

REPOSITORY PNL

COLLECTION Atmospheric Releases

DECLASSIFIED

BOX No. N/A

HW-53961

FOLDER N/A

This document consists of 161 pages. Copy No. [redacted] copies. Series [redacted]

R

HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT

NOVEMBER, 1957

67892

Compiled by
Operation Managers

December 15, 1957

Classification Canceled (Change to

Declassified

By Authority of CG-PL-2

DS Lewis 4/20/92

DG Krohn 6/3/92

AM Cook 6-3-92

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

CLASSIFICATION REVIEW FOR
DECLASSIFICATION BUT LEFT
UNCHANGED

THIS DOCUMENT IS PUBLICLY
AVAILABLE

By [Signature]
Date 5-17-73

[redacted]
[redacted]
[redacted] to an unauthorized person is prohibited.

[redacted]

This report was prepared
[redacted]
Contract W-31-100-Eng-2
Report are those of the authors.

THIS DOCUMENT HAS BEEN SCANNED
AND IS STORED ON THE OPTICAL DISK DRIVE

Route To:	P. R. No.	Location	Route Date	Signature and Date
<u>A.C. Hood</u>				
<u>Arthur J. E. Travis</u>				

DECLASSIFIED

DISTRIBUTION

COPY NUMBER

1	W. E. Johnson
2	L. L. German
3	A. B. Greninger
4	D. M. Johnson
5	W. K. MacCready
6	H. M. Parker
7	R. J. Schier
8	F. W. Albaugh
9	C. A. Bennett
10	J. L. Boyd
11	L. P. Bupp
12	P. F. Gast
13	A. R. Keene
14	H. A. Kornberg
15	T. G. Marshall
16	W. P. Sale
17	R. W. Benoliel
18	J. W. Healy
19 - 21	Atomic Energy Commission, Hanford Operations Office Attn: J. E. Travis
22 - 24	E. J. Bloch, Director, Division of Production, Washington 25, D. C.
25	Savannah River Operations Office, Aiken, South Carolina
26	300 Files
27	Record Center
28 - 35	Extra

TABLE OF CONTENTS

Staff iv

Force Report and Personnel Status Changes v

Promotions and Transfers vi

General Summary vii through xiii

Reactor and Fuels Research and Development Operation Al-1 through Al-26

Plutonium Recycle Program A2-1 through A2-11

Physics and Instrument Research and Development
Operation B-1 through B-15

Chemical Research and Development Operation C-1 through C-39

Biology Operation D-1 through D-7

Operations Research and Synthesis Operation E-1 through E-5

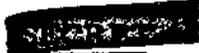
Radiation Protection Operation F-1 through F-9

Laboratory Auxiliaries Operation G-1 through G-19

Employee Relations Operation H-1 through H-9

Financial Operation I-1 through I-7

Invention Report J-1



STAFF

Manager, Hanford Laboratories H. M. Parker
 Manager, Biology H. A. Kornberg
 Manager (Acting), Chemical Research and
 Development : L. P. Bupp
 Manager, Laboratory Auxiliaries J. L. Boyd
 Manager, Operations Research C. A. Bennett
 Manager, Physics and Instrument Research and
 Development P. F. Gast
 Manager, Radiation Protection A. R. Keene
 Manager, Reactor and Fuels Research and
 Development F. W. Albaugh
 Manager, Employee Relations T. G. Marshall
 Manager, Financial W. P. Sale

TABLE I. HLO-FORCE REPORT AND PERSONNEL STATUS CHANGES
 Date November 30, 1957

FORCE REPORT

	<u>At close of month</u>		<u>At beginning of month</u>		<u>Additions</u>		<u>Separations</u>			
	<u>Exempt</u>	<u>Non-Exempt Total</u>	<u>Exempt</u>	<u>Non-Exempt Total</u>	<u>Non-Exempt</u>	<u>Exempt</u>	<u>Non-Exempt</u>	<u>Non-Exempt</u>		
Chemical Research and Development	127	97	224	127	97	224	1	2	1	2
Reactor & Fuels Research & Development	153	100	253	150	97	247	3	4	0	1
Physics & Instrument Research & Development	57	25	82	56	24	80	1	1	0	0
Biology Operation	34	43	77	34	42	76	0	2	0	1
Operations Res. & Syn.	14	3	17	13	3	16	1	0	0	0
Radiation Protection	44	154	198	44	177	221	0	2	0	25
Laboratory Auxiliaries	45	184	229	44	184	228	1	2	0	2
Financial	16	34	50	16	34	50	0	0	0	0
Employee Relations	13	11	24	13	11	24	0	0	0	0
General	1	2	3	1	2	3	0	0	0	0
TOTALS	<u>504</u>	<u>653</u>	<u>1157</u>	<u>498</u>	<u>671</u>	<u>1169</u>	<u>7</u>	<u>13</u>	<u>1</u>	<u>31</u>
Totals excluding Internal Transfers	504	653	1157	498	671	1169	7	11	1	29
Composite Separation Rate	-----									
Separation Rate (based on separations leaving G. E.)	-----									
Controllable Separation Rate	-----									

PERSONNEL STATUS CHANGES
 TABLE II. PROMOTIONS AND TRANSFERS (1)

Date November 30, 1957

Component	PROMOTIONS			EXEMPT TRANSFERS (2)						NON-EXEMPT TRANSFERS	
	Exempt	To	Non-Exempt	To HLO		From		To		To HLO	From HLO
				Other HAPO	Other G.E.	Other HAPO	Other G.E.	Other HAPO	Other G.E.		
Chemical	2	0	0	1	0	0	0	0	0	2	0
Reactor & Fuels	1*	0	2	3	0	0	0	0	0	3	0
Physics & Instrument	0	0	1	0	0	0	0	0	0	0	0
Biology Operation	0	0	1	0	0	0	0	0	0	1	0
Operations Res. & Syn.	0	0	0	0	0	0	0	0	0	0	0
Radiation Protection	0	0	1	0	0	0	0	0	0	1	11
Laboratory Auxiliaries	2	0	2	1	0	0	0	0	0	2	0
Financial	0	0	1	0	0	0	0	0	0	0	0
Employee Relations	0	0	0	0	0	0	0	0	0	0	0
TOTALS	5	0	8	5	0	0	0	0	0	9	11

(1) Data through 11/30/57
 (2) Transfers within HLO not included

1248022

SUMMARYBUDGETS AND COSTS

Fiscal year to-date costs are \$6,767,000 at the end of November or 38% of the \$17,621,000 FY 1958 Revised Budget. November costs of \$1,490,000 increased \$61,000 over October.

Funds for IPD and FPD process technology continue to be in short supply with the FPD situation being critical as present funds will support the current level of effort about another six weeks. Control measures instituted to reduce spending in weapons research were effective; however, this program will have to remain in its much reduced status for the balance of the year unless the present authorization is increased.

RESEARCH AND DEVELOPMENT1. Reactor and Fuels

Irradiation of a graphite sample (1.6 g/cc) in the MTR L-42 position at 975 C resulted in 1.11% contraction transversely to the extrusion axis of the bar. The best estimate of equivalent damaging exposure in a Hanford pile is 10,000 to 19,000 MWD/AT. This surprisingly high contraction will be rechecked in an MTR irradiation scheduled for early December.

Fabrication of solid, bonded, aluminum clad fuel elements appears feasible by cold closure cladding of nickel plated uranium cores and bonding using differential thermal expansion equipment. Bonding of I and E elements by similar methods is also under study but in a more preliminary state.

Although aluminum alloys appear extremely promising for use as fuel jacketing at high coolant temperatures and pressures in respect to corrosion, exploratory experiments conducted at high (ca. 1000 psi) pressures indicate that plastic deformation into crevices, voids, etc., may be a serious problem.

Evidence has been obtained that in 90 C process water the corrosion rate of aluminum is increased several-fold in the presence of irradiation.

A series of photomicrographs produced by T. K. Bierlein and B. Mastel were judged as the best effort presented in world-wide competition at the World Metallurgical Congress. The pictures were taken with the aid of an electron microscope of structure produced on the surface of Zircaloy-2 by ion bombardment.

Three new development contracts for thick-wall, ribless Zircaloy-2 process tubes were negotiated with vendors during November, two for NPR-size tubes and the third for KER-size tubes to replace those now in the KER loops.

Progress on the whole Plutonium Recycle Program was reviewed with Dr. W. K. Davis, Director, Division of Reactor Development and his associates in a two day meeting in the Laboratories.

1248023

DECLASSIFIED

The FRPR Phase I bid package was approved by AEC-HOO. Award of the Phase I construction contract will require about two months following authorization of funds, not now available. Phase II and Phase III design are each about 10% complete. A shortage of design funds during the month, later corrected, delayed design progress.

Modifications of FRPR design scope in progress include removal of the 1500 KW turbine-generator and substitution of an alternate primary and back-up power system, changes in architectural design to minimize the possibility of missile action in the event of an incident, and minor changes to provide space for a fuel element examination facility.

The technical feasibility of fabricating 19-rod cluster Pu-Al fuel assemblies has been established for the method of casting short rods, machining to size, loading into cladding tubes and weld closure. Since this method is of doubtful economic feasibility, development work is proceeding on extrusion of Pu-Al and PuO₂-Al, vacuum injection and pressure injection casting of Pu-Al, swage compacting of Al powder-UO₂ in Al and Zr tubes, and sintered high density UO₂-PuO₂.

Untreated "PWR-grade" uranium dioxide powder contained in stainless steel was swaged at 850 C to achieve 93-94 percent of crystallographic density. Cold swaging followed by a few final passes at high temperature was found to yield an equivalent high density.

Investigation of the high temperature characteristics of UO₂ using an electron gun to simulate reactor temperatures revealed extensive sublimation and recrystallization but no melting near the assumed melting temperature.

Responsibility for fabrication of a complete loading of plutonium-aluminum fuel plates for the Materials Testing Reactor has been assigned to HLO by the AEC. Work has started with delivery scheduled early in 1958.

2. Chemical Research and Development

Effective fission product decontamination of a simulated uranium product stream from Purex one-cycle operation was achieved by niobium pentoxide precipitation in the solution or by passing the fluid through a column packed with niobium pentoxide.

Other work in support of Purex one-cycle operation has shown that the effective life of the anion exchange resin used for plutonium recovery will be determined by total alpha radiation damage rather than by chemical environment.

Newly designed paddles have operated four weeks in UNH calciners. Inadvertent loss of a feed nozzle shut down one calciner and inspection showed five pins were sheared. This was an effective demonstration to indicate shear pins on the new paddles will operate in a manner to protect arms and blades from damage.

Pilot scale dissolution of fuel elements has been satisfactorily demonstrated in the annular dissolver prototype.

Authority to proceed on the Nonproduction Fuels Reprocessing Program was received and the following work was accomplished:

1. Addition of ammonium nitrate to the aqueous ammonium fluoride solvent used in the Zirflex process resulted in better dissolution of the tin component in Zircaloy-2 and simultaneously reduced the quantity of hydrogen evolved.
2. Design of major pieces of equipment for a pilot scale Darex plant was completed and orders placed for the titanium to be used in these components.
3. Solvent extraction and boil-off methods of removing chloride from the Darex dissolver solution are under study.
4. The use of a sulfuric acid system to dissolve 300 series stainless steel as an alternate to the Darex process is being explored.

Fused potassium-aluminum chloride salt is being studied as a solvent for uranium oxide as one pyrochemical process having application to plutonium recycle fuels. Powdered UO_3 readily dissolves in this system but sintered massive UO_2 samples dissolve slowly. Excess aluminum added to a melt solution produces aluminum-uranium alloy.

Gamma spectrometric analytical techniques are being developed to measure strontium-85 and strontium-90 in soils, ground water, and vegetation; the method may also simplify measuring numerous radioisotopes in urine.

3. Physics and Instruments

To obtain more information on the problem of nuclear safety in the dissolution of 0.94% enriched fuel elements, measurements were made of the buckling of random stacks of solid elements and of I and E type elements. The spread in the bucklings due to the randomness of the loadings was large. An analysis of the statistics of random loads and their relation to the uniform spacing results will be attempted to arrive at values pertinent to a "worse credible case."

For the IPR program, measurements of the buckling of 1.66-inch diameter slugs were completed. At IPD's request this program was revised to provide data on cluster elements next; experiments on these elements have begun.

The measured reactivity temperature coefficient of the PRPR fuel when coolant is absent from the process tubes is only one-half the value used in the reactor hazards analysis.

The large plastic scintillator mentioned in previous reports has proved to be a useful tool for contamination surveys of large areas. It has been used in truck, boat and airplane surveys and has demonstrated a sensitivity sufficient to solve several recurrent survey problems.

DECLASSIFIED

1248025

~~SECRET~~

..

HW-53961

Project CG-731, Critical Mass Lab design, received all required GE approvals and was transmitted to HOO-AEC. Continued hazards studies have not uncovered any situations in which the proposed containment would be unsatisfactory.

A potentially hazardous situation, from a critical mass standpoint, in the 234-5 Building was reviewed with CPD and limits were set on the allowable accumulation of plutonium in the hoods in question. Critical mass data and specifications were provided for other situations in the 200 and 300 Areas.

Work is continuing on the program to improve methods of calculating the neutron physics parameters of thermal reactors.

The increased sensitivity of the new transistorized Alpha Hand Counter under practical use conditions in 329 Building was demonstrated by its detection of two contamination cases which were missed by the standard fourfold counter.

Work continues on the problem of measuring temperature coefficients of graphite lattices following the unsatisfactory results of the first experiment reported last month.

Work in the basic data field continued with preliminary measurements of the fission cross sections of Pu-239 and Pu-241 on the neutron spectrometer, collection of data on the neutron slowing down distribution in water, initiation of time-of-flight measurements at the Van-de-Graaff, and progress on the determination of w for protons.

4. Biology

During the month routine sampling of terrestrial and aquatic organisms was reduced to optimize the value of information with cost.

There were no marked changes in contamination of forms collected except for whitefish flesh from Priest Rapids, which increased by a factor of 25 from last months value, due to upstream migration.

In very preliminary observations, it seems that plutonium can cause ovarian damage in animals before other damage is observable. The apparent gastrointestinal toxicity of plutonium earlier observed seems to be due, in large part, to the nitrate anion.

Technical and Other Services

The responsibility for providing radiation monitoring for construction forces was transferred to the respective landlord product departments on November 15, 1957.

One case of plutonium deposition resulted from a contaminated minor injury to a CPD employee. Preliminary analyses indicated less than 10% MPL. The total number of cases of plutonium deposition on record is 210.

1240026

~~SECRET~~

~~SECRET~~

Iodine-131 emission rate was up from October by a factor of three partly due to a single release of 13 curies. The average emission rate was 8 curies per week.

At the request of the Chemical Processing Department, an intensive study of their present measurement and control system has been initiated. Primary purpose of this study is to define the necessary and sufficient controls for SS accountability, process control, and product evaluation. This study is to be completed in approximately one year.

Varying degrees of statistical and mathematical assistance on 32 separate problems were given to other components within HLO and other departments and operations. The following items are of particular interest:

1. A study was completed of the feasibility of using certain reject data to predict the likelihood of a rupture occurring in a given lot of fuel elements.
2. Bias correction equations were developed for the most recent set of equations predicting plutonium formation and U-235 consumption as functions of exposure.
3. A statistical analysis of numerical integration techniques used to estimate fuel element cross sectional neutron flux from empirical indicator pin values was completed.
4. Mass spectroscopy data on the U-235 isotopic content of the September composite of UO_2 production were statistically analyzed. Based on this work this method of analyzing has been accepted as standard.
5. A preliminary study was made of the type and amount of matrix analysis necessary to provide the Electrical System Planning Operation and the Electrical Design Operation with routine electrical network analyses.

There are 31 active HLO projects exclusive of the PRFR. Twenty are fully authorized, two are authorized for only limited work, six are awaiting AEC action, and three are in the project proposal stage. Authorized funds total \$3,910,000 of a total estimated amount of \$14,635,000. The projects are essentially on schedule with these exceptions:

1. CA-658 Shielded Personnel Monitoring Station, which is substantially delayed for reasons outside Laboratories' control.
2. CG-660 Modification to Metallographic Cell — delayed by shipping damage to the Bausch and Lomb metallograph.
3. CA-681 Hanford Equipment in the ETR — Hanford obligations on schedule.
4. CG-747 Plutonium Fabrication Pilot Plant — funds not available.

There is considerable activity in preparation for a revision of the Hanford Classification Guide.

DECLASSIFIED

~~SECRET~~

Supporting Functions

1. Financial

The FY 1958 Midyear Budget Review was completed and submitted for approval. Highlights of the changes in this budget presentation are as follows:

- (a) An increase of \$132,000 was requested for Equipment Not Included in Construction Projects.
- (b) Personnel forecasted for June 30, 1958 are 1,176, an increase of 12 over our last budget estimate at this date. Average for the total year does not change.
- (c) An increase of \$338,000 was requested for operating programs with the Biology and Medicine Program and Fuel Elements for the MTR constituting the major changes.

Consideration is being given to the preparation of a property management and accountability manual which would eliminate the current series of OPG's on the subject.

A graphic presentation of the flow of HLO costs is scheduled to be completed and distributed in December. This is the first of a series of events to better acquaint HLO personnel in financial matters. Others to follow after the first of the year are presentations, both oral and written on appropriations, legislation, costs and budgets.

2. Employee Relations

At month's end the staff of the Hanford Laboratories Operation totalled 1157, including 504 exempt and 653 nonexempt employees. There were 420 exempt employees possessing technical degrees including 222 BS, 103 MS, and 95 PhD's.

Final clearance was obtained for copy for the 1958 Research and Engineering Progress issue of the GE Review. Hanford Laboratories will contribute approximately 45% of the Review's coverage of the Atomic Products Division.

Nine Radiation Monitors were removed due to lack of work; 11 were transferred by seniority bumping; and two were placed in HLO as Engineering Assistants. Two servicemen were removed from the rolls by senior HAPO employees displacing them. One Calibrator B was removed due to lack of work.

Thirty-six suggestions were approved by the HLO Suggestion Board.

A meeting was held with the HAMTC regarding negotiations with the Regional Monitors. HAMTC presented the Company with a Y-type seniority arrangement which is currently under consideration.

There were no new grievances received during the month. Since January 1, 1957, grievances totalled twenty, including one non-unit grievance.

~~SECRET~~

There were no disabling injuries during the month. There were 26 medical treatment injuries with a frequency of 1.50 as compared to 1.39 last month. For the year to date the frequency is 1.67.

For the first time since reorganization, there were no security violations during the month. Total violations for the year to date are 81.

Investigation of TMB, an effective new pyrophoric metal fire extinguisher, was made and reported. Coverage to all HLO was given in Hanford Laboratories' News and the report was also submitted for release in the AEC Safety Information series.

A Salary Plan brochure, together with guides for interpretation in Hanford Laboratories, was distributed to all HLO exempt employees during the month.

A comprehensive salary differential study was conducted during November following the October cost-of living and better-living increases granted to non-exempt employees. The study showed no cases of improper pay differential relationships between first-line supervisors and those being supervised.

The Point Score Evaluation Plan for semi-technical jobs was issued in its final form and fully implemented during the month.

A detailed analysis of level 3, 4, and 5 component Attitude Survey results was made during the month. The entire analysis will be completed during December and will serve as the basis for joint evaluation of the component climate, applicability of the questionnaire and possible corrective action with components desiring it.



