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FUELS PREPARATION DEPARTMENT

HW--60327-Del.

MONTHLY REPORT FOR APRIL, 1959

DE93 000990

By Authority of PR-24 Compiled by Fuels Preparation Department

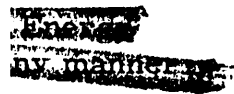
DS Lewis 8/10/92  
DD Knecht 8/11/92 May 25, 1959 Richland, Washington

PNK Eick 8 21-92

Work performed under Contract No. W-31-109-Eng-52 between the Atomic Energy Commission and General Electric Company.

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FUELS PREPARATION DEPARTMENT  
MONTHLY REPORT SUMMARY  
FOR APRIL, 1959

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### PRODUCTION

Five hundred ten (510) tons of acceptable uranium fuel elements were produced. This was 101% of forecast production (page B-2).

Two thousand five hundred seventy-five (2,575) lead poison elements were produced (page B-3).

### ENGINEERING

Conclusions regarding nickel plating of fuel elements at present indicate that:

1. nickel plating does not significantly contaminate reactor effluent;
2. improved adherence of the nickel plate is essential if the full potential of this development is to be realized.

An investigation and remedial development work is underway to improve nickel plate adherence during irradiation. Pending completion of this work, the production test to determine relative uniform corrosion resistance under current reactor and higher power-exposure is temporarily delayed (page C-10).

Two uranium-zirconium coextrusion runs have now been completed offsite as part of the fuels development for NPR. All material from the first run has been sampled in the as-extruded form and subsequent testing and fabrication is underway. Fifteen tubular billets and two rod billets were extruded during April. Material for extrusion run #3 is being assembled and the extrusion is planned at Bridgeport Brass in June. Almost all Zircaloy-2, copper and graphite to underwrite coextrusion work for the next seven months has been received or is on order. Encouraging preliminary results were obtained in the end closure problem in tests that were performed to provide bond welding between the uranium and zirconium. Additional development work is planned with Olin Mathieson Corporation utilizing their Zeiss electron beam welding equipment. Associated nondestructive testing development for extrusion processes is proceeding very well with prototyping of equipment underway in a number of areas (page C-14).

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First phase reports on Broadband Electromagnetic testing studies, eddy current methods and ultrasonic Lamb wave studies have been made in support of the 4000 program. Second phase studies and application developments are now underway in these areas (page C-18).

During the past four months the uranium metal quality level as measured by acceptance and in-process inspections decreased slightly from the level for the previous four month period. The average rejection rate for surface defects in virgin uranium is about 1.2% compared to less than 1% for the previous four month period. The average rejection rate for surface defects in recovered uranium has remained at higher levels. However, in February and March a decreasing trend appeared to be developing (page C-5).

About 5500 uranium cores were canned in the Fuel Element Pilot Plant for process development purposes. This continues a trend to increase throughput in the Pilot Plant (page C-12).

#### GENERAL

A revision of the Official Production Forecast was completed during the month. Continued operation of eight canning lines is predicted during the eighteen months covered by the revised forecast (page B-5).

Month end inventories of bare uranium cores and finished fuel elements were adequate to meet requirements. The bare metal inventory at month end (620 tons) was slightly less than one month supply due in part to an increase in forecasted May production. Month end finished fuel element inventories in combined 100-300 Area storage totaled 599 tons (page B-3).

The Fire Protection Operation was transferred to the Construction Engineering and Utilities Operation on April 1, 1959 (page E-1).

Final arrangements for consolidation and transfer of the General Ledger functions to Contract and Accounting Operation were completed (page D-1).

#### PERSONNEL STATISTICS

Number of employees March 31, 1959	768
Number of employees April 30, 1959	727

	<u>Exempt</u>	<u>Non-Exempt</u>	<u>Total</u>
General	1	1	2
Manufacturing	53	276	329
Engineering	52	26	78
Financial	13	16	29
Maintenance & Power	31	243	274
Relations Practices	<u>7</u>	<u>8</u>	<u>15</u>
Total	157	596	727

STAFF

General Manager, Fuels Preparation Department	L. L. German
Manager, Manufacturing Operation	W. M. Mathis
Manager, Engineering Operation	J. W. Talbott
Manager, Financial Operation	W. S. Roe
Manager, Maintenance & Power Operation	E. Hilgeman
Manager, Relations Practices Operation	W. A. Shanks

PATENT SUMMARY - APRIL, 1959

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

<u>Inventor</u>	<u>Title</u>
T. B. Correy	An Improved Current Wave Shape and Proportion of Alternating Current for Inert Arc Welding and Metallic Arc Welding and the Equipment for Producing the Improved Wave Shapes
D. C. Worlton	A Method of Applying Lamb Waves in Ultrasonic Testing
T. D. Gibbs	Electrical Device to Actuate an Annunciator Fire Alarm System

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General Manager  
Fuels Preparation Department

MANUFACTURING OPERATION

April, 1959

I. CURRENT OPERATIONS

A. Production and Productivity

1. Statistics

	NORMAL						ENRICHED			6"	
	8" Solid	8" I & E		Rev. K	O	6" Water Mix	6" I & E			Solid	Total
		C	K				C	K	O		
<u>Current Month's Production</u>											
Acceptable Fuel Elements Produced(Tons)	40.6	0	52.6	147.9	198	3.1	23.6	18.3	25.6	0.3	510
As % of Forecast Production	102	0	105	101	99	39	148	108	95	0	101
As % of Past 3 Month's Average Production	66	0	57	360	93	78	87	141	160	8	100
As % of Past 12 Month's Average Production	26	0	55	1479	137	155	69	610	256	5	98
% of Forecast Achieved - Last Fiscal Quarter	128	145	165	45	113	433	98	95	86	367	108
% of Forecast Achieved - Last 4 Fiscal Quarters	115	108	110	45	106	180	104	95	96	80	106
<u>Operating Efficiency</u>											
Current Month (%)											94.5
Forecast (%)											95.0
Previous Month (%)											94.9
<u>Manufacturing Yield</u>											
Current Month (%)	74	-	86	88	83	70	84	81	81	-	
Forecast (%)	77	82	82	82	82	70	82	82	82	-	
Previous Month (%)	79	84	80	83	82	70	87	81	81	82	
Bare Uranium Available for Processing(Tons)	74	88	102	98	157	6	0	41	29	25	620
Finished Products in Storage(Tons)	87	42	98	98	159	7	30	32	40	6	599
Special Products Finished (Pieces) Poison Uranium Utilization											2,575 92.5

2. Activities

a. Production

Finished fuel element production was five hundred ten (510) tons, 101 percent of forecast. Forecasted April production was changed slightly (from 509 tons to 505 tons) due to a first quarter review of the Official Production Forecast, HW-58930-RD. Except for the curtailment of four canning line shifts, eight lines were operated throughout the month. The production curtailment was necessary due to excessive absence for personal illness. Continued high yields and operating efficiency enabled production requirements to be met despite the curtailment.

b. Yield Control

	<u>March Yield</u>	<u>April Yield</u>
8" I & E	81.5%	85.2%
8" Solid	79.5%	74.3%
6" I & E	81.1%	82.2%
6" Solid	82.5%	96.8%

The yield for eight-inch I & E elements increased sharply from 81.5 percent experienced in March to 85.2 percent this month. Gains in facing and thin wall reject categories were principally responsible. Facing performance was improved by better tool fabrication and setting. Also the surface finish standard was relaxed to permit greater flexibility in lathe operation without sacrificing over-all fuel quality. The thin wall reject rate has been significantly reduced due to improved control of silicon additions to the canning baths and improved control of canning temperatures. Optical measurements of can wall thickness are being made immediately after facing and results forwarded to Canning operating personnel. With this information optimum canning bath temperatures can be maintained. The optical measurements are easily obtained and eliminate the time delay previously experienced by the former caustic stripping method. Yield gains made in the facing and thin wall categories were partially offset by an increase in weld rejects. An investigation of suspected causes of weld rejects, particularly those associated with contamination of the interior spire surface has been initiated. A correlation has been noted between the occurrence of stained spires and heavy contamination at the base of the internal weld. It appears that cleaning process chemicals are not fully removed from components by the rinsing processes and thus interfere with welding. Preliminary test results show that O II model spires which have the smallest inside diameter and thus the one most difficult to rinse are particularly susceptible to this problem. Plans have been completed to alter the water spray equipment on the component cleaning machine to improve rinsing of all components and to reduce carry-over of cleaning solutions.

Four autoclave failures occurred in April. Three were caused by defective weld closures and voids in the braze layer under the cap. The fourth failure is attributed to a thin cap. The trend in autoclave failures since January is unfavorable and considerable attention is being given to this problem.

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c. Other Activities

The Special Products crew canned 2,575 lead "poison" pieces during April. There are 7,500 bare lead pieces to can when storage pallets are available.

Spools were welded on 1,443 water mix fuel elements, with 2,026 yet to be welded.

A total of 7,719 fuel elements were reclaimed by machining off the original weld and rewelding during April.

