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CG-PR-2

MONTHLY REPORT

HW--57702

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By AM Eick 10-16-92

FUELS PREPARATION DEPARTMENT

DJ Kplok 10-16-92

FOR

SEPTEMBER, 1958

Compiled by

Fuels Preparation Department

October 23, 1958

Richland, Washington

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<u>J. E. Francis</u>		<u>703</u>		

MASTER

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FUELS PREPARATION DEPARTMENT
MONTHLY REPORT SUMMARY FOR
SEPTEMBER, 1958

MANUFACTURING OPERATION

Four hundred sixty-four (464) tons of acceptable uranium fuel elements were produced which was 97% of forecasted production.

Sufficient "O" size I & E fuel elements were provided to complete I & E charging of the old reactors two months ahead of schedule.

The yield for eight inch I & E fuel elements dropped to 73.3% from 77.1% in August. Some improvements were realized in the marred surface, assembly, and surface reject categories but these were more than offset by higher rejection rates for braze layer contamination and external thinwall.

The yield for six inch enriched I & E fuel elements was 82.3% for September compared to 80.5% for August. This improvement resulted from reductions in surface and marred surface reject categories. The porosity level has continued in good control and much improved over the experience earlier in the year.

The month's supply for individual product types of bare cores varied from over 4 to eight inch solid material to about one-third for enriched "C" size I & E. Supplies of eight inch I & E cores were over one-half month.

A 1.4 month supply of finished material was on hand in the combined 100-300 storage areas. There was a large inventory of solid fuel elements. Eight inch "O" size I & E products were in short supply.

There were no autoclave failures in September.

Stronger bonds for I & E fuel elements will result from recent changes in duplex furnace operating conditions.

Both Harvey Aluminum Inc., and Hunter Douglas Corporation agreed to a statistical sampling plan for HAPO acceptance of incoming aluminum components.

To meet increased reactor requirements for I & E fuel elements, the production rate was increased from three to four canning lines per shift on September 2.

ENGINEERING OPERATION

An improvement in the rupture trend was experienced over the previous month. This was attributed to early discharge of fuel elements from rupture-prone regions in the reactor, flux depeaking, brittle bond reduction, and the use of tighter nondestructive test standards.

Specifications and drawings are under preparation for the demonstration E-N loading requested by FPD. Welding by electron beam method is planned. Increased emphasis is being given to the development of the process for I & E self-supported elements. Cold welding using ultrasonic techniques is under investigation as a means of eliminating difficulties sometimes encountered with spot welded supports.

Very favorable results have been obtained in the program to reduce penetrations and improve bonds by reducing the silicon concentration in canning baths. All I & E production lines have been modified to provide for this improvement.

Cold extruded "C" size I & E cores have been shown to be equal to those produced by standard methods through ex-reactor testing. This process has proven to be more expensive for I & E elements and has been discontinued. Extrapolation is being made into the potentially profitable area of coextruded zirconium clad elements. This process would provide for coextrusion of zircaloy-2 and uranium without copper or steel cladding with resultant economies possible.

Barium titanate transducers were substituted for quartz crystals in the pilot plant transformation tester with favorable results. This change indicates about 10 times signal amplitude increase with greater stability and reliability. A number of theoretical studies have been initiated in support of the 4000 program objectives for nondestructive testing. Prototype equipment is also being fabricated for ultrasonic Lamb Wave studies. Encouraging results are being obtained with eddy current measurements of zircaloy cladding thickness equipment.

A study of electroless nickel plating of aluminum has been completed. It appears that this process has been developed to a high degree and is employed extensively commercially. Considering the potential of this process for uniformity and integrity of plating, additional evaluation and work is proposed. In the near future it is planned to irradiation test two tubes of regular nickel plated and electroless nickel plated fuel elements to compare effectiveness.

A Directive was issued to proceed with design for the Pilot Plant modification. Press specifications have been completed. Process specifications are being written and equipment layouts have been completed. Billet designs for the initial fuel sizes requested by IPD have also been finished.

The actual boiler move under Project CG-759 was completed September 29. This boiler weighs 190 tons and was transported 26 miles to its new location without damage.

FINANCIAL OPERATION

An Integrated Procedures Council, with representation from each level 3 Operation, was established as of October 1. Purpose, objectives and organization of the Council were set forth in a Department OPG issued by the General Manager.

Final progress report was issued on the status of compliance with recommendations made by the travelling auditors. Necessary action has either been taken or definite plans have been made to accomplish all action scheduled.

MAINTENANCE & POWER OPERATION

A Work Sampling Study of craft productivity was completed. Results showed a slight improvement of applied time from last year's 62.2% to 63.1%.

The ash sluice line from the power house broke on September 5. It was repaired and put back in service during the month. Present repairs are of a temporary nature pending the installation of an Ashcolite pipe line by construction forces.

EMPLOYEE RELATIONS OPERATION

Pay-performance relationship work charts for all exempt employees are being prepared to reflect contemplated shifts in the trend line as a result of introduction of the new Savings and Security Program.

The D. D. Wilson grievances, which are the subject of an arbitration demand by the Council, were discussed at several meetings and a revised Step II answer has been provided the Council. The Council furnished the Company with an overtime distribution procedure which, if satisfactory, should result in withdrawal of the arbitration demand.

Six greivances were processed at Step I during September. Of the six grievances three involved jurisdiction, and one each involved overtime and the absence payment plan. The other concerned refusal of a supervisor to allow an employee steward representation during a Personnel Development discussion.

As of month end the Department had completed 760 days without a disabling injury. The medical frequency rate increased very slightly from 3.94 in August to 3.95 in September. There was one serious accident during the month.

PERSONNEL STATISTICS

Number of employees August 31, 1958 744
Number of employees September 30, 1958 742

<u>OPERATION</u>	<u>EXEMPT</u>	<u>NON-EXEMPT</u>	<u>TOTAL</u>
General	1	1	2
Manufacturing	50	272	322
Engineering	49	24	73
Financial	16	20	36
Maintenance & Power	36	250	286
Employee Relations	14	9	23
TOTAL	166	576	742

L. L. German
GENERAL MANAGER

FUELS PREPARATION DEPARTMENT

LI German/jak

MANUFACTURING OPERATION

September, 1958

I. CURRENT OPERATIONS

A. Production and Productivity

1. Statistics

	NORMAL				ENRICHED			6"	Total
	8"	8" I & E			6"	6" I & E		Water	
	Solid	C	K	O	Solid	C	O	Mix	
<u>Current Month's Production</u>									
Acceptable Fuel Elements Produced (Tons)	84	5	99	210	0	41	23	2	464
As % of Forecast Production	62	17	104	120	-	164	144		97
As % of Past 3 Month's Average Production	32	8	124	284	-	152	766		89
As % of Past 12 Month's Average Production	22	5	275	1667	-	178	2300		81
% of Forecast Achieved - Last Fiscal Quarter	118	110	93	7	90	121	0		107
% of Forecast Achieved - Last 4 Fiscal Quarters	104	90	152	7	96	84	0		100
<u>Operating Efficiency</u>									
Current Month (%)									91
Forecast (%)									93
Previous Month (%)									93
<u>Manufacturing Yield</u>									
Current Month (%)	78	82	66	77	-	82	82	77	
Forecast (%)	85	82	82	82	-	80	80		
Previous Month (%)	79	77	77	77	-	81	81		
Bare Uranium in Storage (Tons)	302	98	107	102	11	11	18	0	649
Finished Product in Storage (Tons)	198	58	134	95	12	29	15	3	541
Special Products Finished (Pieces) Poison Uranium Utilization (%)									600 95

2. Activities

a. Production

During September the manufacturing plant worked on a two-shift basis with four canning lines on each shift. Four hundred sixty-four (464) tons of

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a. Production - continued

acceptable uranium fuel elements were produced which was 97 percent of the four hundred seventy-six (476) tons forecast in HW-56826-RD. Although the total tonnage produced was slightly less than forecast, the product mix was quite different. When the forecast was made in July, one old reactor was to be charged with I & E fuel elements each month. However, IPD stepped up the charging rate. To meet this demand, the manufacturing plant rescheduled production from solid to "O" size I & E fuel elements. By so doing and by depleting "O" size I & E finished inventories, sufficient material was made available to complete I & E charging of the last old reactor this month - two months ahead of the schedule. This change in the charging schedule is the primary reason for the variance of the actual product mix from that forecast.

b. Yield Control

	<u>August Yield</u>	<u>September Yield</u>
8" I & E	77.1	73.3
8" Solid	78.6	78.0
6" I & E	80.5	82.3

The yield for eight-inch I & E fuel elements dropped to 73.3 percent from 77.1 percent in August. The bulk of this production was in "O" size elements and for the first time in our experience four canning lines of I & E elements were processed simultaneously. Some improvements were realized in the marred surface, assembly and surface reject categories but these were more than offset by higher rejection rates for braze layer contamination and external thinwall. Greater sensitivity of the non-destructive testers to brittle bonding and a slightly higher porosity level was responsible for the increase in the braze layer integrity rejection rate.

The external thinwall rejection rate has increased significantly since late August because of difficulties in optimizing canning variables, particularly with X-8001 components. A delicate balance must be maintained between assembly conditions and excessive erosion of the can wall. Test programs involving cycle modifications, canning temperature - silicon relations and sleeve control have been initiated to correct the problem.

