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FUELS PREPARATION DEPARTMENT

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MONTHLY REPORT - MARCH, 1960

By L. A. K. C. K.

Dr. K. K. K. K.

Compiled by Fuels Preparation Department

April 29, 1960

Richland, Washington

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

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FUELS PREPARATION DEPARTMENT
MONTHLY SUMMARY REPORT
MARCH - 1960

PRODUCTION

A new monthly production record was established during March when plant output was 711.4 tons, which is 103 per cent of forecast.

At month end the bare uranium inventory was 871 tons as compared to 969 tons at the end of February. Finished inventory was 763 tons at month end as compared to 582 tons for the previous month.

Thirty-six tons of dingot uranium fuel cores were fabricated during the month for shipment to IPD to permit evaluation of the dingot program. No significant fabrication problems were encountered during the processing of this material.

ENGINEERING

Fourteen fuel elements failed in the reactors during March. Jacket ruptures continued to be the major cause.

A purchase order was issued for special thin wall spires and cans to be used in the nickel plating program. If this work is successful, increased corrosion resistance will be achieved and AlSi dissolution of the can wall will be prevented. It is estimated that the larger uranium core sizes provided by these changes will allow conversion ratio gains worth \$170,000/year/reactor.

Work at the Ajax Magnethermic Corporation indicates that induction pre-heating of composite billets is practical for all sizes and component variants under consideration.

A number of extrusions and coextrusions were made on the 2750 ton press. Considerable progress was demonstrated in dimensional control, other aspects of the process, and personnel training.

A contract has been initiated with the AeroProjects Corporation for the application of ultrasonic welding to NPR fuel element closures. With this process it may be possible to obtain totally bonded closures which afford double protection against water entry.

Further improvement in fuel element quality will be experienced with the adoption of a modified external bond test which is more accurate and reproducible than those previously used.

Tests to correlate ultrasonic and stud pulling bond strength measurements were carried out. Initial results showed good correlation, but more confirmatory work is necessary. A need exists for a nondestructive bond strength measurement technique since present methods destroy the test piece.

An instrument has been developed for IPD which measures the degree of crystalline orientation of polycrystalline graphite.

A method has been developed which utilizes the Hanford Test Reactor to measure the purity of NPR billet graphite.

Tests are underway to verify studies which propose a measurement technique to determine the asymmetrical power distribution in fuel elements. It is expected that the capabilities of this method will be demonstrated during April.

GENERAL

Manufacturing yield for 8" I & E was 84.6 per cent compared to 85.2 per cent for February. The 8" solid fuel element yield was 90.3 per cent, slightly reduced from the 92.4 per cent yield experienced in February.

The March operating efficiency was 93.3 per cent compared to 92.5 per cent for February.

Five autoclave failures were experienced during the month bringing the total for this year to six.

PERSONNEL STATISTICS

Number of employees February 29, 1960	754
Number of employees March 31, 1960	752

	<u>Exempt</u>	<u>Nonexempt</u>	<u>Total</u>
General	1	1	2
Manufacturing	53	297	350
Engineering	50	32	82
Financial	11	7	18
Plant Facilities	35	255	290
Relations Practices	5	5	10
Total	155	597	752

STAFF

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

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PATENT SUMMARY - MARCH, 1960

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 March, 1960. 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.

General Manager
Fuels Preparation Department

LL German/gl

MANUFACTURING OPERATION

March, 1960

CURRENT OPERATIONSProduction and ProductivityStatistics

	8" Solid	NORMAL					6" C 6" O		ENRICHED			Total
		8" I & E					Water Mix	Water Mix	6" I & E			
		CIIN	CIVN	KIIN	OIIN	CIIE			KIIE	OIIE		
<u>Current Month's Production</u>												
Acceptable Fuel Elements Produced (Tons)	61.1	51.3	4.7	310.5	220.9	0	9.7	0.8	25.3	27.1	711.4	
As % of Forecast Production	76	93	59	141	94	0	0	10	72	62	103	
Cum. % of Forecast for Current Qtr.	93	114	45	114	94	137	136	90	83	83	100	
As % of Past 3 Month's Average Production	90	114	235	170	99	0	121	5	77	108	117	
As % of Past 12 Months Average Production	91	109	470	252	103	0	323	7	87	143	127	
% of Forecast Achieved Last Fiscal Quarter	98	94	110	102	107	62	89	77	124	121	104	
% of Forecast Achieved Last 4 Fiscal Qtrs.	106	109	110	88	102	165	89	90	109	96	101	

Operating Efficiency

Current Month (%)												93.3
Forecast (%)												93.0
Previous Month (%)												92.5

Manufacturing Yield

Current Month (%)	90	80	0	86	85	0	82	77	87	86	
Forecast (%)	83	83	78	83	83	70	70	83	83	83	
Previous Month (%)	92	86	0	85	85	86	83	85	83	82	
Bare Uranium Available for Processing (Tons)	200	121	29	174	187	12	42	23	41	42	871
Finished Products in Storage (Tons)	99	61	9	236	237	8	19	15	35	44	763
Special Products Finished (Pieces) Poison											3000
Uranium Utilization											97.0

ACTIVITIESProduction

Finished production for March was 711.4 tons, 103 percent of forecast. This output represents a new record high for fuel elements processed during one month, which is about 5 percent greater than the previous high of 679 tons achieved in August, 1957. The previous high was attained at a time when approximately 90 percent of the production was solid and 10 percent was I & E fuel elements. During March the fuel element ratio was 90 percent I & E and 10 percent solid elements. A total of six product changes was made during the month, which represented the fewest number of product types canned since May, 1959. The high production resulted primarily from high yields in the two major I & E models and a reduction of the work-in-process inventories. In addition, decreased reactor requirements for 6" enriched fuel elements permitted the scheduling of additional 8" material.

Ten canning lines were operated daily as scheduled for a total of 230 canning line shifts.

Two lots (36 tons) of "O" size dingot uranium fuel cores were fabricated early in March for shipment to 100 D reactor for evaluation of the dingot program. No fabrication problems were encountered for processing this material after circuitry defects were corrected on the attenuation tester.

Yield Control

The yield for 8" I & E fuel elements was 84.6 percent compared to 85.2 percent for February. The 8" solid fuel element yield was 90.3 percent, slightly reduced from the 92.4 percent yield experienced in February. The March yield of 86.3 percent for 6" enriched I & E fuel elements reflected an improvement over the 82.8 percent yield attained in February.

Increased porosity resulting in a higher bonding layer integrity reject rate and unusual surface defects on fuel elements after autoclaving were the primary reasons for a reduction in manufacturing yields for both 8" solid and 8" I & E fuel elements during the month. The yield for enriched I & E fuel elements increased slightly from last month as a result of lower defective rates for both internal and external thinwalls.

Approximately 1400 8" I & E fuel elements were rejected after autoclaving because of an excessive surface film and discoloration which could not be removed by re-etching. These pieces were from autoclaves which had had the steam turned off for a portion of a weekend while maintenance was being performed on the equipment.

Five autoclave failures were incurred during the month, bringing the total for the year to six. Two of the failures resulted from water entry through a pin-hole in the cap weld, while one was caused by water entry at the point of arc strike over in the weld area on the cap end.

Two failures occurred in material which had bumper supports welded to the outside of the can for charging under production test P 262-A 11-FP. One of the failures was evident as a small blister under the raised section of one bumper and immediately adjacent to the bumper weld. Sectioning showed that the weld had penetrated through the can wall and into the braze material. In addition, there was evidence that some of the weld nugget had been replaced by AlSi from the braze. The second failure appeared as a slight raising of one end of a bumper. Sectioning of this piece showed an extensive void area below the bumper weld, indicating a displacement of the aluminum can wall during the welding operation. Examination of sections from bumper spot welds on other fuel elements in this group showed evidence of an erratic weld penetration.