In addition to normal testing, five separate two hour irradiations were performed this month for the IPD Operational Physics Operation. Four of these irradiations were Army gas loop fuel mock-ups for rise-factor measurements.

The following pieces were processed through the Fuel Recovery Operation.

	<u>Pieces</u>
8" Solid	3,920
8" I & E	23,045
6" I & E Enriched	9,147
Water Mix	956
	<hr/>
	37,068

B. Plant Conditions, Incidents and Improvements

1. General

Operating efficiency was 94.5 percent compared to a forecast of 95 percent. Nearly all production down-time due to equipment was caused by failure of the transformation testers. Operation of the pen and bond testers was very satisfactory. Reliability of the latter equipment continues to improve.

Bare uranium supplies at month end (620 tons) were slightly below optimum of a month's supply due in part to about a fifty ton increase in forecasted May production. Additional May uranium deliveries were requested to enable current production schedules to be met without further decreasing the bare uranium inventory.

During the month, one freight car of uranium cores was involved in a derailment in Montana. The load on the car after the accident was nearly intact but delivery was delayed for over a week while the material was transferred to another car. Bare supplies at HAPO of the products contained on this car were sufficient so this delay caused no interruptions to our production schedules.

Inventories of finished fuel elements decreased 45 tons (from 644 to 599) this month because reactor charges exceeded Department production. Several reactor outages occurred near the end of the month and were responsible for the added consumption of finished fuel elements. However adequate supplies of all products were available at month end.



2. Quality Certification Program

Arrangements have been completed to initiate the Quality Certification Program on May 4. The Program is a joint effort of the Irradiation Processing and Fuels Preparation Departments and is designed to reduce fuel element rupture rates and increase conversion efficiency through better knowledge of fuel element quality. A quality index is used for selective charging and scheduling of reactor power and exposure. Comparisons of post irradiation and pre-irradiation measurements are used to develop fuel element quality requirements and associated research and development programs. The measurements will include: (1) can-core bonding quality by both non-destructive and destructive tests, (2) cap end base wetting and void quality through destructive test, (3) residual wall thickness by optical measurement. Additional tests are under consideration.

3. Boss Type I & E Spires

Use of boss type I & E spires has been discontinued. This proposed spire design change has been under investigation for some time. Improvements in the fuel element fabrication process were expected from use of the new cap, namely, reduced floating and cocking during canning, easier handling on conveyors, and better lathe indexing. However, modified canning and finishing techniques have improved the performance of the well type cap with the result that there is not now any significant advantage of one model over the other. Further, considerable difficulty in fabricating boss spires in quantity has been experienced in spite of earlier successful production of small experimental lots.

4. Extended Can Pre-Heat Test

Production testing of a longer can pre-heat canning cycle was initiated. The object of the program is to eliminate braze metal freeze-out during the assembly operation that tends to obstruct bonding. The test cycle developed by process engineering provides a sleeve can pre-heat of about 73 seconds as opposed to the standard 47 second period. The test cycle appears to promote better bond integrity, residual wall thickness and weld closure quality. Large scale testing of the new cycle is pending complete evaluation of preliminary data.

5. Salt Bath Transformation Investigation

A program has been initiated to determine residual stresses in re-heat treated cores. It has been found that an angle quench causes less core warp than a vertical quench. However, alpha annealing of cores quenched by each method produces greater distortion on cores quenched at an angle. It has also been noted that re-heat treated cores exhibit less distortion after alpha annealing than those not so treated indicating that received cores contain residual stresses which can be subsequently relieved by beta heat treating or alpha annealing. Until these investigations are complete, cores rejected by the transformation tester are being returned to the National Lead Company.

6. Steel Sleeve Supplies

Delays in the deliveries of "E" and "D" type sleeves have reduced inventories of these models to a minimum. Because of the stock piling of steel by customers in anticipation of a steel strike this summer the lead time to obtain tubing

7. Steel Sleeve Supplies - continued

has increased from four to twelve weeks. Sleeve vendors expect tubing deliveries in time to be able to provide adequate quantities of sleeves by mid-May. Should a strike delay deliveries beyond that date however, it may be necessary to extend usage of current sleeves past the established 25 cycle optimum period.

C. Operating Plans

During the month, a quarterly review was made of the Official Production Forecast. For the 18-month period covered by the new forecast, reactor requirements and finished production for normal uranium fuel elements are 6 percent higher than the previous schedule. This is attributed in part to a decrease in enriched material requirements and in part to a reduction in exposure levels somewhat earlier than previously anticipated. It is expected that eight canning lines operating at continued high efficiency and yields will provide sufficient production capacity to meet new requirements.

D. Employee Relations

1. Safety Performance

Members of the Operation were treated for 25 medical treatment injuries for a frequency of 4.55.

An accident occurred during the month which was informally investigated as a serious accident. A metal eruption occurred on April 20, about 10:30 p.m. while metal from the recovery furnace was being bailed into large molds for convenient disposal. One of the molds, although appearing completely dry, was not adequately pre-heated before molten metal was poured into it. Initial freeze-out delayed the eruption until the mold was nearly full. The eruption caused a small amount of metal to be thrown approximately 20 feet vertically and also threw approximately an inch of metal over the side of the mold. Fortunately, no injuries occurred, nor were there any damages to equipment. However, the incident points out the need for policing of procedures and care needed in bailing techniques. The pouring of metal into large molds will be discontinued until procedures can be reviewed with all Facilities Services personnel.

2. Radiation Control

	<u>March</u>	<u>April</u>
Greater than 300 mrad	No badges	1 badge
Combined Manufacturing Operation exposures	3,513 mrad	6,902 mrad

A major improvement in the fission product speck problem on shipping pallets returned from the Irradiation Processing Department has been noted during the month. No high level specks have been detected for several weeks, and it appears that the extensive pallet survey program, together with better controls by the shipper, have resulted in the removal of contaminated pallets from service.

3. Security Violations

One security violation was reported during April.

4. Civil Defense

Members of the Operation participated in a civil defense drill on April 17, 1959.

II. PERSONNEL MATTERS

A. Reports of Invention

Members of the Operation engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during April 1959.

B. Meetings

Members of the Operation attended 13 staff meetings, 40 safety and security meetings and 16 informational meetings.

C. Visits and Visitors

H.E. Berg visited the Harvey Aluminum and Hunter-Douglas plants in California during the month. Discussions were held regarding future aluminum component deliveries.

W.R. Kirk visited the National Lead Company at Fernald, Ohio on April 21, 1959, and on April 23 and 24 Mr. Kirk attended the Annual Meeting of the Society for the Advancement of Management in New York.

D.G. Kern visited John Frankel and George Christensen, Harvey Aluminum Company in Torrance, California on April 21 to discuss quality of aluminum caps and cans relative to Harvey's evaluation as a new vendor. On April 22, Mr. Kern visited Ray Quadt of Hunter-Douglas Company in Riverside, California to discuss their evaluation as a new vendor.

J.P. Keenan and W.C. Mayer attended the Northwest Quality Control Conference in Portland, Oregon on April 2.

M.A. Ziegler, A.M. Miller and Amos VanVorst of Alcoa, Edgewater, New Jersey were visitors during the month to discuss aluminum component quality and delivery problems.

D. Significant Reports Issued

1. Routine

<u>Number</u>	<u>Title</u>	<u>Author</u>	<u>Date</u>
HW-58930-RD	Official Production Forecast, April Review	HE Berg	4-21-59
HW-59841	Monthly Report Quality Control Operation FPD, March 1959	KV Stave	4-1-59

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1. Routine Reports Issued - continued

<u>Number</u>	<u>Title</u>	<u>Author</u>	<u>Date</u>
HW-60147	General Analytical Program I	GB Hansen	4-24-59