The yield for six-inch enriched I & E fuel elements was 82.3 percent for September compared to 80.5 percent for August. This improvement resulted from reductions in surface and marred surface reject categories. The porosity level has continued in good control and much improved over the experience earlier in the year.

c. Other Activities

Six hundred (600) lead-cadmium pieces were processed by the special canning crew.

The first production run of six-inch natural I & E fuel elements was made on September 12 - 13. Additional runs were made later in the month. After processing these pieces through the bond and penetration testers, they were

c. Other Activities - continued

palletized and moved to the 306 Building. There water mixing nozzles were welded in place. A new welding machine has been ordered for installation in the 313 Building special products room. Subsequent to this installation, the complete fabrication of water mixing fuel elements will be made in the 313 Building.

At month end there were six hundred forty-nine (649) tons of bare uranium in storage - 14 tons more than at the previous month end. The month's of supply for individual product types of bare cores varied from over 4 for 8-inch solid material to about 1/3 for enriched "C" size I & E. Supplies of 8-inch I & E cores were over 1/2 month. Reactor speed-up in charging "O" size I & E fuel elements caused the manufacturing plant to reschedule from solid to I & E elements and to change the uranium receipt schedule. The National Lead Company was requested to ship 185 tons of I & E pieces in lieu of the same quantity of solid pieces scheduled for delivery in the next three months.

Deliveries of bare enriched I & E uranium were delayed as the result of railroad shipping problems. However one baggage car of material arrived in time to complete the enriched production run for September. The amount of enriched material shipped in each box car of natural uranium has been increased by 50 percent, thereby providing some relief from the critical supply problem.

Based on the forecast of reactor needs for October, a 1.4 month supply of finished material was on hand in the combined 100 - 300 storage areas. While the total quantity was within one ton of August inventory, some products were in short supply. Shifting reactor requirements for fuel elements caused the charging rate of eight-inch solid fuel to drop off sharply. At month end there was a large inventory of solid material. Eight-inch "O" size I & E fuel was in short supply. This condition will continue for at least two months - the time required to increase delivery of "O" size I & E aluminum components from Alcoa.

In September the projected annual turnover rate of essential materials was 2.15.

The following pieces were processed through the fuel recovery operation:

		<u>Pieces</u>
Solid 8"	Natural	13,016
I & E "K" 8"	Natural	7,931
I & E "O" 8"	Natural	19,294
I & E "C" 8"	Natural	3,964
I & E 6"	Water Mix	2,456
6" Cored	Enriched	12
Total		46,673

On September 12 a shipment totaling 66,202 pounds of natural uranium and 2,569 pounds of enriched uranium scrap was sent to the National Lead

c. Other Activities - continued

Company. Eight hundred fifty-three (853) pounds of enriched uranium scrap in the form of C-6 oxide were shipped to Oak Ridge. On September 30, 21,918 pounds of enriched uranium were returned to National Lead Company.

B. Plant Problems and Incidents1. General

Operating efficiency was 91.1 percent. Approximately one fourth of the lost time was caused by equipment. Operational outages were responsible for the balance.

2. Autoclave Failures

There were no autoclave failures in September.

3. Bond Improvement for I & E Fuel Elements

Stronger bonds for I & E fuel elements will result from recent changes in duplex furnace operating conditions. On September 8, 1958 the silicon content was increased and the temperature of the duplex furnaces was decreased. By so doing all 306 Pilot Plant developments for stronger bonds, except the prototypic horizontal agitator basket, have been adopted in the production plant.

4. AlSi Recovery Furnace

After 12 months use at operating temperatures of 800°C, the 7-C recovery furnace heating channels were short-circuited by AlSi penetration. The furnace was withdrawn from service and relined.

C. Operating Plans1. Bare Uranium Quality

The I & E bare core reject rate from seams plus striations increased slightly above the August rate while the solid bare core reject rate for seams plus striations varied little from past experience. The porosity level of canned pieces was slightly above that of August.

2. I & E Spire Wetting

Ways to improve I & E spire wetting through the use of etching solutions were investigated during the month. However none proved as satisfactory as the Aluminux etch tested during August. Consequently arrangements are being made for an extended production test of the Aluminux etch process.

3. Boss-Type I & E Spires

Evaluation has shown that the boss-type spire is easier to handle, and cheaper to fabricate than the currently used well-type spire. Also there is less spire cocking and floating during the assembly operation in the canning furnace.

3. Boss-Type I & E Spires - continued

Orders for boss-type spires have been placed with various aluminum component vendors. Initial deliveries are expected in December, at which time conversion will be made to take advantage of the quality and cost improvements offered by the boss-type spire.

4. Inspection Agreement with Aluminum Vendors

Both Harvey Aluminum, Incorporated and Hunter Douglas Aluminum Corporation agreed to a statistical sampling plan for HAPO acceptance of incoming aluminum components. Shipments not meeting the specified quality level will be returned to the vendor at his expense for 100 percent inspection or may, at HAPO's option, be 100 percent inspected here at the vendor's expense. Negotiations with Alcoa are continuing in this regard.

5. Production Scheduling

To meet increased reactor requirements for I & E fuel elements, the production rate was increased from three to four canning lines per shift on September 2. Although additional non-destructive testers and automatic welders are being installed on CG-713, only two of the five testers were available this month. No automatic welders were ready for use. In spite of these equipment limitations, I & E production was increased from 60 percent of total August output to 80 percent of the total September output.

6. Lead-Cadmium Production

Reactor areas inventory build-up and increased use have changed shipments of lead-cadmium pieces from 2,500 to 8,000 monthly. The special canning crew will fabricate this product for 8 - 10 days each month in order to meet reactor needs.

7. In-Process Can Inspection

In the past, loading and unloading of the cap and can cleaning machine was performed by two operators. One inspector examined the components and inserted cans into sleeves. After the production level dropped from 5 to 4 canning lines per shift, no longer were these three men utilized efficiently. By rearrangement of both the work place layout and duties, now two operators are performing all work at the station, thus releasing the inspector for reassignment.

8. Hanford Test Reactor

Reactivity values obtained in regular production fuel elements were considered normal. However, there is a marked trend, especially over the past 6 months, toward reactivity improvement in all fuel element models. Fewer neutron absorbing impurities are being received in the uranium.

Special tests for the Irradiation Processing Department, Hanford Laboratories, and Babcock and Wilcox Company included graphite and bismuth bars testing.

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D. Employee Relations1. Safety Performance

Members of the Operation were treated for 24 medical treatment injuries for a frequency of 4.66.

2. Radiation Control

	<u>August</u>	<u>September</u>
Greater than 300 mrad	1 badge	2 badges
Combined Manufacturing Operation exposures	4,109 mrad	5,845 mrad

The apparent exposure increase probably was due to slight heat fogging of film. Special film packets for measuring high doses of fast and slow neutrons as well as gamma rays have been placed at strategic spots throughout the 313 Building, 306 Pilot Plant, 305 Test Reactor, and two storage buildings for enriched uranium. Purpose of these special dosimeters is to assist in evaluating personnel exposure in the event of a nuclear safety accident.

II. PERSONNEL MATTERSA. 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 September 1958.

B. Meetings

Members of the Operation attended 22 staff meetings, 12 safety and security meetings and 12 informational meetings.

C. Visits and Visitors

On September 22 - 24, Messrs. A. R. VanVorst, B. F. Wade and John W. Hood from the Aluminum Company of America visited the Manufacturing Operation to review quality trends in aluminum components, Manufacturing Operation needs for the future, and to discuss in further detail a statistical sampling plan which Manufacturing Operation recommended as a basis for accepting Alcoa products.

D. Significant Reports Issued1. Routine

<u>Number</u>	<u>Title</u>	<u>Author</u>	<u>Date</u>
HW-57326	Monthly Report, Quality Control Operation Fuels Preparation Department, August 1958	KV Stave	9-2-58
HW-57318	Uranium Quality Control Analytical Results	GB Hansen	9-4-58

1. Routine Reports Issued - continued

<u>Number</u>	<u>Title</u>	<u>Author</u>	<u>Date</u>
HW-57410	Production Report - FPD - Manufacturing Month Ending August 31, 1958	HE Berg	9-10-58
HW-57413	General Analytical Control Program I	GB Hansen	9-10-58

2. Non-Routine

HW-57446	Effect of Salt Bath Variables on Braze Porosity	DD Stone	9-15-58
HW-57490	Solid Enriched Uranium Cores	HE Berg	9-16-58
FW-57533	Uranium Core Weight Loss in Fuel Recovery	DD Stone	9-19-58

WM Mathis
Manager - Manufacturing

WM Mathis:RIB:rhs

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1958

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ENGINEERING OPERATION September, 1958

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
TC Evans CC McBride	duPont, Aiken, S.C.	SM Gill	9-16/ 18	Attend Working Committee of FEDC
JA Fellows RF Hartmann	Mallinckrodt Chem. Works St. Charles, Mo.	"	"	"
CE Polson AE Guay CE Crompton	NLO, Cincinnati, Ohio	"	"	"
E Blasch	NLO, Cincinnati, Ohio	RE Olson	9-26	Discuss questions re direct cast I&E cores
CD Vail	Minneapolis Honeywell Co. Spokane, Wash.	CE Fitch	9-16	Check new defective equipment
JW McFarlane	"	"	9-18/ 19	Repair of new equipment

TRIPS

	<u>Company Visited</u>			
GW Riedeman	Hunter Douglas, Riverside, Calif.	RA Quadt	9-9	Discuss zircaloy extrusion and castin
"	Oregon Metallurgical Corp. Albany, Oregon	SM Shelton	9-10	"
DO Hunter	Ohio State University Columbus, Ohio	R McMaster	9-6/ 21	Attend conference course on non- destructive testing
LE Kusler	Foundry Dept., GE Schenectady	J Keverian	9-3	Discuss uranium casting techniques
"	Research Lab., Schenectady	J. Kiesler	9-4	"
"	National Lead Co., Albany, N. Y.	J. Farr	9-5	"

TRIPS (cont'd.)