Other Activities

The following pieces were processed through the Fuel Recovery Operation during March:

8" Solid	2,718
8" I & E	34,194
6" Water Mix	480
Total	37,392

PLANT CONDITIONS, INCIDENTS AND IMPROVEMENTS

General

The March operating efficiency was 93.3 percent compared to 92.5 percent for February. About 45 percent of the canning line downtime was due to equipment problems, while the balance was charged to operational outages and experimental programs and production tests.

At month end the bare uranium inventory was 871 tons, or a 1.4 month supply. A new uranium delivery schedule was received early in the month which reduced slightly the uranium receipts scheduled for March from that shown in the Official Production Forecast. The deficit is scheduled to be made up during April; however, it is expected that the supply of OIIN fuel cores will be tight through May, 1960.

Finished inventory at month end was increased to 763 tons, which represents a 1.2 month supply. The inventory increase is due in part to reactor charging being somewhat below forecast for the month.

No scrap shipments were made to NLO during March. The rate of scrap generation is expected to decrease significantly beginning next month as the result of a study which was initiated in January on the scrap rate, which was increasing at that time. It was determined that a major portion of our uranium scrap is coming from striation defects on the virgin and recovered cores at the pickle inspection station.

During the past year several PWR's were run and tests were conducted on material with these characteristics. It has now been concluded and recorded in an unclassified document, "Incidence of Striations in Fuel Element Cores", HW-64002, by C. A. Strand, that this material is acceptable for production.

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Beginning in April, 1960, these pieces will be set aside and accumulated into lots, whose identity and material history will be maintained. These lots will be sent to the reactors and given the same treatment as other material. Evaluation of this program is expected to take at least two years because of the low rupture rate as compared with the number of pieces produced in FPD.

Beginning in this report, the basis for calculating the uranium utilization figure (which is listed on the statistics page) will be changed. This method change will not make a significant difference in the value, but should result in a more stable and meaningful figure. In the future, scrap generated will be related to production input rather than to uranium receipts. Since receipts and metal inventories vary from month-to-month, the uranium utilization value has tended to fluctuate inversely with inventory increases or decreases.

306 Pilot Plant

A total of twelve special tests were conducted during March. Development efforts were directed toward improving the processes and materials being used in the 313 Building.

During a one month period ending on March 18, self-support ribs were attached to 2218 CIVN fuel elements, with a welding yield of 96 percent to the etch machine. During the same period 20 mil bumper rails were attached to 945 OIIN and solid fuel elements with a welding yield of 90 percent to the etch machine. Since two of the autoclave failures and other weld imperfections previously discussed were experienced with this latter material, the lot was rejected.

305 Test Reactor

Special tests occupied approximately 15 percent of the reactor operating time during the month.

while another SWR measuring the dih of graphite bars was conducted for HLO.

The preventive maintenance program has been effective in correcting conditions which could have resulted in nonscheduled reactor downtime. Inspection of the sprockets and chain on the drive mechanism of the west stringer indicated the need for replacement of these parts, which has now been scheduled. Work is being performed during available scheduled periods on the building air conditioning equipment to prepare it for summer operation. All fuel element and graphite standards were checked during the month and were found to be holding within standard deviation.

OPERATING PLANS

Bond Quality

A test was recently made using a higher vibration frequency on the aluminum during the canning operation in an attempt to reduce braze porosity and improve the component wetting. The model BD-13 Peterson Vibrolator, which was used in this test, produced material which exhibited less porosity in the

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braze layer as measured by a three-fold reduction in the total count from the external bond test. Based on the increased quality of the external bond achieved from the higher frequency vibration, the Model BD-13 Vibrolators have been installed on all canning lines.

The revised circuitry for improving the reliability and reproducibility of test results on the external bond integrity of fuel elements was installed on a trial basis in station 2-C during the month. Initial results indicate that higher degree of reproducibility and reliability has been achieved. However, because of differences in sensitivity of the new test, as compared to present equipment, a further evaluation of test results will be made before installing the new circuitry in the other testing equipment.

The obtaining of reproducibility in internal bond test results is difficult when using probes with steel shafts. Since the alignment of the crystals on the probe is critical, any bending of the shaft which results in a permanent distortion causes misalignment and consequently nonreproducibility when compared with test results with another probe. In an attempt to solve this problem, a probe was fabricated using a fiberglass shaft. This material is sufficiently rigid and not as prone to misalignment from bending as is the case with a steel shaft. A marked improvement in the reproducibility of the internal bond test has been obtained with the use of probes with fiberglass shafts.

Determination of Uranium Quality

In the continuing evaluation of techniques for the measurement of the quality of uranium metal by x-ray diffraction, a brief study of the measurement of x-ray radiation intensity has been concluded. This study was designed to determine if there was any advantage to peak area measurement on a strip chart over the peak height method of measurement currently being used. From the results of this study, it appears that there is good agreement between the two methods when ten planes are used. Therefore, the use of the faster and more direct peak height measurement method for Growth Index will be continued.

Dingot Uranium

Dingot material is scheduled to be received at an increasing rate in the future and is presenting a problem as it becomes mixed with ingot material. It is even difficult to keep the virgin dingot material separate from regular cores, and after small amounts are processed through recovery and numerous balance areas, the segregation problem becomes more difficult. If strict segregation of this material should be maintained, it would double the amount of record keeping for that core size, and create a need for additional storage space needs. Further discussions and consideration are underway to arrive at a satisfactory solution for the initial stage of this program.

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Projection Fuel Elements

A new reactor schedule, "Projection Fuel Element Requirement", HW-64372, by R. L. Dickeman, was issued on March 18, 1960, which establishes a basis to be used in planning for production of these fuel elements. Part of this program, the bumper fuel element, will require additional testing and development work before it can be established as a production item for use in the old reactors.

The projected reactor needs for bumper and self-support fuel elements have been accelerated as follows:

<u>Time</u>	<u>Percent of Total Production</u>
2nd Qtr, FY 1961	5 %
3rd Qtr, FY 1961	10 %
4th Qtr, FY 1961	20 %
2nd Qtr, FY 1962	60 %
3rd Qtr, FY 1962	80 %
4th Qtr, FY 1962	99 %
Thereafter	100 %

Special Products

A shipment of lithium-aluminum rod sections was received during the month from SRO for use in a program to replace fringe poison loadings in HAP0 reactors. This material contains about 3.1 percent total Lithium, which is enriched to a nominal 38.5 atomic percent Lithium-6. Because of the Lithium-6 content, this material requires a detailed accounting system on a weight basis, much the same as uranium. In addition to the chemical and reactivity requirements for the material, sampling and analytical techniques were developed for determining the Lithium-6 content of the material.

Receipt of the 12,000 piece order of rods was completed on March 25, 1960, when the third shipment was delivered to HAP0 from Savannah River. Canning of this material was delayed because of installation of a new lathe in the Special Products room and an additional ventilation system over the machine where these pieces will be processed. Tooling problems have also contributed to the delay as the length of these rods is two inches longer than previous "N" pieces. Since the receiving hydrogen analysis of this material will take several weeks, the vendor's chemical analysis was obtained for temporary use. IPD has been notified that a waiver may be required if this material is to be made available before receiving tests are completed.

Study of the effects on FPD of the E-N load for one of the old reactors was completed during the month. This program will require the rearrangement of equipment in the Special Products room, and the weld reclamation program will be moved to another location. Cost estimates and production assumptions and schedules for the program are being prepared.

EMPLOYEE RELATIONSSafety Performance

Members of the Manufacturing Operation were treated for 25 medical treatment injuries during March, a frequency rate of 3.94.