Manager,
HANFORD LABORATORIES

HM Parker:kss

DECLASSIFIED

1248029

REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATIONTECHNICAL ACTIVITIESA. FISSIONABLE MATERIALS - 2000 PROGRAM1. METALLURGY PROGRAMCorrosion Studies

Extrusion Clad Fuel Elements. Extrusion clad fuel elements of good quality can be made and the process looks very promising, although it requires care and good quality control.

A single fuel element clad by Battelle Memorial Institute in a press of their own design was autoclaved 40 hours, cleaned, and exposed in the 314 Building flow tube for 28 days (300 Area water, 95 to 100 C, 25 gal/min). The measured corrosion in this element was very similar to the corrosion rate on standard production fuel elements in the same tube. The corrosion was reasonably uniform.

Nine other elements clad by the General Cable Company in a Schloeman press were much less satisfactory. Only one of the nine elements survived 40 hours of autoclaving and a subsequent 21 days in the 314 Building flow tubes. Most of the elements that failed were so badly swollen and cracked that the point of water entry could not be determined. This type of cladding necessarily has longitudinal diffusion welds, with potential foreign-material inclusions in the welds. Although such inclusions are often weak points with respect to corrosion, it is believed they can generally be avoided by proper cleanliness and special operating procedures.

Metallographic examination of jacket pieces autoclaved at 260 C is now in progress. A preferential attack in the diffusion weld area was observed, but may be related to inclusions.

Ceramic Coatings on Uranium. Ceramic coatings can now be put on uranium with 75 percent yield. The main cause for rejects are non-glazed areas over inclusions in the uranium.

The coatings are of good quality. Coated slugs can be hit with a hammer or dropped on the floor without damage. Rolling a coated slug down three flights of concrete steps scratched the coating near the ends of the slug but did not chip it. Sliding a coated slug through 30 feet of BDF tubing made no mark on the slug but caused some wear on the ribs. A coated slug was undamaged after four days in boiling water.

This project is being closed out. Some autoclave tests and the final report remain to be completed.

SECRET

Radiometallurgy Examinations

Production Test IP-32-A Irradiation of Insulated Slugs (RM-176). Three four-inch cored insulated natural uranium fuel elements were exposed to about 600 MWD/T in the KW through hole. In August 1957, the observed elongation of the canned elements was 0.025 to 0.030-inch and the diameter growth was from zero in one case to 0.015 to 0.020-inch for the other pieces.

This month #3 and #5 slugs were uncanned. The most obvious irradiation effect was that the cores had been restricted by uranium in both cases. For one element (#3) the core had been completely closed at one end. Dimensional data for this element are not yet available.

The element #5 showed no evidence of any bonding to the insulated aluminum can wall. Measurements of its dimensions show that its diameter had increased from 0.017 to 0.023-inch, being from 0.003 to 0.006-inch thicker at its center than at either end. The length had decreased 0.085 to 0.090-inch.

Examination of Production Test 105-3N Supplement A. Work was continued on the determination of the post-irradiation elevated temperature tensile properties of uranium. Two samples with an estimated exposure of 150 MWD/T were tested in vacuo, one at 300 C and the other at 600 C. Both samples were somewhat ductile, which has not been the case with samples of higher exposure tested at similar temperatures. The elongation was 10 percent for the sample tested at 300 C and 5.8 percent for the sample tested at 600 C.

Examination of Zirconium Alloy Process Tube Sections Exposed to Pile Atmosphere (370-470 C). The examination of zirconium alloy process tube sections exposed to pile atmosphere (370 to 470 C) was completed. Two capsules containing samples of 65 percent cold worked zirconium, 65 percent cold worked Zircaloy-2, and 30 percent cold worked Zircaloy-3 were opened and tested. Capsule #1 had an estimated exposure of 1.8×10^{21} nvt, and capsule #5 had an estimated exposure of 6.55×10^{20} nvt. Dimensional measurements were not changed by the irradiation, but the percent weight gain was greatest for the 65 percent cold worked Zircaloy-2 samples, with smaller amounts noted for the 65 percent cold worked zirconium and 30 percent cold worked Zircaloy-3.

Strips of the zirconium alloys from both exposures, along with unirradiated controls, were tested in simple bend over a one-inch gage length. The irradiated samples proved more ductile than unirradiated samples with the same nominal degree of cold work. All the irradiated samples sustained the maximum bend possible with the test jig (approximately 90°) without failing while all the unirradiated cold worked samples failed before reaching the limits of the jig.

Tests were then carried out on annealed unirradiated samples, with results which were similar to those found on the irradiated samples. Hence, it is concluded that the effects of the pre-irradiation cold work have been substantially annealed out during irradiation at elevated temperature.

DECLASSIFIED

1248031

Basic Metallurgy Studies

Electron and Optical Microscopy. The study of the microstructure of reactor fuel and its cladding material is a relatively simple means for detecting radiation damage. Two microscopic approaches are being used: (1) metallographic studies of polished and etched surfaces, and (2) fractographic studies.

As stated in a previous report, the microstructure in a given area of a specimen was not identical with the microstructure in the same area of the specimen after irradiation. A rotation of one grain with respect to its neighbor had occurred. Electron microscope examination of the identical area in replicas prepared before and after irradiation of the specimen show concrete evidence that rotation within a single grain can also occur. To establish whether such rotation may occur as a consequence of a small number of thermal cycles in the range 150-400 C, a specimen has been subjected to four such cycles in the hot stage microscope facility. The 16 mm movie film used to record the microstructure has been carefully analyzed. No evidence of microstructural changes in the particular field of view covered was detected. Additional studies of the replicas of irradiated, precharacterized metallographic specimens will be made in order to clarify present irradiation damage theories.

Replicas have been obtained from the fracture surfaces of irradiated impact specimens and are now being studied optically and in the electron microscope. The fracture surfaces of the irradiated impact specimens show characteristics of brittle fractures. In contrast with non-irradiated control specimens, the irradiated specimen shows little evidence of "tongues" which are extremely ductile regions within a grain. Most of the cleavage facets in the irradiated specimen contain small depressions about 0.5 micron in diameter. In certain grains these depressions are localized near the boundaries. The non-irradiated control specimens do not show these depressions. Fractographic work is continuing with specimens irradiated to various exposures and fractured at different temperatures.

At the recent Second World Metallurgical Congress held in Chicago, a metallographic exhibit entitled "Electron Micrographs of Zircaloy-2," was judged the best in the show. Two technical papers, an invited discussion, and a technical motion picture film covering some of the metallographic work at Hanford were also presented.

Pre-Irradiation Study of Thermocouples. A knowledge of the errors in temperature measurement using thermocouples in a neutron flux is essential for the quantitative evaluation of the effects of neutron irradiation on materials. Due to a lack of such information, a program of measuring thermocouple stability in-reactor is currently in progress.

Two sets of thermocouple leads have been fabricated containing chromel-alumel, copper-constantan, and iron-constantan couples. One set has asbestos insulation, the other quartz. Aluminum (2S) tubing has been

SECRET

1246032

DECLASSIFIED

Al-4

HW-53961

swaged over both assemblies as a protective outer covering. These leads are to be inserted into a test hole (X₂ level at KW), and resistance measurements made between the open leads. As fabricated, the resistance between leads is $\sim 7 \times 10^0$ ohms. Damage to the insulation attributable to in-reactor conditions may be noted by a change in the resistance readings. A panel board incorporating the necessary instruments for the test has been built, and the whole assembly is now at KW ready to be charged.

Work has continued on the lead capsule to be used for the 300 C thermo-couple stability test. Present design seems to be satisfactory, but efforts are being made to use a minimum amount of lead in order to decrease the heat generation due to gamma heating. Several capsules have been fabricated containing varying amounts of lead, and they will be tested to see if a minimum has been reached.

An out-of-reactor test has been implemented to determine the relative life and stability of chromel-alumel, copper-constantan, and iron-constantan thermocouples operating at 300 C in a 75 percent helium, 25 percent carbon dioxide atmosphere. Testing arrangements are similar to those to be used for the in-reactor tests.

HAPO Irradiations - PT-3NA. The design of advanced fuel elements depends upon knowledge of the effect of irradiation on the significant mechanical and physical properties. A program to obtain this information for beta-heat treated uranium is under way. During the month three elevated temperature tensile tests were made in the Radiometallurgy facility on specimens exposed to 0.018 a/o burnup. Room temperature tests indicated that embrittlement was produced by even this low exposure. Vacuum annealing for up to 100 hours at 400 C and 10 hours at 600 C resulted in recovery of yield strength and slight recovery of ductility.

The most significant feature of the latest tests is the ductility exhibited by the low exposure material. The sample tested at 300 C had pronounced "necking" before fracture. The specimen tested at 450 C did not exhibit "necking", although the fracture was 45° shear failure. A number of cracks were visible along the gage length of the sample near the fracture. The specimen tested at 600 C had a square, brittle appearing fracture. It is not known whether differences in the mode of deformation between the high and low alpha range are responsible for the values obtained. An additional specimen from this exposure is being tested at 600 C to confirm the results obtained.

Radiation Damage in Thorium-Uranium Alloys. Alloys of thorium containing one w/o or alloy, four w/o or alloy, and 5.4 w/o or alloy have been obtained for irradiation tests to determine changes in mechanical properties and some physical properties due to burnup. Tensile specimens and samples to be used for density, hardness, and metallography have been heat treated and fabricated from the 5.4 w/o or alloy alloy with both high and low carbon content. A new irradiation capsule was designed for these tests to permit irradiation in a 5/8-inch diameter napkin ring stringer at the MTR. A number of these capsules have been fabricated.

SECRET

1248033

Sections of these two alloys and the one and four w/o alloys were heat treated at several temperatures after cold working to study recrystallization and to determine the conditions required for annealing. From the hardness measurements and microstructures observed, annealing for two hours at 800 C effects complete recrystallization and softening of the one and four w/o uranium alloys. In the 5.4 w/o uranium alloys, two hours at 900 C are required to complete recrystallization.

Effect of Heat Treatment Upon Corrosion Resistance. Corrosion tests in 680 F water are being run on specimens of Zircaloy-2 and Zircaloy-3 in the as-worked and heat treated conditions at the Bureau of Mines, Albany, Oregon. Corrosion test results for specimens of Zircaloy-2 and argon melted Zircaloy-3 heat treated in air and helium from 400 to 800 C for 10 to 1000 minutes have been reported to 196 days exposure. These results are in agreement with the results after 140 days exposure. The corrosion resistance of Zircaloy-2 is impaired only after 1000 minutes at 800 C in helium. Zircaloy-3 loses some of its resistance to attack after a 10-minute heat treatment at 800 C in air. A group of vacuum melted Zircaloy-3 specimens with the same heat treatments as the argon melted Zircaloy-3 have been in test to 140 days. These specimens exhibit lower corrosion rates throughout than the argon melted Zircaloy-3, and the only harmful treatments indicated thus far are 800 C treatments in air. No results have been reported for the 90 vacuum heat treated specimens placed in test in October.

New Fuel Element Development

Uranium Wafer Fabrication. A method for the coining of uranium wafers to guarantee their self-alignment in stacking was developed. This coining operation, which has to be carried out at 300 F to prevent cracking, is applicable to wafers made by conventional production methods and will give them the "true-line" characteristic.

Results of preliminary free upsetting experiments with beta-treated uranium blanks at room temperature indicate good cold workability of uranium up to approximately 60% reduction of cross sectional area. Still higher degrees of plastic deformation in compression can be obtained, without damage to the metal, by hot upsetting at 600 F.

On the basis of the above results an experimental die set was ordered for determination of the optimum upsetting requirements of uranium and development of the suggested scrapless wafer production process, including the "true-line" producing features.'

Cold Closure Fuel Elements. The sequence of operations employed in cold closure fuel element fabrication can be accomplished by means of an assembly line process with a high degree of mechanization. Increased production, reduced unit cost, and higher yield will result in improved economy of fuel element preparation. Continued development of individual operations has yielded the following results:

SECRET

1248034

DECLASSIFIED

1. Pre-closure elements have been sized to finished dimensions. Die design, cup geometry, and lubrication studies are continuing in order to determine the proper set of variables to reduce the severity of a drawing operation. The feasibility of sizing to finished dimension will depend upon the quality of the thin can wall after closure. Buckling of the thin wall or marring of the surface during pressing and extraction from the closure assembly will demonstrate the need of a thicker wall and a subsequent finishing operation.
2. Initial work done on the cold closure of I & E elements indicates the general line of approach to a solution of the problem. A sound closure will only result from simultaneous flowing and joining of oxide free cap and tube metal. Several modified punches for this type of closure are being considered.
3. Pre-stressing calculations have been completed for a restraining die for closure of elements sized to finished dimension.
4. Unbonded cold closure pieces have been metallurgically bonded by application of heat and pressure. The data obtained from a frost test, chisel test, and tensile test demonstrate the existence of a strong bond of good quality. Microscopic examination of transverse sections of such a bonded element reveals a structure necessary for good heat transfer with no breaks or penetration points being observed in the nickel layer.

Insulated Fuel Elements. The three cored insulated uranium fuel elements which were irradiated in a K-through hole facility to 620 MWD/T are being examined in the Radiometallurgy facility. The fuel cladding increased in diameter by 0.012 - 0.016-inch because of plastic yielding of the unbonded aluminum cladding when strained by uranium fuel thermal expansion during operation. However, there has been no significant change in the outside dimensions of the uranium itself. The axial holes in the uranium appear to range from nearly unaffected in the center fuel element of the three elements irradiated, to partial and nearly complete closure in the flanking fuel elements. The non-uniform behavior of the axial holes in the uranium indicates a flux variation over the length of the three four-inch fuel elements that existed during their irradiation. Radiometallurgy examination is continuing.

Rod Cluster Fuel. Rod cluster elements meet many of the requirements for a fuel loading of the NPR. Heat transfer and rupture safety advantages have been demonstrated previously in ELMO loop tests and in irradiations at the MTR and Hanford H Reactor. A stainless steel clad four-rod cluster element charge continued to operate in KER loop 3 at about 40 kw/ft during November. The present exposure is about 600 MWD/T. Maximum bulk water temperature has been 233 C and will shortly be held at 243 C. The uranium

1246025

SECRET

SECRET

rods of 0.520-inch diameter are expected to increase in volume during this high temperature irradiation; however, the stainless steel cans are expected to restrain diametrical growth, forcing the fuel rods to lengthen.

A shipment of Zircaloy-2 clad uranium rod of 5/8-inch diameter was received from Nuclear Metals. The shipment contained pieces with 0.020-inch clad thickness. The present contract with NMI calls for experimental amounts of this rod along with production quantities of rod with 0.030-inch clad. Six fuel rods were made from this shipment with end closures formed by counter-boring and welding. Autoclave tests of welded, beta-treated, and pickled rod are in progress.

The use of a 2.125 ID Zircaloy-2 process tube in KER loop 1 in March 1958, is probable. A schedule for assembling four-rod cluster elements has been worked out with FPD and HLO Fuels Fabrication Development. This test, scheduled to operate in March 1958, is composed of 15 feet of four-rod cluster elements fabricated from coextruded rod. The 100 feet of rod for this test should arrive at Hanford in early December with assembly of the fuel elements completed by January 15, 1958.

Two baskets, containing four seven-rod cluster fuel elements, are ready to be charged into the KE Reactor through-hole facility. Goal exposure for this experiment is 2500 MWD/T. Central core temperatures of 350-400 C are expected. Since fuel behavior is extremely sensitive to operating temperature, thermocouples are being installed. Data from these thermocouples will make it possible to: (1) use the information in correlating any swelling observed, and (2) calculate the coefficient of heat transfer between the uranium and stainless steel jacket.

Design for a seven-rod cluster fuel element sized for the NPR was started this month with prototypes of the fuel element scheduled for fabrication during December 1957. Due to the possible bending of the process tube in the reactor, a maximum fuel length of three feet is felt to be practical. A spider arrangement was designed to support the seven rods at the ends; internal supports will be fixed into grooves rolled on each rod. Experiments show that the rolling of a groove 3/16-inch wide and 0.030-inch in depth can be accomplished. Further tests to determine the effects of rolling on the Zircaloy cladding will continue.

Restraint of Uranium Swelling by Zirconium Cladding. Data have been reported on the swelling rates of unrestrained uranium irradiated in the 400-500 C and 600-700 C temperature ranges. To date no data are available on the swelling of unalloyed uranium restrained by high strength cladding and irradiated with a 300-350 C cladding surface temperature and a maximum fuel temperature in the range 450-600 C. In order to obtain data for the temperature and restraint conditions of primary interest, an MTR irradiation has been designed. Final assembly of the test fuel rod and capsule have been completed. The experimental assembly was shipped to the MTR on November 22, and is scheduled to be charged in the MTR on December 2. The fuel rods will be irradiated with calculated surface temperatures of 300-350 C to an exposure of 2500 MWD/T.

SECRET

DECLASSIFIED

Advanced Studies Program for Tritium Production. The increased severity of operating conditions in advanced design reactors require that a special study be made of the feasibility of producing tritium in these reactors. A proposed design for a tritium producing element consists of an aluminum clad Al - 3.5 percent lithium alloy rod separated from a concentric fuel bearing tube by an annulus of cooling water. The coolant is expected to be near 300 C. Two aluminum alloys for cladding the tritium producing center rod meet the requirements of low neutron cross section and show promise of meeting the requirements of low corrosion rates and low permeability to gases produced in the target material. In the initial phase of the experimental work it is planned to investigate the permeation rates of hydrogen through these alloys. A device to permit experimental determination of permeation rates has been designed and is expected to be completed by early December.

High Temperature - High Pressure Bake Testing of Fuel Elements. Spectrochemical analysis of the can wall of an AlSi bonded fuel element that was bake tested 1500 hours at 450 C gave a qualitative indication of the diffusion that took place. There was no longer an AlSi layer since most of the silicon had diffused into the uranium leaving the jacket with a fairly homogeneous silicon content of 0.5 percent. Important from the standpoint of reactor application was the observed diffusion of uranium to the outside of the jacket. The concentration at the surface was 50 ppm uranium in the aluminum. Alpha track autoradiographic techniques are being tried as a means of determining the distribution of uranium in the jacket so that diffusion constants can be determined.

Bond Evaluation. A need has arisen for equipment and techniques to test the heat transfer properties of 5/8-inch diameter Zircaloy clad fuel elements. The approach selected consists of adapting the frost test to the new geometry and material of the fuel element. A new track, coil, and feed mechanism to fit the smaller element were installed on the frost test machine, and additional capacitors to tune the circuit were attached. A water cooled dummy and a Zircaloy clad stainless steel defective standard were made up. A trial of the system indicates that it will be effective for the desired use. Determination of reject limits must await the procurement of a supply of actual uranium elements, when the frost test results may be compared against those of metallographic examination.

An important aspect of the evaluation of experimental fuel elements consists of measuring the degree of quality deterioration resulting from irradiation. Quality deterioration is expected to take place during irradiation in three principal respects: (a) irradiation growth and distortion, (b) jacket surface corrosion, and (c) capacity for heat transfer across the core jacket interface.

Fairly satisfactory methods are used for determining the degree of quality loss from the first two causes; however, no adequate test is available for determining change in heat transfer rate as a result of irradiation, and evaluation of a process with respect to endurance of heat transfer properties in its product is practically impossible.