2. Non-Routine

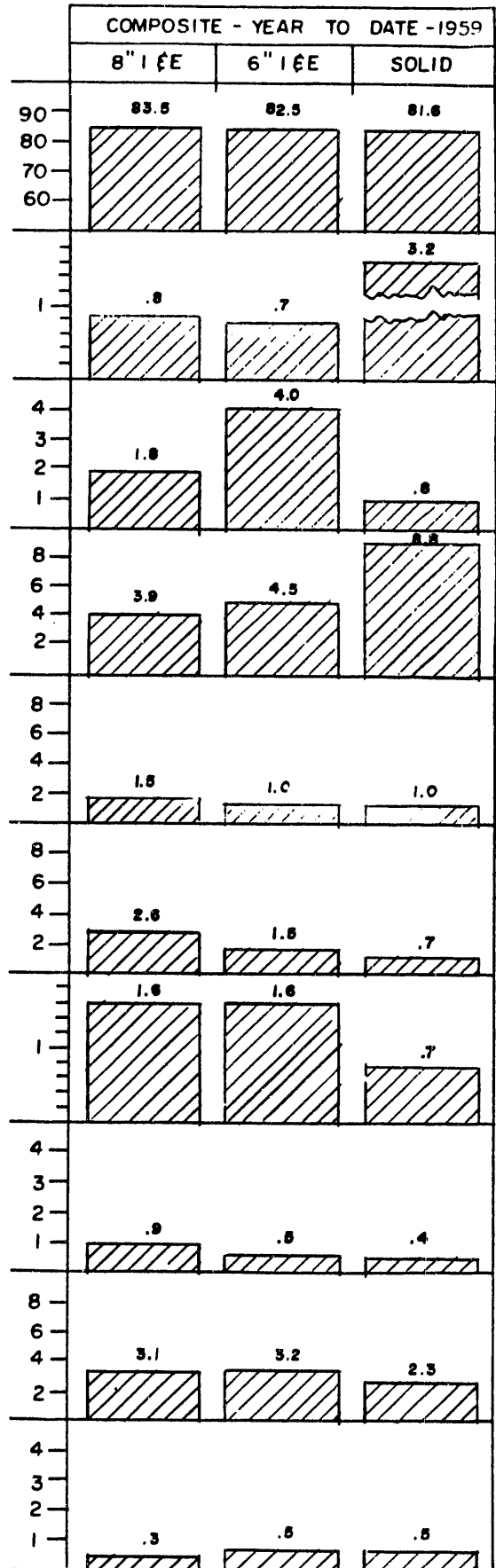
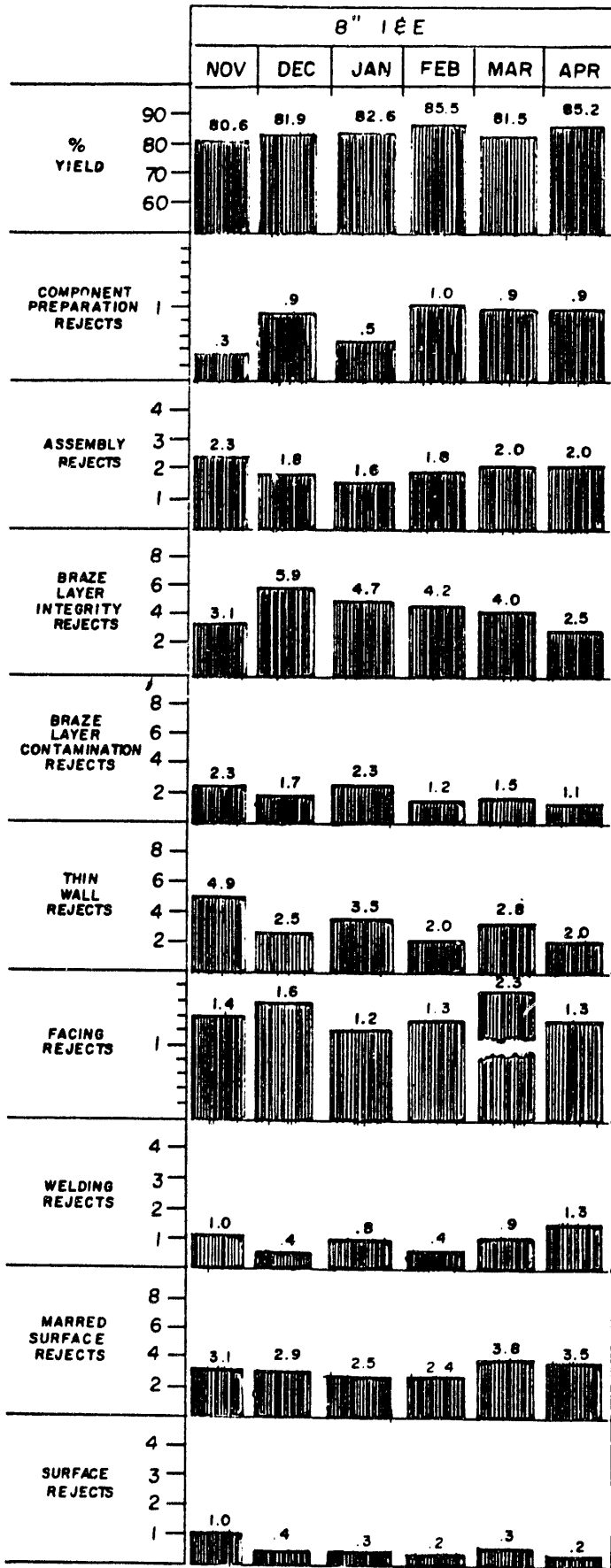
HW-60204	An Alternate Method For Reactivity Testing in the Hanford Test Reactor	RO Budd	4-29-59
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*W Mathis*  
Manager - Manufacturing

WM Mathis:RWM:rhs

# YIELD STATISTICS

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ENGINEERING OPERATION  
April, 1959

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
Richard Taylor	Boeing Aircraft Seattle, Wn.	TB Correy	4-27	Discuss square wave welding.

TRIPS

	<u>Company Visited</u>			
CH Allen EV Padgett	Sciaky, Chicago, Ill.	W Farrell	4-20	Discuss welding techniques
	Precision Resistance Welding & Flexopress Corp., Cincinnati, Ohio	R Kroker W Klingeman	4-21	" " "
	Taylor-Wingfield Corp., Warren, Ohio	R. Pearson G. Harris	4-22	" " "
	Graham Mfg. Corp., Needham Hts., Mass	HJ Graham	4-23	" " "
	Aeroprojects, Inc. West Chester, Pa.	Dr. Potthoff D Kertpatrick BJ Jones	4-24	" " "
JT Stringer	Sciaky Bros., Chicago, Ill.	W Farrell	4-20	Discuss welding techniques
	Aeroprojects, Inc.	Dr. Potthoff	4-24	" " "
	National Lead of Ohio	CE Polson JA Fellows	4-21/22/ 23	Attend Metal Quality Working Committee meeting
JE Bergman	National Lead of Ohio	CE Polson JA Fellows	4-21/22/ 23	Attend Metal Quality Working Committee meeting
GF Jacky	Heath Plating, Inc. Kent, Washington	F Bradford	4-14	Observe nickel plating of aluminum
	Industrial Plating, Inc., Seattle, Wn.	W Foley	4-14	" " "

TRIPS (cont'd.)

<u>Name</u>	<u>Company Visited</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
GW Riedeman	Airline Welding, Hawthorne, Calif.	HL Meredith	4-1 & 4-3	Consult on welding zircaloy
	Bridgeport Brass Co., Riverside, Calif.		WA Mazzacane	4-2
JH Johnson JW Nickolaus	American Brass Co., Waterbury, Conn.	HF Sawyer	4-9/10	Observe extrusion plant layout
JH Johnson JW Nickolaus	Nuclear Metals, Inc. West Concord, Mass.	HF Sawyer	4-8/9 4-6 thru 4-9	Observe extrusions
JH Johnson	Loewy Hydropress, Inc. New York, New York	PG Mayer	4-7	Discuss extrusion press with vendor
JH Johnson	G.E., Idaho Falls, Idaho	R Neidner	4-29 thru 5-1	Observe HAPO facilities at MTR and ETR
JH Johnson	Phillips Petroleum Idaho Falls, Idaho	L Jones	4-29 thru 5-1	" " "
TW Gore	Washington Boiler Inspectors Assoc., Seattle, Wn.	KA Jones	4-6/7	To present paper on boiler
TW Gore	Dix Steel Co., Spokane, Wn.	T McDonald	4-9	Consultation on NPR building shell
AJ Karnie	Loewy Hydropress, New York, NY	PG Mayer	4-7/10	Press consultations
	Nuclear Metals - American Brass, Waterbury, Conn.	J Freeman	4-7/10	Observe extrusion and coextrusion
JW Talbott	Heath Plating, Inc. Kent, Washington	F Bradford	4-24	Inspect nickel plating facilities
	Industrial Plating, Inc., Seattle, Wn.	RW Olsen	4-24	" " "
	Loewy Hydropress, New York, N.Y.	PG Mayer	4-27	Discuss extrusion press.

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TRIPS (cont'd.)

<u>Name</u>	<u>Company Visited</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
JW Talbott	G.E., Schenectady	CH Linder	4-28/30	Attend Engineering Managers meeting
LC Clossey	Cleveland, Ohio		4-5/8	Attend 5th Nuclear Congress meetings

PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Operation</u>	<u>Nature of Change</u>	<u>Date</u>
GF Jacky	Engineer	4430	Transferred from 4420	4-15
WL Hampson	Engineer	4470	Transferred from Mfg.	4-1
GX Beard	Eng'g. Asst.	4440	Transferred from Mfg.	4-6

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 April, 1959 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.