Radiation Control

During the four week badge period ending March 2, 1960, Manufacturing Operation personnel received a combined total of 7,660 mrad of exposure. One exposure case in excess of 300 mrad was recorded.

It has been necessary to restrict temporarily an employee of the Analytical Laboratory from work wherein he might be exposed to airborne uranium. Bioassay data have shown that this employee was gradually approaching the HAPD limit for maximum permissible body burden of uranium. The reason for the extent of this employee's deposition is not evident since both his predecessors and his successor on the work have not shown any substantial deposition of uranium. There appears to be nothing in the employee's work habits which would make the difference and the sustained air activity in his work location has been well within the permissible limit.

Security Violations

None

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 March.

Acting Manager - Manufacturing

HE Berg:HFT:gl

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STATISTICS

1958-59

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ENGINEERING OPERATION

March, 1960

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
TC Evans	duPont, SRP	JT Stringer	3/22	Self-support program
J Fellows	MCW	"	3/29-31	Discuss feed materials
P Tade	Sciaky Bros.	EV Padgett	3/30	Discuss spot welding
DB Petherick	Perine Machinery	LA Conner	3/28-4.	Set up lathe in Special Products
JT Anderson	J & L Co., L.A.	LA Conner	"	" " "
E Meyer	Sylvania-Corning	DC Worlton	3/14	Discuss Nondestructive Tstg.
H Ulrich	" "	"	"	" " "

Company Visited

GW Riedeman	Harvey Machine Co.	GA Moudry	3/11	Zircaloy procurement
AE Guay	Ajax Magnethermic	EL Keller	3/11-19	Discuss induction heating
TB Correy	Aeroprojects, Inc.	JB Jones	3/14-15	Discuss ultrasonic wldg.
SM Gill	" "	"	"	" " "
TB Correy	Gulten Industries	JA Pitrelli	3/16	" " "
SM Gill	" "	"	"	" " "
TB Correy	Bridgeport Brass	DR Jefferson	3/17	Discuss extrusion contract
SM Gill	" "	"	"	" " "
JW Nickolaus	Parker Rust Proof Co.	Leland	3/21	Discuss lubrication
"	Moczik Tool & Die	C DeBuigne	3/22	Discuss extrusion tooling
"	Ajax Magnethermic	EL Keller	3/23	Discuss induction heating
AJ Karnie	" "	N Ross	3/22-26	Discuss induction heating
TG Lambert	APED	J Bergman	3/10	Nondestructive testing
GL Waldkoetter	NLO	Mr. Polson	3/2	" "
"	MCW	J Fellows	3/3	" "

PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Operation</u>	<u>Nature of Change</u>	<u>Date</u>
JL Simek	Design Draftsman	4480	Trans. from CPD	3/28/60

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 March, 1960 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.

NONE

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PROCESS ENGINEERING

Fuel Performance and Requirements

Twelve natural uranium fuel elements (11 I & E and one solid) and two enriched uranium fuel elements failed in the reactors during March. These ruptures are summarized as follows:

<u>Type</u>	<u>Reactor</u>	<u>Exposure (MWD/T)</u>	<u>Rupture Classification</u>	<u>Jacket Alloy</u>
I & E Natural	B	511	Unclassified	X-8001
	C	429	Side Hot Spot	C-64
	D	548	Unclassified	X-8001
*	D	560	Unclassified	X-8001
	DR	212	Side Other	X-8001
	F	376	Side Hot Spot	C-64
	F	538	**	C-64
	H	450	**	X-8001
	KW	661	Unclassified	X-8001
	KW	373	Unclassified	X-8001
	KW	387	Unclassified	X-8001
Solid Natural	KE	402	Core Split	C-64
I & E Enriched	C	494	Side Hot Spot	C-64
	DR	377	Side Hot Spot	C-64

* Alloyed dingot uranium

** Not examined

Although the number of ruptures sustained this period was less than experienced in February, jacket failures continue to be the major rupture category. The majority of these ruptures have either been reluctant to discharge or have stuck, necessitating removal of the process tube. Because of problems associated with removal of stuck charges, some ruptures will not be examined and their classification is shown as unclassified. Except for a recently observed increase in maximum uranium warp, no fuel element quality variables are apparent, which would account for the higher incidence of jacket failures and stuck rupture charges.

Fuel element dimensional stability data obtained from production test material irradiated during the first three quarters of CY 1959 have been analyzed and are summarized in Table I. It will be noted that the more recent Quality Certification test data shows an increase in the average and maximum warp of chloride blank heat-treated natural uranium I & E fuel elements. Although the reason for this increase has not been determined, an analysis of warp orientation with respect to the process tube rib marks has shown a disproportionate number of warped pieces (about 2 to 1) are oriented with the convex side in the direction of the tube ribs. This indicates reactor variables as well as uranium fabrication variables may be contributing to fuel element dimensional instability. The improved stability of self-supported fuel elements may substantiate this conclusion.

TABLE I

FUEL ELEMENT WARP AND DIAMETER CHANGE

Type of Fuel Element	Uranium Heat Treatment	Reactor	Production Test	Exposure (MWD/T)	Warp (Mils)			Diameter Change (Mils)		
					Ave.	Std. Dev.	No. Pcs.	Ave.	Std. Dev.	No. Pcs.
I & E Natural	Chloride Blank	DR	Chloride Blank vs. Carbonate Rod Heat-Treated Uranium (IP-220-A-4)	800	7.1	5.9	23	+0.8	4.2	9
I & E Natural	Carbonate Rod	DR	Chloride Blank vs. Carbonate Rod Heat-Treated Uranium (IP-220-A-4)	800	7.7	7.2	42	+3.0	7.5	20
I & E Natural Self-Supported	Chloride Blank	B, D, DR, F, H	Quality Certification Program (IP-216-A-7 FP)	700	9.5	7.9	44	+1.5	4.1	16
I & E Natural Self-Supported	Carbonate Rod	B	Evaluation of Self-Supported Fuel Elements in B Reactor Ribless Tube Facility (IP-85-A)	800	5.6	4.9	30	+4.2	4.2	28
I & E Natural	Chloride Blank	B	Evaluation of Self-Supported Fuel Elements in B Reactor Ribless Tube Facility (IP-85-A)	800	5.4	4.5	25	+2.3	3.4	12
I & E Enriched	Carbonate Rod	C	Effect of Braze Voids on Incidence of Hot Spots (IP-210-A-1 FP)	800	6.5	6.0	70	+5.3	3.8	23

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Preliminary post-irradiation data on four columns of alloyed dingot uranium I & E fuel elements exposed to 400 MWD/T in D Reactor show no significant difference between dingot and ingot uranium.

In co-operation with IPD, the component dimensions for all I & E fuel elements are being revised to more nearly optimize finished fuel element dimensions with respect to hydraulic resistance and flow balance in the reactors. Briefly, these revisions reduce fuel element diameters about five mils with essentially no change in uranium core dimensions.

Anticipating early authorization to prepare E-N material for a full old reactor demonstration loading, work has been initiated on material and process specifications, including the equipment required in support of this program.

Ten charges of CIIN I & E fuel elements were coated with a silicate (zincilate WST-100) protective surface coating for in-reactor testing. It is expected that this coating will reduce fuel element jacket abrasion and eliminate the need for using a soluble oil during reactor charging.

Sixteen charges of X-8001 alloy clad OIIN I & E fuel elements, having various degrees of non-uniform autoclave film, were scratched and photographed to determine the effect of autoclave film damage on the in-reactor corrosion of X-8001 alloy jackets.