1246037

SECRET

Experiments were conducted to determine the feasibility of measuring the surface temperature of freshly discharged submerged slugs by means of a scanning thermocouple. Trials applied in the 105 C basin indicated an appreciable shift of the meter needle (uncalibrated) when the thermocouple was moved from an unirradiated slug to an irradiated one, although there was no apparent change as the slug was scanned (as would be expected if there were no zones of poor heat transfer). To get an idea of the magnitude of temperature difference that might be expected over regions of poor heat transfer, a synthetic slug was made up, consisting of an electric heater element snugly fitted inside an aluminum can, with a small piece of mica sheet interposed for a heat barrier. Variations in intimacy of contact between heater element and jacket also were expected to lead to variations in surface temperature. This synthetic slug was rotated, immersed in flowing tap water and was scanned with a thermocouple. In the transverse plane of the mica spot, the temperature varied from 103 F to 112 F with fairly good reproducibility, indicating that the method is probably feasible. Positive evidence of its feasibility will be to find measurable temperature differences on the surface of an irradiated slug known to have zones of poor heat transfer. Such a slug, however, will be hard to obtain. Meanwhile, the test may be applied to numerous irradiated slugs to determine the extent of temperature variations normally encountered.

Plating Development. In preparation for the hot press wafer fuel element program, it was necessary to design racks that would accommodate KER I & E wafers which were to be nickel plated in three ways: (a) outer and inner cylindrical surfaces only, (b) outer and inner cylindrical surfaces and one side only, (c) over entire surface of wafer. In each of the three cases it was necessary that the number of electrical contact points should be reduced to a minimum. Experimental plating racks have been in the Technical Shops, and several batches of wafers have been successfully plated with 0.0005-inch Ni or less. It appears that a successful technique for controlling the deposition of the nickel plating has been developed.

Welding Development. A group of nested tubular fuel cores assembled to form a ten-foot length fuel element is being developed for the PRP reactor. A support and spacing system is required on the tubular elements to accurately fix the location of the several components. Three rib supports attached to the 0.030-inch thick tubes by an adaptation of the resistance spot welding process are being developed. Very preliminary evaluations indicate that spot seam welding may be developed into a suitable process for this application.

In order to use thermocouples in fuel elements, it is necessary to seal the thermocouple sheath at the point where the sheath enters the fuel element. The seal must be positive and must be able to withstand the temperatures involved during irradiation and also must be corrosion resistant in service. A method of fusion welding the stainless steel sheath which has a 0.010-inch thick wall and a diameter of 0.062-inch into a heavy stainless steel fuel element end cap has been developed. The fusion welding is done with the electron beam vacuum welding process. Other

DECLASSIFIED

processes are not suitable for this application. As a result of this development, thermocouples can be placed in fuel elements with high quality fusion welding attachment. The results obtained in this application indicate that this welding process has a strong potential for critical miniature component assembly.

The evaluation of extended surface co-extruded fuel elements for improved reactor service requires that a method of supporting the fuel element in the process tube be developed. The supports to function satisfactorily must be attached to the Zircaloy-2 jacket in such a way that the uranium Zircaloy-2 interface bond is not disturbed. A method of accomplishing this requirement is being evaluated. The method consists of resistance spot welding the support member to the Zircaloy-2 fuel element jacket. Preliminary microsections of the attachment area indicate that this method may be suitable.

Fuel Element Rupture Simulation Studies

Programs and schedules for determining the rupture behavior of prototype fuel elements were developed and reviewed with FPD and IPD personnel. A study was started to determine the most efficient way to perform rupture simulation tests under conditions of heat generation. Among other alternatives under consideration is the moving of the ELMO-5 facility from 1706-KE to 185-D, adjacent to the direct current generators used for heat transfer experiments.

Rupture behavior of insulated slugs was evaluated in two tests using the isothermal rupture simulation facility, ELMO-4. Insulated slugs were found to behave about the same as unbonded slugs, the corrosion product buildup being sufficient to split the process tube. At 240 C, flow was blocked 16 minutes after failure. At 200 C, one hour was required for comparable flow obstruction. This facility will be out of service during January for modifications to result in higher attainable pressures, temperatures, and flow rates.

2. REACTOR PROGRAM

Coolant Systems Development

Low Temperature Corrosion Studies. The 1706-KE single pass tubes are operating at pH values of 6.0, 6.5, and 7.0, in accordance with PT-105-550-E, to determine the effect of pH on slug corrosion rates in the present reactors. During November, trouble was experienced with high rates of film formation. For a brief period it was necessary to purge once each shift. A study was started to determine the nature of the film, deduced to be possibly the result of a reduced rate of alum feed.

Tube 2943-KW is being used to determine the effect of radiation on the corrosion of aluminum in process water at moderate temperatures, in accordance with PT 105-550-E, Supplement A. Preliminary data are available from slugs exposed at temperatures near 90 C. These data reveal that corrosion rates in regions of high flux are markedly greater than in regions of low flux.

1240039

DECLASSIFIED

Service Testing. Tests were started to evaluate the performance of special types of poison slugs designed to be resistant to abrasion and corrosion. One type is a nickel plated slug, and the other is an aluminum jacketed slug containing a zinc ring at each end.

Tests are in progress to evaluate a modified design of rear face resistance thermometer sensing elements. Designs now in service have been found to fail from fatigue.

Testing continued in the ELMO-1 facility to evaluate the buildup of scale in heat exchangers cooled with raw river water.

Organic Coolant Studies. Following the completion of in-reactor experiments in ORA-2 dealing with a ternary eutectic of biphenyl and the ortho and meta terphenyls, a new irradiation was started using Santowax QM, an organic coolant which is solid at room temperature. Soon after start of the test, the addition of monoisopropyl was found necessary in order to prevent the pump from stalling. Consequently, the data to be secured from this run will be of reduced value.

In conjunction with the Construction Engineering Operation, a study was started to establish the scope for a small scale in-reactor organic coolant facility capable of handling small sized fuel elements. This study is scheduled for completion by mid-December.

Ex-Reactor High-Temperature Loop Studies. Using the ELMO-6 facility, an experiment was initiated to determine the corrosion rate of aluminum alloys at 300 C under "ideal" conditions comprising pH 4.5 adjusted with phosphoric acid and 450 sq cm of aluminum surface per gallon contained volume in the loop. Preliminary results show the corrosion rates to be extremely low.

Internally-externally cooled, 1.80-inch OD and 0.680-inch ID, M-388 aluminum alloy, canned uranium slugs, candidates for KER irradiation, were discharged from the ELMO-7 facility following two months exposure to flowing water at 1650 psi and 300 C. Several depressed areas about 1/4-inch in diameter and 0.020-inch deep were noted on the can surfaces. These are deduced to be associated with voids in the AlSi layer. A similar test under the 240 C near term KER conditions was started.

Examination was made of specimens of 304L sensitized stainless steel following three months exposure in the ELMO-2 facility at 180 C at a pH of 4.0. No intergranular corrosion was observed. Some intergranular corrosion was observed in 304L sensitized stainless steel exposed in the ELMO-9 facility for two months at 250 C at a pH of 4.0.

A test is in progress in the carbon steel ELMO-5 facility to check predictions by workers at KAPL that silica would be effective as an inhibitor of aluminum corrosion at high temperatures. Results to date have been contrary to KAPL predictions. At high pH with silica addition it was found that aluminum corroded at an excessive rate.

High Temperature In-Reactor Loop Tests. Carbon steel loop KER-1 was out of service because of modifications incidental to its reconversion for use with water coolant. Following start-up and run-in tests expected to be finished in mid-January, it is planned to operate the loop at temperatures between 200 and 275 C, at pH's between 8 and 10 adjusted by LiOH, using natural uranium, four-rod cluster fuel elements clad in stainless steel.

Stainless steel loop KER-2, containing M-388 aluminum alloy clad, internally-externally cooled, massive natural uranium fuel elements (Cow slugs) operated throughout the month without incident at 180 C outlet temperature with pH of 4.5 adjusted by H₃PO₄. These slugs are scheduled for discharge in January. The next charge is to be corrosion resistant aluminum alloy clad, hot press canned, internally-externally cooled, 1.6 percent U-235 uranium wafers without bulkheads. Operating conditions will be 235 C outlet temperature, pH about 4.25, adjusted with H₃PO₄, and with a high ratio of aluminum surface to loop volume.

Stainless steel loop KER-3 operated routinely during the month except for a period of 19 hours at reduced temperature to enable valve repairs. Current process conditions comprise operation at 235 C outlet temperature, nominally neutral pH, using natural uranium, four-rod cluster fuel elements clad in stainless steel. The next scheduled charge for this loop consists of co-extruded Zirclad rod clusters of 1.6 percent U-235 uranium.

Stainless steel loop KER-4 was discharged on November 13, following operation with Cow slugs for 62 days at an outlet temperature approximating 190 C at pH 4.5 adjusted by H₃PO₄. The loop was removed from productive service for repairs to the No. 2 pump and is expected to start up on December 16. The charge will comprise 10 M-388 aluminum alloy clad, internally-externally cooled, natural uranium wafer slugs (Elephant slugs) to be operated at outlet temperatures up to 240 C, at pH 4.5 adjusted with H₃PO₄.

Decontamination Studies. A proprietary compound, Turco 4306 B, is being evaluated as a decontaminant for the rear face piping of the present reactors. A test in the 1706 ex-reactor tubes to determine the degree to which high corrosion rates persist following a purge with Turco 4306 B was terminated. The data indicate that corrosion rates returned to normal approximately 60 days after the purge.

Thermal Hydraulic Studies

Flow Hazard Studies. A report was issued (HW-53593) concerning the results of experimental tests in a K process tube where the supply pressure was reduced, both suddenly and slowly in accord with a reactor power outage. The tests determined the increase in outlet water temperature when the power reduction occurs after the start of the flow reduction. The results are useful in calculating reactor bulk outlet water temperatures following sudden BPA power outages.

Further steady state boiling curves were determined for conditions simulating I & E fuel elements in a "C" tube. Steady state boiling curves have been determined for a range of annulus to hole flow ratios bracketing those which occur in a reactor. These boiling curves have been used to outline the range of flow reductions to be used in studies of the response of a reactor process tube to imposed hazardous conditions.

Hydraulic Studies. Collection into one report of all experimental data concerning the pressure drop-flow relationships for standard process tubes and components for all Hanford reactor types was completed. The data for a given assembly are presented for a temperature of 10 C together with a theoretical temperature correction curve. The data agree with the theoretical correction to temperatures up to 80 to 90 C. Deviations at higher temperatures have been tentatively ascribed to deaeration of the water.

Laboratory data were accumulated for determining the variation of Panellit pressure with outlet water temperature for both solid and I & E slugs in BDF geometry. The pressures agree reasonably well with those calculated from standard pressure drops and rear fitting critical flow conditions.

A charging machine was designed for the hydraulics laboratory to make charging of the experimental equipment conform to that of a reactor.

Calculations were made determining the flow split of a special I & E slug train for K Reactor.

Organic Heat Transfer Studies. The electrically heated test section of the organic heat transfer loop failed at conditions of moderate temperature and pressures. The failure was due to "burnout" arising from a plug downstream of the test section and high stresses caused by thermal expansion of the rigidly fixed test section. An expansion loop in the piping downstream of the test section and a scram circuit actuated by high element surface temperatures are being incorporated in the loop to prevent future failures of this kind.

Mechanical Equipment Development

Organic Cooling Systems Components. Preliminary start-up tests of a component test facility were completed. The electrical heating capacity of the facility was found to be too small to obtain the desired operating temperatures. Additional heaters are being installed. A mechanical rotating shaft seal (Dura Seal Type PT) was tested at temperatures up to 175 C. The leakage rate without rotation was approximately two ounces per day. When rotating, the leakage rate became negligible. Some difficulty was experienced in flaring two-inch tubing with a wall thickness of 0.125-inch. A special block and die were found to be necessary for satisfactory flaring.

Fabrication was started on a simple organic fire test apparatus. The fire tests will be started shortly after the completion of fabrication.

DECLASSIFIED
SECRET

1248042

Irradiation Test Engineering

Shielding Studies. Analysis of the attenuation of Magnetite concrete heated to 100 C was completed and reported in HW-53395. Foil data for tests after heating to 200 C were corrected for decay and geometry and are now being assembled for reporting. The Magnetite was heated to 300 C and placed back in the test well for irradiation. The foil loadings combined bare gold, cadmium covered gold, and sulphur in an attempt to achieve all foil irradiations in one test. The data from two attenuation tests on unheated ordinary concrete were analyzed. The relaxation length for the fast and thermal neutron flux was found to be 11.6 and 8.2 cm, respectively. With the thickness of concrete available, equilibrium between the fast and thermal neutron flux was not obtained. The value determined for the fast neutron relaxation length is in good agreement with previously reported data. In order to obtain a fast neutron transverse all the way through the test well, large sulphur foils (1-1/4" diameter, 5/16" thick) were used in one of the ordinary concrete loadings. After irradiation the sulphur foils were burned in aluminum dishes leaving only the radioactive P-32. By this technique the measurable activity of the foil was increased by a factor of about seven. The relaxation length determined by these foils in the outermost layers of the test slabs was in agreement with the relaxation length previously determined for the innermost slabs.

A literature survey was started concerning an experimental program to evaluate irradiation damage to concrete. Preliminary work was also performed on the feasibility of irradiating standard ASTM two-inch cubes of cement mortar. Calculations based on an equivalent sphere irradiated in the K Reactor indicate the temperature differential from center to outside surface could exceed 70 F and that the tangential tensile stress would be about 4000 psi. Thus, the cube would probably be damaged by surface cracks due to thermal stresses. Irradiations of samples of Ottawa sand and Type II cement were made in order to obtain experimental estimates of dose rates to be anticipated from two-inch cubes of mortar. Cement was the most significant contributor to dose rates. Based on a short exposure and a ten-hour decay period, the gamma dose rate at one foot from a two-inch cube of Type II mortar was calculated to be greater than 20 R/hr.

Modifications to the counting room continued throughout the month. In order to cut down on line noise, two transformers were installed. Tests were performed using the new source of power and indicate no problem should be encountered with line noise. The sample changer was equipped with a gas flow proportional counter, and work is now under way to change three other counters from Geiger to gas flow proportional counting.

Nonmetallic Materials Development

Thermocouple Development. Two new thermocouple alloys, Driver-Harris Geminol-P and Geminol-N have been received and are being tested in the laboratory. According to the data furnished by the Driver-Harris Company, the couple has a slightly lower thermoelectric power than chromel-alumel but is reportedly more resistant to corrosion at high temperatures in a reducing atmosphere.

1240043

SECRET

Four experimental thermocouples are now at 100-D Reactor awaiting installation. These include: (1) a 20-gauge Geminal couple with vitreous alumina insulators; (2) a 20-gauge chromel-alumel couple with porcelain insulators; (3) two chromel-alumel couples with vitreous alumina insulators. These will be installed in a graphite stringer with regular stringer couples.

Thermal Conductivity of Graphite. Thermal conductivity has been measured on two rods of CSF virgin graphite by the cylindrical-radial flow method in the range from 165 C to 586 C. The thermal conductivity decreased with temperature from 0.33 to 0.15 cal/(cm)(deg C) on one sample, and from 0.24 to 0.16 cal/(cm)(deg C) on another. The values are close to those expected for heat flow parallel to the carbon layer planes. Sample orientation with respect to the bar extrusion axis will be checked by thermal conductivity and x-ray measurements at room temperature.

Graphite Development. Property measurements are reported in the table below for various batches of experimental graphites prior to their insertion into irradiation facilities at both high and low temperature. In comparing the impervious graphites, it is seen that better crystallite development exists in the pressure molded stock, BP-AGOT and BP-GBF, than in the resin impregnated GBF-82T. This is probably a function of the comparatively low heat treatment, 900 C, after resin impregnation. The effect of high temperature irradiation on the dimensional changes of the two materials will show if the poorly ordered resin residue allows greater contraction of the impregnated stock than the well graphitized molded material. This would support current contraction mechanism models. The other graphites represent materials proposed for low density moderator use.

DECLASSIFIED

1248044

~~SECRET~~

AL-16

HW-53961
Thermal
Expansion
Coefficient
x 10⁶

Material	Description	Crystallite Parameters in Å				Thermal Expansion Coefficient x 10 ⁶
		C ₀	L _c	A ₀	L _A	
TSP	Standard Texas coke AGOT graphite with a special "p" purification	6.723	415	2.463	125	2.28
TSP 1.4 g/cc	Low density Texas coke AGOT graphite with "F" purification	6.732	395	2.462	100	3.00
TS 1.25 g/cc	Low density Texas coke AGOT graphite unpurified	6.740	370	2.462	85	3.40
SP-AGOT	Representative of recent standard AGOT processing	6.735	400	2.463	105	4.42
BP-AGOT	Pressure molded AGOT stock with permeability 1/10 of conventional	6.732	360	2.462	105	2.51
BP-GBF	Same as above with GBF purification	6.733	365	2.463	105	3.82
VT-AGOT	New petroleum coke with AGOT graphitization	6.740	390	2.463	105	4.58
GBF-82T	Resin impregnated GBF stock with 900 C bake	6.767	335	2.462	50	5.18

High Temperature Graphite Irradiation. Samples have been recently obtained from the GEH-9-5 high temperature irradiation in the MTR L-42 position. Samples in this assembly received approximately 1.46 times the exposure of the GEH-9-4 irradiation. Results are given in the table below.

Position	Sample	Irradiation Temp., °C	Flux (nv)		Contraction (Percent)
			Thermal	Fast (> 1 Mev)	
1	1.6 g/cc TSGBF	600	-	8 x 10 ¹⁸	0.04
2	1.2 g/cc Experimental	750	-	4 x 10 ¹⁹	0.07
3	1.6 g/cc TSGBF	750	1.4 x 10 ²¹	1.4 x 10 ²⁰	0.06
4	1.6 g/cc TSGBF	975	1.8 x 10 ²¹	2.6 x 10 ²⁰	1.11

All samples showed length contraction transverse to the extrusion axis of the bar from which they were cut. Sample #4 from GEH-9-4 and sample #3 of GEH-9-5 which received a comparable exposure at the same temperature contracted the same amount within experimental accuracy. The low density sample #2 of GEH-9-5 contracted slightly more, indicating that the low density graphite has a higher contraction rate than the 1.6 g/cc density

1246045

~~SECRET~~

graphite. The #4 sample exposed at 975 C appears to have contracted 1.11 percent. Such a large contraction was unexpected but appears to be caused by the irradiation. This will be rechecked by further irradiation tests. The best present estimate of Hanford equivalent damaging exposure would lie between 10,000 and 19,000 MWD/AT for the number four position of GEH-9-5.

GEH-9-6 will be charged early in December on MTR cycle 97 for a planned three-cycle irradiation. The assembly will contain four sample-heater units with three samples of 1.6 g/cc TSGBF graphite and one low density sample. Neutron flux monitors consisting of bare aluminum-cobalt wire, cadmium covered aluminum cobalt wire and a nickel wire have been included at each sample position.

In-Reactor vs. Ex-Reactor Graphite Oxidation Rates - IP-28-A. Data from PT 105-548-E, C Pile Graphite Burnout Experiment, indicated that above 650 C, radiation induced chemical reactions are probably of negligible importance compared to the thermally induced CO₂-C reaction. The magnitude of this radiation effect was not determined with sufficient accuracy so another test, PT IP-28-A, has been planned. The object of the present test is to determine the reaction rate of reactor gas and graphite samples when exposed both in and out of a reactor to similar conditions of temperature, gas composition and gas flow. A thermocouple installed with the samples in channel 2773-C will control the temperature of samples in a follower furnace out of the reactor. A gas preheater has been installed upstream of the follower furnace to simulate more closely the temperature conditions in the reactor. A special front bellows with pressure taps will be installed on 2773-C to determine the gas flow rate in that channel. All modifications to the control instrumentation have been completed; the special bellows will be installed during December, and the test is expected to start in January.