<u>Name</u>	<u>Company Visited</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
GF Jacky	Northrop Aircraft Corp. Hawthorne, Calif.	J Seymour	9-22	Discuss nickel plating of uranium
"	Chemplate Corp. Los Angeles, Calif.	B Sherwood	9-22	"
"	NAA Corp., Downey, Calif.	S Kritzer	9-23	"
"	General American Trans- portation Corp.	HJ Thompson	9-24	"
"	GE-APED San Jose, Calif.	EW O'Rorke	9-25	Discuss aluminum jacketing tech.
"	Industrial Plating Works Seattle, Wn.	W Foley	9-26	Discuss nickel plating of aluminum
K Drumheller AJ Karnie	Savannah River Plant Aiken, S.C.	P Loewenstein F Bond	9-15	Discuss presses & tour press facilitie
"	duPont, Wilmington, Del.	MS Bloomsburg	9-17	Discuss press specifications
"	American Brass Waterbury, Conn.		9-18	To review Watson- Stillman press in operation
"	NMI, Cambridge, Mass.	P Loewenstein	9-19	Tour plant
"	Loewy-Hydropress, N.Y.	Mr. Mayer	9-22	Discuss extrusion press
"	Watson-Stillman and Feller Eng'g. Co. Rochester, N.Y.	Mr. DeMateo Mr. Klein	9-23	"
"	Lake Erie, Buffalo, N.Y.	Mr. Swanson	9-24	"
JT Stringer EV Padgett	Sciaky, Chicago, Ill.	Mr. Farrell	9-29	Ultrasonic welding
"	Gulton, Metuchen, N.J.	Mr. Steinberg	9-30	"
"	Aeroprojects; West Chester, Pa.	Mr. Jones	10-1	"

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TRIPS (cont'd.)

<u>Name</u>	<u>Company Visited</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
TB Correy	Sciaky, Chicago, Ill.	Mr. Farrell	9-8/9	Electron Beam welding
"	National Research, Boston, Mass		9-11/12	"
"	Zeiss, N.Y.		9-10	"

PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Nature of Change</u>	<u>Date</u>
<u>Design & Projects</u>			
MS Case	Clerk	Transferred in from Eng'g.-General	9-10

Testing Methods

RL Brown	Rot.Tech. Grad.	Transferred in	9-8
TW Cannon	Engineer	Leave of absence	9-15
DR Cunningham	Rot.Tech. Grad.	Leave of absence	9-12
CJ Denton	Engineer	To exempt	9-1

Advanced Engineering

GF Jacky	Engineer	Transferred in	9-1
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Materials Engineering

GF Jacky	Engineer	Transferred to Adv. Eng.	9-1
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PROCESS ENGINEERINGRegular Production Rupture Experience

Four normal uranium (all solid) and three enriched uranium (all I & E) fuel elements failed in the reactors during September. In addition, one I & E depleted uranium fuel element failed. A summary of these ruptures is present below:

<u>Fuel Element Type</u>	<u>Reactor</u>	<u>Exp. MWD/T</u>	<u>Tube Power</u>	<u>Rupture Classification</u>	<u>Jacket Alloy</u>
Solid normal	B	428	1017	Unclassified	1245
	B	-	-	Unclassified	1245
	DR	392	-	Side other	1245
	F	404	885	Unclassified	1245
I & E enriched	C	699	1023	Side hot spot	1245
	C	875	792	Side hot spot	1245
	KE	778	1098	Side hot spot	1245
I & E depleted	C	567	605	Core split	1245

The improved rupture trend over last month is attributed to discharging fuel elements from rupture prone regions of the reactors below goal, flux depeaking, and possible effects of improved processing (brittle bond elimination) and tighter nondestructive test standards which have been incorporated in the process beginning about June of this year. The depleted rupture is not well understood at this time, but examination in Radiometallurgy is expected to provide information as to the cause of this failure.

IPD Liaison

Procurement of revised K size enriched I & E components will be initiated in November. Both the revised K size normal and enriched aluminum components will be M-388 alloy.

IPD is currently considering a revision of C size I & E designs to optimize flow balance and temperature distribution.

Confirmation has been received from IPD on the quantities and dimensions of target pieces required for the proposed E-N demonstration loading. Procurement of necessary materials will begin as soon as specifications and drawings are prepared. It is expected that the approximately 300 I & E N pieces will be welded on the HLO electron beam welder. No other problems are presented in preparing the fuel elements for the demonstration load.

Current plans include increasing the evaluation of self-supported I & E fuel elements in B reactor from 3 to 13 ribless process tubes. This is in addition to I & E elements with bumper supports for 10 ribbed tubes, and 90 mil supports for four tubes with reduced rib height in K reactors. Development of a process for attaching supports to fuel elements is proceeding in HLO. The present technique, using spot welding, occasionally affects the AlSi braze layer unless precautions are taken to remove the heat rapidly. Cold welding, using an ultrasonic technique is also under investigation.

I & E Program

As of September 15, I & E fuel element loading in the central tubes of the old reactors was as follows:

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Reactor	No. of Central Tubes	Number of Tubes Loaded		% of Central Tubes Loaded
		I & E Natural	I & E Enriched	
B	1540	490	20	33
D	1540	1192	58	81
DR	1540	108	9	8
F	1540	50	-	3
H	1540	445	68	33

Process Technology

A horizontal duplex agitator basket is scheduled for use on one line in 313 Bldg. in mid-October. Horizontal agitation combined with other changes in the duplex bath conditions are expected to eliminate the brittle bond problem.

The use of ultrasonic vibration in the duponal-TSPP wash solution for components has produced cleaner, more easily wet components. Male weld reject rates are a measure of the effectiveness of component cleaning. Based on a 150 piece test, male weld reject rates for ultrasonically cleaned components was 3.4% as compared to 9.9% for 100 pieces cleaned according to the regular procedure.

Tests were carried out using reduced silicon concentrations (down to the range of 6%) in the canning furnace and correspondingly higher canning temperatures. In addition to improved bond strength, less can wall penetration was encountered. The optimum silicon concentration appears to be about 8.5%.

A prototype semi-automatic cap preheater has been installed on one canning line in 313 Building.

Training sessions are in progress to orient maintenance people on the automatic welders. The first automatic welder was placed in operation in 313 Bldg. A prototype automatic weld buffer has been operated in the welding laboratory and performed satisfactorily.

Preliminary work indicates that water mixing spools may be recovered from reject water mixing pieces for \$0.13 per spool as compared with a new cost of \$1.30 per spool.

All I & E canning lines changed to a lower silicon, higher duplex temperature on September 8. Process Specifications for water mixing fuel elements was issued.

Electron Beam Welding

Design of the handling equipment for welding semi-production quantities of fuel elements is being completed but a simpler, less expensive mechanism will be fabricated for pilot plant use. Used high voltage equipment is being procured for the pilot plant welder.

Conversation with APED indicates that they weld ceramic-type fuel elements with zirconium jackets using a tungsten electrode with direct current, straight polarity, in a helium atmosphere. Twenty-four thousand welds have been produced by this method with 98% yields.

MATERIALS ENGINEERING

Heat Treatment of Uranium

Plans for conversion of the beta heat treatment of uranium to chloride (Nusal) salt at NLO are being pursued satisfactorily. At the present time, it appears certain that NLO will begin this processing by November 1, 1958.

Dingot Uranium

Recent large scale heat treating tests have shown that dingot uranium, when heat treated in Nusal, gives a canned fuel element about comparable to the present ingot product insofar as AlSi braze porosity is concerned. Therefore, HAPO plans to accept up to 50 tons per month of dingot uranium. This material will be monitored closely to assure that production performance equals test performance.

Direct Cast Uranium Fuel Cores

As reported last month, attempts to obtain a completely recrystallized structure by heating to 610 C for 35 minutes were unsuccessful. Further attempts this month by using higher temperatures and longer times were also unsuccessful. Based on this experience and the large variability of as-received grain size, this heat treatment is being abandoned. The production test is being modified so that only double beta heat treated cores will be irradiated.

Fuel elements for irradiation were canned in two groups. Fuel cores were heat treated in 313 facilities and canned in the 306 pilot plant. Fuel elements are now being prepared for charging.

Problems were encountered with warp during reheat treatment. The first lot QJ-001 contained 250 pieces of which 42 were rejected for having more than 0.020" TIR warp. Only the pieces with less than 20 mils warp were canned. The second lot QJ-002 consisted of 600 pieces and was segregated into three parts following heat treatment, those with less than 10 mils warp, those between 10 and 20 mils warp, and those with greater than 20 mils warp. The first segment, less than 10 mils warp, had 286 pieces, the second segment contained 265 pieces and the third segment, greater than 20 mils warp, contained 49 pieces. The reason for this large amount of warp may be contained in the explanation given below, but in any case, would not be a serious consideration for this process or producing fuel cores since the machining would be done after any heat treatment. Pieces from QJ-001 and the first segment of QJ-002 will be used for the P.T.