An Improved Current Wave Shape and Proportion of Alternating Current for Inert Arc Welding and Metallic Arc Welding and the Equipment for Producing the Improved Wave Shapes

by T. B. Correy

A Method of Applying Lamb Waves in Ultrasonic Testing

by D. C. Worlton



PROCESS ENGINEERINGRegular Production Rupture Experience

Six natural uranium fuel elements (1 solid and 5 I & E) failed in the reactors during April. A summary of these ruptures is as follows:

<u>Fuel Element Type</u>	<u>Reactor</u>	<u>Exposure (MWD/T)</u>	<u>Rupture Classification</u>	<u>Jacket Alloy</u>
Solid natural	H	526	Unclassified	X-8001
I & E natural	C	605	Side other	C-64
	D	799	Internal	C-64
	DR	566	Hot spot	X-8001
	KW	866	Internal	X-8001
	KW	432	*Hot spot	X-8001

\*May have been caused by broken poison spline in process tube.

No significant trends in fuel element performance were apparent, except for one additional rupture and further evidence of stuck charges in DR involving I & E production lots made up of HAPO reheat-treated cores. IPD has reduced the goal exposure on the reheat-treated lots being irradiated and is returning the unirradiated inventory to FPD for recovery and return of cores to Fernald for recycling. Recognizing the sub-standard performance of reheat-treated material in February, FPD discontinued reheat-treating transformation test reject fuel cores on March 1, 1959. The rupture rate of this material is greater than other production by a factor of three or better.

Both the I & E rupture in DR and the one associated with the broken poison spline in KW were prepared with Aluminux etched caps.

IPD Liaison

The variable goal exposures of I & E fuel elements is being reduced to an average approximating 700 MWD/T to compensate for higher inlet coolant temperatures during the summer season.

Through recent IPD agreement, all future I & E aluminum component orders will be for X-8001 alloy except 50 per cent of the natural I & E components for two old reactors and 50 per cent of the natural and 100 per cent of the enriched components for C Reactor.

Anticipating future changes in I & E self-supported fuel element dimensions for ribless process tubes, prototypic self-supported fuel elements of various dimensions are being made up for flow laboratory tests to facilitate optimum fuel designs.

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As part of a program to accelerate the evaluation of I & E nickel plated fuel elements, a production test design is being prepared in cooperation with IPD to irradiate nickel plated fuel elements and control material. The test is being designed to determine relative uniform corrosion resistance under current reactor operating conditions and at high power and exposure, as well as to determine the integrity of thin nickel plate. Progress on this test is being temporarily delayed pending an investigation and remedial process action to avoid spalling or flaking of the nickel during irradiation, similar to that experienced on a preliminary irradiation test of two tubes, each of electroless and electroplated I & E fuel elements at 400 MWD/T exposure.

#### Production Tests

Preliminary data show no difference in warp or diameter change of I & E fuel elements, prepared using carbonate salt rod heat treated uranium with 43 second and standard delay time before water quench, and irradiated to 600 MWD/T. Examination of material exposed to 800 MWD/T has not been completed.

Direct cast uranium I & E fuel elements irradiated to 600 MWD/T show abnormal diameter growth at the cap and base ends, with average and maximum growth being greater than at center points by 3 mils and 30 mils, respectively. One fuel element is being sent to Radiometallurgy in an attempt to determine the cause of the unusual growth. Six columns of this material exposed to 800 MWD/T are currently undergoing examination.

#### Uranium Technology

During the past four months, the metal quality level as measured by acceptance and in-process inspections decreased slightly from the level for the previous four month period. As shown in Table I, the average rejection rate for surface defects in virgin material is about 1.2 per cent compared to less than 1 per cent for the previous four month period. The average rejection rate for surface defects in recovered material, as shown in Table II, has remained at the higher levels first experienced in October, 1958. However, in February and March, there appears to be a decreasing trend developing.

The results of the test of improvement in reactor stability of alpha annealed cores show that the alpha annealed pieces were significantly low with respect to tube filling capacity values (combination of warp and diameter changes). At low exposures, the effect was not strong, but increased exposure strengthened the effect such that at higher exposures, the difference was strongly significant. In view of the significance of this test, an order has been placed for 5,000 alpha annealed cores for larger scale reactor testing.

In establishing and maintaining a comprehensive quality control program for uranium cores it is desirable, if possible, to establish for the producer sites product specifications for the various characteristics requiring control. Of course, inherent in such a program is the need for equipment and procedures for measuring these characteristics on a production basis. The following outlines HAPO's activities in the areas of specification definition, and equipment and procedures development for the control of grain size and orientation.

TABLE I  
SEAMS PLUS STRIATION REJECTS  
VIRGIN CORES

Lot Type	December		January		February		March 1-15	
	No. of Pieces	% Rej.	No. of Pieces	% Rej.	No. of Pieces	% Rej.	No. of Pieces	% Rej.
CA Mixed lots, Solid, N	2114	2.3	1988	1.1	1077	0.6	None Processed	
KA FMPC lots, Solid, N	None Processed		3907	1.3	17324	0.6	None Processed	
VA Dingot lots, Solid, N	None Processed		None Processed		None Processed		None Processed	
KE FMPC lots, Solid, E	None Processed		886	1.2	None Processed		None Processed	
KG FMPC lots, 'C' I&E, E	19290	0.5	16959	0.3	6932	0.4	None Processed	
KH FMPC lots, 'O' I&E, E	None Processed		4329	0.4	5495	0.2	None Processed	
CJ Mixed lots, 'C' I&E, N	None Processed		4440	4.6	None Processed		None Processed	
KJ FMPC lots, 'C' I&E, N	None Processed		None Processed		None Processed		25331	1.1
CK Mixed lots, 'K' I&E, N	5019	1.9	None Processed		3981	3.8	2019	1.8
KK FM PC lots, 'K' I&E, N	50705	1.7	46016	0.9	5560	1.5	29727	1.3
CL Mixed lots, 'O' I&E, N	13854	1.2	8378	1.7	2578	2.2	None Processed	
KL FMPC lots, 'O' I&E, N	74815	1.2	43834	1.2	70702	0.8	16285	0.9

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**TABLE II**  
**SEAMS AND STRIATIONS**  
**RECOVERED MATERIAL**

Lot Type	December		January		February		March 1-15	
	No. Processed	% Rej.	No. Processed	% Rej.	No. Processed	% Rej.	No. Processed	% Rej.
<u>Normal</u>								
"C" I&E	None Processed		12438	16.5	None Processed		2773	10.2
"K" I&E	30621	20.0	7127	18.2	8014	7.2	8177	12.1
"O" I&E	9315	13.4	9406	16.3	15235	10.4	1719	17.5
Solid	None Processed		5000	21.0	11500	17.3	None Processed	
							AVG.	15.8%
<u>Enriched</u>								
"C" I&E	None Processed		3840	5.8	1610	4.3	None Processed	
"K" I&E	None Processed		None Processed		None Processed		None Processed	
"O" I&E	1618	5.9	4370	5.8	6856	4.5	None Processed	
Solid	None Processed		3090	8.8	None Processed		None Processed	
							AVG.	5.8%

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a. Grain Size

The problem in specifying the grain size of uranium has been the absence of an adequate method for measuring that can be applied by all sites and result in acceptable reproducibility of measurements. In hopes of providing a uniform method, HAPO has been engaged in the development of a nondestructive testing instrument (UAT) for measuring average grain size. Although this instrument is still in the prototype stage, the evaluation results to date are most encouraging.

b. Orientation

The problem in specifying the desired orientation of uranium cores has been the absence of a method readily applicable to production quantities. The evaluation results to date of the Sonic Orientation Resonance Test indicate this instrument may provide a useful tool for the measurement of core stability. It is presently indicated that SORT is sensitive to both stress and orientation. Should this be proven to be the case, it is felt that SORT would still be a useful tool since both stress and orientation are considered to influence reactor stability of cores.

c. Tentative Product Specifications

To relate to the producer sites what is anticipated in the way of product specifications, tentative specifications for grain size and orientation are shown below. Tentative specifications are listed for current measuring methods and for nondestructive test equipment methods since the acceptability of the nondestructive equipment is not fully established. It should be emphasized that these are based on limited data and are listed only as comparative values for ingot and dingot and are not yet considered absolute values. It is hoped that with the collection of additional data such specifications can be firmly established.

TENTATIVE FUEL CORE PRODUCT SPECIFICATIONS

	<u>UAT</u>	<u>HEYN INTERCEPT*</u>
Grain size		
Ingot	MIN. AVG. TRANSMISSION, 10.0 Avg. to Peak Variation 30%	.300 MM Max.
Dingot		
25 T/Mo.	MIN. AVG. TRANSMISSION, 4.1 Avg. to Peak Variation 100%	.440 MM Max.
60 T/Mo.	MIN. AVG. TRANSMISSION, 10.0 Avg. to Peak Variation 30%	.300 MM Max.

\*These values are shown for comparative purposes only and are not yet considered absolute values in view of the limited data from which they were derived.

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TENTATIVE FUEL CORE PRODUCT SPECIFICATIONS, Cont.