Structural Materials Development

Zircaloy-3, BDF Process Tubes. Inspection of the eight, 50-foot long, Zircaloy-3 ribbed, BDF process tubes produced by Superior Tube Company is continuing. Eddy current test results revealed indications of defects in or near the ribs; however, preliminary radiographic inspection did not confirm the presence of these defects. Additional radiographic examinations will be necessary to assure that no defects are present in this tubing.

Tube reducing mandrels and dies were redesigned and fabricated by the Tube Reducing Corporation for Allegheny Ludlum Steel Corporation. The first stage of tube reducing of 15 to 20 process tubes is scheduled to be performed approximately the first of December.

KER Type Process Tubing. To determine the optimum tube reducing schedule for fabricating of KER type, ribbed and ribless process tubing, four-tube reducing operations of 40, 50, 60 and 70 percent reduction of area were performed on ribless extrusions by the Tube Reducing Corporation for Allegheny Ludlum Steel Corporation. Preliminary inspection revealed no serious defects in this tubing. Similar tests on ribbed tubing will be performed during January. An order for the fabrication of six KER type process tubes was placed with Allegheny Ludlum Steel Corporation. These

DECLASSIFIED

1246046

tubes will incorporate a 0.170-inch minimum wall thickness and a maximum of 40 percent cold work. Delivery of these tubes is scheduled for April 15.

NPR Type Process Tubing. Orders were placed with Reactive Metals and Chase Brass and Copper Company for the fabrication of five Zircaloy-2 process tubes (by each vendor) to evaluate the feasibility of fabricating a 2.7" ID x 0.250" wall x 57' long tube. Reactive Metals will fabricate the tubing by extrusion followed by tube reducing. Chase Brass will fabricate by producing two or three short extrusions, butt welding, and finishing by plug drawing. Both companies will make a concerted effort to provide process and cost information by February 1, and complete tubing by June 1.

Zircaloy Quality Control. Corrosion tests of Zircaloy-2 and 3 coupons in 400 C steam and 360 C water were continued. Little difference has been noted between the corrosion resistance of Zircaloy-2 and Zircaloy-3. Samples of welded tubing from NTH Products Company gave good results in the three-inch diameter tubing but exhibited white corrosion products along one side of the weld in the 1-1/2 inch diameter tubing. Preliminary comparison of results obtained at 400 C and 360 C does not indicate that accelerated corrosion tests at 400 C will be completely reliable for quality control purposes. Duplicates of samples which completely disintegrated in 400 C steam exhibited the lowest corrosion rate at 360 C.

Advance Studies

Fluidized-Bed Reactor. The physics analysis of the Rabbit Reactor is being reviewed and extended to a wider range of cases to permit a more comprehensive evaluation of the reactor type. A hemispherical rather than cylindrical shape for the core is being studied.

Generalized Diffusion Theory. The first part of a report on the generalized diffusion theory has been issued as HW-53681, which describes the physical assumptions and formulation of the theory. Numerical calculations, which will be issued as Part 2, are about 60% complete.

Fuel Element Investigation. An extensive series of IBM computer calculations has been carried out to indicate the expected performance of the multiple-hole fuel element. Based on equations in HW-47004 ("Temperature Distribution in Long Cylindrical Fuel Elements Cooled Internally by Several Channels," D. E. Amos), these calculations provide approximate temperature distribution figures.

Summarization of this data has been started. Correlations to be reported include comparisons with similar conventional fuel elements and materials which will permit performance predictions. Comparisons will be on the bases of reactor physics effects and fuel element temperature distribution as related to variations in fuel element configuration.

B. WEAPONS - 3000 PROGRAM

Research and development in the field of plutonium metallurgy continued in support of the Hanford 234-5 Building Operations and weapons development programs of the University of California Radiation Laboratory (Project Whitney). Details of these activities are reported separately via distribution lists appropriate to weapons development work.

C. CUSTOMER WORK

Metallography Service

A production-canned uranium fuel element which was removed from the steam autoclaves was found to contain two unusually large blisters near the cap end of the aluminum jacket. Metallographic sections revealed a large cavity beneath the blisters that was filled with reaction products as a result of water entry to the slug. Subsequent examination located the point of entry of water to be through "hot short" (e.g., brittle) cracks in the weld bead to a shrinkage or gas cavity in the weld metal. Penetration of the water then took place along the AlSi braze to an unbonded area between the cap and the uranium fuel element.

Laboratory tests with the new Buehler automatic polishing attachment (Automet) have shown that it is capable of producing a good mechanical polish on a variety of metallographic specimens. The equipment, as presently set up in a glove box, will allow work to be done on samples which normally could not be done in this laboratory in the past due to some health or other radiological hazard. Since a minimum of handling time is necessary to place the samples in the specimen holder, it is well suited for preparing metallographic specimens of low to moderate radioactivity. One sequence of grinding and polishing operations was developed which allows a variety of metals to be polished at the same time. (Six one-inch or five 1-1/4 inch bakelite mounted specimens may be done simultaneously.) The equipment allows any combination of metals with a hardness equal to or greater than brass to be processed together, and results have been quite reproducible. Further development is needed, however, before soft metals such as aluminum can be polished successfully with the Automet attachment.

Samples Processed During the Month

Total samples processed: 154

Photographs:

Micrographs	183
Macrographs	<u>40</u>
Total	223

DECLASSIFIED
SECRET

1248048

The following Trips and Visits Reports apply to activities on 2000, 3000, and 4000 programs. Technical activities on the 4000 Program are reported separately in HW-53961 A2.

F.W. Albaugh

Manager, Reactor and Fuels Research
and Development Operation

FW Albaugh:kb

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
OJ Wick ID Thomas MD Freshley	11/4-8	AEC-ASM Congress, Chicago, Ill. ANL, Lemont, Ill.	Present paper Attend meeting and discuss Pu fabrication problems	L Kelman	Yes "
JH Rector	11/4-8	Gorton Company, Racine, Wisc., Metals Show, Chicago, Ill ANL, Lemont, Ill.	Examine equipment, contact vendors re equipment and discuss Pu fabrication problems	H Klema L Kelman	No Yes
ED McClanahan	11/18-22	Rice Institute, Houston, Texas	Discuss x-ray diffraction techniques and studies on thermal expansion	J Waser	No
RM Fryar	11/1-5 11/25	ASM Congress, Chicago, Ill. AIEE Meeting, Spokane, Wn.	Present paper "	CB Hinton	No "
H Harty	11/18	SAME, Seattle, Wn.	"	"	No
TW Ambrose	11/12-15	Oregon State College, Corvallis, Ore. U. of Oregon, Eugene, Ore.	Recruiting	"	No
JM Batch	11/18-22	Purdue University, Lafayette, Ind.	Recruiting	"	No
JM Davidson WA Snyder	11/1	BNL, Upton, L.I., New York	Discuss graphite irradi- ations and stored energy	RA Myers	Yes
HP Oakes	11/1	Carpenter Steel Corp., Union, N. J.	Consultation on fabri- cation of Zr	N Chernick	No
LA Hartcorn	11/1-7 11/8	ASM, Chicago, Ill. National Lead of Ohio, Cincinnati, O.	Attend convention Discuss thorium metal- lography and status of work by committee on metallography of MQMC.	AE Quay	No Yes

Al-21

HW-53961

1248050

DECLASSIFIED

SECRET

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
LD Turner	11/4-8	ANL, Lemont, Ill. Chicago, Ill.	Attend Hot Lab. panel planning group and visit Natl. Metals Show	W Doe	Yes
JM Davidson	11/11-13	Phillips Petroleum Co., MTR, Idaho Falls, Ida.	Disassembly of GEH-9-5 assembly experiment	WS Little	Yes
RE Nightingale	11/12-15	BNL, Upton, L.I., N.Y.	Present paper and attend AEC-sponsored joint French-American meeting on graphite reactors	H Kouts	Yes
HP Oakes	11/26-	Western Pneumatic Tube Co., Kirkland, Wn.	Consultation on Zr tube fabrication	C Eckmann	No
	11/18	MTH, El Cajon, Calif.	Consultation on Zircaloy fabrication	W Miller PC Berkey	No
	11/19	La Fiell, Los Angeles, Calif.			
PJ Pankaskie	11/8	Tube Reducing Co., Wallington, N.J.	PRP tube fabrication (DDR-6) consultation	Mr. Randall & RE Rohrbaugh (Allegheny-Ludlum) WC Greenleaf	No
JW Riches	11/14	Reactive Metals, New York, N.Y.	Consultation on Zr fabrication	DA Crampton	"
	11/15	Chase Brass & Copper Co., Waterbury, Conn.	"	S Randall	"
	11/16	Tube Reducing Co., Wallington, N.J.	"	RE Rohrbaugh	"
	11/18	Allegheny-Ludlum Watervliet, N.Y.	"	Mr. Rudd	"
	11/19	New Rochelle Tool Co., New Rochelle, N.Y.	"	F Loewenstein	"
	11/20	Nuclear Metals, Inc., Cambridge, Mass.	"		
JE Minor	11/1	Nuclear Metals, Inc., Cambridge, Mass.	Discuss performance of off-site fuel development work.	P Loewenstein	Yes

SECRET

1248051

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
TK Bierlein	11/1	WAPD, Bettis Field, Pittsburgh, Pa.	Discuss remotized etching and replication	T Padden	Yes
	11/2-8	AIME(Second World Metallurgical Congress) Chicago, Ill.	Present paper	--	No
	11/8	ANL, Lemont, Ill.	Discuss irradiation effects in fissionable materials	JF Schumar	Yes
	11/5	GE X-Ray Dept., Milwaukee, Wisc.	Discuss equipment	Mr. Edholm	No
SH Bush	11/2-8	AIME(Second World Metallurgical Congress), Chicago, Ill.	Present paper	--	No
	11/8	ANL, Lemont, Ill.	Discuss irradiation effects in fissionable materials	JF Schumar	Yes
WV Cummings RS Kemper	11/2-8	AIME(Second World Metallurgical Congress), Chicago, Ill.	Present paper	--	No
MK Millhollen	11/4	Aeroprojects, Inc., W. Chester, Pa.	Discuss assembly, fabrication, & model techniques in reference to PRPR fuel assembly	Mr. De Silva	No
	11/5	Brooks & Perkins, Detroit, Mich.	"	Mr. Kirkpatrick	No
	11/5	Micromatic Hone Corp., Detroit, Mich.	"	J Greening	"
	11/6	Flexonics Corp., Maywood, Ill.	"	Mr. Ramsaier	"
	11/7	Chgo. Hdwe. Foundry Co., N. Chicago, Ill.	"	--	"
	11/7	A.I.T. Diamond Tool Co., Skokie, Ill.	"	--	"
	11/8	Knight Models, Inc. Chicago, Ill.	"	--	"
	11/8	Chgo. Powdered Metal Prod. Co., Schiller Park, Ill.	"	--	"

A1-23

HW-53961

DECLASSIFIED

1246052

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
RJ Anicetti	11/4	Pacific Scientific Co., Los Angeles, Calif.	Furnace design consultation & applicability of honing	H Mescher	No
	11/5	Micromatic Hone Corp., Los Angeles, Calif.	"	CA Groom	No
DC Kaulitz	11/4-5	Kux Press Co., Chicago, Ill.	Discuss specialized fabri- cating equipment for fuel elements	J Kux	No
	11/6	Sutton Engr. Co., Pittsburgh, Pa.	"	W Larson	No
R Neldner	11/4	GE, KAPL, Schenectady	Discuss equipment & technique associated with in-reactor	ET Renz	Yes
	11/5	ANL, Lemont, Ill.	"	EL Martinet	Yes
FB Quinlan	11/18	NTH Products, Inc., San Diego, Calif.	Consultation on Zircaloy fabrication	W Miller	No
	11/19	Harvill Corp., Los Angeles	"	PM Winslow	No
	11/19-20	Le Fiell Mfg. Co., Los Angeles	"	PC Berkey	No
SH Bush	11/20-25	Paris & London offices of Div. of Intl. Affairs, AEC	Attend Paris Conference on Fuel Element Technology	A Cottrell	Yes
EA Evans	11/27-29	Saclay & Chatillon, France Harwell & Culcheth, England	Discuss French & British programs in metallurgy, ceramics, & irradiation	Messrs. LeClaire & Makin	Yes

Al-24

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
JD Rogers	11/4-5	Phillips Electronics, San Francisco, Calif.	Service electron micro- scope	B Mastel	No	326, 300
RE Fearnow	11/13-15	Phillips Pet. Co., Idaho Falls, Ida.	Discuss irradiations in regard to GEH-3 and GEH-4	JJ Cadwell JE Minor DC Kaulitz	Yes	303, 300; 61 105-KE; Redox, 200-W

HW-5396

1246053

VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
WK Davis UM Staebler RC Dalzell RC Lovington	11/18-19	US-AEC, Washington, DC	Discuss Plutonium Re-cycle Program	FW Albaugh JJ Cadwell WE Roake RM Fryar EA Evans	Yes	303, 3760, 325 & 326, 300
P Berner	11/20	Star Machinery Co., Seattle, Wn.	Discuss extrusion presses	GS Allison DC Kaulitz HJ Pessl	No	303, 300
S Saginor LJ LeClereq WO Brandt	11/20	Gladding McBean & Co., Los Angeles, Calif.	Consultation on ceramic fuel fabrication methods	WE Roake DR Stenquist	Yes	325, 300
TE Stephens	11/25-26	Kaiser Engineers, Oakland, Calif.	Discuss metallic U fuel problems associated with gas cooled reactor	JJ Cadwell	Yes	303, 300
JK Davidson	11/25-26	American Car & Foundry, Washington, DC	"	JJ Cadwell	Yes	303, 300
JL Scott	11/12	ORNL, Oak Ridge, Tenn.	Discuss properties of irradiated graphite	WA Snyder	Yes	326, 300
A Beckett	11/18	Phillips Chem. Co., Los Angeles, Calif.	Discuss nuclear mats.	R Harrington	No	326, 300
WP Eatherly	11/25	National Carbon Co., Parma, Ohio	Discuss new & improved graphites for reactor application	RE Nightingale, et al	Access Permit	326, 300
EF Wilson	11/26	ACF Industries, Inc., Washington, DC	Discuss radiation damage to graphite & graphite oxidation as applied to gas cooled reactors	RE Nightingale	Yes	326, 300

DECLASSIFIED

A1-25

HW-53961

SECRET

1240054

VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
MJ Sinnott	11/20-22	U. of Michigan, Ann Arbor, Mich.	Consultant Agreement	169 FW Albaugh JJ Cadwell OJ Wick	Yes	326, 328, 303; 300 234-5, 231-2; 200-W
EJ Leshan	11/26	American Standard Atomic Energy Div., Redwood City, Calif.	Plutonium recycle calculations	JR Triplett	Access Permit	713, 700

A1-26

HW-53961

DECLASSIFIED
SECRET

1248655

PLUTONIUM RECYCLE PROGRAMMONTHLY REPORT - NOVEMBER 1957REACTOR & FUELS RESEARCH & DEVELOPMENT OPERATIONPlutonium Fuels Development

Al-Pu Capsules for MIR Irradiation (GEH-3-24). Two capsules with Al-12 w/o silicon-1.65 w/o Pu alloy cores and two capsules with Al-1.65 w/o Pu alloy have been and are presently being irradiated in the MIR to determine the effect of irradiation on these fuel materials. One capsule of each fuel material has been irradiated and the radio-metallurgical examination has been completed. The other two capsules were to be charged into the MIR on November 18, 1957, but due to other high priority irradiations in the MIR, the date has been moved back to December 2, 1957. This is the start of Cycle 97 which will be of four weeks' duration. The flux requested for these samples was 2.9×10^{14} nv. The total exposures for the two remaining capsules are now 6.01×10^{20} nvt and 6.07×10^{20} nvt, respectively, which is about 40 per cent burnup of the Pu atoms. At the completion of Cycle 97, the capsules will have accumulated an exposure of about 60 to 70 per cent burnup of the Pu atoms.

Al-Pu Alloy Clusters for KER Irradiation. The Zircaloy-clad, four-rod cluster with Al cores was charged into the KER ELMO-7 out-of-pile loop. The cluster will be tested in pressurized water at 300 C for 50 to 60 days initially and then to a total of about 120 days. The assembly has been exposed to the test conditions for approximately 30 hours to date. This cluster is a forerunner of specimens which will contain Al-8 w/o Pu and Al-12 w/o silicon-8 w/o Pu alloy cores and which will be irradiated in the KER loop facility. The overall length of the clusters is 11 inches. Casting and machining of the Pu-bearing fuel cores and fabrication of the jacketing components are in progress. The test proposal document HW-53511, was issued November 7, 1957.

Casting of Al-Pu Alloys. One of the methods of fabricating plutonium-bearing fuel core materials for PRFR fuel elements is by casting. One hundred and eighty feet of Al-1.65 w/o Pu alloy rods were cast for the 19-rod cluster demonstration fuel element. Eighty feet were cast to 5/8" diameter and one hundred feet were cast directly to the final diameter. The alloy was cast into inclined thick walled graphite molds. Most of the rods were cast in six-inch lengths; however, some eight-inch rods were cast. The casting of longer rods requires more careful pouring techniques. Methods of casting twelve-inch lengths are being developed. The diameter tolerance for rods that were cast to size was 0.505 ± 0.001 ". Less than 3 per cent of the cast pieces were rejected for gas porosity shrinkage or cold shuts. The chemical analysis of the rods is incomplete; however, analysis of samples from the same melt vary less than 5 per cent. Al-8 w/o Pu and Al-11 w/o silicon-8 w/o Pu alloys were cast for a four-rod cluster fuel element which will be irradiated in the KER Loop Facility. Previous results with these alloys showed a large amount of segregation and it was noticed that at a pouring temperature of about 700 C a slush formed in the bottom of the pouring crucible. This slush is apparently caused by a high melting Pu compound which was detected in the crucible up to 850 C. It has been found necessary to cast these alloys above this temperature.

Fuel Element Cluster Studies. Two, 19-rod cluster type fuel elements have been completed. The first was a two-foot model with pure Al cores and the second was a full-size, pile quality fuel element which was loaded with Al-Pu alloy fuel material. Both clusters were canned in type 304-L stainless steel because of the unavailability of Zr-3 and both clusters were fitted with end caps and end brackets to a new improved design. The short unit was fabricated to determine the deficiencies of the proposed assembly operations. After correcting some of the problems found in assembling the short cluster, the full-sized element was assembled with a minimum of difficulty. The six-inch lengths of cast and machined fuel elements were inspected and assembled into the eight-foot tubes. Some difficulty was had in this assembly operation which will be corrected by closer control of dimensional specifications of the tubing and fuel material. Ultrasonic assembly techniques will also be investigated. After decontaminating the ends, the final closures were made with a Heliarc welder. The final closures were bubble tested under kerosene in a vacuum chamber at 500 microns pressure. Of the 20 tubes welded, thirteen were leak tight; six of the rejects were reclaimed by rewelding; however, one tube could not be salvaged. Several difficulties were discovered during the fabrication of this 19-rod fuel element. However, it has been demonstrated that these fabrication techniques of casting, machining, assembly and welding are technically feasible ones for producing the first pile quantities of Pu-Al spike enrichment for the FRPR. A 19-rod fuel element cluster of the NFD design is nearing completion for hydraulic studies.