Uranium Technology

Approximately 43 tons of dingot uranium were canned during the month, of which 18 tons have been charged in the reactor. Of the original 25 tons of dingot charged in January, 12 tons remain in the reactor and approximately 13 tons have been discharged at normal goal. One rupture occurred in the original 25-ton lot, at 560 MWD/T exposure. It was called an unclassified rupture. The bare pickle reject rate for the dingot cores was less than for ingot cores and the bond test and x-ray inspection reject rates were essentially the same. All of the dingot cores were tested on the UT-2 equipment with an overall reject rate of 4.3 per cent, which includes fine grain (peak), large grain, and difference reading rejects. The average hydrogen content of the dingot cores was 2.4 ppm, as compared to the average of 3 ppm on the initial shipment of dingot cores and about 1.8 ppm on ingot cores.

A new core stamping and lotting system was proposed for the producer sites which will (1) allow the routine production cores to be stamped with the same lot number for a 24-hour period, thereby relieving their frequent stamp identification changes, (2) have the producer site segregate the cores into fabricator lots for shipment to HAP0, and (3) speed up the receipt of the lot quality report at HAP0.

Ingot cores are now being received that are made from dingot and ingot massive scrap melted and cast into ingots at MCW and rolled and heat treated at NLO. This material will continue to be received in quantities of up to 60 tons/month and the virgin cores will be lotted separately from normal ingot and dingot cores.

MCW has vacuum outgassed 12 tons of dingot bars in the gamma phase to an average hydrogen value of 0.7 ppm. Cores from this material should be received at HAPO in late April for our evaluation. MCW is also starting to vacuum outgas dingot core blanks from high hydrogen dingots just prior to beta heat treating. If this outgassing of core blanks is successful, MCW will produce about 50 per cent of the dingot uranium with a nine-hour bomb preheat and the remainder on a 30-hour bomb preheat. A 30-hour bomb cycle is now being used on all our dingot cores to obtain low hydrogen metal.

Process Development

Based on results and data from canning tests, aluminum components for nickel plating prior to canning were designed and a purchase requisition drafted. Since the nickel plate prevents dissolution of the can wall by Al-Si, 25-30 mil-thick can walls and spire walls were specified. The reduction in aluminum thickness permits an increase of 17 mils in the uranium core OD and a reduction of 26 mils in the ID, compared to present O-size cores. The increased quantity of uranium is estimated to be worth \$170,000 per reactor year.* This benefit is, of course, in addition to the increased corrosion resistance provided by the layer of nickel on both the internal and external surfaces of the aluminum jacket.

I & E fuel elements were externally nickel plated, tested and heat treated for the initial portion of irradiation test IP-263-A-FP. This portion includes ten charges for adherence testing of 0.5 mils thick chemical nickel plate; five are heat treated for three hours @ 300° C and five for six hours. In each charge, alternate fuel elements are unplated, jacketed in X-8001 alloy. One charge each of the three-hour and the six-hour bake will be discharged at 400 MWD/T, and the remaining irradiated to normal high goal. In addition to normal quality tests and inspections, pre-irradiation tests included bend-testing and "bubble machine" testing for nickel adherence, non-destructive measurement of nickel thickness, and non-destructive jacket-core bond testing before and after heat treatment. The fuel elements appear to be of a high and uniform quality. At present, the fuel elements await pre-irradiation measurement and will probably be charged at the next outage in 105-DR.

Corrosion testing in single pass process water flow tubes continued. Elements exposed a total of twenty-five weeks at 165° showed no accelerated aluminum corrosion or nickel sloughing at discontinuities in the plate.

Process Technology

A test comparing core-spire insertion techniques has shown a good relation between core OD washing and external penetration reject rate, external bond reject rate and external total bond count. The present insertion technique is close to the optimum external tester yield. A slight yield increase (about one per cent) may be obtained by inserting the core to within two inches of the bath surface (rather than the normal one inch), seating the spire against the core, and simultaneously seating the core and spire in the can.

* "Addendum to Physics Aspect of Revisions to the OIIN, CIIN, and KIIIN Slug Dimensions". W. S. Nechodom. March 23, 1960. (Confidential-Undocumented)

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Evaluation of cap-spire pulsing techniques was continued in the pilot plant. Sufficient progress has been made to fully demonstrate the effectiveness of vertical pulsing to insure complete cap-spire wetting following prescribed techniques. Some difficulty has been experienced in duplicating manually controlled pulsing with a mechanical drive system. High-speed moving pictures have been taken for analysis to alleviate this problem.

A new metal ceramic thermocouple well is being evaluated as a potential replacement for the silicon carbide thermocouple wells currently used in the production canning furnaces. The new well is more resistant to breakage and offers improved heat transfer characteristics for more rapid response to bath temperature changes.

In order to improve the present aluminum component cleaning process, possible alternate alkaline cleaning and deoxidizing solutions are being investigated. A test made on "Oakite" 202 solution as a possible cleaning solution yielded an improvement of about 35 per cent in component wettability without objectionable residual filming. Initial tests have also been made to compare Diversey #600 and ACP #100 solution with the present Diversey 514 deoxidizing solution. Results showed that the ACP #100 was comparable with Diversey 514. Since the concentrations of the Diversey #600 solution appeared to be too weak to achieve good component wetting, further testing is planned.

Partial analysis of a test conducted to determine the influence of can-sleeve vibration on finished fuel element quality has shown external braze porosity may be reduced by increasing vibration frequency and raising canning bath temperature.

Internal braze porosity was reduced by raising bath temperature, but was not affected by vibration frequency. The lowest braze porosity was obtained at a bath temperature 60° C above the primary arrest, and at a vibration frequency of 12,500 cpm. Although amplitude of vibration had no apparent effect on the test results, further evaluation is required.

Model BD-13 can-sleeve vibrolators, which are capable of producing vibration frequencies in excess of 12,000 cpm, were recommended and installed on all production canning lines during this period. Bond test rejects were immediately decreased in the order of three per cent, showing a significant improvement over the former BD-16 vibrolators.

The following revisions were made to the "Specifications for Unbonded Fuel, Target, and Poison Elements", HW-47029:

1. Parallel plate gages were specified as an alternate for tube gages to control maximum warp of lithium-aluminum and lead-cadmium elements.
2. The hydrogen content of lithium-aluminum alloy elements was increased from ten cc for a four-inch solid element to 15 cc for the present six-inch solid element.

In addition, the "Nuclear Safety Specifications", HW-47013, for enriched (0.96 per cent U-235) uranium were revised to incorporate the latest limits for the processing, storage, and transportation of this material.

A new Jones & Lamson automatic turret lathe for Special Products is being installed. Capabilities and limitations of the machine are being surveyed to establish feasibility of use on the forthcoming E-N program.

Installation of the duplex loaders and conversion to horizontal agitation in 313 Bldg. is complete. The prototype unit is being installed in the pilot plant.

Two prototype canning baskets have been designed for use in single-jack canning with the new canning jack and long pre-heat cycle. One is to prove the feasibility of supporting the basket by a central hollow shaft which will also contain the sleeve clamping rod. The other is designed around the fabricability limitations of type KT silicon carbide (or some similar refractory material). A steel prototype will be built first, to prove process and functional feasibility.

Meetings were held with the representatives of IPD and FPD Finishing and Quality Control Engineering to discuss fuel element stamping. IPD has proposed a stamping system which will enable them to determine tube and position number of each fuel element after irradiation. This would require a new stamping machine which would stamp both ends of the fuel element. It was resolved that FPD would proceed with fabrication and installation of the second automatic stamper, as per current design, pending more complete justification and development of the IPD proposal.