Mr. Earl Blasch of the National Lead Company and formerly of the American Bearing Division, was contacted in reference to the warp problem outlined above and the large grain size that was seen on macro-sections of some of the fuel cores. Mr. Blasch stated that the initial work with heat treatment was done with a single slug fixture and he feels that the large grain size that appears on one side of the fuel core can be attributed to the change from a single fuel core fixture to a multiple fixture which contains four fuel elements at a time. He believes that the part of the fuel core nearest the other three fuel cores was probably not completely transformed into the beta phase. This would explain both the large grain size and the warp that was

encountered. It also explains why samples examined during heat treating, which were within an inch of the top of the casting, appeared to be satisfactorily heat treated.

Uranium Cold Extrusion

Cold extruded "C" size I & E uranium cores have been shown to be at least equal to cores fabricated from rolled rod in ex-reactor tests. Beta heat treatment produced a uniform fine grain structure. X-ray diffraction studies revealed a pronounced preferred orientation that was completely removed by a single standard beta heat treatment. Dimensional control was excellent and no subsequent machining operations other than cutting to length would be required. However, it appears that the cost of this process would be as much or greater than for the present method of making I & E cores and hence further work will not be done.

As there are several uranium blanks still unextruded, the dimensional control of the cold extrusion process has proven so good, an extrapolation into the potentially profitable area of coextruded zircaloy-2 fuel elements is being pursued. Several of the remaining unextruded blanks are being cut down and clad in zircaloy-2 to attempt coextruding cold, without copper or steel cladding, an economical zircaloy-2 fuel core.

Cast Aluminum Extrusion Slugs

A number of fuel elements were canned using X-8001 solid eight inch cans fabricated from cast slugs. Representative samples of these completed fuel elements will be sent to HLO's Coolant Systems Development Operation for flow tube corrosion tests. All previous tests have shown these cans to be at least equal to those manufactured by standard methods. Satisfactory performance in flow tubes is the last pre-requisite to quality for reactor tests.

Components fabricated from cast slugs should give higher metal quality and greater piece-to-piece uniformity.

Development Activities - Pilot Plant

Approximately 3600 fuel elements were canned in the pilot plant during September. These were all for process development purposes, except for 700 water mix fuel elements for production purposes. The major items of process development were:

1. Canning under optimized conditions for elimination of brittle bonds. This involved the use of a new horizontal basket for the duplex agitator along with optimized bath temperature and composition.
2. Experimental canning using reduced silicon in the canning bath. (Bond strength improvement)
3. Forty-second cycle canning.
4. Cast fuel core canning.
5. Use of components extruded from cast impacts (Hunter-Douglas)
6. Ultrasonic cleaning.

Each of these items will be reported on by personnel initiating these tests.

Pilot Plant - General

Category II Fuel Fabrication Activities: Shop fabricated supports for four KER charges of solid depleted fuel elements have been completed. These supports are detachable and require special welding techniques for assembly. This charge is to be used for bond diffusion studies at elevated temperatures and should be available to IPD in early October, well in advance of anticipated charging date.

Pilot Plant Equipment

The ultrasonic cleaning equipment was installed in the Duponal-TSPP tank September 22, 1958. Process Engineering personnel are evaluating its use.

Two new air cylinders are in use on the duplex agitator. The variable speed D.C. agitator drive motor was received. Fabrication of the new agitator splined shaft was delayed one week. Installation of these items is planned during the water outage.

New chuck jaws with insert pads were installed on the Warner Swasey turret lathe. Both lathes are now equipped with pads covering all current solid I & E fuel element diameters.

TESTING METHODS

Fuel Element Testing

About 65% of the September I & E production was processed through the two installed new Bond-Penetration testers. The maximum number of elements tested per shift per tester was over 1800. It appears that average throughput rates of 1400-1500 pieces per shift are readily attainable. Equipment and procedures were developed to improve calibration and alignment of the Bondtesters. Some minor changes were made to both the Bond and Penetration testers to reduce noise effects and to increase stability.

The Bump Discriminator for the internal Penetration test is not yet in use. Difficulties have been encountered in preparing suitable calibration standards. Prefabricated "bumps" have worn down while being used for repeated calibrations. Also the possibility of passing a penetration inside a bump needs to be better examined.

Preliminary experiments were completed to aid design of a production test for evaluating the in-reactor performance of fuel elements having different quality bonding layers. Methods were demonstrated for segregating "premium" quality pieces with the new Bondtesters. It appears feasible to select I & E² elements which give no unbond indications by the ultrasonic tests and which are almost entirely free of braze porosity as shown by autoradiograph. Another quality class can be selected from elements which pass the old (single-void) count-rate test but are rejected by the new long-memory (small void and porosity) test.

It was recommended that the old manual test conveyor for the Transformation Test no longer be used because excessive vibration makes the test results unreliable. Manufacturing is taking action to secure a satisfactory replacement.

Report HW-57521, "Bond-Penetration Test of Savannah River Fuel Elements," T. G. Lambert was issued. Drawings of the new HAPO Bond-Penetration testers were sent to the SRP as requested.

Project CG-713 Testers

Installation of the third new Bond-Penetration Test electronic system was not completed in September due to shop delays in overhaul of the mechanical components. Completion of this station is now expected by mid-October.

Responsibility for designing the modifications required to adapt the new electronic systems to the old conveyors on the fourth and fifth stations was transferred to Testing Methods from Design & Projects. Drawings for these changes have been completed and submitted to the shops for estimates.

New Methods Development

Barium titanate transducers were substituted for the quartz crystals on the pilot plant Transformation Tester. These give ten times the signal amplitude of quartz and are not susceptible to water leaks as is quartz because of their low impedance. Stability and reliability checks are in progress.

Brief tests indicate that unbonds can be detected under the inner flat portion of Tru-line I & E end caps with a conventional Bondtester. Further tests will be made to determine if unbonded end caps are indicative of brittle bonding.

Randomly selected samples of uranium cores are being measured for grain orientation with the prototype Sonic Orientation Resonance Test (SORT). These data will be used to establish normal distributions and tentative reject criteria. They will also be used to determine the feasibility of using SORT to categorize uranium lots on a statistical sampling system. Several improvements have been incorporated in the prototype including a digital readout and printer.

Considerable attention was given towards developing an eddy current system for testing aluminum cans. Sufficient sensitivity and signal-to-noise ratio was achieved to detect defects smaller than those found in the cans tested during July. This tester will be used by Manufacturing for testing the remaining 90,000 suspect cans.

Development of a high-sensitivity laboratory-type cladding thickness tester for AlSi canned elements was initiated. It is desired to develop an instrument which can be used by Quality Control as a reference for the process penetration testers. It is also desired to determine the feasibility of using such an instrument for categorizing the cladding thickness quality of outgoing lots on a statistical sampling basis.

Investigations are being made of several possible methods for detecting subsurface cracks and flaws which were discovered visually in some recovered dingot fuel cores. Through-transmission ultrasonic tests gave ambiguous results. The eddy-current

Metal Quality Test showed small differences between "bad" and "good" cores, but these differences are somewhat obscured by diameter variations. Frequency measurements with SORT also showed differences, but these may be due to grain orientation differences. Further comparisons are being made.

Difficulties have been encountered in developing an internal probe for the 105-C basin Bondtester for irradiated I & E elements. The long signal cable required for the underwater installation severely attenuates the signal and requires modifications to the tester. Repairs and improvements are also being made to the external tester.

NPR and Category II Development

Encouraging results are being obtained with eddy current measurements of zircaloy cladding thickness using the Metrol Inc. Radac unit. A cladding thickness standard has been fabricated for establishing calibration curves.

A preliminary design has been completed of a probe for bond and cladding thickness testing the interior of tubular NPR elements.

Examination of the Nuclear Metals unirradiated coextruded rod which ruptured during storage has been completed and the results will be reported in detail in a separate document. In summary, a buildup of black powdery UO_2 with traces of UN was found beneath the blistered area suggesting air contamination prior to or during extrusion. The region at which the cladding split was not a region of thin cladding. The zircaloy to zircaloy bond at the integral end closure was poor. Another rod which was blistered but not split was identical except for the degree of oxide buildup. Further nondestructive tests of other rods from this group confirm that the sizes of the blister and unbond defects are increasing with time. For example, one particular rod showed no unbonding by ultrasonic test in March, but indicated a definite unbonded area in June, and this was doubled in area by September.

Nuclear Metals have made changes in the extrusion process to eliminate the air contamination and they state that blistering is no longer a problem. The factors which are causing the continuing progressive failure of these elements are not yet understood and merit further investigation.

Hanford Test Reactor

Metal testing continued routinely and several special experiments were completed. The graphite was received from the Babcock and Wilcox Co. for the special cross-section measurements.

Installation of the sub-critical neutron flux monitor is about 95% complete. Rough drafts of an operating and service manual and a status report were completed.

Washington Designated Program - Nondestructive Testing

Equipment has been designed and is being fabricated for initiating experimental studies of the ultrasonic Lamb Wave phenomena. Theoretical studies are underway to

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HW-57702

establish an effective research program. Arrangements have been made to visit Dr. Floyd Firestone in New York who holds the original patent on possible testing applications of Lamb Waves.

Work on the broadband eddy current method study was confined to establishing a detailed program and specific objectives for each phase.