Vacuum Injection Casting. Another type of injection casting apparatus is being fabricated for evaluation. This particular design will have a pressure vessel that tips 90° to immerse the dip tube after the fuel jacket tube has been evacuated. The system is then pressurized to force the molten metal into the fuel jacket.

Still another type of vacuum injection casting apparatus is presently being evaluated for adaption to casting Pu-Al alloys. This design uses an external air cylinder to raise the melt crucible within a pressure vessel to the point where the dip tube is immersed in the molten fuel material. Essentially this apparatus consists of a stainless steel pressure vessel, 12 inches in diameter with a flange mounted lid. The gaskets and the bottom mounted air cylinder are water cooled. A stainless steel dip tube, 3/4" in diameter is attached to the lid and extends into the pressure vessel. The portion of the dip tube, which extends outside the tank, has a nearly 90° bend so that the fuel tube is inclined slightly from the horizontal. When castings were first attempted with this equipment, the maximum fuel length obtained was about 18 inches, however, the tubes were not preheated in these cases. By preheating the tubes to 400 or 500 F with a 2000 amp transformer, it was possible to inject metal to the full length of the closed tubes. One tube was successfully filled with AlSi to a length of 8 feet 10 inches. The castings are being radiographed to determine the effect of air pressure on reducing solidification shrinkage.

Mechanical Pressure Injection. The investigation of the feasibility of mechanical pressure injection casting of Pu-Al fuel elements is progressing. The casting unit was assembled and put into operation. The first attempt to injection cast 28 Al into a 3-foot 8-inch length 0.505" diameter stainless steel tube failed due to excessive frictional forces between the hydraulic cylinder connecting rod and the packing gland. The friction resulting from excessive heating of these parts was caused by the conduction of heat from the casting cylinder. Water cooling alleviated this problem and a

three-foot length of tube was filled with 2S Al. The pressure vessel enclosing the stainless steel tube was not heated and it appears that the rising melt froze before reaching the top of the cold casting tube. The quality of the casting appears very good and it is being radiographed. Future modifications of the injection casting unit include improved methods of feeding the molten metal into the cylinder and resistance heating of the pressure vessel.

Extrusion Program. Cast 1100 Al, AlSi, and compacted mixtures of Al powder and UO₂ have been extruded. Four Al extrusions were made through shear type dies with no gland and a 1/64" throat radius. The ratio of the billet area to that of the extrusion was 9 to 1. A thin coating of oil dag was put on the container walls and the billets were generously coated with Aquadag before heating to the extrusion temperature of 500 C. The finishes of the final extrusions were very good in all cases. Two of the four extrusions were in excess of six feet long.

An AlSi extrusion, four and one-half feet long was made at an extrusion temperature of 550 C. The extrusion ratio and lubricant were the same as those used on the Al extrusions. A fine surface finish was observed of approximately one half of the extrusion. At this point about 120° of the die lip sheared off. This failure of the die was attributed to excessive relief in the throat. Die design and lubrication techniques appear to be adequate for future test purposes. Experiments to determine extrusion constants, temperatures and speeds for Al-U alloys are scheduled to begin shortly. Delivery of pressure sensing and recording instrumentation is expected soon. Experience with these few preliminary extrusions has indicated that one fuel length rod can be extruded every 15 minutes.

Billets composed of 20 w/o UO₂ and 80 w/o -325 mesh flaked Al powder were cold compacted under 13 tsi pressure. After pressing, these billets had a density of 45.5 per cent of theoretical. The UO₂ was not degassed, dried or ball milled before blending and as a result, large particles of UO₂ were dispersed in the Al matrix. One of the billets was extruded through a flat face die at a temperature of 550 C. With the exception of the temperature, the extrusion conditions were the same as those described for cast Al billets. Large particles of UO₂ balled up on the extrusion as it passed through the die. As a result, the final surface was rather rough. The density of the extrusion was 68 per cent of theoretical. A short length of the finished extrusion was heated at 600 C for two hours and its diameter increased by 35 per cent. This increase was attributed to the release of adsorbed gasses from the surfaces of the Al and UO₂ powders. Higher green compact densities should decrease the dimensional changes. Two green compacts were coextruded in an Al jacket 0.045" thick. After undergoing a 9-to-1 reduction through a streamlined die, the jacket was approximately 0.005" thick and the core density was 75 per cent of theoretical. The billet was evacuated through a thin-walled Al tube as it was heated to 550 C for extrusion. Initial examination indicated excellent concentricity of the jacket and core. A commercial lubricant, Nechrolene, was used to coat the container walls. For the most part, the surface finish of the final extrusion was excellent. A short section of the coextrusion was heated at 600 C for two hours and no changes in the rod diameter were observed. Metallographic examination of the bond area and end effects is being performed.

Swage compacting of Al powder--UO₂ mixtures in Al and Zircaloy tubes is also being investigated.

Plutonium Fabrication Pilot Plant. The Phase I design effort of the Plutonium Fabrication Pilot Plant which constitutes the building and utilities is about 70 per cent complete. However, design effort has been drastically curtailed due to lack of funds.

Facilities. Appropriation requests for the helium leak detector and the Fenn Model 4F swage have been submitted. The purchase specifications for the swage and dies are being prepared. An oxide compaction press has been designed and will be built on site. It will be installed in the hydrogen sintering furnace hood and will use the existing extrusion press hydraulic power system. The design of a dual purpose inert atmosphere vacuum welding apparatus for closing FRPR type fuel elements has been initiated. It is felt that a smaller chamber will perform equally as well as the more costly equipment presently in use.

UO₂ Fuel Development

Swaging of Uranium Dioxide. Simultaneous compaction and cladding by swaging offers promise as a method of fuel element fabrication at reduced costs. Previous studies have demonstrated the reproducibility of uranium dioxide densities to be within ± 1 per cent. Densities obtained from various types of uranium dioxide powder can vary by as much as 15 per cent because of differences in powder characteristics. Swaging studies were directed toward the development of fabrication techniques for a complete fuel element. A three rod cluster fuel element was fabricated from individual fuel rods formed by swaging uranium dioxide powder in stainless steel. Each fuel rod was 0.600 inch in diameter and approximately 18 inches in length. The density of the uranium dioxide fuel core was 89 per cent (minimum) of the theoretical. The effect of temperature was further evaluated by swaging uranium powders at 850 C. Untreated "PWR grade" uranium dioxide, which has previously been swaged at 600 C to 89 per cent of the theoretical, was compacted by swaging to 93-94 per cent of the theoretical density at 850 C. Titania, 0.75 w/o, was added to ball milled "PWR grade" uranium dioxide which was then swaged at 600 C. However, the swaged density of this powder was not increased by the TiO₂ addition. Further studies on hot swaging showed that it is necessary to hot swage on only the last few passes in order to achieve maximum uranium dioxide density. Efforts are now directed toward fabricating a Zircaloy clad uranium dioxide fuel element for irradiation in the MTR.

High Temperature Studies of Uranium Dioxide with an Electron Gun. The high temperature characteristics of uranium dioxide are being investigated by means of an electron beam gun as part of a study of simulated in-reactor material behavior. High density sintered uranium dioxide or cold pressed powder fail to melt in a vacuum near the melting temperature. Sublimation occurs very freely. A marked resemblance is seen between the surfaces of the electron heated uranium dioxide and uranium dioxide from high exposure in-reactor test specimens. Each exhibits a similar recrystallization structure. A fused uranium dioxide sample similarly heated exhibited similar sublimation characteristics; however, the surface showed visible signs of localized melting.

Fabrication of Uranium Dioxide by Combined Pressing and Sintering. The sintering of uranium dioxide under pressure is being investigated as a technique of fabricating a high density, dimensionally uniform oxide element. Uranium dioxide compacts having densities 87 per cent of theoretical were obtained by pressing at 700 C and 35,000 psi

for 30 minutes in a helium atmosphere. Sintering appeared to have begun. However, higher temperatures are required to obtain further sintering and higher densities. The properties of Inconel dies do not permit their use above 700 C. Graphite dies are being used at higher temperatures although lower pressures are required due to the limited strength of graphite. Uranium dioxide compacts having 70 per cent theoretical density have been obtained at 1,000 C, 2,000 psi for 30 minutes.

Fabrication of Extruded Uranium Dioxide Rods for Thermal Conductivity Experiments. Sintered uranium dioxide rods 1/4 inch in diameter and 3 inches long are required for measuring thermal conductivity of irradiated uranium dioxide. The rods are to be fabricated and irradiated at HAPO and shipped to BMI for the thermal conductivity measurements. A portion of the rods were fabricated by extrusion, sintering in hydrogen at 1700 C and centerless grinding. Central voids in the rods made many of them unsuitable for thermal conductivity experiments. The voids are believed to be caused by uneven sintering shrinkage as a result of variations in green density across the diameter of the rods. It was found that isostatic pressing at 40,000 psi of the dried extruded rods before sintering resulted in sintered rods which did not contain voids. Additional rods will be fabricated by this technique.

Fabrication of Isostatically Formed Fuel Element. Isostatic compaction of the uranium dioxide powder fuel and forming of the cladding take place simultaneously in the fabrication of the "garbage can" fuel element. Although the concept is being promoted as a possibly inexpensive fabricating method for plutonium-bearing fuel elements, preliminary test elements will contain enriched uranium dioxide. Irradiation of a fuel element containing uranium dioxide enriched to 2.4 per cent U²³⁵ has been delayed because of poor welded cladding closures due to difficulty in excluding uranium dioxide particles from the weld area. Successful welding of such a fuel element has now been achieved, and it will be irradiated in the MIR at an early date.

While investigating methods of making closures in the isostatic fuel element, Interact-S, a new product for joining aluminum parts, was evaluated and found to be unsatisfactory in 170 C water. Interact-S consists of a zinc-aluminum alloy tube filled with a flux containing chlorides of zinc, lithium, sodium, and potassium. The material is used as a solder and forms an alloy with aluminum which is stronger than aluminum. Although gas tight closures of aluminum fuel element cans were obtained, exposure to 170 C water for eight hours resulted in disintegration of the alloy. The material may be useful at lower water temperatures.

Mark IIa PRPR Fuel Element Hydraulic Tests. A dummy Mark IIa PRPR element which had been submitted to Coolant Systems Development Operation for hydraulic testing was recovered for modification. The element originally contained lead inserts simulating uranium dioxide. These lead pieces were somewhat porous as a result of having been fabricated by isostatic pressing of lead granules. Failure of some lead pieces to properly support the cladding of the outer tube of the fuel element permitted severe distortion of the cladding. The lead pieces are being replaced with steel inserts to permit continuation of hydraulic studies.

Thermal-Hydraulic Studies

Document HW-51767, concerning the flow decay after power failure to the PRPR primary coolant pumps, was re-examined with regard to the size of the pump flywheels. It was determined that the assumptions made were unduly conservative. More realistic assumptions reduced the required flywheel size from 1245 to 650 (lb)(sq ft).

Experimental equipment for studying the hydraulic characteristics of non-standard process tube assemblies was designed. Although the pressure and temperature ratings are much less than those of the PRFR, considerable knowledge of flow characteristics can be obtained from this mockup.

The PRFR 19-rod Pu-Al fuel element was examined with regard to the difference in longitudinal thermal expansion of the three rings of rods. An approximate solution indicates that the center fuel element will expand about 0.05 inches more than the surrounding rings. It is believed that shortening the pitch of the wires wrapped around the fuel rods from the present 20 inches to 6 inches would decrease coolant channeling and decrease the temperature differential between the center rod and the outer rings of rods.

Coolant Systems Development

Progress was made on a literature survey of stress corrosion, crevice corrosion, and galvanic corrosion. This complete review is desirable before some of the materials of construction are specified. Studies continued concerning the materials specified for the primary heat exchanger which uses softened well water for secondary cooling.

Some pressure drop tests were completed on the Mark-I and Mark-II fuel elements, but the data have not yet been rectified.

Mechanical Equipment Development

Construction of the Single Tube Prototype Facility, Phase I, progressed to approximately 30 per cent completion. Work on the facility will soon cease until long term delivery items are received. The Heliarc method of welding was found to give excessive penetration on 2-1/2 inch schedule 160 pipe joints. Consequently, the welding procedure was changed and the shielded metal arc method is now being used. The pressurizer for the facility was stamped as meeting the ASME Code.

Design of Phase II of the Single Tube Prototype Facility continued. The 14 inch gate valve order was placed and the requisition for two 8-inch check valves cancelled as the check valves did not meet the requirements for thermo-siphoning flow. Injection cooling of the primary pump's mechanical seals was examined and rejected in favor of a pumping ring and external heat exchanger.

The bellows test facility was modified to permit testing of shroud tube bellows. The bellows were tested at 750 F and 5 psi gas pressure for 12,500 cycles of half the expected expansion without any sign of failure. The test will be rerun under conditions of full expansion. During the testing, difficulty was experienced with gaskets. Sheet gaskets of the Garlock type shrank, asbestos packing would not remain leaktight, and a sheet paper type decomposed. A suitable seal was finally obtained using asbestos cord with glyptal coating. However, even this seal held for only two hours under test conditions.

Two of the four prototype nozzle cap seal designs were tested. The bridgman seal was modified to permit tightening without having the plug rotate on the ring. This modification eliminated the problem of galling between the mating surfaces. This

seal leaked slightly at 100 psi and less so at 4000 psi. The "O" ring seal utilizing the conical plug principle was modified to accommodate a self-energizing seal. The test pressure caused the conical plug to deform and the seal to leak. This seal held a maximum pressure of 1000 psi and failed when the "O" ring blew out of the groove.

New designs for all but the bridgman seal were developed and are being fabricated. New types of commercially available seals were ordered for use in these tests.

Modifications to the Nozzle to Process Tube Test Assembly were completed. A tentative design for another test assembly to utilize nickel seals was completed and delivered to the Advance Engineering Operation for their suggestions and approval. The inlet jumper to process tube assembly was reworked and retested. The flares failed to pass the hydrostatic pressure test. Flaring tools were ordered which will allow the fabrication of more accurate flares.

Two different packing materials were tested in the outlet gas seal packing gland. Neither packing was found to be satisfactory. Braided asbestos packing (lubricated and graphited) was tested at room temperature, 12 inches of water pressure, and 60 ft-lb torque. Although no gas leakage was experienced, the packing was rejected as the lubricant was squeezed out of the packing under compression. John Crane Super-Seal Plastic packing (Blue cape asbestos fiber, mica lubricated) was tested under similar pressure and temperature conditions and a torque of 100 ft-lb. This packing failed to hold the gas pressure. Letters were written to five packing manufacturers asking for recommendations for this application.

The final design of the mechanical flexing machine for the testing of the inlet and outlet jumpers was started. Requisitions for the necessary material were issued. Stainless steel tubing of various wall thicknesses was received and will be used to test flaring procedures and to fabricate test jumpers.

The calandria and moderator storage tank mockup were placed in the 185-D Building. Installation of the facility was started. A design for a temporary dump valve for the calandria dump tests is currently under study. Evaluation of the prototype wrench for disconnecting jumpers was started. Design and development of other special tools has been postponed. Design of a mockup facility to study the system for detecting process tube and shroud tube leaks was started. Further studies of charge-discharge procedures were postponed until delivery of the charge-discharge machine. Further studies of the shim control system were postponed until the delivery of the prototype shim control element and drive assembly.

Process Tube Development

Work performed at both Chase Brass and Copper Company and Allegheny Ludlum Steel Corporation provided additional data on techniques for the fabrication of FRPR process tubes. Orders were placed for five additional tubes from each company to establish their processes, and these orders include the fabrication of flange and tapered portions of the tubes. Delivery of these tubes is scheduled for March 15.

Jacket Sheathing

A contract was negotiated with Nuclear Metals Inc. for the fabrication of ribbed, 30 mil wall Zircaloy jacket tubing by direct extrusion. Forging of starting stock for this contract has been initiated and it is anticipated that the first experimental extrusions will be performed early in January.

The Wolverine Tube Company shipped jacket sheathing of 0.030 inch, Zircaloy-3 tubing in diameters from 0.505 inch to 1.00 inch I.D. Both Carpenter Steel Company and NTH made continued progress toward the development of fabricating techniques to produce welded tubing.

Solubility of Aluminum Corrosion Product

Solubility of aluminum oxide corrosion product has been determined in 300 and 350 C deionized water. Solubility is calculated from weight loss of a sample maintained in a stirred autoclave at a known temperature and rate of water refreshment. Solubility at 250 C was reported in the October Monthly Report (HW-53299 Al). The following table summarizes the solubility data:

<u>Temperature, °C</u>	<u>Solubility as Al₂O₃ ppm</u>
250	0.1
300	0.46
350	0.26

The decrease in solubility between 300 and 350 C has not been definitely explained but may be related to a phase change in the corrosion product.

Refreshed Autoclave Studies of Al Corrosion

Two new aluminum alloys developed by Argonne National Laboratory, alloys A203X and 198X, have been found to corrode by a logarithmic rate process rather than the more rapid parabolic dependence on time typical of the many alloys previously tested. Corrosion data for both 198X and A203X can be expressed by the same equation:

$$C \text{ (mils)} = 0.255 \log (0.1 T \text{ (Hours)} + 1)$$

This equation predicts about 0.75 mil of corrosion penetration after one year exposure in refreshed low flow 360 C deionized water. This is about 20 per cent of the corrosion which would be predicted from the parabolic corrosion process after one year at the same temperature. At shorter exposures the percentage differences in the two expressions are smaller.

Casting of Aluminum Uranium Alloys

The corrosion of aluminum-plutonium alloys in water must be determined in support of the Plutonium Recycle Program. As the present corrosion testing facilities are not equipped to handle plutonium, a number of aluminum-uranium alloys have been cast in the laboratory to be used as stand-ins for aluminum-plutonium alloys, as follows:

<u>Melt No.</u>	<u>Nominal Percentage of Ingredients</u>
1	98.34 w/o Al, 1.66 w/o U
2	94.00 w/o Al, 6.00 w/o U
3	86.52 w/o Al, 1.64 w/o U, 11.84 w/o Si
4	82.81 w/o Al, 5.99 w/o U, 11.20 w/o Si
5	95.46 w/o Al, 4.54 w/o U

The billets from these melts are being machined into appropriate corrosion testing shapes.

Plutonium Fuel Cycle Analyses

Generalized Plutonium Recycle Analysis. The debugging of the IBM 650 code is complete and the program is ready for use in reactor survey and other applications. Preparation of a report describing the code and its use has been started.

Reactor Burnup Analysis. The RBU code being developed by American Standard was reviewed, and several minor changes in the formulation were proposed. General progress in the work at this time appears excellent.

Experimental Reactor Design

General. The Phase I bid package which includes the containment shell, a major portion of the structural concrete below the 0'-0" level, the storage basin and tunnel area was approved by the AEC. Award of the Phase I construction contract will require about two months following authorization of funds, currently not available.

Estimated design completion for the entire PRFR project is about 20 per cent. Phase II (the service building and miscellaneous structures) and Phase III (the reactor and auxiliary equipment) are each estimated at about 10 per cent completed.

A major scope change in the electrical power supply for the PRFR is being incorporated in the design. At the request of the AEC that no electrical power be generated in the PRFR, a study has been undertaken to find means of replacing the 1500 KW turbine-generator. Since the turbine generator was primarily part of the emergency power system, the study will have to include system and emergency analyses.