Initial contacts were made with Sonobond Corp. to resolve certain areas relating to the fabrication of the production ultrasonic welder for attaching supports to fuel elements. Sonobond expects to deliver the welding heads and power supply by the end of June, as scheduled. Design of the automatic handling and feeding mechanism is proceeding on schedule at HAPO. Detailed design will be far enough along by mid-April to permit fabrication to start. Completion is scheduled for June 25.

Approximately 3700 uranium cores were canned in the Al-Si pilot plant for process development purposes. Twenty-four hundred (2400) of the fuel elements are for reactor use. The major items of process development were:

1. Aluminum component cleaning and wettability tests in molten Al-Si to:
 - a. Evaluate Diversey #600 as a replacement for the present deoxidizer Diversey 514.
 - b. Evaluate Oakite #202 as a chemical cleaning agent.
 - c. Study the effect of concentration of Diversey #600 on component wettability.
 - d. Evaluation of pulsed spire vibration to assure cap-spire wafer bonding.
2. Provide fuel elements for the evaluation of DC power supply on automatic welder.
3. Determination of heating and cooling rates of CIVN uranium cores.
4. Determine if a correlation exists between uranium core size and the hydrogen gas content of molten Al-Si baths.
5. Normal canning to provide fuel elements in C-64 alloy for nickel plating and irradiation testing.
6. Study the effect of fuel element cleaning on electrical resistance spot weld penetration of self-supported and bumper fuel elements.

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7. Sprayed Zincilate WST-100 on fuel elements for protection during charging on PT-IP-297-F.

During the month, 431 OIIN bumper supported fuel elements were produced with a yield of 91.6 per cent. One thousand, nine hundred and sixty-one (1961) CIVN self-supported fuel elements were produced with a yield of 93 per cent.

MATERIALS ENGINEERING

NPR Fuel Development

Uranium Billet Cores

During the past month, machining facilities at NLO have become overloaded and caused delays in delivering billet cores for NPR coextrusion development. A priority was established whereby NPR outer tube billets would be finished first.

Currently, four NPR outer tube billet cores have been received with twenty-four more enroute from NLO. A total of thirty billets were ordered, but significant improvements in yield at NLO allowed completing about five extras from allotted material.

A total of twenty-four NPR inner tube billet cores are on order with none delivered. All processing except heat treatment and machining is completed. This material is second priority for machining.

A development order of 2,000 pounds each of normal and depleted uranium billet cores is completed except for machining: This material is third priority. This program is to explore the effects on coextruded tube quality of a range of low residual alpha working in billet cores.

PCTR studies require substantial quantities of special bare uranium in various enrichments. Three large orders of 1.00%, 0.95% and normal uranium are in process but are delayed at Bridgeport Brass Company awaiting feasibility study approval before extrusion can be done. The current schedule provides for extruding (during April) the 0.95 metal first, 1.00 second, and 1.6% enriched on another order, last.

Reactor tests to provide operating data on zircaloy clad fuels under conditions slightly exceeding those expected for routine NPR fuels require 2,000-4,000 pounds of 1.6% enriched coextruded fuel elements suitable for charging into KER. As the dimensions for these special fuels were just recently established, and from these fuel dimensions, the billet dimensions calculated, billet core designs have just been transmitted to NLO. All the castings have been in storage at NLO for six weeks awaiting these designs. Fabrication of these billet cores requires extrusion at Bridgeport Brass and will follow the 0.95 and 1.00 metal extrusions stated above.

Zircaloy Cladding Components

Newly revised NPR fuel element dimensions required a rather extensive re-assessment of the zircaloy cladding supply negotiations. The new dimensions and required quantities were sent to all prospective suppliers with the request that they resubmit their proposals for the pilot order. All negotiations will be completed and the orders placed by early next month. Scheduled delivery for this 8,000 pound pilot order is 7-1-60 to 10-1-60.

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Copper Extrusion Cans

A request for comments on producing thin wall large diameter copper tubes for coextrusion billet outer cans was sent to two prospective suppliers, both of which expected to be able to produce the products. Both companies utilize spinning, or a variation thereof in their process.

Induction Heating of Composite Billets

On 3-23-60, an induction heating test was observed at Ajax Magnethermic Corporation using a 120 KW single phase, 60 cycle heating unit; a 6-in. NPRIT billet was brought to extrusion temperature in about 14 minutes. The heating unit was hand controlled by an operator observing the outer copper can temperature as monitored by a thermocouple. At the completion of the cycle, the eight thermocouples buried in the billet assembly were reading within $\pm 5^{\circ}\text{F}$. Six thermocouples inserted through the end caps of the billet were reading within $\pm 20^{\circ}\text{F}$.

The problems associated with induction heating of composite assemblies were discussed with representatives of Ajax Magnethermic. The use of soft iron extrusion cans, copper plated zircaloy components, copper and copper-nickel end plugs and effects of component size variation were included in this discussion. From these discussions it was concluded that an induction heating cycle could be used for these individual variants or any combination of them.

Two or three more tests will be run to determine whether or not a long soak cycle can be developed for use with this equipment.

Extrusions

Two extrusions were made on the 400 ton HLO press to test the use of copper plated zircaloy. This completes a series of five extrusions. The first three extrusions showed exceptionally good surface finish; the last two showed some evidence of pickup and scratching.

One coextrusion (NPROT) was made on the 2750 ton press using a floating mandrel. Concentricity measurements in the as-extruded condition are reported below:

NPR Outer Tube - HAPO 1

Dimensional Measurements

Outside Diameter

Inside Diameter

Wall Thickness

External Clad Thickness

Internal Clad Thickness

Copper On

2.487"-2.482"

1.844"-1.840"

0.324"-0.317"

Copper Off

2.466"-2.444"

1.850"-1.844"

0.307"-0.296"

0.035"-0.015"

0.034"-0.013"

Average Peel Test Results

Outer Clad - Fair
Inner Clad - Poor

Average Interface Cleanliness

4 (Fair)

Extrusion Press (2750 Ton Loewy)Training

Training of necessary personnel on press operation was completed during the month. At least two individuals are trained for each position on the press crew during extrusion.

Alignment

Considerable experience was gained during the month on press alignment. The majority of this experience was obtained during actual alignment of the press by Loewy personnel. Complete and satisfactory alignment has not been obtained to date, due to the time required in the delicate adjustment between the platen and the container-liner assembly. Work is now in progress to provide more direct guiding of the container holder and should allow final alignment of the press by 4-4-60.

Evaluation of Coextruded Product

The first results have been obtained from the joint study with HLO people on the defect testing of as-coextruded sections. A three-fold intent has been:

1. to distinguish the performance of fuels having clean versus impure interfaces during corrosion testing;
2. to establish a base-line of performance to evaluate the change attributed to beta heat treating;
3. an electron micrographic characterization of the impurities in the interface.

J. W. Goffard has defect tested duplicate samples of interfaces rated 7 (good cleanliness) and 2 (poor minus cleanliness) and the rate of attack of the clean interface was much superior to the impure interface.

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Beta Heat Treating by Induction Scanning

During the period March 12-17, 1960, the setting-up of the vertical scanner at the Ajax Magnethermic Corporation was completed. The set-up data showed that a 1-ft. length could be uniformly heated to $1350 \pm 10^{\circ}\text{F}$. Run-to-run variability could be maintained within the same range.

Four lengths of KER-IT/TT that were 28-in. long were scanned to determine the amount of warp that would occur from heat treating followed by air cooling. These tubes showed no significant trend. Two tubes showed less warp and the other two showed more warp after heating. The finished readings of warp were 8, 11, 13 and 48 mils (single throw in 28-in.).

These air cooled tubes have been given preliminary x-ray diffraction evaluation. On the basis of 4 or 5 runs on each tube there is no doubt that transformation has been completely attained.