DESIGN & PROJECTS

Project Status

CG-713 - Conversion to I & E Lead-Dip Fuel Elements:

Two automatic welders are complete except for minor testing. A third welder is 95% complete. Work on the other two welders is progressing satisfactorily. All welder installation work is expected to be complete by the end of October.

The order for the buffers has been placed with delivery promised November 12, 1958. Negotiations are being carried on with the vendor to improve this date by two weeks.

CG-759 - Additional Steam Generating Facilities - 300 Area:

At month end, design on this project was 88% complete and construction was 20% complete. Construction is approximately two weeks behind schedule, principally because design was not completed on schedule.

The actual boiler move was started on September 24 and completed on September 29. The boiler weighs 190 tons and was transported intact 26 miles. All phases of the move were performed on schedule; no difficulties were encountered.

Welding and setting of the main boiler columns is now underway at 384 Building.

Construction work is progressing satisfactorily at 284 West Building. All work at 200 Area is scheduled to be completed by November 1.

CA-774 - 300 Area Water System Modifications:

Excavation of the trench and laying of 16" pipe is in progress. Approximately 8800 feet of the 10,600 feet included in the contract has been laid. Walls and bottom of the 225,000 gallon tank have been concreted. Footings for the 382 Building addition have been concreted. Work in the 303 Area, completing the 8" loop, has been completed.

CG-787 - Installation of Fire Protection System - 313 Building Addition:

Shop drawings have been approved for fabrication and shop work in Seattle has started. Field work in Building 313 is expected to start early in November.

CA-792 - Storage Warehouse for Manufacturing Operation - 300 Area:

Shop drawings submitted by the contractor have been approved as corrected. Field work is expected to start during the week of October 6.

CGF-810 - 306 Building Pilot Plant Modification:

A Directive to proceed with design in the amount of \$41,000 was issued by the AEC on September 12, 1958.

Press specifications were discussed with several press manufacturers and were reviewed by Paul Loewenstein. The press specifications are now complete, with all applicable and desirable recommendations included. On the basis of the information acquired from Mr. Loewenstein, discussions with manufacturers, and a newly proposed fuel element design by IPD, the press capacity specified was increased to 2750 tons.

Equipment layouts have been completed. These layouts will remain in general form until detail equipment design has progressed further. D.C. Lehfeldt has continued to work with HLO in integrating pilot plant and metallurgical facilities building layouts.

One draftsman has been assigned full time for detailed design work for the billet assembly equipment. A second draftsman will be assigned as soon as he is made available.

Research and Development

Billet Design:

Billet design details have been completed for five tube designs. Basic assumptions for these calculations have been: (1) fuel sizes as outlined by IPD, (2) maximum press tonnage 2750 tons. These billet designs will be used in writing process specifications. No further work or changes will be made until fuel element revised dimensions are officially issued. Additional calculations of billet designs for revised fuel element designs have been and will continue to be made as the need arises. This information is available for use when necessary.

Process Specifications:

An outline of the required process specifications has been completed. Process specifications for individual operations are being written. Specifications for copper component fabrication will be complete by October 8, 1958. These specifications will be issued by FPD and will be contained in a Confidential-Undocumented loose-leaf notebook.

General:

The first meeting of the Coextrusion Working Committee was held September 23. G.S. Allison and J.W. Nickolaus were assigned to formulate a development program for FPD and HLO. Recommendations for responsibility breakdown and a schedule of development programs were prepared.

DRAFTING & FILES

Major Jobs in Drafting

306 Building

Electron Beam Welder - Bell Jar; Magnetic Couplers;
Structural

313 Building	Miscellaneous Equipment As-Builts - Electrical, Mechanical & Tooling Water Mixing Spool Conveyor Layout - revisions I & E Tester - revisions										
384 Building	Boiler Route Map										
3706 Building	Modifications										
Miscellaneous	NPR Billet Assembly Tooling As-Built Map revisions										
Drawings Produced:	<table><tbody><tr><td>New</td><td>44</td></tr><tr><td>Revised</td><td>72</td></tr><tr><td>Large Charts</td><td>7</td></tr><tr><td>Small Charts</td><td>6</td></tr><tr><td>Miscellaneous</td><td>37</td></tr></tbody></table>	New	44	Revised	72	Large Charts	7	Small Charts	6	Miscellaneous	37
New	44										
Revised	72										
Large Charts	7										
Small Charts	6										
Miscellaneous	37										

ADVANCED ENGINEERING

Electroless Nickel Plating

A study of electroless nickel plating of aluminum has been completed. Review of the open literature and contacts with platers and users indicate that the electroless nickel process has been developed to a high degree and is employed extensively commercially. The plate is equivalent, or superior, to electroplating in corrosion resistance, porosity, and adherence. A well-demonstrated advantage is the uniform thickness of the deposit, which can be readily controlled to 0.1-0.2 mils. The process chemistry is somewhat complex and not entirely understood; however, process control does not appear difficult.

Considering the potential of the process for uniformity and integrity of the plating, and its present state of development, it appears desirable to carry out evaluation studies of plating which is commercially available. Upon demonstration of satisfactory performance by small lots, semi-production quantities could be irradiation tested.

In the near future it is planned to irradiation test two tubes each of regular, electroplated, and electroless plated fuel elements to compare the reactor effluent activity from regular and nickel plated fuel elements.

Electroless nickel plating of uranium has been moderately successful; however, little or no development work has been done for the past three years, since electroplating has been satisfactory. The chief problem appears to be oxidation of the uranium surface in the 95-100 C plating solutions. This has been overcome by applying an electrolytic nickel flash coating followed by electroless plating to the desired thickness. This study is continuing.

NPR Fuel Fabrication Cost Estimate

NPR rod type fuel costs for 1965-1970 were received with IPD and it was concluded that the cost of co-extruded zirconium clad fuel elements would be \$2.50-\$3.00 per pound

of uranium. This includes all fabricating costs from UF₆ to a clad element ready for reactor charging.

INVENTIONS

All Engineering Operation personnel engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief no inventions or discoveries were made in the course of their work during September, 1958 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

Acting Manager - Engineering

JW Talbott:mbs

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FINANCIAL OPERATION

SEPTEMBER, 1958

AUDITS AND PROCEDURES

A schedule of internal audits to be performed prior to July 31, 1959 was prepared and submitted to the Commission through Contract Accounting. The schedule, arranged by AEC Audit Classification, includes provision for some degree of coverage in all classifications applicable to the Department.

An Integrated Procedures Council composed of a representative from each Level 3 Operation and the Specialist - Audits and Procedures was established by the General Manager effective October 1, 1958. Purpose of the Council is to effect the common goals of faster communication, and better control and reduction of cost through correlation of inter-functional procedures. Establishment of the Council at this time was directly related to an oral and written presentation to the General Manager and Level 3 Managers. The presentation included a review of past procedure accomplishments appraisal of present clerical and administrative paperwork routines, and an outline of a proposed future procedures improvement program, including the functioning of an Integrated Procedures Council as generally recommended by Company Services Officers.

A final progress report was prepared on the status of recommendations made by Company Traveling Auditors. A satisfactory conclusion has been reached on each proposal with favorable results realized or definitely scheduled to be realized in each instance.

Other accomplishments included:

1. Agreement with other HAPO Internal Auditors concerning coordination of performance and reporting consolidation of certain audit work and recommendations to strengthen deficient controls of mutual interest.
2. Review and clarification for those directly involved of the financial aspects of the 200-W Laundry Operation's linen service program scheduled for operation in the 300 Area in October.
3. Additional determination of possible advantages in key punching financial data within the 300 Area rather than through Data Processing Operation in the 700 Area. Final conclusions are dependent on decisions concerning other changes currently being considered in several of the major electronic data processing applications.

GENERAL ACCOUNTING OPERATION

Continued efforts toward improving the present FPD ledger system have led to a study of advantages to be gained from mechanization of General Ledger and all supporting subsidiary ledgers. Although details of the study are still in the formulative stage, preliminary discussions with the Procedures Specialist, Data Processing, and other FPD Financial Components have disclosed an enthusiastic reception of the idea. Detailed procedures are being developed for presentation to Management for approval.

GENERAL ACCOUNTING OPERATION (continued)

Further reduction in General Accounting personnel from 11 to 10 will be effected on October 13, 1958 with the transfer of an employee to Manufacturing Operation. Original strength of General Accounting on September 1, 1956 was 13. Reductions have been accomplished through procedural improvements and realization of goals established at the time of decentralization.

In order to determine and possibly improve usefulness of General Accounting reports, a "Report Appraisal" questionnaire will be forwarded to recipients with each September report. Comments received will be analyzed and action taken as required.

Individual meetings were held with Engineering, Maintenance and Power, and Manufacturing Operations to discuss the FY-1959 equipment budget. Meeting agenda included an explanation of FY-1959 expenditure and commitment ceilings, allocation and availability of funds, review of past activity, and recommendations for the future. Level 3 Managers expressed a need for monthly reports individually designed for their own requirements. Information desired includes progress toward established goals, forecasts of performance based on historical and current trends, and other specific information not available for existing reports. New reports will be designed and issued in October.

Low bid of \$8,140 was submitted by Raymond Britten of Richland on the 300 Area Fire Station. Since total cost will not exceed \$10,000, the job can be funded as a miscellaneous capital work order under the General Plant Projects Budget Item in the FY-1959 Plant Acquisition and Construction Budget.