Building and Services. Scope design has been started on the following modifications to the process area structure:

- a) Removal of the wall between the lower face access room and cell "A".
- b) Removal of a portion of the upper reactor face wall to cells "A" and "B".
- c) Remove turbine-generator structure from reactor hall.
- d) Provide space for the fuel element examination facility in the wall between cells "A" and "B".

The first two changes are desirable to provide better access to the reactor and to facilitate pressure equalization throughout the containment shell in case of an incident.

Core Components. A minor scope revision was issued moving the reflector vent line 180°, correcting various minor errors in the original drawings, and adding expansion fittings in the vertical lines between the calandria and D₂O storage tank.

It has become apparent that the calandria top tube sheet cooling system incorporated in the original scope drawings is inadequate from the standpoint of thermal stresses in the plate. To eliminate the abrupt temperature gradients a continuous plenum type cooling system will be used.

A design test request to determine shroud tube collapsing pressures, shroud tube attaching methods, and tube sheet warpage was issued.

Shielding. A design test request to determine the corrosion resistance of various shot materials and sizes was issued. This test will simulate the top and bottom shield operating conditions.

Control Studies. Most of the basic relationships necessary for representing the moderator and gas balance systems by appropriate electronic analogs have been derived. Still to be determined is the rate of change of gas pressure during the initial phases of the reactor scram. The Goodyear Electronic Differential Analyzer will be used to evaluate the interaction of gas and moderator system variables under all expected modes of operation, including scrams. First test runs are expected to be made during December.

Missile Shielding Study. To prevent impairment of the containment vessel during an incident, it is necessary to insure that the shell is protected against missiles propelled by pressures generated during the incident. A continuing study is made of the missile problem as the reactor facility design develops to insure that pressures are rapidly equalized, or where this is not possible, that missiles are not created. To date the study has revealed that portions of the walls between the upper and lower access spaces and Cells "A" and "B" should be removed. The method of equalizing pressure between the reactor hall and the process cell is being studied.

Operations. Planning and liaison have been accelerated on problems associated with the experimental program of the PRPR. An effective program requires integration of the reactor and associated fuel fabrication and separations operations in respect to time cycles, materials in process, schedules for accomplishment of developmental objectives, etc.

Preliminary operating scheduling studies for the PRPR have been completed and indicate that about three years will be required to bring the average equivalent exposure level of the spike recycled plutonium in the reactor to 6,000 MWD/AT. Some of the plutonium discharged three years after start-up will have attained an equivalent exposure of 6500 MWD/AT.

Assumptions made in these studies were:

1. The reactor is operated at 71 MW power level with a 60 per cent level efficiency;
2. the reactor is loaded with Mark II-B UO₂ fuel elements (3 component nested tubular element) and 19 rod plutonium-aluminum fuel elements containing sufficient plutonium to give initial heat generation rates equivalent to the Mark II-B UO₂ fuel elements;
3. the initial loading is with 500 MWD/T plutonium;
4. after the first year 2000 MWD/T plutonium is charged;
5. after about 800 days when the first uranium load has been reprocessed the 5000 MWD/T (of uranium) plutonium from this load is charged, replacing any plutonium elements of lower equivalent exposure;
6. plutonium-aluminum fuel elements reach 50 per cent burnup and accumulate 1500 MWD/AT equivalent exposure in 200 days in the reactor; and
7. cooling, chemical processing, and fuel element refabrication require 180 days.

Data are desired at plutonium exposures as high as ~10,000 MWD/AT and under present assumptions the time to reach this exposure would be undesirably long. Considerable incentive exists, therefore, to shorten this time by reducing the out-of-reactor cycle time, in chemical processing and fuel element refabrication, by increasing the reactor level operating efficiency, and/or by development a plutonium fuel element capable of a much higher goal exposure such as the self-shielded element. These studies also indicate that it probably will not be worthwhile to obtain high exposure plutonium for the initial loading. This latter conclusion is based in part on the desire to investigate the behavior of plutonium as its exposure increases.

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATIONMONTHLY REPORTNOVEMBER 1957FISSIONABLE MATERIALS - 2000 PROGRAMMETALLURGYNuclear Safety Considerations for Fuel Preparation DepartmentFuel Preparation Department Studies

- a. Safe limits for the storage and handling of 1.7-inch O.D. washers (1.6 percent U-235 content) were established; the results will be incorporated in the nuclear safety specifications for the Fuel Element Manufacturing Processes.
- b. A study of heterogeneous systems with 1.0 percent enrichment, in which the metal was moderated and reflected by uranium in solution, was completed. This study showed that the reactivity of such systems was less than that of uranium metal-water systems for solid rods of diameters in the range of 0.387 inch - 1.66 inches for uranium solution concentrations up to 1000 gm. uranium per liter. This resulted in an allowable increase in capacity of about 37 percent for the uranium treater (pickling) tank processing 0.94 percent enriched uranium.

REACTORSTUDIES RELATED TO PRESENT PRODUCTION PILESI and E Versus Solid Fuel Elements for K-Pile

Materials and equipment have been readied for the I and E-solid measurements. The necessary machine work on the fuel elements to contain flux measuring foils is in progress. The pie-shaped foils for measuring average fluxes in the fuel elements are being prepared.

Traverses across the 5.5-inch NaI crystal 5-inch photomultiplier tube combination, using an effective point source of Co^{60} , have given sufficient information to enable construction of a constant counting efficiency surface on which to count large area foils. The curvature of this surface is not severe and no difficulty is anticipated in fitting the large foils on the surface.

Dry $7\frac{1}{2}$ -Inch Lattice Temperature Coefficient

The experimental investigation of the natural uranium metal temperature coefficient was attempted. Preliminary analysis indicates that an oven heating element failure early in the experiment resulted in uninterpretable data.

1240067

DECLASSIFIED

The irradiations necessary to determine "thermal" utilization at room temperature and 200°C have been made and the analysis is about 50 percent complete.

The PCTR temperature coefficient for a constant oven temperature of 50°C has been determined, the final value being $-0.357 \pm 0.004 \text{ } \beta/\text{ }^\circ\text{C}$.

The PCTR pressure coefficient data, with the oven at room temperature and evacuated, has been checked and the final value is

$$\frac{\Delta \rho}{\Delta p} = -0.033 \pm 0.0004 \text{ } \beta/\text{Mb}$$

Preliminary analysis of the temperature coefficient of k_{∞} has been made over the temperature ranges of $\sim 20^\circ\text{C}$ to $\sim 100^\circ\text{C}$, $\sim 150^\circ\text{C}$, and 150°C to 215°C . The results are inconclusive in that the slopes of the curves giving PCTR reactivity versus oven temperature for the Full, Full + Cu, and Empty cases do not maintain a consistent relationship to one another from one temperature range to another. This result may be due to errors in the initial least squares analysis or to the use of the slightly incorrect PCTR temperature coefficient ($-0.5 \text{ } \beta/\text{ }^\circ\text{C}$). As reported above, the temperature coefficient has been re-measured for this PCTR loading and the analysis is being repeated.

Thermal Neutron Flux in a Medium With a Temperature Discontinuity

Work continued on the problem of thermal neutron flux in a medium with a temperature discontinuity. The machine program for the calculation of Laguerre polynomials has been tested and found to be mathematically and logically correct. However, on account of partial cancellation of quantities of the same order of magnitude, the results did not have enough significant figures. Schemes to increase precision are being investigated.

STUDIES RELATED TO FUTURE PRODUCTION PILES

Lattice Measurements for 1.66-Inch and Cluster Fuel Elements

Measurements in the small exponential piles have now been completed with the 1.66-inch-diameter natural uranium fuel elements. The value of the material buckling for this fuel element with air in the coolant annulus was found to be $-649 \times 10^{-6} \text{ cm}^{-2}$ for a 5-3/16 inch lattice spacing. This case was investigated in order to provide an extreme point for checking the correlation method by which the effective resonance integral is calculated.

Additional experiments were performed in this loading to aid in the understanding and interpretation of small pile exponential measurements. For example, the cadmium ratio of the neutron descendants of neutrons which can be captured by the cadmium shutter was examined as function of distance from the shutter plane. The spectrum so generated reached equilibrium at a distance of five lattice cells from the shutter plane. It had already been found necessary to discard activities measured closer than five lattice cells to attain an acceptable exponential decay of the axial flux. These results contrast with the three or four lattice cells usually required in the small piles using the cadmium shutter method to obtain equilibrium. The reasons are twofold:

1. At small lattice spacings, there is a more abrupt change between the thermal (shutter) neutrons and the spectrum appropriate to the lattice.
2. At small lattice spacings, there are a larger number of cells per migration length.

An investigation was made of the effective size of the small piles by measuring the extrapolation distance of the assembly. The horizontal flux distribution parallel to the fuel assemblies was measured at a level four lattice units above the shutter. The measured distribution was corrected to a cosine by calculating the contribution of the various harmonics at each position in the traverse. Preliminary evaluation of the data indicates that the extrapolation distance is closer to the value of 1.66-inches deduced from a comparison of small and large pile bucklings for the 1.66-inch-diameter fuel elements than to the value of 1.15-inches deduced from earlier, but similar, comparisons.

An exponential pile was built with base dimensions 5-1/2 feet by 8 feet. This will accommodate cluster fuel assemblies at lattice spacings of 7 inches and 14 inches. Measurements have been completed with closely packed clusters of seven 0.926-inch-diameter uranium rods with air in the annulus at a lattice spacing of 7 inches. The value of the material buckling for this case is not yet available.

A Correlation of Exponential Results

A set of parameters have been found that will allow one to calculate bucklings of natural uranium lattices without water present to an average uncertainty of 4.8 milli-k. The series of lattice spacings used in the measurements were also used to calculate bucklings having the following solid fuel elements: 1.66 inches, 1.36 inches, 1.17 inches, and 0.925 inch. Also, the 1.66-inch O.D. with 0.81-inch I.D. or 1.1-inch I.D. fuel elements were computed with the same set of parameters which fit the above lattices. Of the 31 lattices calculated, seven had uncertainties greater than 7.5 milli-k and the maximum uncertainty was 12.0 milli-k.

In calculating the thermal utilizations with the P_3 program on the 702 computer, a value of 4.8 barns was assumed for the scattering cross section of graphite. The value found for η was 1.3123 and the effective resonance integral was determined from the following expression

$$\left(\int \sigma \frac{dE}{E} \right)_{\text{eff}} = 7.105 \left(1 + 3.905 \frac{S}{M} \right) \times 10^{-24} \text{ cm}^2$$

Development of Methods for Calculating Reactor Parameters

Fast Effect

In obtaining the experimental value of β , the ratio of fast fissions to thermal fissions, it is necessary to make use of the ratio of the integral of the product of flux and radius in samples of natural uranium to that of samples of J material. The possibility that considerable error could have entered into this ratio has been investigated. Results show that any variation in method of evaluating the integrals affects both natural uranium and J material values in

1248869

DECLASSIFIED

such a way that the ratio is only slightly changed.

The final quantity to be evaluated with respect to method and possible error is the cadmium ratio itself. This is the ratio of the activity in a bare pin to that in a cadmium covered pin. This investigation is almost completed and will terminate the study of correlation of experiment and theory of fast effect.

Computational Programs

Work is continuing on the reprogramming of P-3 calculations. An auxiliary program has been written which will permit the use of a single input deck, independent of the number of regions in the problem. At present a different deck is required if the number of the regions is changed. Debugging of this program has not begun.

Another auxiliary program is being written which will permit conversion of actual data into floating point form, for input to the routine buckling calculation program.

Coordinated Theoretical-Experimental Reactor Physics Program

In support of the theoretical part of this program, a study of small source theory has begun with the aim of extending its application to heterogeneous reactors. A screening of material concerning the factors in the four-factor formula has been started and a bibliography of the most significant references is being prepared.

Plutonium Isotopic Concentrations at High Neutron Temperatures

A calculation is being made of plutonium isotopic concentrations versus exposure for neutron temperatures up to about 1200°C. Linearized equations and tripartite cross sections (CRRP-680) are being used. Values of the parameter g for temperatures above 400°C have been calculated. The epithermal ratio, r , was found by fitting the composition versus exposure predictions of HW-33912; an $r = 0.046$ duplicates results within 1 percent at 500 MWD/T and within 2-1/2 percent at 1000 MWD/T. Values of the parameters are now being calculated. When these parameters are obtained, the plutonium isotopic concentrations can be readily determined.

Instrumentation

Continued investigations of the experimental cross-correlation detector circuits indicate that effective cancellation of random events generated in the multiplier phototube and amplifier is feasible up to a frequency of approximately twenty kilocycles per second. This limitation is imposed by the semiconductor clamping circuits.

An investigation was initiated on wide-range logarithmic devices and techniques for possible use with reactor instrumentation. A literature search of existing devices and techniques was started.

STUDIES RELATED TO SEPARATIONS PLANTS

Buckling of Fuel Elements in a Random Array Versus a Uniform Array

The buckling was measured for one percent enriched 0.925-inch fuel elements positioned in a uniform array in a water moderated lattice. The spacing between rods was 1.26 inches; for this spacing in the hexagonal lattice, the H_2O/U volume ratio was 0.87; a value of 1380 μB was obtained for the buckling. The buckling has now been measured for these same fuel elements in 4 different random arrays as might exist in a dissolver. The spread in the bucklings due to the randomness of the loadings was very large. Preliminary analysis of these data indicate the buckling to be larger for the uniform array at this H_2O/U volume ratio. An error analysis is being made to determine the limits of uncertainty which exist in the measured values.

The buckling was measured for two different random distributions of 1.66-inch O.D., 0.94-inch I.D. fuel elements with one percent enrichment. The H_2O/U volume ratio for these fuel elements when stacked at random was 1.5. The results of these two measurements indicate the buckling to be about 20 percent less for the fuel elements in the random distribution at the H_2O/U volume ratio of 1.5. Before definitive results can be given, further measurements are required and an error analysis completed.

Determination of k_{∞} of $UO_3 - H_2O$ and Uranyl Nitrate Mixtures

In reference to the "criticality experiment," previous measurements had indicated the maximum enrichment, for which all mixtures of UO_3 and H_2O would have a $k_{\infty} < \text{unity}$, was about 1.03 percent; this value was extrapolated since the data indicated the maximum k_{∞} to occur at smaller H/U ratios than those used in the experiments.

In order to establish the safe enrichment value more precisely, additional k_{∞} measurements were taken in the PCTR at an H/U atomic ratio of 4; the enrichment values were 1.00 percent, 1.07 percent and 1.15 percent. The data analysis has not been completed.

The first k_{∞} measurements for enriched uranyl nitrate-water mixtures are planned for the latter part of December. Members of Development and Corrosion Chemistry are preparing the compounds for the nitrate part of the criticality experiment. The first measurements will be taken with $UO_2(NO_3)_2 \cdot 6 H_2O$ with enrichments in the range of 1.2 percent to 3.15 percent.

Plutonium Critical Mass Facility

The Preliminary Project Proposal Revision No. 1 of the Critical Mass Laboratory (Project No. CG-731) has received all of the necessary approvals by General Electric personnel and has been sent to the local Commission for their consideration. This proposal (HW-52948) requests authorization of \$175,000 for design of a Plutonium Critical Mass Laboratory to be located at Hanford.

An additional study of possible hazards associated with the Plutonium Critical Mass facility has been made. One of the main points of concern has been the potential damage of a shock wave, arising from a nuclear burst, to the

DECLASSIFIED

hemispherical reactor building. The analysis shows the possibility of any damage of this type to be very small.

The mechanisms of bursts, as reported by a large number of individuals, have been studied to gain a knowledge of the various approaches used. A study is now being performed to predict magnitudes and consequences of bursts in the following systems:

1. Open cylinder containing a homogeneous system of fissionable materials and water moderator;
2. Closed cylinder containing a homogeneous system of fissionable materials and water moderator;
3. Open cylinder containing an array of uranium fuel elements and water moderator.

The results of these calculations will not only serve for the hazards analysis of the Plutonium Critical Mass facility, but will also serve as a basis for estimating the hazards of an inadvertent burst in any of HAPO's chemical processing facilities.

Nuclear Safety, Critical Mass Consultations

234-5 Building Nuclear Safety

- a. A meeting was held with members of CPD to discuss the possibilities of a criticality incident resulting from plutonium build-up on the floor of Hood 9A (Continuous Task I - II hood). A study was also made to establish maximum safe plutonium mass limits on the floor of this hood as well as visual (dimension) limits that can be used as a guide to determine when operations must be shut down and a hood clean-up made before further resumption of hood operations.
- b. Prints on the building processing hood vacuum system (Project CG-734) were reviewed for nuclear safety.
- c. The construction of the new machining hood for model Pit 65 was inspected and safe positioning of metal and turnings in this hood established.

Power Fuel Studies

A meeting was held with a member of CPD (Facilities Engineering) regarding the design of a continuous fluidized bed calciner for converting UNH solutions to UO_2 with the U-235 enrichment ≤ 3.0 percent. A study will be made to furnish data for a safe nuclear design.

Neutron Age Measurement

A run on this measurement scheduled for November 5 was not made because the neutron source irradiation was interrupted due to a reactor outage. A source was successfully irradiated and a run was made later in the month. This run was a repeat of the first preliminary run of the large source in water using

improved techniques developed since the first run. After the data were accumulated it became obvious that the Reactor Operations personnel had improperly mounted the source in its mount. It is not presently known if the data obtained will be interpretable in view of the resulting incorrect source positioning.

Mass Spectrometer for Plutonium Analyses

The construction of this spectrometer is proceeding according to schedule in the Technical Shops.

Analog Computing

Discussions were held with CPD Facilities Engineering personnel who desire to obtain a plot of temperature through the walls of waste tanks for an increase of temperature with time within the tanks.

A new approach to the problem of transients in a fluidized bed reactor is being undertaken.

REACTOR DEVELOPMENT - 4000 PROGRAM

STUDIES RELATED TO THE PLUTONIUM RECYCLE PROGRAM

Doppler Coefficient for UO₂

Work is continuing on the determination of the errors incurred in these measurements.

PRPR Annular Fuel Measurements

Measurements of k_{∞} and f were begun in the PCTR on the 3-element Mark II-A PRPR fuel clusters. All measurements pertinent to the case with air in an 8-inch lattice spacing have been taken, but have not been analyzed. Measurements should be completed for the D₂O cooled cases by the first week of next month.

Theoretical PCTR Study

The Effect of a Cavity on Neutron Flux

The main effort has been in attempting to obtain the inverse Laplace transform of the thermal flux, which will give the slowing down flux. Much difficulty has been encountered due to the complex form of the thermal flux; this difficulty has not yet been resolved. The possibility of a direct solution of the age equation is also being investigated.

The thermal flux expression is currently being numerically evaluated to determine the distortion at points in the vicinity of the cavity.

Instrumentation

The investigation continued on the use of G-M tubes for gamma detection of the

1240073

SECRET

DECLASSIFIED

primary coolant for slug rupture detection. Cost estimates of commercial read-out systems are being compiled.

A report was essentially completed outlining the requirements and expected performance of the PRPR profilometer. The profilometer is proposed as an instrument to measure the diameter and warp of fuel elements.