<u>CRYSTALLOGRAPHIC ORIENTATION</u>	<u>SORT</u>	<u>HAPO G.I.</u>
INGOT	.7770	± 1.0
DINGOT		
25 T/Mo.	.7750	± 2.0
60 T/Mo.	.7770	± 1.0

On April 27, the new induction heated chloride salt, heat treating furnace was placed in operation at Fernald. It is expected that all uranium cores will be heat treated in slug blank form in the chloride salt bath early in May. For the core types of which significant quantities have been processed, the rejection for porosity-type defects continues to be lower for the chloride material. The Sonotest rejection rate for chloride, 19 second delay, is about 10.5 per cent compared to 2.5 per cent for carbonate. The rejection rate for approximately 10,000 pieces of 43 second delay processed to date is 3 per cent. Added control of the heat treating process variables is expected to reduce this level below that of the carbonate material.

During April the Working Committee of the FEDC met at Fernald, Major items of interest were:

1. Agreement was reached by the two reactor sites (HAPO and SRP) regarding the cost in dollars per ppm of various impurities (particularly rare earths) that might be introduced into the metal through the necessity of processing low grade uranium ores at the producer sites.
2. A fundamental heat treating study for uranium was proposed.
3. Available British information on uranium technology and British fabrication practice was reviewed. It was agreed that the British undoubtedly had much unpublished information that would be of value to the four sites and that this information should be tapped.
4. MCW has made significant progress toward producing dingot metal that is free of extrusion defects, low in hydrogen, and comparable to ingot metal in grain size. It is expected that HAPO will begin receiving dingot metal again in 2 - 3 months at a rate of 25 tons/mo.

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### Nickel Plated Fuel Elements

The four-tube in-reactor test for evaluation of effluent contamination associated with nickel-plated fuel elements has been discharged with final exposures ranging from about 330 to 350 MWD/T. One tube each of chemical plated and electroplated elements were discharged as scheduled at approximately 1/2 of high goal exposure; these exhibited extensive separation of the nickel from the aluminum. Further, C-reactor was scrambled, presumably due to a temporary partial blockage of one of the remaining tubes containing electroplated elements. In considering discharge of the single remaining tube, effluent analytical data was reviewed. It appeared that the nickel plate does not significantly increase the concentration of undesirable radioisotopes, and that additional information which might be gained by continued irradiation of the one remaining tube would probably be of marginal value, considering the imposed risk of another reactor shut down.

Under water examination of the fuel elements has thus far revealed:

1. The 1 mil thick electroplate generally separated from the aluminum in the bore of the fuel element rather than on the external surface.
2. The 1/2 mil thick chemical plate exhibited sloughing of the plate on approximately 50% of the elements in the charge. Approximately 50% of the plate was removed from the worst piece. The sloughing does not appear to be corrosion-induced, since pieces in the zone of heaviest corrosion did not slough off. These included one piece with a hot spot.
3. The 1 mil thick chemical plate appeared to be the best material in the test, with no sloughing in the bore, and only one, possibly two, elements with sloughing from the external surface.
4. Sloughing of the chemical plate was not evident until the elements were cleaned in the chromic-phosphoric acid solution. Whether or not this solution attacks the nickel plate is not known; however, tests indicated that gross dissolution of the nickel, as observed on the 1/2 mil thick chem-plate, does not occur.
5. Nickel plate appears to protect the aluminum from heavy corrosion in hot spot areas.

Further evaluation of examination data, radiometallurgy examinations, and ex-reactor adherence tests are planned.

Conclusions at present are:

1. Nickel plating does not significantly contaminate reactor effluent. Although confirmation from a larger number of tubes is desirable, future development

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work may be carried out with considerable optimism in this respect.

2. Improved adherence of the nickel plate is essential. Likewise it appears that conventional tests for adherence are unsatisfactory.

Results of ex-reactor corrosion tests may be summarized:

1. No accelerated attack of the aluminum or sloughing of the nickel plate is evident after exposure to single-pass reactor coolant for seven weeks at 60 C and nine weeks at 120 C, and two weeks at 160 C.
2. A chemical plated C-64 jacketed element which had been previously exposed for four weeks at 275 C deionized water was tested for an additional ten days. Increased penetration was observed at discontinuities in the plating at sharp corners of the cylinder; however, the rate of penetration was not catastrophic and the plate did not undercut or slough off. Continued testing is planned, along with another element having a natural defect in the plating.
3. Preliminary tests of aluminum samples chemically plated by two vendors in the Seattle area indicated that a pore-free nickel can be readily produced with careful cleaning and handling of the material. Pre-plating cleaning methods included a one hour etch in hot dilute nitric acid, and removal of three to fifteen mils by etching in "Aluminux".

#### Process Technology

There were four autoclave failures during April. This is a total of six since spire-etch was started December 2, 1958.

Three hundred fuel elements with large inclusions were canned to use in testing aluminum cleaners to replace the nitric acid at etch.

The optimum I & E canning cycle test was completed and shows a significant improvement in internal penetration reject rate. The variables data (such as undercutting, bond strength, and total bond count) are still being analyzed. The optimum cycle was a 45 second cycle with a supplemental can-sleeve assembly preheat position to get a  $73 \pm 5$  second can-sleeve preheat and a  $35 \pm 5$  second submerge time.

Cap wafer heating rate studies have shown that a minimum preheat of 20 seconds is needed before spire insertion to raise the wafer temperature above eutectic temperature (577 C).

A layer of flux (All State 31) was used on the duplex bath to determine the effect on the compound layer formation. The bonds produced were very uniform, but also very weak. The metallographic and x-ray diffraction work is not completed on the fluxed cores. This flux contained zinc chloride, which contaminated the Alsi with 0.5% Zn, but other fluxes without zinc are to be tested later.



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Bonding on the internal bore of I & E fuel elements is presently considered one of the major fuel element fabrication problems. This bonding problem is primarily voids but some non-wet aluminum and uranium and poor bond layer structures are also found. The major development programs on internal bond problems are now directed toward removing gas from the core bore in the duplex and canning furnaces, outgassing in core blank form, improved heating rates and lead reaction times in the bore. A test using lead plugs in the core bore at various duplex conditions has been run but has not been evaluated metallographically. The lead plugs increase the heat transfer rate in the bore and allow more lead-uranium reaction time since the lead plugs prevent the bore from being sealed off by solidified AlSi and the melting point of the lead plugs is 250 C lower than for AlSi.

Sample I & E and solid enriched Li-Al target elements were fabricated for 305 Reactor tests to determine loading patterns for the production test.

Six charges of self-supported fuel elements were fabricated for a test in B Reactor.

The feasibility of automation of resistance spot welding self-support rails depends on a solution to the electrode life problem. It appears that ultrasonic welding is the best solution to this problem and it should also be easier to automate the process.

Mechanical fabrication of prototype handling equipment for spot welding the rails onto the fuel elements has been completed. The unit has been transferred to Maintenance shop for piping and wiring of the electro-pneumatic control system. Design of a prototype tester to test the strength of the rail-to-fuel element bond has been completed. Installation of the new Sciaky Resistance Spot welder is approximately 85 per cent complete.

Installation of the buffer exhaust system, designed by Process Engineering for Project CG-713, has been completed and the system is in operation.

Tool and mandrel design, finished piece specifications, detailed instructions for machining and an approved list of special safety rules and handling instructions for machining I & E "N" material have been completed. A work order for machining 400 pieces has been issued to HLO.

Design modifications to improve the in-process reliability and reduce maintenance of the duplex agitators in 313 Bldg. have been completed. Significant changes were replacement of the key drive with a square shaft and elimination of the free fall of the basket by direct connection to double acting cylinders. This will provide smoother action and controlled speeds in raising and lowering the basket, while maintaining continuous agitation.

#### Pilot Plant Activities

About 5300 uranium cores were canned in the Pilot Plant for process development purposes and 220 aluminum dummies were dip canned for machining studies

and display purposes. The major items of process development were:

1. Statistical tests to determine the optimum can-sleeve preheat and submerge times at 9.2, 10.2, and 11.2% Si in the canning bath to reduce bottom freeze-out, non-wetting, braze porosity, and AlSi penetrations.
2. Single jack canning test using an "optimized" can-seleve cycle.
3. Test using flux on the duplex bath to determine effect on core bonding.
4. Ultrasonic cleaning test with baffles in the cleaning tanks to determine effect of tank size on efficiency of ultrasonic cleaning of caps and cans.
5. Test run to determine effect on spire-cracking:
  - a. Use of cap wafer abrader with and without vibration.
  - b. Use of external gripping tongs and internal-spire gripping tongs.

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MATERIALS ENGINEERING

NPR Fuel Program

Coextrusion

Extrusion Run #1

All material has been sampled in the as-extruded form and is available for subsequent testing and fabrication work. Bond samples, including nondestructive testing of two rods, have shown bond continuity and strength to be good for all material tested.

Dingot uranium at the 39:1 reduction ratio showed center cracks after the rods were swaged. High concentrations of uranium hydrides along the grain boundaries were observed in that material which showed cracks. Ingot uranium with the same history showed no cracking, nor did it show metallographic evidence of hydrides. The dingot uranium coextruded at a 22:1 reduction ratio is apparently sound. It is possible this situation could be eliminated by beta heat treating the extruded material before swaging. This would alter the grain structure and eliminate the location of hydrides in the grain boundaries.