OPG F 1.2 - Contracts, was revised in accordance with a recent revision of the HAPO guide. The revision provides for the General Manager to enter into consultant agreements and retainer agreements with individuals not on the pension rolls, provided the aggregate annual amount approved does not exceed the maximum rate for salary Level 9 under the exempt salary plan. Prior to this change, the General Manager could negotiate consultant agreements, subject to the approval of the HAPO General Manager, if the total fee did not exceed \$7,500. The revision also includes the procedure previously covered in Advice F 1.2.1 - Processing Contracts.

The Maintenance and Power organization guide was rewritten to clarify functions and responsibilities of the Operation and avoid any misunderstanding between Maintenance and Power and Manufacturing regarding assigned responsibilities. Two additions were incorporated to establish Landlord Functions and responsibility for maintenance service to the Plutonium Recycle Test Reactor and the Plutonium Fabrication Pilot Plant.

The procedure for processing requests for AEC authorizations, approvals, and agreements has been modified to include General Accounting Operation in the routing procedure to insure Financial review prior to submitting requests for approval.

The Financial organization guide was reviewed and updated in accordance with the General Manager's annual review of the Operation's functions and responsibilities.

GENERAL ACCOUNTING OPERATION (continued)

Travel activity increased during September. A total of 63 days were spent in travel status compared with 29 days in August, and 6 days in July. September statistics compared with August are shown below:

	<u>September</u>	<u>August</u>	<u>Increase or (Decrease) Over August</u>
Travel advances to employees:			
Balance at beginning of month	\$1 942	\$ 100	\$1 842
Current month charges	<u>5 596</u>	<u>3 943</u>	<u>1 653</u>
	<u>7 538</u>	<u>4 043</u>	<u>3 495</u>
Less:			
Expenses accounted for	3 428	1 749	1 679
Advances refunded	<u>1 040</u>	<u>352</u>	<u>688</u>
	<u>4 468</u>	<u>2 101</u>	<u>2 367</u>
Balance at end of month	<u>\$3 070</u>	<u>\$1 942</u>	<u>\$1 128</u>
Outstanding travel advances:			
Current	\$3 070	\$1 942	\$1 128
Outstanding over 15 days	<u>-0-</u>	<u>-0-</u>	<u>-0-</u>
	<u>\$3 070</u>	<u>\$1 942</u>	<u>\$1 128</u>
Number of expense reports submitted	17	7	10
Number of cash advances	18	12	6

PERSONNEL ACCOUNTING OPERATION

Special arrangements were made for preparation of the payroll for week ending October 5, 1958 so that retroactive salary adjustments can be made to bargaining unit employees in the event the Hanford Atomic Metal Trades Council rejects the offer of the new Savings and Security Program. Special arrangements were required as a result of extending the deadline for acceptance of the program by HAMTC to October 15, 1958.

Eleven FPD employees cancelled "check-off" authorizations between September 20 and October 1, the period permitted by the HAMTC Agreement. This action is not too significant, as most of the employees who cancelled their authorizations had indicated their desire to do so earlier in the year.

Tabulating cards for the annual report Salary Administration and College Graduate Statistics, were prepared and forwarded to Mr. L. L. Weiss, Manager - Consolidated Reports and Statistics.

PERSONNEL ACCOUNTING OPERATION (continued)

A member of Personnel Accounting attended a meeting conducted by the Manager - Union Relations for department supervisors to assist in the explanation of terms of the GE-HAMTC Agreement with respect to payment practices.

In accordance with recommendations of the traveling auditors, a spot check was made of the accuracy of work sheets accompanying insurance claims to Metropolitan Life Insurance Company. During September, the insurance company made three revisions on seventy claim forms processed.

A daily percentage of participation in the Savings and Security Program has been furnished Personnel Practices Operation since the plan was first offered. Current participation is 98.9%. Of those participating, 94.7% have authorized a full 6¢ deduction.

Salary checks are currently being mailed to 13 out-of-town banks for deposit to the personnel accounts of forty-three FPD employees.

PRODUCT COST OPERATION

A meeting was held with HLO to discuss routine maintenance charges on power equipment in HLO buildings. It was mutually agreed that the present procedure of billing maintenance to Power prior to billing power to HLO should be changed; therefore, effective October 1, 1958, maintenance will be billed directly to HLO on routine orders. This not only gives a greater degree of control of maintenance costs to HLO but also reduces Power Operation's costs.

Meetings were held with Engineering to determine the type of control desired on charges at standard from HLO for Research and Process Technology. Cost details were furnished to show the magnitude of dollars in this category.

Level 4 Managers and most Level 5 Supervisors or foremen receiving cost reports were contacted to determine the adequacy of present reports. A separate letter has been forwarded, detailing the results.

The summary of Maintenance and Equipment Cost Report was expanded to show fiscal-year-to-date, previous years' comparable period costs, percent of operating cost, and other requested information. By contacting each Level 4 Manager in Manufacturing Operation it was learned that the report had good reception. When used in conjunction with Manufacturing's man-hour maintenance summary, most questions concerning maintenance costs can be answered.

Initial steps were taken with Data Processing to remove FPD from the Work Order program. Estimated cost of necessary runs was requested. Internal accounting procedures have been drafted and will be completed prior to the target date of January 1, 1959.

The overhead rate from the HAPO assessment pool was decreased from 9.59% to 8.99%. This, plus other internal changes is equivalent to an approximate \$102,000 reduction of C & A charges to production.

PRODUCT COST OPERATION (continued)

The overtime lunch freezer, presently located in the 3707-A Building, will be moved to the Power House in the near future. Inventories - Product Cost will retain responsibility of accounting for and ordering frozen lunches; however, the Power House Operator will distribute lunches and maintain the freezer. Since the majority of lunches are distributed by the Power House Operator after 4:00 p.m. the move will result in a more efficient operation of overtime lunch distribution.

Format changes providing a more effective presentation have been adopted for Process Materials and Other Inventories report. The new presentation results in easier reading and lists month-end quantities as well as dollar value.

At a meeting with SS Accountability personnel it was resolved that beginning in October SS Accountability would post quantities of SS materials transactions directly to Product Cost Report forms. The new procedure eliminates the Balance Report published by Accountability and the transfer of figures to the Product Cost Report by Inventories-Product Cost. The procedure will be on a trial basis for two months to determine effectiveness through actual operation.

The value of SS material in transit will be excluded from raw material balances shown on the Balance Sheet beginning with the September report. The Balance Sheet total will show actual value of material on hand at the close of the month. A footnote to the report will reflect the value of material in transit in order to reconcile the Balance Sheet with the Trial Balance.

The FY-1959 target budget has been completed and was submitted to the HAPO General Manager on September 26, 1958. Production assumptions used in the target budget are outlined in Document HW-56654-RD and are the same as those used in the budget revision prepared in July.

Information received from the Manufacturing Operation subsequent to issuance of the FY-1959 Target Budget indicates the following changes in forecasted production for the first six months of FY-1959:

- (1) 8" solid production will be 9% less.
- (2) 8" I & E production will be 11% more.
- (3) 6" I & E production will be 6% more, and
- (4) Manufacturing yields for 8" I & E will be about 5% below the values assumed in the budget.

We have not attempted to determine the dollar effect of the above changes on our revised budget since the Official Forecast will be reviewed and adjusted in October.

The Manager of the Canning Operation has requested a monthly report on consumption of aluminum components and steel sleeves. The report will compare actual consumption to standard consumption and show variances for current and previous month. The report will provide the Manager with control limits in support of the waste control program currently under way in the Canning Operation.

Manager - Finance

MAINTENANCE AND POWER OPERATION

SEPTEMBER 1958

GENERAL

There were 4 cost reductions completed, representing an annual saving of \$8,117. This brings the quarterly budget realization to 106 per cent. The annual cost reduction budget realization is 82 per cent.

Two representatives of AEC's Property Management Group visited the Department on September 25. They were escorted by the respective level 4 Managers through Area Maintenance, Instrument and Electrical Maintenance, and Manufacturing Maintenance. Their verbal comments indicated acceptance of our Property Management procedures.

A statistical summary of the age distribution of craft personnel in the Area Maintenance Operation was completed. The more significant results of this study were: 1) The mode of the ages of our Janitors, Millwrights, Carpenters and Painters is very high. 2) The mode of the ages in some crews is very high. 3) Compared to HAPO, the mode of the ages is 10 years higher in Area Maintenance. 4) Compared to FPD, the mode of the ages in Area Maintenance is 20 years higher. Average age in Area Maintenance is 45; in HAPO 39 (1956); in FPD 39.

The Work Sampling Study of Craft Productivity was completed. A report was issued on September 11. The study indicated a slight improvement in productive effort from 62.2 per cent in 1957 to 63.1 per cent in 1958. Significant improvement was noted on the time spent on breaks and in miscellaneous conversations. Working and travel time were adversely affected in part by the fence around the 305-B and 314 Buildings.

On September 19, an Off-Hours exempt meeting was held to discuss the Productivity Report. The purpose of this meeting was to interchange ideas for improving craft productive time. The activities that can be done by Top Management, Middle Management, and First Line Supervisors were discussed. Following this meeting a dinner meeting was held, which was attended by 32 people.

Traffic in the east and south parking lots was re-routed on September 8 to prevent possible conflict between vehicles leaving the parking lots and the construction work going on in connection with the sanitary water system expansion.