Five KER-IT/TT have been beta heat treated and quenched at an intermediate cooling rate with an air-blast. In each case, warp of the pieces occurred. To provide proof of the cause of warp, all pieces were processed under the same conditions. It was subsequently shown that the five air lines feeding the quench head were improperly metered and warp occurred in the same direction in each tube relative to the quench head. The warps were 46, 46, 77, 115 and 215 mils (single throw).

A new quench head is being constructed and the symmetry of air flow will be correct to affect minimum warp. Work is scheduled to be resumed on April 7, 1960.

The successful operation of the last period fixed the design criterion, and pilot plant equipment was ordered on March 28, 1960. The equipment comprises a complete heating facility (motor generator, heat station, control meter station, a 6-ft. vertical scanner and control). Acceptance of the equipment is expected by June 15-30 and delivery by July 1-15, 1960.

Fuel Element End Closure

The Design, Development and Research Contract for the work on the combination projection-seam welding development for the NPR fuel element end closure has continued to be delayed due to the work being classified. As of this past week, however, all security requirements have been met and the work should proceed starting within about a week.

The application of ultrasonic welding to effect an end closure of a totally bonded type has been discussed with Aeroprojects Incorporated, West Chester, Pennsylvania. Aeroprojects has pioneered the application and development of ultrasonic welding and has good R&D facilities in place.

The application of ultrasonic welding to a bonded end closure for the NPR tubular fuel sections indicates the possibility of achieving a totally bonded end closure which would afford double protection against water entry to the uranium end face. The process envisioned is to prepare the end by the usual method of chemically milling to about .100 inches deep and then ultrasonically spot welding a thin zircaloy sheet preformed ring to cover the uranium. Thin sheet or foil in the .005 inches to .010 inch range would be used and would be attached by overlapping spot welds. With appropriate tool and fixture design and indexing, it is felt that the entire end can be bonded, including perhaps .050 inches up the zircaloy cladding at the sides. Using thin zircaloy sheet, fully annealed, it is believed that the material can be stretched into the corners and across the end during the attachment process, compensating for the eccentricity of the piece as extruded or as heat treated. Following this operation, a regular unbonded end cap would be tungsten-inert gas welded in place. If pure zirconium rather than zircaloy-2 sheet or foil would give a little better ductility and stretch into the corners better, this could also be used.

Aeroprojects felt that this concept had good feasibility and plans have been made for them to develop the process. It is anticipated that the work will start about April 1, and the feasibility phase concluded by June 15, 1960.

Nondestructive Testing

Zyglo-Pentrex inspection station in the 306 Building should be in operation by April 15, 1960.

Ultrasonic and eddy current testers have been moved from Testing Methods Laboratory to the 306 Building.

Radiographic Testing Operation (HLO) has developed a technique for radiographing the closure welds on NPR fuel elements. The technique will detect voids larger than 20-mils in diameter. This sensitivity is not satisfactory for NPR fuel element welds. If a satisfactory ultrasonic weld tester can be developed, NPR fuel element welds will not be radiographed.

Four sections of NPROT billet cores and four sections of NPRIT billet cores are being procured for Testing Methods. These sections will have different grain sizes and will be used to develop a grain-size tester for NPR billet cores.

Equipment

Autoclaves

The autoclave instrumentation was rewired per instructions of Carl Swanson, HLO, Operation, Research, to eliminate a temperature overshoot on start-up. Reset action in the present equipment was removed. A test startup was performed successfully with no temperature overshoot.

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Additional Bushings in the Glove Box in 306 Building

A design was completed on a high frequency bushing and a low voltage bushing consisting of eight conductors. These will be installed in the left hand door of the glove box on the beam welder. These bushings are made of nylon and will have an "O" ring seal for vacuum. The high frequency bushing will have two hard, brass, hollow conductors through the nylon bushing equipped with "O" ring seals. The cooling water for the high frequency coil, located inside the glove box will flow through these conductors. The high frequency cables will be connected to the conductors on the outside by means of specially made connectors.

The low voltage bushing will be equipped with eight solid 1/4-in. conductors through the nylon bushing and each will have "O" ring seals. These conductors will be used for strain gauge and low voltage connections inside the glove box.

Control Panel for Automatic Operation of the Manual Heliarc Welder

This control panel consists of two sequence timers, each equipped with seven microswitches. There are also eight 50 ohm rheostats and a variac in the panel. The panel is wired for automatic welding operation of NPR tubes.

This means the operator will push a button to start his arc, after a short time, a warning light will light indicating to the operator to move his electrode to the welding position at which time the table will begin to rotate, and at the same time perform the weld. Upon the completion of the weld, the second timer will start and apply the crater fill action to the completed weld. After the weld has been completed, the timers will return to the start position.

New Rotary Table Design for Welding Long Fuel Elements

A new design of a rotary table to be installed on a manual welding table in 306 Building has been completed. This table will have a 10-inch, 4-jaw chuck mounted on a 3-in. diameter, 24-in. tube suspended vertically by two single ball bearings, and driven by a gear reducer and a D.C. variable speed motor.

It will then be possible to weld any length fuel element up to 36-in. in length. The chuck and 3-in. tube will be free-wheeling by using a Warner electric clutch. This will allow the operator to rotate the chuck assembly by hand to check the alignment of the piece to be welded.

All material is on order and the job is expected to be started within the next week. This drive unit is being considered for a production setup.

TESTING METHODSProcess Fuel Element TestingExternal Bond Test

One Bond Tester modified to evaluate recent developments has been operating in the canning line the past three weeks. Its performance has been decidedly more consistent, reproducible and accurate than regular units. As expected, its improved performance resulted in a decreased yield. In some lots of virgin material the rejection rate rose to as high as twenty-five percent, while in other lots of recovered material the rejection rate dropped to less than two percent. Extensive destructive examination conclusively established that unaccepted material was properly rejected in terms of present specifications.

Importantly, the sensitivity level of the modified unit remains constant to a much greater degree than with unmodified units. It is believed that the more reliable measurements provided by these improvements are suitable for product specification use. An Appropriation Request has been initiated for the conversion of all units.

Internal Penetration Test

Unwanted signals arising from spire bumps and braze layer voids which tend to mask penetration signals have been one of the most serious troubles of the internal penetration test. Recent experiments suggest that these undesired signals may be very significantly reduced simply by surrounding the coil with a small piece of high permeability metal. Apparently, the shielding action focuses the field in such a way as to improve the response to penetrations. The effect is being studied in the laboratory.

Bare Core Station (UT-2)

At least twenty-five thousand cores, including two lots of dingot and two lots of ingot material, have been run through the UT-2 station recently installed in the production area. The equipment over-all performance during the initial run-in period was very satisfactory. The unit is now fully operational.

The test provided an opportunity to operate the data logging portions of the equipment for the first time under production line conditions. Data for the entire group of material was logged, processed (by Data Processing) and plotted on graphs which show the distribution of minimum, average, and difference in grain size as a function of voltage for each lot. The graphs clearly show over-all differences in grain size quality by lot. In this test, for example, the graphs show the dingot material to be significantly

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larger grain material than the ingot. Further correlation studies are planned in order that quantitative grain size values may be attached to instrument voltage values.

New Methods Development

NPR Test Station (UE-2)

Co-extruded Fuel Inspection

The frequency of the cladding integrity test has been lowered from 360 KC to 120 KC to improve its response to small cladding defects. The lower frequency lessens instrument response to nominal surface irregularities which tend to mask bonafide defect indications. Whereas a 0.015 diameter hole extending through the cladding was the minimum size detectable with the higher frequency, it is found that the lower frequency resolves holes 0.009 inches in diameter. With a smooth surface it is expected that an 0.007 inch diameter hole would be detected.

