational flexibility, have been completed.

Major effort continues in PRTR with a great deal of overtime being required to provide 24 hour coverage during the critical tests. The modification and improvement of equipment continues. A number of pumps were overhauled and several dismantled due to excessive vibration. The D₂O pressurizer nozzle modification was completed and a complete job procedure and final report were prepared. Due to the concentrated use of manpower for PRTR, some customer work has been curtailed, with only minor work and routine maintenance being performed. As a result, the backlog has increased considerably.

The Birds' six-inch continuous centrifuge in the 321 Building process canyon was found to be out of alignment and the main drive wheel out of balance, causing terrific vibration. By replacing the concrete base with steel, balancing the drive wheel, and making the proper alignments, satisfactory operating performance has been attained. Due to trouble in the Tank Farm sprinkler system, water backed up and water-logged a number of electric motors which operate various pumps. The trouble in the sprinkler system is being investigated for corrective action and the motors and associated pumps are being overhauled.

The revising and replacing of equipment in A-Cell of the 325-A Building is still in progress and is expected to be complete by the end of March. Work is being performed under critical restrictions, requiring extreme radiation protection.

D. Inventions and Improved Methods

All personnel in the Operation engaged in work which might lead to inventions and/or discoveries advised that, to the best of their knowledge, none were made in the course of their work during February 1961.

E. Costs and Savings

Two cost reduction items totalling \$4,660 have been processed through Financial and are awaiting approval by the Cost Improvement Board

E. Costs and Savings (Cont'd)

Continued mild weather during the month will again have a favorable effect on reduction of total costs for steam generation.

F. Status of Projects and Major Jobs

3717 Building Sheetmetal Shop Addition - The fixed-price contractor has completed the new addition, and shop machinery is being re-located. The new press brake is to be installed by March 6 at which time the factory representative will be on site to inspect the installation and provide operating instructions. Beneficial use of the facility was attained February 10, 1961.

384 Building Railroad Siding - This work is complete except for the installation of the wheel stops, which have not been delivered. The track is in use.

303 Area Grounds Improvement - Over-all construction progress is 75 per cent complete.

Modification of Ash Sluice Area, 384 Building - Construction was completed and turned over to Operations.

384 Building Personnel Facility - All construction was completed and the facility was occupied by Operations.

Project CAF-894, Increased Compressed Air Capacity, 384 Building - Vendor drawings for the fabrication of the compressor were received and approved. Over-all progress is only slightly behind the project schedule but considerably behind relative to the facility requirement. An attempt is being made to shorten the construction schedule.

PRTR Parking Lot Access Road - Invitation to bid has been issued with bid opening scheduled for March 7, 1961.

3717 Building Ventilation - This work has been contracted with J. A. Jones Construction Company.

Steam Distribution Extension to 3718 Building - All work has been completed and placed in operation.

303-J Building - Detailed design for the heating and ventilation is complete, with construction scheduled during the 4th Quarter of FY-1961. Scoping of the building alterations to convert the north half to layout, mockup and projection room is complete.

F. Status of Projects and Major Jobs (Cont'd)

10" Water Line from 384 Building to Distribution System - All work has been completed except for the repairs to the 382 Building west wall. The new grid system pressure controller unit is working far better than was anticipated, and has helped smooth out the action of the original unit located at the opposite end of the pump discharge header.

Additional Sand Separator, 382 Building - The construction contract scheduled for award March 8 is being held up pending availability of funds for a companion project sponsored by HLO.

Budget Studies

Sanitary Water - The study was completed, requesting PRTR filter plant modification for additional 800 gpm bed and tie to the 300 Area grid system. This study also includes funds to be budgeted for FY-1963 to increase water supply to 300 Area.

Steam Generation Facility Expansion - A rough draft of the study recommending the installation of two 65,000 lb/hr package boilers in the 384 Building was completed. This work is to be funded from FY-1963 General Plant Projects.

Steam Distribution System Expansion, Laboratory Area - The study was completed covering the expansion of the steam distribution system in the laboratory area to be included as a FY-1962 General Plant Project.

FPD Facilities Consolidation - This completed scope study recommends a Consolidated 303 Area Service Facility to house Department Administrative offices, laboratories, warehouse and maintenance facilities. Scope drawings and justifications are scheduled for completion March 17.

G. Special Reports Issued

300 Area Water Supply Study, by R. G. James.

300 Area Steam Generation Facility Expansion, by R. G. James.

Steam Distribution System Expansion, Laboratory Area,
by R. G. James.

FPD Plant Facilities Scope Study, by G. A. Huff, T.H. Whatley
and G. W. Giard.

III. PERSONNEL

A. Safety, Security and Radiation Experience

Medical Treatment Injuries	17
Frequency Rate	3.26
Disabling Injuries	0
Serious Accidents	0
Security Violations	0
Radiation Incidents	0

B. Meetings

Round Table-Staff	20
Safety and Security	23
Information	6

Manager
Plant Facilities Section

E Hilgeman:RTM:mkm

RELATIONS PRACTICES OPERATION
FEBRUARY, 1961

STATISTICS

<u>EMPLOYMENT</u>	<u>February</u>	<u>January</u>
Additions: Exempt	3	3
Nonexempt	8	15
Total	11	18
Reductions: Exempt	0	5
Nonexempt	7	5
Total	7	10

HEALTH AND SAFETY

Disabling Injuries	0	0
Serious Accidents	0	0
Medical Treatment Injuries	48	53
Medical Treatment Frequency	3.40	3.65

SECURITY

Violations - FPD	0	1
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SUGGESTION PLAN PARTICIPATION

Eligible employees	672	673
FPD suggestions received	55	102
Annualized rate per 1000 eligible employees	982	1,819
No. of suggestions adopted	20	8
Net annual savings	\$1,410	\$740
Amount of awards	380	160
Per cent of total awards to savings	26.9	21.6
Average amount of awards	19	20

GENERAL

At the end of February Fuels Preparation Department passed the 2,000,000 hour mark without a Disabling Injury. Manufacturing has achieved 1,500,000 hours, and Plant Facilities has exceeded 1,000,000.

The February medical treatment frequency rate was 3.40, well below goal level of 3.65.

Spring housekeeping planning has been completed and the program is scheduled to start March 1. The activity will be called Spring-Time Clean Up Time to replace the title Operation New Broom used in the past four spring programs. Publicity will include the use of a painted sign near the area entrance, posters for Department work locations, and at least one GE News feature.

All facilities will be inspected by designated teams during the week of March 20. This year it is planned to include all women office employees in the inspection program.

The work on standardizing emergency signal systems in FPD facilities is in progress. To date revisions have been completed in 313, 3706 and 3717 Buildings. New instruction cards are being made for posting as work is finished in the buildings involved.

No security violations were reported during February.

The General Manager's Annual Report to Employees was conducted on February 24 and 27 in the Village Theater.

The third annual dance for all Department employees was held at the Camp Hanford Officers Club February 4. All funds for the social event were raised through ticket sales.

Approval letter No. AT-132 was signed by AEC. It provides for moving and traveling expenses for non-exempt journeyman instrument technicians being sought through open market recruiting.

Manager - Relations Practices

RW McCullough:mfj

END

**DATE
FILMED**

11 / 27 / 92