The roofs on Buildings 305, 313, 384, 3506-A, 3707-A, 3713, 3717, and 3722 were repaired in preparation for winter weather.

AREA MAINTENANCE

<u>Duplicating</u>	<u>Process</u>	<u>No. of Orders Processed</u>	<u>No. of Impressions</u>
	Multilith	683	409,087
	Verifax	81	1,772
	Ozalid	154	8,698
	Photocopier *	1	10
		Total	419,567

* This is an A. B. Dick machine, which was installed on September 18.

There were 10 Formal Reports completed, consisting of 5,221 copies and 187,002 pages.

General Maintenance

There were 13 double moderators fabricated for the Calibrations Operations, HLO. These consisted of two paraffin filled cylinders. The ID and OD of the two units must be fabricated to close tolerance so that one will fit within the other.

There were 10 jumpers fabricated and installed in the tube assembly mock-up in the 314 Building. The mock-up consists of 1/6 of the complete tube bundle to be used in PRTR. After installation of the jumpers, numerous modifications were made.

The 40-ton shear in the 321 Building has been placed in operation. This machine requires considerable maintenance and adjustment. It is being used to make special cuts on prototype fuel elements.

A special lucite hood was installed in the basement of the 325 Building for the PFPP Development Group. This hood is being used for smoke tests of hood ventilation. Numerous modifications were required following the initial installation to obtain the results desired by the development engineers.

The exterior painting of the 329 and 3760 Buildings was completed. Work was begun on the 326 Building.

INSTRUMENT AND ELECTRICAL MAINTENANCE

The Portable Shop repaired a total of 1,011 radiation detection instruments. Average time per instrument was 0.96 man-hours.

A temporary 230 V service for use by the contractor working on the 305-B Building was installed.

Contractors working in the 314 Building inadvertently penetrated a 4" conduit carrying a 440 V line. Necessary repairs and replacement were made.

A single channel analyzer was assembled for the Special Analysis Operation in the 325 Building. This analyzer has provisions for automatic scanning and recording of gamma ray spectra.

A Solar Time Printer was completed for the Critical Mass Operation in the 326 Building. This device will print out the time of day to permit correlation with counting records.

The 256 Channel Analyzer in the 329 Building Counting Room has operated for the past three months with no down time. This is considered outstanding performance considering the high usage and the large number of electronic components in the instrument. This good experience is the result of specialized, routine preventive maintenance provided this device.

Thermocouples were installed in 36 sleeves and cans for Process Engineering, FPD. These thermocouples are to measure surface temperatures during the canning operation.

Repair and calibration of the Effluent Water Gamma Monitor for 100-KW was completed.

The Tool Crib Attendant in the 3708 Building was transferred to Manufacturing Maintenance. This work is being discontinued.

POWER

<u>Statistics</u>	<u>September</u>	<u>August</u>
Average Steam Generated (M lbs/hr)	30.1	20.8
Maximum Steam Generated (M lbs/hr)	50.0	28.0
Total Steam Generated (M lbs)	21,743	15,475
Coal Consumed (Tons)	1,574.27	871.51
Evaporation Rate (Steam/#Coal)	6.90	8.87
Efficiency - Actual	59.2	65.8
Efficiency - Theoretical	66.1	66.0
No. of Boilers on: 1 2		
Date of Change : 1 3		
Sanitary Water from 3000 Area (Million Gals.)	64.2	68.7
Total Water from 3000 Area (Average Rate GPM)	1,486	1,540
Total Water from #3 and #4 Wells (Million Gals.)	10.4	11.9
Total Water from #2 Well (M Gals.)	.30	.30
Peak Water Consumption for 24 hours (Million Gals.)	2.5	2.4

The lower evaporation rate and lower efficiency, compared to theoretical, are due to frequent changes of the boilers on line during the month due to construction activities. In addition, although coal from the coal pile was used for the entire month, we are reaching the bottom of the pile. During dozer operation, considerable sand was carried to the boilers, resulting in poor firing conditions.

At the present time, the coal pile represents a 1.75 month supply of coal. This is compared to the normal 3 month inventory normally maintained. Construction activities have prevented the use of the railroad track and necessitated use from the coal pile for a prolonged period of time.

No. 5 Boiler was inspected by a Third Party Inspector on September 23. This boiler was found to be in satisfactory condition.

The ash sluice line from the power house broke on September 5. It was repaired and put back in service during the month. Present repairs are of a temporary nature pending the installation of an Ashcolite pipe line by construction forces. The portion of the line, which is in poor condition after six years of use, will be replaced with Ashcolite.

An additional safety valve for the high pressure air tank in the 327 Building was installed. This was done upon the recommendation of the Third Party Inspector.

The cathodic protection installation work on the east high tank has been completed with the exception of the electrode in the riser. This electrode will be installed after painting is completed. It is necessary to withhold installation of this electrode to provide room inside the riser for the painters to work and to prevent paint from getting on the electrode and impairing its efficiency.

Productive Maintenance Program

Outstanding orders as of 8/31	32
Orders issued in September	59
Orders completed in September	10
Outstanding orders as of 9/30	81

PLANT ENGINEERING

There were 31 training classes held for craftsmen of HLO and FPD. This represents 304 man-hours of craft training. In addition, three classes representing 51 man-hours of training were conducted for the janitorial force in 100-D and 100-F Areas.

Modifications to the areas occupied by Personnel Accounting in Salary and Wage Administration, 3707-C Building were completed. These modifications provide improved accommodations for the personnel in these groups and prevent conflicts of work flow.

Installation of the filming amine tanks and pumps has been completed in the 384 Building. The filming amine will inhibit corrosion in the condensate return lines.

Proposed revisions to the Parking Lot were prepared and circulated in FPD and HLO for comment. Comments received to date indicate favorable acceptance of the proposed modifications.

Engineering and installation work associated with the addition of the minus 25 degree tube on the proton accelerator were completed. All components are working as planned.

FIRE PROTECTION

<u>Fire Responses</u>	<u>No.</u>	<u>Loss</u>
HAF0	3	\$10.00
Construction	0	--
Private	0	--
Outer Area	0	--

Significant Fires

On September 26, glycerine heated to near ignition point for zirconium processing in the 314 Building ignited at the point the calrod penetrated the surface. There was no significant loss.

INVENTIONS

All personnel of 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 September, 1958.

SAFETY, SECURITY AND RADIATION EXPERIENCE

Medical Treatment Injuries	20
Frequency Rate	4.58
Disabling Injuries	0
Near Serious Accidents	0

There were no Security Violations reported.

There were no Radiation Occurrences reported.

MEETINGS

Round Table-Staff	28
Safety and Security	31
Information	8

Manager
Maintenance and Power Operation

E. Hilgeman:JPF:mkm

EMPLOYEE RELATIONS OPERATION
SEPTEMBER, 1958

PERSONNEL DEVELOPMENT

Six personnel development programs were initiated, in progress or concluded during the month.

1. Sixteen exempt employees continued to participate in the PBM-I course.
2. Ten exempt supervisors and one manager are continuing the Communication Training Program under the direction of the Communication Specialist.
3. Three new exempt employees participated in the HAPO-wide Management Orientation Program. The Manager of Maintenance and Power in FPD presented a portion of the Program dealing with philosophy of decentralization.
4. Seventeen exempt employees participated in the Labor Law series conducted by our Manager of Union Relations.
5. At least eight exempt employees studied the British documentary film describing the engineering of Calder-Hall and construction of its spherical housing.
6. Two exempt and one nonexempt employee are enrolled in the fall semester Business Training Course conducted by the Financial Operation.

Company sponsored courses totaled 1.38% of exempt employees' normal working hours.

Catalogues from the Richland Adult Education Night School program and from the Columbia Basin College were distributed to exempt and nonexempt personnel a week prior to school registration.

Four Technical Graduates, one summer student and one professor transferred to other assignments or returned to school during the month, leaving two Technical Graduates on the FPD roll at the end of September. One Technical Graduate has taken a permanent assignment with Fuels and a second has returned to take a permanent assignment effective October 1.

The Personnel Development Specialists initiated a series of conferences to unify the HAPO-wide approach to in-plant personnel development activities.

A pilot study using twenty personnel development inventories was completed. Studying and documentation of this program is continuing.

COMMUNICATION

The Savings and Security Program was implemented through special Newsletters, priority messages and Management News Bulletins.

Three General Manager's meetings were arranged during the month, one with exempt and two with nonexempt employees.

A letter was prepared for the General Manager to be mailed to employees' homes as part of the Fire Prevention Program.

GE News coverage for FPD activities and employees, totaled 111 column inches during September. Of this number four column inches were devoted to routine items and 107 column inches to planned communication in support of FPD programs. The weekly average was 4/10 of a GE News page per issue.

Other communication activities during the month included the Safety Topic, assistance on the Good Neighbor Fund Sign-up Program and counsel in preparation of the Fire Prevention Program.

During the month thirteen Management News Bulletins, three priority messages, one Employee Newsletter and two issues of the FPD Newsletter were distributed.

Special subjects covered in FPD media included attention to the construction activities and its safety aspects, organization changes within Manufacturing, and information concerning road closing due to construction activities.

The community newspapers presented very favorable local publicity concerning the boiler movement from 200-W to the 300 Area.

A news article on "Nondestructive Testing" was approved for publication and a signed article outline was submitted to Public Communication for further possible development.

Four speeches were presented by FPD employees to local community groups.