Extrusion Run #2

Extrusion Run #2 was completed at Nuclear Metals during the week of April 4, 1959. Fifteen tubular billets and two rod billets were extruded. The major operational problem encountered was with furnace temperature control. Two billets were overheated during the preheat but were apparently kept under the transformation temperature.

The tubes extruded on this run were of three reduction ratios, all starting from the standard 4" diameter billets. Preliminary examination of these tubes has been started and evaluation of outside diameter dimensions to date indicate close control.

Preliminary examination of tubular samples indicate some instances of unbonding may be present.

Extrusion Run #3

Extrusion Run #3 calls for 9-12 NPR outer tube extrusions and 32 rod extrusions. The NPR outer tube billets will be extruded using fixed, stationary and floating mandrel tooling. The rod extrusions will be pushed using integral die cones of 120°, 90°, and 60°, including angles.

All materials for Extrusion Run #3 will be on-site by May 11, 1959. The uranium being used for the NPR tubes is from ingots of National Lead origin. Originally it was planned to use some dingot uranium alpha re-extruded from a 9" intermediate size. However, delivery of this item is

still indefinite. Therefore, the extrusion date of June 8 at Bridgeport Brass has not been changed. The zircaloy for this extrusion run has already been extruded by Bridgeport and is enroute to HAPO.

### Procurement of Materials

Almost all zircaloy-2, copper, and graphite to underwrite coextrusion work for the next six or seven months has been received or is on order.

Hot extrusion has been the standard technique of fabrication of zircaloy-2 for the billet shells. Large diameter thin-walled zircaloy fabricated by this technique is expensive. In the 4-7" thin-wall size range, i.e., outer billet shells, it appears the welded zircaloy, if of satisfactory quality, would be the most economical material to use. A small development order was placed with Airline Welding and Engineering, Hawthorne, California to develop a process and produce ten welded zircaloy-2 shells. Much of this development work has been completed and tests of welded areas submitted to us. It is estimated this job will be completed and the welded billet shells developed within the next month.

### Heat Treating

One feasible technique for the heat treating of NPR fuel rod and tube sections is by electrical resistance of the piece itself. Equipment is available on-site to supply the necessary power. A stand with supports and control clamps has been designed for this method of heat treating, and actual tests will be carried out within a month or six weeks.

Another relatively easy way of heat treating is in a resistance furnace with a controlled atmosphere. In order to further evaluate this technique, the 8' long furnace previously used on extrusion cladding work is being reactivated. This will permit the treatment of lengths up to 8' long of all sizes, except the outer NPR tube. In addition, a small muffle furnace for copper brazing is being installed and this will permit heat treatment of any section up to 2' in length.

### End Closure

A criterion tentatively established by IPD is that the end closure on NPR fuel elements be bonded. It would appear that one method of doing this would be to completely fuse into position an end disk or ring by welding to the uranium. In order to determine whether this is feasible, several pieces of thin-walled zircaloy tube were slipped over uranium billets and heliarc weld beads laid around the circumference. This produced excellent bonding between the zircaloy and uranium at the weld. One possible problem with this technique would be that uranium might contaminate the weldment, and tests are being made to determine whether this exists. Several samples of zircaloy to zircaloy were welded at Bettis (WAPD) on their Zeiss electron beam welder. Examination of these welds indicated that this process can give a narrow deep weld. It appears that this technique may have application in the design of the end closure. Further development work is planned with Olin Matheison Chemical Corporation, the only other known owner of Zeiss equipment in this country.

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### Electron Beam Welders

At the present time, the electron beam welder is being installed in the 306 Building. Considerable trouble has been experienced with the mechanical roughening pump requiring that it be reworked. The internal ports were found damaged at installation inspection. F. J. Stokes Company has agreed to let us use it at no responsibility and ship a replacement on 6-1-59.

Beneficial use of the electron beam welder is anticipated for 6-1-59.

The combined efforts of the X-ray Department, Fuels Design, Fuels Fabrication Development and Materials Engineering have produced very good cathode design that has been tested. One unit only has been tried which had a useful life of approximately 100 shift hours on a two shift basis. This compares very favorably with the anticipated life on the basis of work by others of eight hours.

### Copper Welding - Billet Closure

The technique has been refined by using argon gas to start the arc and helium for welding the closures. Sealing off the evacuation tube has been refined by modifying a pair of bolt clippers so that they have wide flat parallel jaws for crushing the tube. It is then cut off with a heliarc torch producing a hermetic seal.

The billet assembly fixture has been revised and should be ready for use by May 6, 1959.

Bids for the permanent rectifier power supplies are to be opened on May 4, 1959.

### Pulsed Square Wave

An invention report has been filed on a pulsed square wave that will have essentially the welding characteristics of direct current straight polarity combined with the cleaning action of alternating current. A unit of this type has been long desired by the welding industry. The development of the controlled solid state rectifier has made this possible.

### Chemical Processes

A temporary facility has been installed outside of 306 Building (NE corner) for the removal of copper from extruded rod and tube by metal acid dissolution. Two 15' long U shaped stainless steel tanks, one acid, and one rinse are provided. The necessary piping for heating the acid solution drainage and flowing rinse water are provided.

During the month about 30 rod and tube sections 10-12 feet long were processed in one 8-hour period. Conditions of acid strength, temperature and copper buildup in the solution were varied so that optimum conditions could be

established with regard to the time and completeness of removal. Acid strength and copper concentration were determined by analysis of samples taken during the work period. The results of this have not been tabulated and analyzed as yet for accurate determination of process specifications. However, on the basis of a cursory examination of data, the specifications will approximate 50-25% HNO<sub>3</sub>, 0-10% copper, and 50-60°C temperature. A problem was encountered in reduced reaction rate of copper at the point of contact with the support rack for the work piece. These appeared as spots of residual copper after all the zircaloy-2 surfaces were clean. It was necessary to shift the work pieces several times during the dissolution period to avoid this problem.

The recovery of uranium and zircaloy-2 lathe chips from coextruded rod by dissolution in nitric acid is being investigated by Chemical Research and Development-HLO. The pyrophoricity and explosiveness of uranium and zircaloy-2 interface material (epsilon phase U-Zr-2) is considered a hazard where significant concentration of this phase is present. The results of experimental dissolution on samples of chips gave no indication of sensitivity. A sample of saw filing will be similarly tested to investigate effect of larger material surface area.

#### Special Fuel Element Fabrication

Fifty thick wall AlSi dip canned "doe" fuel elements which were canned during the month for KER test loop charging were all rejected in the bond test. Destructive examination revealed large non-wet areas. Aluminum dummy cores canned in the same thick wall cans under identical conditions exhibited good bonding. Test canning of several "doe" cores with longer core and can preheat increased vibration of both core and can, and mechanical abrading of the internal can wall produced only slight improvement. Additional canning tests with abraded core surfaces and techniques to erode core surfaces in the bath will be made. The problem appears to be related to the core surfaces and the fact that the particular elements used in this test were recovered by machining off the cladding whereas previous "doe" cores were the original as-cast condition.

#### Aluminum Cans - Cast Blanks

Aluminum caps and cans of X-8001 alloy fabricated from cast blanks are being produced. Currently, sufficient "O" size I & E cans and spires fabricated from cast blanks are available for monitor tube charges that are to precede lot charging of about 5,000 fuel elements as part of the evaluation program. Most of the required out-of-pile tests have been completed and so far the components appear excellent.

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## TESTING METHODS

### Process Fuel Element Testing

#### Internal Penetration Test

Two new type probes which will allow testing for spire wall cracks near the cap end are being fabricated. These are expected to be ready for evaluation tests about 5/15/59.

#### External Bond Test

Efforts to improve the test sensitivity and reproducibility for detection of non-wet unbonds continued. One circuit change currently under evaluation in the 313 building shows considerable promise. Improved resolution also was obtained with two different Bondtester systems which are under development in the laboratory. Comparison tests of these alternate approaches will be completed during May.

#### Quality Certification Program

Fuel elements of each size are being selected for use as calibration standards for the statistical sampling total count Bondtest. Procedures are being established jointly with Quality Control to make this measurement of total unbond area on both the inner and outer surface of I & E elements.

### NPR and Category II Development

Work orders were issued to the HLO Technical Shops for fabrication of some of the electronic components for the pilot plant prototype nondestructive testers for coextruded fuel elements. These include internal and external cladding thickness, cladding integrity, and bond quality testers. Target date for completion is early July. Bid quotations have been received on the data recording system for this test station. Some design details on the accompanying mechanical handling system must yet be completed before this unit is ready for fabrication.

Detection of HF (white spot) contamination on zircaloy is being investigated. Preliminary work with an optical method using small photocells has been encouraging. A prototype detector and readout system is being developed.