CROSS SECTION PROGRAM

Pu-239 and Pu-241 Low Energy Fission Cross Sections

Preliminary measurements of the fission cross section of Pu-239 and Pu-241 have been made at 0.0047 ev. relative to that at 0.1 ev. The measurements were made using a liquid nitrogen cooled beryllium filter and a mica crystal to obtain the 0.0047 ev. neutrons. A multiple plate ionization chamber containing foils of Pu-239 and Pu-241 with different isotopic content was used to compare the fission cross section with the 1/v boron cross section. The results which have been obtained are

$$\frac{(\sigma_{239} / \sqrt{E})^{0.0047 \text{ ev.}}}{(\sigma_{239} / \sqrt{E})^{0.10 \text{ ev.}}} = 0.773 \pm 1.5\%$$
$$\frac{(\sigma_{241} / \sqrt{E})^{0.0047 \text{ ev.}}}{(\sigma_{241} / \sqrt{E})^{0.10 \text{ ev.}}} = 0.768 \pm 3.8\%$$

The results for Pu-239 are not in agreement with the previously reported value 0.812 ± 1.3 percent for the ratio between 0.005 and 0.1 ev. This previous value was obtained with a LiF monochromator and much less reliable beryllium filter. The reason for the discrepancy is unknown and requires further investigation. Continued measurements are planned to determine the reliability of the preliminary ratios reported above.

Multichannel Formula for Fission Cross Section Analysis

The simple one-level resonance formula used for analysis of neutron cross sections is known to be unsatisfactory for analysis of fission cross section resonances because of interference effects. By using simplifying assumptions, several investigators have developed formulas which include interference terms from the Wigner and Eisenbud general theory. These formulas have met limited success in properly fitting the observed fission and total cross section shapes. However, the formulas are theoretically not completely satisfactory because of the unjustified simplifying assumptions.

An analysis of the Wigner and Eisenbud theory has been made to simplify the results to a formulation suitable for calculation. Preliminary results have been obtained which should be correct for the analysis of the fission and capture cross sections where the compound nucleus formed has a few fission channels and many gamma decay channels open. The analysis uses the condition that

$$\sum_1^{\infty} y_1^{\alpha} y_1^{\wedge} = \int \alpha \lambda \sum_1^{\infty} (y_1^{\wedge})^2$$

where y_l^α denotes the gamma decay amplitude for the l^{th} gamma channel and the α^{th} resonance to reduce the many gamma channels to effectively one channel for calculating purposes. This condition is related to the degree of fit of the one-level formula to the neutron cross sections of nonfissioning heavy nuclei and is believed to be verified as a good approximation by experimental results.

Time-of-Flight Equipment

A study has been made of the channel width stability of the vernier chronotron since changes in channel width can cause errors in absolute timing or an effective resolution broadening. The measured power supply voltage coefficient of channel width stability was 0.002 m μ sec for a voltage change of one percent. A channel width instability associated with duty cycle (or counting rate) was found which is a more serious limitation. The measured change of channel width was 0.015 m μ sec per channel between counting rates of one and 3600 counts per minute. This instability is presumably caused by dimensional changes in the loop amplifier tubes dependent on power dissipation.

Time-of-Flight Measurements

Several preliminary runs were made on the Van de Graaff on d, d neutrons and Be, d neutrons. Prompt gamma bursts and known neutron groups were identified. The width of the charged particle burst on the target of about six m μ secs is limiting resolution at present and efforts are underway to reduce this burst width.

Subthreshold Fission Measurements

Analytical Laboratories Operation has electrodeposited a satisfactory Np-237 foil. Efforts are underway to obtain the remainder of the foils.

Three Crystal Spectrometer

Consultation has been given to project engineers on construction and installation specifications. All major components fabricated off-site have now been shipped.

TEST REACTOR OPERATION

Operation of the PTR continued routinely during the month. There were three unscheduled shutdowns; one was due to operator error and two were due to electronic failure.

The temperature coefficient measurements on the 7-1/2-inch graphite-natural uranium lattices were completed during the month. Critical mass experiments were made on 1.00 percent enrichment $\text{UO}_3 \cdot 2\text{H}_2\text{O}$ and 1.15 percent $\text{UO}_3 \cdot 2\text{H}_2\text{O}$ buffers with 1.00 percent, 1.07 percent, and 1.15 percent core tanks. Measurements were started on the annular UO_2 fuel in the 8-inch D_2O lattice.

The gas door seal was replaced with a rectangular gasket eliminating the leaks around the gas door.

One control rod failed when the end weld on the moving fuel-cadmium tube broke. The rod continued to operate but lost about 20 percent in effectiveness because of shifting of the fuel pieces. A replacement tube has been built and addi-

1240075

DECLASSIFIED

~~SECRET~~

tional spares are being fabricated.

An improved quicker method of changing the reactor core volume size has been designed and the necessary special graphite pieces are being prepared.

Two-shift operation continued throughout the month.

Flux traverses of the TTR and thermal column have been completed. These data are now being analyzed.

Thermocouples are being installed in the thermal column. The resistance heaters are in place and electrical work preliminary to actual connection of the heaters is being done.

There were two unscheduled shutdowns during the month due to instrument failure.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

The first of a series of experiments designed to measure the distribution of airborne contaminants released in the vicinity of the 100 Areas as these materials move across various portions of the Wahluke Slope was completed. A fluorescent pigment tracer material was released at the 100-H Area and ground level concentration samples were collected along a N-S line approximately four miles long and about three miles east of 100-H. The most distant sampling point was five miles from the generation point. A shift in wind direction during this experiment prevented a clear delineation of the distribution of concentration. However, it was extremely encouraging to find that significant concentration measurements could be obtained at the relatively large distances employed. Our tracer technique appears to be highly feasible for this work and continued experiments of this type should provide valuable information on the distribution of materials emanating from the 100 Areas as they cross the Wahluke Slope.

Analyses of the airborne concentrations of natural dust particles during a period of very light winds provided excellent data on the "background" of such materials under non-erosive wind conditions. The observed concentrations within representative particle size ranges are shown in the following table (concentrations in particles/ft³).

Size Range μ	Height above Ground (ft)		
	0.7	6.5	40.3
5-20	130	120	110
20-50	17	8	5
50-200	0	0	0

An erosion experiment was completed on November 19, but no analyses had been completed at month's end.

DOSIMETRY

The large plastic scintillator was used to measure gamma radiation levels on the Columbia River from above the reactor areas to below the mouth of the Yakima River. The effluent stream from a reactor could be traced downstream till it had diffused throughout the river. Patches of high activity algae were easily located. A short trip up the Yakima River showed that the radiation level dropped very sharply to the same value found on the Columbia above the reactors. The scintillator was used in an airplane around plant areas and along the river with satisfactory results. For example, the site of a year-old contamination release near 100-B was easily located. The scintillator was used from a truck to survey the site of a recent contamination release near 200-W. Large radioactive particles along the highways were readily detected. Regional Monitoring Operation will take over the instrument as a part of their regular program.

Three individuals potentially contaminated in a recent incident near 200-W Area were examined with the Body Monitor counter in a shadow-shield arrangement. Detection limit was about $0.01 \mu\text{c}$. No contamination was detected. A laboratory worker contaminated with Am^{241} was examined after decontamination; no contamination was found.

Development was completed of a pulse reader for pencils. With this device it was possible to begin to investigate the possibility of using pencils for background dose measurement. Doses of 5 to 30 mr can be measured to about 10% accuracy. Below 5 mr there is difficulty in getting reproducible results. This was traced to the presence of a variable reading of about 0.5 mr for pencils that had received no dose. This "insertion reading" is associated with the pencils rather than the reader as evidenced by the fact that after a few insertions within a few minutes of each other, the insertion reading disappears. More saturation measurements were taken. At an exposure rate of 17 mr/hr, which is considerably higher than will normally be encountered in background work, there is no detectable loss in charge collected at 20 volts charging voltage and only 10% loss at 10 volts. Radiological Development Operation made another leakage test at 20 volts charging voltage. 100 pencils were exposed for 10 days in a lead cave where almost all of the radiation should be due to cosmic rays. Eighty percent of the pencils gave results in a Gaussian distribution around $9 \mu\text{r/hr}$. This cannot be analyzed into a cosmic ray rate and a leakage rate because only the free air rate is known for cosmic rays, $4 \mu\text{r/hr}$. It is evident though that the leakage rate is quite small. Twenty percent of the pencils read more than the Gaussian distribution would indicate they should, but at worst they read only twice as much.

Further measurements were made of the heat equilibration time of the Van de Graaff calorimeter. With isothermal operation this time was comparable to the calorimeter time constant so accurate measurements were difficult. With adiabatic operation good and reproducible measurements were possible.

Calibration of the most sensitive range of the current integrator built in March was completed. Currents in the range 3×10^{-7} to 3×10^{-5} ampere can be

1248077

DECLASSIFIED

~~SECRET~~

measured to 0.05% accuracy.

The Van de Graaff accelerator operated satisfactorily during the month. The 256-Channel Analyzer is being installed in the building.

Samples of plutonium metal and plutonium fluoride were obtained and studied in the accelerator laboratory with the long counter and the double moderator. Emission and dose rate constants were obtained for use in plant areas. Average energy of the neutrons from the two sources were approximately equal and approximately equal to the value calculated from the known fission spectrum. This is of interest because the spectrum from the fluoride has been believed, on the basis of old work reported in the literature, to have an average energy 1/3 that of the fission spectrum. These old measurements could be in error or it may be that many of the low-energy neutrons are captured in plutonium which then fissions giving neutrons of higher energy. This change in average energy will require a change in the calibration of BF_3 counters used for dose measurements with plutonium; dose rates will be increased by a factor between two and three.

Values of 26.5 and 35.0 ev/ip were obtained for protons in argon and air, respectively. These compare closely, about 1%, with values for alpha particles.

INSTRUMENTATION

The transistorized Scintillation Alpha Hand Counter has been in Building 329 for general personnel use for about three weeks. No maintenance work or even recalibration has been necessary during this period, and the instrument has operated satisfactorily. In at least two known cases, alpha contamination has been found with this instrument for which the standard four-fold counter would not indicate.

Testing continued on the portable gamma-energy analyzer containing a pulse-height analyzer, high-voltage supply, amplifier and count-rate meter. Extensive actual source use testing is being done with excellent results so far with Cs^{137} , Co^{60} , Na^{22} and Ba^{133} giving energies from about 300 Kev to 1.33 Mev. Two more models will be fabricated.

The calibration of the Redox Stack Effluent Monitor was completed and the instrument is operating properly. This is expected to be the last calibration unless it becomes desirable to measure the emission amounts of additional radioisotopes. At the present time, it measures continuously and indicates separately the amounts of I^{131} , Ru^{103} , and Ru^{106} being emitted. A recent I^{131} emission was determined from a fixed filter sampler to be 14.1 curies; the continuous stack monitor indicated a total of 13.8 curies and also indicated the emission rates during the entire time.

Neutron energy response curves were obtained using various types of moderators to provide response information on the neutron dose rate instruments used at Hanford.

The central station equipment circuitry development for the Radiotelemetering Network has been completed, and the circuitry drawings are approximately 50% completed. The readout devices have been tested to receive data properly, and

1240070

~~SECRET~~
SECRET

DECLASSIFIED

the relay circuitry for coding and sequence timing is complete.

The mechanical design was completed on the Dog Counter for the Biology Operation and fabrication was started.

Evaluation tests were started on the prototype scintillation exposure-rate meters and on a Victoreen Remote Area Monitoring System.

WASHINGTON DESIGNATED PROGRAMS

The construction of the mass spectrometer for this program is proceeding according to schedule in the Technical Shops.

CUSTOMER WORK

Analog Computing

The computer was inoperative for a 52-hour period this month. After failure to locate the trouble service was obtained from the Goodyear field service office in Los Angeles. While the machine was returned to operation, minor problems still exist which will be corrected on future service visits.

The Goodyear's Engineering Section has notified Hanford that in December new fan motors will be installed on the computer. This is to increase the air flow through the machine in order to provide additional cooling.

Weather Forecasting and Meteorology Service

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	90	85.5
24-Hour General	60	88.5
Special	154	92.2

The temperature average of 40.4 was near, but slightly above, normal. Total precipitation (0.39 inch) and average wind speed (4.6 mph) were both substantially below normal.

Continuing assistance has been provided the Industrial Hygiene Operation in a systematic survey of air pollution in the 300 Area due to emission of oxides of nitrogen from the 313 Building and the 321 Building. Measurements of wind velocity and estimates of other pertinent meteorological parameters have been provided for these surveys and correlations of observed meteorological conditions and environmental contamination levels have been undertaken.

The Radiation Monitoring Operation was correctly advised as to the general area contaminated by an unusual iodine emission from the Redox Plant on November 23. This advisory service was provided from meteorological observations.

Summaries of atmospheric humidity and temperature measurements were compiled for the Power and Mechanical Design Operation, CEO, and the Facilities Engineering Operation, CPD.

~~SECRET~~

Optical Service

A paper was completed outlining the requirements and expected performance of the PRFR profilometer. The profilometer is proposed as an instrument to measure the diameter and warp of PRFR fuel elements. It is expected that this paper will be issued as an informal report.

Some modifications were made in the design of the optical alignment system for the reactor charging machine. The modifications were necessary to eliminate mechanical interference in the system. The complete system of optical components is being tested in the optical shop.

The Redox crane periscopes were inspected after the crane operators complained of poor viewing conditions. A thick coat of greasy dust on one prism surface and on a lens surface proved to be the cause of the trouble.

A high temperature furnace employing two mirrors to focus the heat flux of a carbon arc is being designed at the request of Ceramic Fuels Development. Such a furnace provides pure heat fluxes in a controlled atmosphere or a vacuum which can produce temperatures of about 3000°C. in a 1/8-inch cube of material.

The routine optical shop work included the fabrication of 10 glass bearings, four glass sample holders, a plastic "Y" fitting for water flow experiments, glass parts for a magnetic balance, a glass spacer for a mass spectrometer, parts for the reactor charging machine periscope, two glass viewing parts, and a remote lamp changer for the Underwater Borescope. Two three-power heads for Redox, a variable power microscope and two pairs of binoculars were serviced and a visual measuring device for the technical shops was assembled. Several lead glass windows were polished for the 1-F cubicle at Redox.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

PF Gast:mcs

1248000

~~SECRET~~

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
J. G. Simmons	11/13-14	Goodyear Aircraft Corp. Long Beach, Calif.	Service Analog Computer.	AE Tucker	No	300: 326

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
C. R. Lagergren	11/4-6	University of Wash. Seattle, Wash.	Ph.D. Recruiting	--	No
R. E. Heineman	11/12-13	Mass. Institute of Technology Cambridge, Mass.	Ph.D. Recruiting	Dr. George Hazzard	No
E. D. Clayton R. A. Bennett C. R. Richey	11/12-15	Brookhaven National Lab., Upton, N. Y.	Present Paper at Joint French-U.S. Meeting on Graphite Reactors.	H. Kouts	No
D. A. Kottwitz	11/14-15	Oak Ridge Nat'l Lab. Oak Ridge, Tenn.	Attend Solid-State Program Review Meeting.	--	No
G. R. Hilst	11/14-15	Dept. of Meteorology and Climatology Univ. of Washington Seattle, Wash.	Deliver lecture and confer with staff members.	F. E. Church	No
J. De Panghai	11/15-23	Oak Ridge Nat'l Lab. Oak Ridge, Tenn.	Health Physics Conference.	John Neiler	Yes
B. R. Leonard	11/25-26	Radiation Counter Lab., Skokie, Ill. Columbia University New York, N. Y.	Training Course Meeting of Nuclear Cross-Section Advisory Group.	-- V. H. Sailor	No Yes

Chemical Research and Development Operation

ORGANIZATION AND PERSONNEL

C. E. Huck, Engineer, transferred from Manufacturing Engineering, FPD, and was assigned to Chemical Development.

J. R. McHenry, Senior Scientist, terminated to accept employment elsewhere.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Analytical Service

Oxygen and hydrogen analysis was resumed for KAPL-120 loop water. The data ultimately support a Westinghouse water purification study.

Automatic Analyzing Monitor

Effort continued to improve the performance of the analyzing monitor during tests in the 100-F Area. The testing was handicapped by low, fluctuating line voltage and relatively short periods of reactor operation in the area. Low line voltage resulted in low sample evaporation rates, poor functioning of relays controlling positioners, and, during intervals of minutes duration, inoperability of electronic components. Attention is being given to methods for voltage stabilization at the optimum 115-v.

Sources of the beta counter background were studied. During pile operation the background was nearly twice that when the reactor was not at full power. Four additional inches of lead above and below the counter halved the background. The proportional beta counter functioned properly during the testing, recording about 32,000 c/m per sample (25 ml) in the total beta channel and about 7000 c/m in the P^{32} - Si^{31} sample after 100 minutes decay.

The chemical-treatment system of the monitor was revised to avoid a problem of line-plugging with free sulfur released in the arsenic reduction step. Capillary orifice adjustments were necessary.

Uranium Oxidation - Melting Experiments

As a result of discussions at ANL and ORNL it was decided to minimize the number of laboratory experiments to avoid duplication of effort. ANL is aiming toward a complete theoretical understanding of the oxidation reactions of interest and their results should be applicable to the Hanford problem. However, work will be continued at the planned level on fission product volatilization.

Process Assistance

The waste disposal aspects of cleaning the rear face piping at 105-H with Turco 4306-B were evaluated. Analytical results from the sampling of reactor effluent

1248002

SECRET
DECLASSIFIED

water and river water led to the conclusion that release of spent cleaning solution caused no major pollution problem. The slightly higher than normal concentrations of Fe^{59} , Zn^{65} , and Np^{239} in the F Area water supply indicated that radioactive contamination in drinking water was potentially the most serious of the disposal aspects investigated. It was recommended that future tests of this cleaning method should provide for slow release of the spent solution to the river. Also, since the first test did not provide enough data to permit formulating routine disposal specifications of the spent solution, it was recommended that future tests be supported by disposal evaluation programs.

Document HW-53372, "Disposal of Decontaminating Agents For Reactor Rear Face Piping," by W. N. Koop, was issued.

SEPARATIONS PROCESSES

Purex Flowsheet Studies

The goal in present Purex flowsheet studies is the development of a one-cycle solvent extraction flowsheet (EA, LB, ES, LC) which accomplishes the major part of the necessary fission product decontamination and employs an anion exchange cycle and a tail-end step for additional decontamination of the plutonium and uranium streams, respectively.

Studies undertaken during the month had as their objective the determination of the ultimate fission product decontamination possible by exhaustive scrubbing of organic uranium streams with nitric acid solutions by temperature variation, and in the stripping operation.

From the laboratory results it appears that a gamma ratio of five to ten in the uranium product from a one-cycle (EA, LB, ES, LC) flowsheet would be a fairly optimistic goal in plant operation unless strongly complexing scrubs can safely be employed in the ES column. Accordingly, studies were initiated to explore the feasibility of employing a scavenging step with niobium pentoxide to remove the residual fission product activity from the uranium stream.

The residual fission product activity in the uranium product appears to be efficiently scavenged by precipitation of niobium pentoxide. Precipitation of niobium pentoxide by addition of potassium hexaniobate solution to a concentration of ca. 10^{-3} M niobium to a solvent extraction uranium product which had a gamma ratio of 3 resulted in a product of gamma ratio 0.3. The niobium pentoxide precipitate, however, was very difficult to separate by either filtration or centrifugation.