The Vice President (Editor of the "Economic Quarterly") of the Seattle First National Bank was a special tour guest to the 305 Test Reactor. Thirty students of the White Swan High School visited the Test Reactor as part of another tour.

SALARY AND WAGE ADMINISTRATION

Nineteen positions were audited in September. This has accomplished the primary goal of auditing all eligible positions within a two-year period. In addition, two audits were made of positions later deleted, and thirteen additional audits were made of positions occupied by more than one incumbent.

A letter and two charts summarizing the results of the Informal Mid-Year Review were prepared and forwarded to the General Manager. One chart illustrated the Department exempt annualized salary rate by month as forecasted by the 1958 annual and mid-year informal reviews, and the actual monthly annualized salary rate through July.

The second chart graphed the mid-point figures by quarter to date, and as forecasted through March, 1959.

Pay-performance relationship work charts for each exempt employee are being prepared to reflect contemplated shifts in the trend line as the result of introduction of the new Savings and Security Program. Updated charts will be ready for use in reviewing pay-performance relationships in November compatible with the new appraisal-salary review schedule.

Monthly increases to the annual salary rate by Level 3 Operations through March was prepared for the Product Cost Operation for their use in budgeting. This data reflected increases scheduled from the Informal Mid-Year Review. An estimate of the increase to the Department annual salary rate was given for the fourth quarter of fiscal year 1959.

In connection with the HAPO nonexempt compensation study attention has been focused on the development of a clerk-functional job evaluation plan. Major evaluation factors and definitions to be used for evaluating all such HAPO jobs and degree definitions for the major factors have been prepared. Validation of the evaluation plan is in process. Work currently is being done concerning development of performance appraisal techniques.

UNION RELATIONS

The FPD D. D. Wilson grievances which are the subject of an arbitration demand by the Council were discussed at several meetings with the Council. An overtime distribution procedure has been furnished the Company by the Council and a revised Step II answer has been provided the Council. Agreement on an overtime procedure should result in a withdrawal of the arbitration demand.

Although there are a number of FPD cases which the Council has expressed intent to arbitrate there are presently none in what is considered to be an active state and, therefore, none scheduled for arbitration.

On September 17 and 24 the Manager, Union Relations conducted a Labor Relations seminar for FPD personnel. The first meeting dealt with a brief history of labor law together with an analysis of the HAMTC-GE Contract and the second session was devoted exclusively to analyzing, interpreting, and applying the HAMTC-GE Contract. Most of those attending were immediate supervision and individual contributors.

Grievance Statistics

	<u>Unit</u>
Received this month	6
Received since 1/1/58	90

Grievance Statistics (Continued)

	<u>Unit</u>				
Step I					
Answer unsatisfactory	5				
Answer satisfactory	1				
Pending time limit to close	4				
Settled this month	8				
Step II					
Discussed this month	2				
Pending time limit to close	2				
Settled this month	0				
Pending arbitration	3				
Subject of September Grievances: (6 Total)		<u>Mfg.</u>	<u>Eng.</u>	<u>Maint. &</u>	<u>Emp.</u>
		<u>Oper.</u>	<u>Oper.</u>	<u>Power Oper.</u>	<u>Oper.</u>
Jurisdiction	1			2	
Overtime	0			1	
Absence	1			0	
Miscellaneous	1			0	
Subject of Grievances for 1958: (90 Total)					
Jurisdiction	12			39	
Seniority	0			3	
Overtime	5			6	
Absence	7			0	
Unsafe Equipment	1			0	
Transfer	2			0	
Responsibility	3			0	
Hours of Work	3			1	
Health and Safety	0			1	
Ratio	5			0	
Holdover Time	1			0	
Miscellaneous	1			0	

HEALTH AND SAFETY

	<u>September</u>	<u>August</u>
Disabling Injuries	0	0
Serious Accidents	1	0
Medical Treatment Cases	46	45
Medical Treatment Frequency	3.95	3.94
Employee Hours of Exposure	116,488	114,170
Orientation Presentations	2	1
Attendance	15	11
Safety Instruction		
Supervisors	8	0
Inspections	27	26
Suggestions Evaluated	7	1

Medical examinations for August totaled 60. This was 88.2% of quota for the month. Year to date scheduling is 121.4% of quota.

Program

The Medical Treatment Frequency rate did not change significantly during September, and injuries to the hands again totaled 31. This was 67% of total injuries reported. Of the 31 hand injuries at least 50% could have been prevented if gloves had been worn.

On September 12, Fuels Preparation Department completed 3,000,000 hours without a Disabling Injury. This established eligibility for the National Safety Council Award of Honor. On October 1 the award was received by the Department and appropriate publicity arranged.

The Department completed 760 Days and 3,066,934 hours without a Disabling Injury through September 30.

The monthly safety meeting for office personnel was held on September 17. R. I. Beaver presented a talk and demonstration on the safe use of cutlery in the home.

Activities

Job activity during September involved contacts on the following items: Housekeeping, streets and walks, barricades, pipeline construction, power house construction, high tank work, work limitations, electrical equipment, home safety, roof access, parking lots, vehicle purchase, supervisors' instruction, life belts, eye protection, safety shoes, toxic solvents, safety meeting preparation, inspections, attic entry, welding equipment, hand protection, explosive and toxic gases, guards, flameproofed clothing, equipment repair, file cabinet safety, steam usage, bus operation, cranes, construction planning, suggestions, ladders, special orientation, scaffolding, injury reports, electrical wiring, metal recovery safeguards, respiratory protection, excavation, staging and suspended work decks, materials handling, and production procedures.

FIRE PREVENTION AND CIVIL DEFENSE

	<u>August</u>	<u>September</u>
Fires and Investigations	0	0
Fire Loss	0	0
Number of Inspections	44	61
Hazard Reports Submitted	9	7
Fire Surveys Completed	0	1
Orientation Presentations	1	2
Attendance - Nonexempt Employees	11	15
Suggestions Evaluated	3	1

Program Development

A Fire Prevention Month Program for October has been developed by a committee selected from each level 3 operation. The highlights of the program include: (a) Mailing a pamphlet entitled "Buying, Building and Owning a Fire Safe Home" to all employees homes; (b) Conducting fire drills in all major buildings; (c) A Topic of the Month on Fire Prevention; (d) Fire demonstrations at the fire station; (e) A speaker's bureau for safety meetings; (f) self-inspection of property by supervisors; (g) A display at the badge house; and (h) An inventory of all hazardous chemicals, gases and flammable liquids to aid the Fire Protection Operation in developing pre-fire plans within the 300 Area.

A program designed to obtain the optimum in built-in fire protection for plant property has resulted in approval and construction of the following projects, the status of which are:

1. Expanded area water system: Actual construction 50% complete.
2. 313 Building Sprinkler System: Field construction to start 11/1/58.
3. 3715 Mfg. Warehouse, with sprinkler system: Construction to start 10/6/58.
Completion date is 1/1/59.

General Activities

Approved 17 engineering plans for new and modified construction projects.

Completed a self development course in Labor Law.

Post indicator valves and barricade at the road intersection at SW corner of 3707-C Building were removed and valves replaced with grade level valves to reduce traffic hazard to fire trucks and other emergency equipment.

Flash screens on methanol still (311 Bldg.) were removed, cleaned and re-installed in a reverse position, since they were originally installed up-side down.

Approved new method for dumping diluted methanol in special canning room in 313 Bldg.

Assisted Maintenance Engineering with preparation of specifications for sprinkler systems in 3713 and proposed 3722 Buildings.

Arranged for firemen to stand by during welding operations on fly-ash separator at 384 Building.

PERSONNEL PRACTICES

Employment

Personnel added:	13	Removed:	14	
Reduction of force:		By FPD		0
		By seniority bumping		0
Transfer requests active at month end:				47

Procurement:

Offers:	6	Requests for personnel:	22
Interviews:	9	Transfers (all):	10

Upgrades within FPD: 4

Attendance Awards: 13

Service Pins: 0 - 10 year; 5 - 5 year

Employee Benefits and Service

Benefit Plans participation:

Pension:	99.9%
Insurance:	100.0%
Stock Bonus:	61.7%

Nonveteran employees subject to selective service:

10 in 1-A; 6 in 2-A; and 11 others. In addition there are:
6 technical occupational deferments active; 14 standby and 36 ready
reservists; 3 employees on military leave.

Suggestion Plan

	September <u>1958</u>	Year to Date <u>1958</u>	<u>1957</u>
Average number of eligible employees	576	581	606
Number of FPD suggestions received	38	391	401
No. per 100 eligible employees	6.6	67.3	62.6
No. of suggestions adopted	23	190	106
Net annual savings	\$ 11,601	\$ 47,729	\$ 23,084
Amount of awards	\$ 1,285	\$ 5,435	\$ 3,156
Percent of total awards to savings	11.1	11.4	13.7
Average amount of awards	\$ 11.10	\$ 28.61	\$29.77

Technical Personnel Placement

	<u>September</u>	<u>FY 58</u>
Openings referred to FPD	92	165
FPD candidates offered	4	10
PhD candidates referred to FPD	2	3
Other candidates referred to FPD	4	20
Active transfer cases of FPD people	1	1

Nonunit Grievances

Received this month	0
Received since 1-1-58	2

Both of these cases were answered satisfactorily at Step I.

General

Security Violations in the Department this month: 0

Manager - Employee Relations

END

**DATE
FILMED**

1 / 15 / 93