Seventy-seven previously tested rod type elements were retested after having been subjected to a straightening process. Twelve indicated defects and all twelve were from the same coextrusion lot. Subsequent destructive examination showed no bond defects other than a more irregular bonding layer than normal. One pinhole was found in the zircaloy cladding. The second test of the fuel elements was made at much higher sensitivity than the original test because of improved circuitry and high resolution ultrasonic transducers. It is apparent that the second test had more than sufficient sensitivity for detecting bond defects which can be confirmed by destructive examination. The test sensitivity can now be

reduced somewhat with good confidence that it will detect undesirable bond defects.

Ten of fourteen other 0.75" diameter rods bondtested indicated defects in the uranium core. This was confirmed by destructive analysis. It thus appears that the 10 megacycle Lithium Sulphate crystal bondtest equipment also may be used to detect subsurface cracks in the uranium.

### New Methods Development

#### Bare Core Test Station

A temporary installation of the grain size portion (Ultrasonic Attenuation Test) of this new test has been installed in the pilot plant. This is being used for measuring the grain size variables of incoming uranium on a statistical sampling basis.

All the electronic units for the final prototype Bare Core Test Station have been received except for a dual preset digital voltmeter. Shipment of this is promised for June. Several pieces of laboratory equipment are being used temporarily to perform this function.

No success has been had in using the "Weir" type test tank for this new test. The high flow rate of recirculating water creates air bubbles which interfere with operation of the ultrasonic tests. This is tolerable with the present Transformation Test in the 313 building but is not with the more sensitive new tests. No satisfactory method for eliminating the bubbles has been found. It was therefore decided to use the same automatic test tank design that is used for the new Bond-Penetration testers. This will increase the estimated cost for the four new 313 Bare Core Testers by \$20-25,000. However, the workability of the design is well demonstrated and it removes the bubble problem. In addition the Bond-Pen type tank has some flexibility that the Weir type tank does not have in that the former could be used with an internal test probe. This may be needed in the future for detecting (1) surface defects in the inner hole (2) partially untransformed regions in the inner volume of a core, or (3) internal crack type defects which are parallel to the core surface.

An order was placed with the Tally Register Company for a data logging system to automatically record the test outputs on paper tape. Delivery is promised for 6/10/59.

Heyn Line grain size measurements on nine uranium samples showed reasonably good correlation with results from the Ultrasonic Attenuation Test. Sixty-eight more samples await metallographic examination.

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#### Extrusion Defect Detection

Dingot cores of uranium which was extruded in the gamma phase were found to have some internal crack type defects. The sensitivity of the eddy current Metal Quality Test for detecting these defects was investigated. It was found that the crack must be larger than about one-eighth inch in a direction parallel to a core diameter in order to be reliably detected. This is less sensitivity than desired and alternate test methods will need to be searched for unless the current work at MCW eliminates the defect problem.

#### Sonic Orientation Resonance Test (SORT)

Uranium cores are being tested to select samples for an in-reactor evaluation of SORT.

Negative results were obtained from some rough experiments to determine if the measurement of two flexural modes of vibration at right angles to each other would indicate an asymmetric volume distribution of preferred grain orientation. It has been conjectured that this condition may be a contributing factor to uranium warping during irradiation.

#### Cap-Core Bondtest

Components have been received for continuing this development using a five megacycle ultrasonic system.

#### Weld Bead Pinhole Test

Ultrasonic measurements were made on actual pinholes which were found in the process by visual inspection. These gave strong signals comparable to those previously obtained from artificial defects formed by drilling very small holes through the weld bead. When the true defects were sectioned, none penetrated from the surface all the way to the braze layer. It is likely then that a pinhole to the braze layer would give an even larger signal by this test method. Also sub-surface defects in the weld bead should be detectable.

Prototype equipment is being designed for testing both the cap and base welds. Focused ultrasonic crystals have been received and are now being compared with the unfocused flat crystals previously used.

#### Hanford Test Reactor

An interruption to routine metal testing occurred the first time a new cross-checking procedure for the metal standards was used. Failure to fall into the allowable tolerance range was found to be due to use of a different control rod setting and inadequacies in the control rod calibration. Limits were set on the control rod settings to be used in order to permit continued metal testing with the new standards procedure. As soon as scheduling permits, the control rod will be recalibrated. This will take about one week of reactor time.

Special tests included graphite tests for HLO, tests on aluminum and stainless splines for IPD, tests of new poison pieces for IPD, and several special irradiations.

New power level settings and drift factors were placed in use as recommended in the recently issued Test Reactor Manual. The new sub-critical flux monitor continued to operate properly. Drawings for the improved control console are 95% complete.

### Customer Work

#### Transplutonic Element Bondtests

Several aluminum clad, aluminum alloy elements were bondtested for the HLO Plutonium Metallurgy Operation. The bonds were found to be good although some difficulties were encountered in making the test due to bowing of the six foot long elements. The test gave some indications of defects in the core material.

### Washington Designated Nondestructive Testing Program

#### Broadband Electromagnetic Testing Studies

The second phase of the program is being continued. A hydrogen thyratron pulser such as that used to drive crystals in the ultrasonic tests is now being used to pulse the eddy current driver coils to give greater currents and thus improved signal to noise ratios.

The formal report "Broadband Electromagnetic Testing Methods, Part 1 - Analytical Basis," HW-59614 was issued by H.L.Libby, covering the first phase of this program.

An eddy current test probe was devised which weights the conductivity measurement in one direction, thus making it possible to determine the direction of maximum or minimum electrical conductivity in material having anisotropic electrical properties. This probe operates at a single frequency, but should also function in the broadband system. Its ability to determine the degree of preferred crystal orientation in uranium will be evaluated.

An eddy current ultrasonic transducer was devised and the generation of ultrasonic waves in metal was demonstrated. The presence of the ultrasound in the metal is now being detected by use of a crystal transducer. The eddy current transducer efficiency is low and difficulty is being experienced in detecting the ultrasound with it. The main advantages of such a transducer are that it requires no couplant medium between the transducer and the metal other than free space, and that it promised to permit the generation of extremely high frequency waves in the metal.

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A document titled, "The Eddy Current Method, A Nondestructive Test," HW-60113, H. L. Libby, was prepared and issued which summarizes in outline form and figures basic eddy current principles.

Ultrasonic Lamb Wave Studies

The rough draft of the first phase formal report was completed.

Analytical studies have developed a much simpler method of computing  $f_d$  versus phase velocity curves than is possible with Lamb's original equations. The method has made it feasible to compute these curves for zirconium, stainless steel, brass and uranium. Plans are to include these curves in the report. Routine computations are being made with the IBM 709 computer.

Application studies were started this month. First attempts will be to apply Lamb waves to bond testing Hanford production elements and weld testing. Special AISi bond samples have just been obtained having non-wet, brittle, and good bonds.

DESIGN & PROJECTSCG-759 - Additional Steam Generating Facility - 300 Area

Final inspection has been completed and acceptance of all work performed by the lump sum contractor was made on April 17, 1959. Close out of this project is underway.

CA-774 - 300 Area Sanitary Water System

Repair work on the 225,000 gallon reservoir started April 21. Grouting was completed May 1, 1959. The sump, which leaked badly prior to repairs, was tested unofficially and there was no measurable leakage.

CGF-810 - 306 Building Pilot Plant Modification

A visit was made to Loewy Hydropress by A. J. Karnie on April 7 and April 10, 1959. Information obtained on these visits indicated that the manufacturer would have to move at a faster rate than he has in order to meet his scheduled shipping date of October 19, 1959. Following additional contacts by our Purchasing people and a visit by J. W. Talbott on April 27, the indications were that Loewy is taking the necessary steps to meet the scheduled shipping date.

The revision to this project proposal was transmitted to Contract Accounting on April 16 and is currently being reviewed by the AEC.

CAF-820 - Storage Space - 300 Area

The work on this project has been advertised for bid.

CGF-847 - New Fuel Cladding Facility

The project proposal for this facility was transmitted to Contract Accounting on April 16 and is currently being reviewed by the AEC.

The building site has been tentatively established north of the 306 Building. This site was one of three alternate locations. The availability of utilities to this location is at least as good as any of the other locations, and this will be the final location unless extremely unusual soil conditions are encountered.

A number of pre-engineered building constructors have been contacted. They have all said a building of the type we require can be erected within two months of the time they receive the order.

Crane manufacturers have also been contacted and feel the crane can be delivered within ten weeks of the time the order is placed.

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Miscellaneous

Installation of the extension to the pickle stack to provide an outlet point 80 feet above grade has been completed. Operation is satisfactory, and from simple observation of the fumes, it is apparent that the purpose of the stack, which is to keep fumes from the 313 ventilation system inlets, will be achieved.