Fourteen NPR inner tubes were routinely tested in the station. Surprisingly, all fourteen pieces indicated prevalent unbond indications on the inner jacket at instrument settings which gave no indications on a standard element known to be well bonded. The pieces have not as yet been destructively examined.

Component Inspection

Temporary provisions have been made in the NPR testing tank for the testing of uranium billets and zirconium sleeves. A small motor attached to one end of the tank rotates the components, while the scanning head is manually translated. Special transducers which generate the low ultrasonic frequencies (400 KC to 1 Megacycle) necessary to penetrate the billets are on hand.

Another billet inspection station which may be operated separately from the fuel tester is also under fabrication.

A series of different size holes are being drilled into a special billet which will serve as a standard against which the ultrasonic test may be calibrated.

End Integrity Test (UT-4)

Design of a prototype instrument for the detection of braze layer voids between cap and can has been completed.

The design provides for a two crystal scanning system which experimental results indicate may be required for complete scanning coverage. Plans are

to begin laboratory evaluation studies within the next few days.

Lamb Wave Studies (WO - A 02790)

Thickness Measurement

Extensive tests have confirmed that a frequency analysis of Lamb waves provides a reliable measure of the metal thickness in which they flow. Measured frequencies radiating from aluminum plates ranging in thickness from 0.010 to 0.050 have been observed to be in good agreement with theory. The development of an instrument for practical application of this principle is about forty per cent complete. If successful, this instrument will read out the metal thickness of a part under inspection in digital as well as analog form.

Various transducer types and combinations have been measured in order to obtain the widest possible band width. The most favorable combination appears to be a five and ten megacycle Branson type "Z" transducer, either one acting as the sender and the other as the receiver. The resulting over-all band width is measured to be around seven megacycles.

Bond Studies

A wide variation in the amplitude with which Lamb waves are excited in typically well bonded fuel jackets has been observed. In a first attempt to determine the significance of these variations, an element was carefully examined at a half-dozen selected points. The ultrasonic response at each point was measured and recorded, after which a stud was attached. The strength of the bond at each point was then determined by pulling the studs in a tensile machine. With the exception of one data point which bore no correlation to the others, a plot of the results gave a nearly linear relationship between ultrasonic response and the magnitude of the force required to break the bond. Further tests are being made to substantiate these results.

Service Work

Development of an eddy-current instrument which measures degree of crystalline orientation in polycrystalline graphite is nearly complete. This work has been done at the request of Research and Engineering, IPD.

At the request of Radiographic Testing, HLO, a series of five lectures on ultrasonic testing has been prepared for presentation by Testing Methods to their people. One one-hour lecture is being presented per week.

Instructions have been issued to Technical Shops for the construction of testing equipment being fabricated for Ceramic Fuels, Plutonium Fuels Development and Plutonium Metallurgy, HLO.

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ADVANCED ENGINEERING

NPR Fuel Cost Estimate

A recent estimate of NPR fuel element fabrication costs considering new fuel design changes revealed that costs will be 16 percent higher than previous estimates indicated. The increased cost is the result of higher Zirconium to Uranium weight ratios inherent in new fuel designs.

NPR Irradiation Testing

A study of FPD irradiation testing requirements for evaluating NPR size fuel elements produced in the 333 Building emphasizes the shortage of irradiation facilities capable of duplicating NPR operating conditions that will exist during the period preceding fabrication of the first NPR fuel load. Acquisition of adequate facilities is desirable to implement the irradiation test program suggested.

Hanford Test Reactor

Routine testing continued throughout the month. Assistance was provided for several special tests. During the week of the 14th the testing procedure for NPR graphite was completed. Document HW-64445, "Testing Nuclear Purity of NPR Graphite, was issued describing the method and results. The purity as determined by the NPR procedure agrees to within ± 0.038 di with respect to the purity values measured by routine "F" size tests on the same graphite. This agreement is felt to be within the testing precision desired for NPR graphite.

NPR Uranium Billet Nuclear Purity Specifications

A method for obtaining purity of NPR billet material using the Hanford Test Reactor has been completed. The method assumes that equivalent normal size, 8 inch long, 1.336 inch diameter solid fuel elements will be available from NPR billets.

The accuracy of purity measurements by the method should be within an "effective absorbing power per gram of uranium" of $\pm 7.0 \times 10^{-6}$ cm²/gm uranium. A rough draft giving the method of testing and the definition of "effective absorbing capacity per gram of uranium" has been prepared and will be issued in April.

Asymmetrical Power Measurements (Test Reactor Mockups)

Fission products gamma energies between 0.5 and 0.9 M.E.V. look promising to use for power asymmetry measurements. Studies show that adequate disintegration rates will be available from a test reactor irradiation. Other studies show that a 1/2 inch diameter collimator drilled in a 2 inch thick lead brick will be necessary to obtain sufficient gamma counts from the above disintegrations.

Also, it was calculated that when counting the activity on one side of a fuel element interference by gammas coming from a diametrically opposite point are no larger than 3 percent of the activity being counted. This means that a power asymmetry of 10 percent can be easily detected. Also, it is unlikely that the

asymmetry as determined by the considered method will compare directly with either the fuel element surface power asymmetry or the volume averaged asymmetry but rather will fall somewhere between these two values of asymmetry.

A simple test to verify analytical methods will be conducted the first week in April. Further refined tests to demonstrate the capabilities of the method will also be conducted in the remainder of the month.

DESIGN & PROJECTS

CGF-810 - 306 Pilot Plant Modification

All work on this project has been completed except for acceptance tests on the extrusion press. The first coextrusion was made on March 15, 1960. Acceptance tests were started in earnest on March 25, 1960. The first two tubes extruded had a wall thickness variation of 15 mils, with an allowable maximum of 14 mils. The third tube was well within the specifications. On the fourth extrusion, the mandrel broke in tension, and a rod was extruded. The next two extrusions were not within the specification, and the remainder of the vendor's mandrels were damaged during extrusion. At this point the acceptance tests were discontinued until new mandrels and billets could be obtained.

The chemical processing facility built on this project was put into service in the 306 addition on March 28.

CAF-847 - New Fuel Cladding Facility

Authorization to expend the funds necessary for procurement of the heating and ventilating units has been received and the requisition has been placed.

The project proposal has been rewritten to provide for the change from 36" to 24" fuel elements.

Results of a trip to Ajax Magnethermic indicate the induction pre-heating of billets is very practical.

CGF-876 - 303 Area Maintenance Facility

A request for additional study and analysis on this proposal was received from the AEC. The information requested has been assembled for transmittal.

Compressed Air Facility

The project proposal on this facility is being routed for approval.

Self-Supported Fuel Element Facility

A draft of this proposal was discussed at the Design Review meeting on March 29. Applicable suggestions are being incorporated in a revised draft.

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DRAFTING AND FILES

Major Jobs in Drafting

306 Building:	Welding Chuck for Welding Zirconium End Closure Welding Shield Bailey Test Tank
313 Building:	Ultrasonic Welder and Details Additional Fuel Element Components Lead Agitator As-Builts Miscellaneous As-Builts
333 Building:	Plumbing and Piping Electrical-Press Power Circuit Electrical-Runout Table Circuit Autoclaves, Neutralizer Tank
Miscellaneous:	3713 Building - Electrical As-Builts Map As-Builts

Drawings Produced

New	60
Revised	79
Small Charts	14
Large Charts	2
Miscellaneous	38

Manager - Engineering

FINANCIAL SECTION

MARCH, 1960

The biennial inventory of uninstalled cataloged equipment was started on March 21, and completed March 29, 1960 as scheduled. Preliminary results show seven items missing valued at \$2,192. Total pieces of equipment to be inventoried numbered with a 1,400 first cost in excess of \$900,000. Reconciliation is not sufficiently advanced to report items to be added to the record nor those to be written off. Of the seven items missing, two were assigned to the Manufacturing Section and five to Plant Facilities. With the exception of an oscilloscope valued at \$1,040, all items are small, highly portable instruments with low unit value.