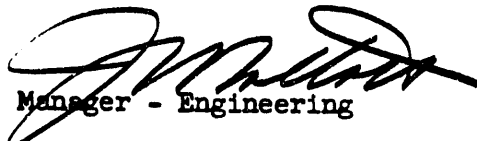
DRAFTING & FILES

Major Jobs in Drafting

306 Building:	Layout Revisions Ultrasonic Surface Test Transformation Tank Weld Bead Tester
313 Building:	Fire Alarm Circuits Consumable Electrode Welder Chuck Automatic Stamper - I & E Miscellaneous Wiring Diagrams Miscellaneous Equipment As-Builts
384 Building:	One Line Diagram Miscellaneous As-Builts
Miscellaneous:	300 Area - Operator's Water Map 333 Building - Topog and Site Study 333 Building - Cutoff Machine 333 Building - Tanks Customer Work: 105 KE Cap Remover System

Drawings Produced

New	68
Revised	62
Large Charts	6
Small Charts	100
Miscellaneous	87

  
Manager - Engineering

JW Talbott:mbs

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## FINANCIAL OPERATION

APRIL, 1959

Physical inventory and reconciliation of installed equipment assigned the Engineering and Manufacturing Sections are substantially complete. Start of physical inventory of equipment assigned to Maintenance and Power Section is scheduled for the week of May 10, 1959. Originally, the entire physical inventory phase of the work was scheduled for completion May 1, 1959, with reconciliation to follow. However, as the work progressed it became evident that reconciliation should be performed concurrently with taking of the inventory. Due to the imminent transfer of detail property records to Contract Accounting Operation, additional emphasis has been placed on completing the inventory ahead of schedule. Current scheduling contemplates final reconciliations to be completed sometime in July, two months earlier than originally planned.

A report covering the final results of the physical inventory of Precious Metals conducted March 31, 1959, was written and distributed. Final results disclosed a book physical adjustment of 4.6 grams of platinum valued at \$14.63. Variances were specifically identified and were attributed to normal operational loss.

The report covering the physical inventory of coal as of March 31, 1959, was written and distributed. Results disclosed a 757-ton physical inventory overage. Recommendations include reduction of the average ledger value to current market through an increase in the fourth quarter liquidation price.

Preliminary unitization report on Project CG-759, Additional Steam Generating Facility-300 Area, was completed during April. Final report will be completed and published after the project is financially closed.

Final arrangements for consolidation of the general ledger functions were completed this month. All general ledger account balances will be transferred to Contract and Accounting Operation by May 11. FY-1959 records and documents supporting the account balances are being transferred to Contract and Accounting Operation. All other records will be placed in storage.

The routine clerical and mechanical work of all HAPO Personnel Accounting Operations was pooled in Contract and Accounting Operation effective 4-27-59, in accordance with planned realignment of financial functions. This action had minor effect on FPD as arrangements had previously been made with Relations and Utilities Operation to perform this type of service for FPD beginning December 29, 1958. However, FPD participated as a member of a task force in arranging and planning for the consolidated function.

Arrangements were completed with Data Processing to permit nonexempt salaried employees to specify minimum weekly deductions for Federal Withholding Tax. This assures nonexempt salaried employees of the same privilege long available to exempt salaried employees.

Planning was resumed for consolidation of FPD personnel records into one central file following temporary suspension of this activity due to realignment of Financial and Employee Relations functions.

Operating reports were ready for distribution to management three days after final cost transfers, a gain of one day over previous two months' activity.

A cost study was prepared for Manufacturing Maintenance covering improvements in operating efficiency. During the first quarter CY-1959, a 2% improvement over forecast was experienced which resulted in a production increase equivalent to the output from eight canning lines for 1.2 days. The out-of-pocket cost savings resulting from the improved operating efficiency amounted to approximately \$7,700.

Annualized savings from the Department's cost reduction activities aggregated \$127,519 during the first quarter of CY-1959.

Productivity for the quarter ended March 31, 1959, expressed in terms of dollars of Output per dollar of Input, increased 5% from the previous quarter. Increased productivity resulted from higher production at lower unit costs. In terms of dollars, this productivity gain amounted to approximately \$119,000.

  
Manager - Finance

WS Roe:mh



MAINTENANCE AND POWER OPERATION

APRIL 1959

On April 1, 1959 the Fire Protection Operation was transferred to the Construction Engineering & Utilities Operation. The responsibility for Fire Prevention was transferred to the Relations Practices Operation, FPD. The responsibility to insure that the high level of Fire Protection service continues in the 300 Area was assigned to this Operation.

There were 2 Cost Reductions completed, representing an annual savings of \$37,055. Total savings for the year were \$52,504 - 42% of total budget.

The responsibility for the approval of Excavation Permits and grounds utilization in 300 Area and environs was reassigned from the Landlord Representative to the Manager, Plant Engineering. This responsibility change was formalized in FPD's OPG No. G 3.3.

DUPLICATING

<u>Process</u>	<u>No. of Impressions</u>
Multilith	546,263
Verifax	3,054
Ozalid	<u>12,531</u>
Total	561,848

This is the largest number of impressions produced in a month by this Operation. The volume of work was produced with no increase in manpower.

POWER STATISTICS

	<u>April</u>	<u>March</u>
Average steam generated (M lbs/hr)	43.4	53.0
Maximum steam generated (M lbs/hr)	65	78
Total steam generated (M lbs)	31,300	39,430
Coal consumed (Tons)	1,974	2,337.55
Evaporation rate (Steam/# Coal)	7.9	8.4
Efficiency - Actual	65.5%	*
Efficiency - Theoretical	69.4%	*
No. of Boilers on:        1    3    2		
Date of Change        :        1  16  17		
Sanitary water from 3000 Area (Million Gals.)	74.85	83.14
Total water from 3000 Area (Average Rate GPM)	1,733	1,862
Total water from #3 & #4 wells (Million Gals.)	17.7	16.2
Total water from #2 well (M Gals.)	.30	.30
Peak water consumption for 24 hours (Million Gals.)	2.7	3.0

\* Efficiency figures were not available during March due to the run-in of the No. 6 Boiler.

On April 27, 1959 the steam flow meter on the new north export line fell to zero. Investigation revealed that the condensate in this large U-shaped loop had formed a seal due to failure of the trap at the base of the U. This trap was replaced with a larger trap plus a strainer blow-off. No further trouble has been experienced.

Water lines to the 308 Building (Plutonium Fabrication Pilot Plant) were chlorinated and flushed. This building now has normal water supply.

#### INVENTIONS

A Report of Invention on an "Electrical Device to Actuate an Annunciator Fire Alarm System" by T. D. Gibbs was completed.

A Report of Invention by John Forsberg and Clive Glass, Instrument Technicians, is in process.

All other 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 April 1959.

#### SAFETY, SECURITY AND RADIATION EXPERIENCE

Medical Treatment Injuries	-	44
Frequency Rate	-	9.58
Disabling Injuries	-	0
Near-Serious Accidents	-	0

There were no Security Violations reported.

On April 14, 1959 an Instrument Technician received contamination on his hands and clothes while working in the Spectrographic Laboratory, 325 Building. He was wearing the prescribed protective clothing. All contamination was immediately removed except that which was on his trousers. A "Report of Contaminated Personal Effects" has been filed covering this incident.

#### MEETINGS

Round Table-Staff	-	20
Safety and Security	-	19
Information	-	4

  
Manager  
Maintenance and Power Operation

E. Hilgeman:JFF:mkm



UNION RELATIONS

Grievance Statistics

Received this month 7  
Received since 1/1/59 32

Step I

Answer satisfactory 2  
Answer unsatisfactory 5  
Pending time limit to close 5  
Settled this month 2

Step II

Discussed this month 1  
Pending time limit to close 2  
Settled this month 4  
Pending arbitration 4

Subject of April Grievances:  
(Total 7)

	<u>Mfg.</u> <u>Oper.</u>	<u>Eng.</u> <u>Oper.</u>	<u>Maint. &amp;</u> <u>Power Oper.</u>	<u>Emp.</u> <u>Oper.</u>	<u>Fin.</u> <u>Oper.</u>
Hours of Work	1		0		
Jurisdiction	1		5		

Subject of Grievances Since 1/1/59:  
(Total 32)

Vacation	1		0		
Jurisdiction	3		19		
Transfer	1		1		
Responsibility	1		1		
Absence	0		1		
Overtime	0		1		
Hours of Work	1		2		

EMPLOYEE COMPENSATION

Benefit Plans Participation

Pension Plan	100%
Insurance Plan	100%
Stock Bonus Plan	45.2%
Savings and Security Plan	96.2%

Suggestion Plan Participation

	<u>April, 1959</u>	<u>1959 Year to Date</u>
Eligible employees	570	585
FPD suggestions received	38	185
Annualized rate per 1000 eligible employees	800	949
No. of suggestions adopted	29	47
Net annual saving	\$ 8,520	\$51,029
Amount of awards	\$ 1,030	\$ 3,045
Percent of total awards to savings	12.1	6.0
Average amount of awards	\$ 35.52	\$ 64.79

GENERAL

Security Violations in the Department this month: 1

*W. A. Shanks*

Manager - Relations Practices

**END**

**DATE  
FILMED**

**12 / 2 / 92**