Two project proposals were reviewed during March. These were the revisions to CAF 847, New Fuel Cladding Facility, \$4,700,000 and CGF 894, 300 Area Compressed Air System Expansion, \$80,000.

The Equipment Not Included in Construction Projects Budget for FY 1962 and Revision of Budget for FY 1961 was completed March 14, 1960.

Assistance was furnished the Engineering Section in the preparation of the Plant Acquisition and Construction Budget for FY 1962 and Review of Budget for FY 1961. Budget was completed March 25, 1960.

Responsibility for making Washington State Use Tax determination was assigned to General Accounting effective with March business. Necessary procedures have been completed to code all source documents in this Department which will virtually eliminate any need for after-the-fact review and analysis.

Four HAPO OPG's and two revisions were issued during the month, bringing to 74 the total issued. Forty-three HAPO OPG's remain to be issued, and of these, eleven were being made ready for issue at month end.

Procedures have been placed in effect by General Accounting for centralized handling and audit of requests for periodical subscriptions. Need for Department-wide coordination of this function was pointed out in a recent audit memorandum.

In order to further reduce clerical effort required on expense accounts, a "Bookless Bookkeeping" system was adopted effective with April business. This system was originally placed in use in the Department in January, 1959, but subsequently discontinued with the realignment of financial responsibilities last spring. With the return of expense account responsibility to the Department and in view of earlier savings generated through "Bookless Bookkeeping", it is expected that considerable benefits will accrue.

Considerable time was devoted to a special analysis of travel activity for FY 1960 and the two previous fiscal years. Results were furnished Contract Accounting for incorporation into a HAPO consolidated report.

Formal audit reports were issued during the month covering the following subjects:

Audit of Small Tools
Audit of Special Clothing & Protective Equipment
Audit of Material of Property Passes

These reports concluded audit work which was in progress for several months and completed the schedule of audits through April, 1960.

Additional audit work included follow-up of the GE Traveling Auditors memorandums, evaluation of employee end of shift work practices in the Department and review of purchase requisition approvals.

Schedules completing the Fiscal Year 1962 Budget and the Revisions to Fiscal Years 1960 and 1961 Budgets were submitted on April 5. Late in March the decision was made that the official production forecast should be revised to include an E - N demonstration load and to accelerate the projection type fuel element program. As a result, a complete revision of personnel and cost estimates was necessary. This delayed the submission date considerably.

Funds required for Production during FY 1960 amount to \$9,807,000, as compared with the Midyear Review and Financial Plan amount of \$9,974,000. Production Costs are expected to total \$11,920,000 in FY 1961 and \$17,554,000 in FY 1962.

Expenditures of \$995,000 have been authorized by IPD for Research and Development activities during FY 1960. In FY 1961 and FY 1962 \$1,100,000 and \$1,135,000 respectively will be required to carry on the Research program.

Gross funds requirements, including funds for providing services required by HLO, are estimated as follows:

	<u>Gross Cost</u>
FY 1960	\$14 008 000
FY 1961	16 962 000
FY 1962	22 891 000

Results of the December physical inventory of precious metals and special materials were received from Contract and Accounting Operation. The reconciliation indicated no discrepancy between quantities on hand and book amounts. A formal report of findings is being prepared.

Manager - Finance

WS Roe:mh

PLANT FACILITIES OPERATION

MARCH 1960

GENERAL

The Construction Contract for ESR-205, "Sand Separator Station, 300 Area," was awarded to J. P. Head and notice to proceed issued. All engineered procured equipment are on the plant site. The station is scheduled to be ready for operation May 13, 1960.

DUPLICATING

<u>Process</u>	<u>No. of Impressions</u>
Multilith	586,083
Verifax	5,068
Ozalid	<u>6,285</u>
TOTAL	597,436

UTILITIES

	<u>March</u>	<u>Feb.</u>
Average steam generated (M lbs/hr)	66	78
Maximum steam generated (M lbs/hr)	108	113
Total steam generated (M lbs/hr)	48,905	54,309
Coal consumed (tons)	2,562.50	2,950.64
Evaporation rate (steam/coal)	9.54	9.20
Efficiency-Actual	68.5	67.5
Efficiency-Theoretical	73.2	74.8
No. of Boilers on	3 2 3 2 3	
Date of change	1 7 19 20 30	
Sanitary water from 3000 Area (million gallons)	83.04	80.28
Total water from 3000 Area (average rate GPM)	1860	1922
Total water from #3 & #4 wells (million gallons)	15.74	13.91
Total water from #2 well (M gals)	.30	.30
Peak water consumption for 24 hrs. (million gallons)	3.0	3.0

INVENTIONS

All personnel in the Operation engaged in work which might lead to inventions and discoveries advised that to the best of their knowledge none were made in the course of work during March 1960.

SAFETY, SECURITY AND RADIATION EXPERIENCE

Medical Treatment Injuries	18
Frequency Rate	3.45
Disabling Injuries	0
Serious Accidents	0

There were no Security Violations or Radiation Incidents reported.

MEETINGS

Round Table-Staff	16
Safety and Security	13
Information	7

Manager
Plant Facilities Operation

E. Hilgeman:GSS:skd

RELATIONS PRACTICES OPERATION
MARCH, 1960

STATISTICS

EMPLOYMENT

		<u>March</u>	<u>February</u>
<u>Additions</u>	Exempt	1	2
	Nonexempt	<u>11</u>	<u>21</u>
	Total	12	23
<u>Reductions</u>	Exempt	2	1
	Nonexempt	<u>11</u>	<u>12</u>
	Total	13	13

HEALTH AND SAFETY

Disabling Injuries	0	0
Serious Accidents	0	0
Medical Treatment Injuries	47	60
Medical Treatment Frequency	3.45	5.09

SECURITY

Violations -- FPD	1	0
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BENEFIT PLAN PARTICIPATION

Insurance	100 %
Pension	99.9%
Savings & Security	92.7%

SUGGESTION PLAN PARTICIPATION

	<u>March</u>	<u>February</u>
Eligible employees	597	596
FPD suggestions received	49	49
Annualized rate per 1000 eligible employees	985	987
No. of suggestions adopted	16	12
Net annual saving	\$7,209	447
Amount of awards	\$ 995	\$ 265
Percent of total awards to savings	13.9	5.9
Average amount of awards	\$ 62.19	\$ 22.08

GENERAL

Forty-five facility inspections were conducted during the month by the Specialist - Health and Safety, and the Central Safety Council management teams made two inspections of plant buildings and grounds.

Operation New Broom 1960, the FPD spring clean-up campaign, was successfully completed during the month. Area grounds and buildings were considerably improved in appearance through a thorough housekeeping effort.

Instruction placards and breathing tubes for administration of mouth to mouth resuscitation have been installed in 30 locations in FPD buildings. Further training and instruction will be given to all interested groups on request, through the Fire Protection organization.

The recently completed revision of the 300 Area Emergency Plan is being mailed to all 300 Area exempt employees. The plan, a joint effort of HLO and FPD covers all types of emergency and prescribes personnel action.

Instruction cards specifying evacuation, take cover, fire, criticality and crash alarm signals and action on the part of personnel have been prepared for posting on bulletin boards in all 300 Area buildings.

All non-unit, nonexempt employees were familiarized with the new Compensation Program. The plan is scheduled to be effective April 11.

Manager - Relations Practices

RW McCullugh:mb

END

**DATE
FILMED**

8 / 24 / 92