Sorption on solid beds of partially dehydrated niobium pentoxide also appears to be effective in removing zirconium-niobium from uranium product solutions. A synthetic LCU prepared from LBU produced in Mini operation was passed through a six inch deep bed of partially dehydrated niobium pentoxide at room temperature and at rates of 1 to 3 ml/min, cm^2 . Decontamination performance was as follows. For comparison, decontamination performance is included for a silica gel (28 to 200 mesh) bed of similar dimensions employed in the same fashion.

REPRODUCED

DECONTAMINATION OF U PRODUCT ON Nb₂O₅ AND SiO₂ BEDS

Feed: 4.0 x 10³ GSC c/m, ml, 2.3 x 10⁴ γ/m, ml Zr-Nb,
1.4 x 10⁴ γ/m/ml Ru-Rh

Throughput (No. of bed Volumes)	Nb ₂ O ₅ Bed			SiO ₂ Bed		
	Gross	Zr-Nb	Ru-Rh	Gross	Zr-Nb	Ru-Rh
2	8.0	140	3.7	2.1	14	1.0
10	4.5	40	2.1			
20	3.3	30	1.5			
30	3.1	25	1.4			
40	2.9	21	1.3			

Metal Dissolution

Annular Dissolver. Initial dissolution studies in a pilot-plant-scale annular dissolver were undertaken. The dissolver vessel is 2-1/2 feet in diameter and is 5 feet tall. The bottom of the central portion of the vessel is elevated 1-1/2 feet above the bottom of the 3-1/2 inch wide annular slug crib. A slug support grid three inches above the bottom of the annulus protects the sparger ring. Six equally-spaced 1-inch pipe downcomers run from the bottom of the central portion to the annular slug crib at the level of the sparger ring. The downdraft condenser tower used is contained in a 6-inch pipe and is 18 feet long.

Six hundred pounds of jacketed 8-inch solid slugs were charged upon a six-hundred pound heel produced in other batch and continuous dissolution studies. The de-jacketing and dissolution procedure used were based on those used at the Purex Plant. No difficulties were encountered during the jacket removal. Visual inspection revealed complete jacket removal.

The following table compares the cuts made in the annular dissolver with those made in the standard 321 Building pilot-plant dissolver under similar conditions. The times listed are those necessary to reach a 2.1 M uranium concentration:

<u>Dissolver</u>	<u>Cut Number</u>	<u>Cut Pounds</u>	<u>Time Hours</u>	<u>HNO₃/U M Ratio</u>
Standard*	First	131	6.1	3.14
Standard*	Second	146	7.0	2.87
Annular	First	297	5.4	3.53
Annular	Second	267	6.1	3.81

* Previously reported (HW-52859 C and HW-52808)

It is apparent that dissolution rates in the annular dissolver should be adequate.

SECRET

~~SECRET~~

The higher nitric acid to uranium ratio for the annular dissolver cuts is believed to have been caused by some of the reflux acid being entrained with the off-gas. The same downdraft condenser was used with both dissolvers, but the annular dissolver cuts were two-fold larger and required twice the air bleed rate (8 vs. 16 cu.ft./min.).

Some difficulty was experienced with foaming during the second cut. It was necessary to maintain the pot temperature some three degrees below boiling to prevent foam-over despite a free board of two feet. No such difficulty was encountered during the first cut nor during the jacket removal.

Solvent Extraction

Purex IC Column. Studies directed toward the development of a cartridge for the Purex IC Column to provide increased capacity under Phase II Flowsheet (HW-47889) conditions were continued.

As reported last month, the difficulties experienced with the nineteen cartridges tested to date have been that at low capacities (CF = 2) flooding frequencies are at or above the maximum obtainable with the plant pulse generators, and efficiency is poor at pulse frequencies within the range of the plant pulse generators. To circumvent these difficulties, modifications of the flowsheet parameters, temperature and flow ratio of aqueous to organic streams, (A/O), are being tested. Present studies are directed toward the possibility of operating the IC Column with increased A/O and at ambient temperature at low capacities and with A/O and temperature at flowsheet values (1 to 1 and 40°C) at higher capacities.

Five runs were made with a cartridge consisting of groups of four stainless steel sieve plates (0.125-inch-diameter holes, 23 per cent free area) alternated with single polyethylene sieve plates (0.1875-inch-diameter holes, 33 per cent free area). All plates were on a two-inch spacing. Flooding characteristics at ambient temperature, A/O = 1 to 1, and a 0.5-inch-pulse amplitude were:

Flooding volume velocity at 60 cyc./min. = 1400 gal/hr/sq.ft.

Flooding frequency at 670 gal/hr./sq.ft. = 100 ± 5 cyc/min.

Flooding frequency at 1170 gal/hr./sq.ft. = 90 ± 5 cyc/min.

The minimum A/O at ambient temperature to give satisfactory efficiency (as determined by observation of the color line) when operating at 80 cyc/min and 670 gal/hr/sq.ft. was found to be 1.3 to 1. When operating with heated streams (ICX = 50 C and ICF = 35 C) at a volume velocity of 1170 gal/hr/sq.ft., a frequency of 70 cyc/min., and an A/O of 1.2 to 1 gave an H.T.U. of 1.2 feet in the 8-foot-high cartridge. Similar conditions, except that A/O = 1 to 1, did not appear to give adequate stripping.

Additional efficiency studies are planned.

Spiral Cartridges. Capacity tests were made in a three-inch diameter by three-foot high column containing a spiral baffle with a three-inch pitch and horizontal

1248085

~~SECRET~~
~~DECLASSIFIED~~

sieve plates. The system 30 per cent TBP in spray base and water was used. The results were compared to those obtained in an equivalent sieve-plate cartridge. General observations for aqueous continuous operation include:

1. Variations in the aqueous to organic flow ratio from 0.2 to 2.0 did not appreciably change the flooding frequency of either the spiral or sieve plate cartridge at volume velocities between 200 and 800 gal/hr/sq.ft.
2. At a 0.44-inch amplitude the spiral cartridge flooding frequency was about five cyc/min lower than that of the sieve plate cartridge. At a 1.0-inch amplitude the flooding frequency was 10 cyc/min lower.
3. An increase in plate spacing from 2 to 4 inches slightly increased the flooding frequencies of the spiral cartridge. However, spiral cartridge channeling (gross bypassing of the organic and aqueous phases due to organic "riding" the spirals) was evident at high capacities and low frequencies with the four-inch spacing.
4. Variation in plate-hole size from 0.06 to 0.19-inch diameter (23 per cent free area kept constant) did not affect the flooding frequencies of either cartridge. Some channeling was evident when 0.06-inch-diameter holes were used in the spiral cartridge.

Step Tray Contactor. The testing of a 16-inch-diameter step-tray solvent extraction contactor under Purex O-Column conditions was continued. The unit contains three trays spaced 30 inches apart. Each tray has a 26-inch-long, 4-inch-diameter aqueous downcomer which is capped with a distributor plate containing five 1/2-inch-diameter holes. The organic distributor, located four inches immediately below the downcomer, contains nine 1/2-inch-diameter holes. The controlled interface was maintained at the top.

The following table summarizes the flooding tests:

<u>Run No.</u>	<u>No. of 1/2-In.-Diam. Holes in the Organic Distributor</u>	<u>Temp. °C.</u>	<u>Flooding Volume Velocity, Gal./Hr./Sq.Ft.</u>
1*	7	22	420 ± 90
1*	7	45	610 ± 90
4	9	18	< 350
5	9	52	730 ± 30

* Previously reported (HW-52303 C)

The foregoing data indicate that increasing the organic distributor open area has little or no effect on the contactor capacity and that the operational stability is sensitive to the contactor temperature.

Observations made during runs include:

SECRET

1. At a volume velocity of 560 gal./hr./sq.ft., the organic hold-up under each tray decreased from 16 to 11 inches upon raising the column temperature from 52 to 60 C.
2. The organic hold-up under the trays was sensitive to the throughput rate. At 52 C, the depth of organic under the trays increased by six inches for a volume velocity increase of 70 gal./hr./sq.ft.

One efficiency run was made at 560 gal./hr./sq.ft. at 60 C. A uranium DF of 194 (1.9 ft. HTU) was measured. A 3-inch-diameter pulse column with 8.5 per cent free area nozzle plates operated at a comparable temperature and volume velocity yielded a 1.5 ft. HTU.

No further work is planned at the present time.

Continuous UNH Calcination

Ammonia Addition to UNH. Ammonia addition to UNH feed has reportedly improved the reactivity of UO_3 produced by the pot calcination process.

Three additional runs were made in the miniature calciner to further evaluate the effect of added ammonia on the calcination process. Operating conditions were as in past runs; the feed point temperature was 260 C and the discharge temperature 340 to 350 C.

Feed compositions were: 100 per cent UNH; 100 per cent UNH containing, on an uranium basis, 1.7 weight per cent ammonia (added as ammonium nitrate); and 100 per cent UNH containing 1.6 per cent ammonia (added as 28 per cent aqueous solution) and 200 ppm sulfur added as sulfuric acid.

The most significant operational feature of these calcination runs was a much greater production of fines (enough to plug filters and hinder operation) when ammonia or ammonium nitrate was present but sulfur was absent or at a low level (200 ppm). With both ammonia and sulfur absent or with both ammonia and a higher sulfur content (2000 ppm) present, few fines were produced and no operational difficulty was experienced. Products of these runs have not yet been characterized.

In order to show up possible differences in the thermal decomposition behavior of UNH ascribable to ammonia addition, samples from the continuous runs were converted to uranyl nitrate dihydrate under vacuum and subjected to thermogravimetric analysis. No marked differences were observed although there was a very slight indication that uranyl nitrate containing no additives might decompose in two steps. The gross rates of denitration were quite similar under the conditions used irrespective of feed composition.

The 321 Building 16-inch-diameter by 8-foot-long continuous calciner was operated with ammonia addition to the feed to produce two test lots of UO_3 for evaluation at the K-25 Plant. The program consisted of two runs which differed only by the sulfur content of the feed; (a) no sulfur and (b) 250 parts sulfur per million parts uranium. The ammonia content of the 100 per cent UNH feed (2.4 wt. per cent relative to uranium), feed point temperatures of 290 C, and agitator speed of 75 rpm were maintained throughout both runs.

DECLASSIFIED

Anhydrous ammonia was added to the 60 per cent UNH with greater than 98 per cent absorption being achieved. However, analyses before and after concentration to 100 per cent UNH showed a 10 per cent loss of ammonia to have occurred during the concentration.

Preliminary observations include:

1. The capacity of the concentrator was reduced by 25-30 per cent during this run. However, it has not been definitely established whether this was due to the ammonia or malfunctioning of the equipment.
2. Severe "cake" buildup of a chalk-like consistency on the agitator, feed points, and shell, with resultant poor heat transfer, was evidenced during operation with no sulfur in the feed.
3. The UO_3 production rate was reduced markedly to a maximum of 75 lb/hr as compared to a normal rate of 250 lb/hr for this calciner.
4. A constant operating bed level could not be maintained except by periodically opening and closing the powder discharge valve.
5. The UO_3 product was light yellow in color and was appreciably finer than the spheroid material previously produced.
6. The addition of 250 ppm sulfur to the feed had essentially no effect on cake build-up, capacity, or bed level control.
7. Revised shaft seals incorporating a grease seal performed satisfactorily.

Agitator Assemblies - 224 UA Building. Hinged-arm agitator assemblies, designed to reduce the failure incidence of agitators in the continuous calciners, 224-UA Building, have been installed on H and K cell calciners and have accumulated a total of about four weeks running time. A successful demonstration of the shear-pin safety feature of the hinged-arm agitator assembly (ref. dwgs. SK-2-43236 and SK-2-43238) occurred when the No. 1 feedpoint in H cell calciner dropped into the powder bed shortly after startup. Shearpins on five hubs were sheared, but no arm or blade damage occurred. Extensive damage to the agitator arms usually resulted when such incidents occurred in the past.

Mechanical Shaft-Seal Wear Rings. Both a "Flame-plated" coating (tungsten carbide applied by Linde Air Products Co.) and a Rokide coating (aluminum oxide by Norton Abrasives Co.) on two 18-8 stainless steel wear rings were worn away after less than 400 hours of dry-running against a fully hardened type 440-C stainless steel ring. Performance of the base material (304 sst), however, was surprisingly good, although wear rates (after coating disappearance) were as high as 500 micro-inches/hr.

Stellite and other materials will be investigated in an effort to find a long-life wearing combination which could be used in a mechanical shaft seal for the continuous calciners, 224-UA Building.

SECRET

~~SECRET~~

234-5 Processes

Porous Carbon Off-Gas Filter. Testing was completed on the prototype 234-5 Task II off-gas filter. The filter element was of porous carbon 4.5 inches O.D. by 2-1/8 inches I.D. by 6-inches-long with a porosity of 60 microns. A powder cake was deposited by drawing dispersed UF₄ in dry, heated air through the unit at a flow rate of 8 cu.ft./min. It was demonstrated that the removal of the powder cake could be accomplished by the following methods:

1. Sudden vacuum reversal at a vacuum of 3 inches of water and an air flow rate of 4 cu.ft./min.
2. Gradual vacuum reversal at a vacuum of 20 inches of water and an air flow rate of 4 cu.ft./min., either with or without.
3. Sudden vacuum reversal at a vacuum >10 inches of mercury and no air flow initially.

The pressure drop across the filter was 40 inches of water initially and 60-70 inches of water after the cake was deposited. The run conditions and results are summarized below:

<u>Method of Cake Removal</u>	<u>Differential Pressure Across Filter, In. H₂O</u>		<u>Estimated Cake Removal, Per cent</u>
	<u>ΔP_1(a)</u>	<u>ΔP_2(b)</u>	
1	70	50	90
2	60	51	75
2(c)	51	45	>95
3	60	40	>95

- Notes: (a) ΔP before removal of cake.
 (b) ΔP after removal of cake.
 (c) Continuation of preceding test with vibration.

In every case the cake removal was characterized by the bulk of the powder dropping to the bottom of the pot.

Powder Handling Problems - 234-5 Building. A program to assist CPD with certain powder handling problems connected with the operation of continuous Task I and II, 234-5 Building, took three directions:

1. Laboratory tests of a one-inch-diameter rotary feeder valve (SK-2-6554) feeding cornstarch and heated (150 C) talc, both with and without pressure drops across the valve. Results show that (a) valve discharge rate is entirely dependent on the magnitude of hopper vibration, (b) vibrator location on the hopper is not critical, (c) hopper vibration prior to valve operation is undesirable, and (d) pressure drops across the valve in excess of two inches of water prevent complete powder discharge through the valve.

~~SECRET~~
DECLASSIFIED

2. Recommendation and procurement of Teflon spiral-convoluted bellows (Resistoflex Corporation, Roseland, New Jersey) for vibration isolators in the system.
3. Definition of powder and system parameters which affect the design of powder handling systems.

Process Control Development

Assistance to Purex Plutonium Resin Column Controls. The thickness of the viewing windows of the XCP gamma absorptometer has been reduced from 1/4-inch to 1/8-inch and the aluminum back up plates removed in order to increase the output signal from the ionization chamber. The source holder and ionization chamber are now installed in the Purex plant instrument. An approximate calibration curve for the plant instrument was established in the laboratory using uranium solutions and a simulated sample cell. Final calibration data will be obtained by correlating the results of laboratory analyses of process stream samples with monitor results. Laboratory studies with radio cesium solutions indicate that the expected gamma activity of the process solutions will contribute about 1 per cent to the ion current at 50 grams plutonium per liter.

The resin level indicator has operated satisfactorily in nitric acid solutions with concentrations varying from 1 to 5 molar. Preliminary laboratory tests indicate that conductivity measurements in the C Column may be made in direct contact with the resin. If this proves to be true in the plant column, an improved response time will be achieved.

Nitric acid has deteriorated the rubber insulation on the wiring to some of the instruments. The wiring on two instruments was replaced and covered with polyvinyl-chloride film for protection in future use.

Assistance to Project CG 686. The electronic equipment for the six gamma monitors being installed at Redox, was tested in the 300 Area prior to delivery to the plant. Only minor changes were necessary, primarily to adjust for correct instrument loading. The electronic equipment is now being installed in the Redox Plant. Chemical Development has supplied Facilities Engineering with a "check off list" to determine the operability of the instruments before release from construction forces. Chemical Development personnel will assist in this check out procedure and with the calibration of the instruments.

The remote indicating flowmeters for these gamma monitors were modified and they are now operable with cable lengths up to 340 feet. The changes included minor circuit modifications and changing the float to a 400 series stainless steel.

The prototypical in canyon degasser system being tested for possible use on the F-1 sampler at Redox is performing satisfactorily with UNH solutions at specific gravities up to 1.6. Solutions simulating the IAFS composition are now being added to the system to evaluate whether or not "freezing" (F.P. ~35 C) will occur at some point in the system.

~~SECRET~~
DECLASSIFIED

Density Determination in the Purex HA Column. A float type density detector (hydrometer) is being fabricated and will be tested for possible use at the feed point on the new Purex HA Column to determine the organic density (uranium concentration). The remote indicating hydrometer system will be tested in a glass column in the 321 Building.

A Fisher and Porter rotameter coil (differential transformer) having a normal travel of 2-1/2-inches will be used with a Foxboro Dynalog recorder. Laboratory tests indicate that cylindrical float (20 gauge steel) 2-3/4-inch-diameter by 16-inch in length will have a maximum travel of 1-3/4-inch in solutions of specific gravity ranging from 0.89 to 1.000 feet. This corresponds to the most sensitive range of the rotameter coil being tested.

Magnetic Flowmeter Test. The 0-10 GPM Foxboro magnetic flowmeter was modified to operate in the 0-2 GPM range. In this range the meter has a precision of ± 1 per cent. At flow rates less than this the electronic circuitry is unstable and the meter of little value. The flowmeter is now being installed in a test loop using 100 per cent UNH solution.

pH Probe Development. A probe-type pH unit using Poly F-B-A electrode seals has operated at temperatures ranging from 80 to 100 C for three weeks. No apparent damage to seals or electrodes has been detected up to the present time in the carbonate test solution (pH \sim 10).

WASTE TREATMENT

Special Geological Studies

The footage originally proposed in the fixed price portion of the CA-700 Project was completed by the Hatch Drilling Company during November. An extension of the project completion date to late January is now indicated to permit drilling of the additional wells and footage authorized. The Geological Survey completed their portion of the CA-700 Project during November. Deepening of the #5 well at the 216-BC site has begun as part of Project CG-764.

Observation Wells

No significant changes in the pattern of radioactive contamination in the ground water beneath waste disposal sites was observed. Ground water samples from a well adjacent to the 216-S 1 and 2 cribs (former D-1 and D-2 disposal site) continued to indicate the presence of traces of Sr⁹⁰. There is some evidence that the strontium concentration is gradually decreasing. Average reported concentrations approximate the MPC for drinking water. No other ground water samples were found to contain detectable Sr⁹⁰ or Cs¹³⁷.

The flow of waste water to swamps and caverns in the 200 West Area has reduced from about 6.5 millions of gallons per day to about 5.5 millions of gallons per day within the past six months. Consequently the peak of the 200 West ground water mound has subsided about 2 feet since June, 1957, and now is at a maximum elevation of about 474 feet above mean sea level. The 200 East Area waste water flow and ground water mound elevation displayed no significant change.

~~SECRET~~

1248091

Preliminary attempts to study the movement of underground water by tritium dating have produced anomalous results that discourage the ultimate success of the technique. Ten surface water samples were found to possess a hydrogen-to-tritium ratio ranging from 3.3×10^{17} to 8.3×10^{17} . Two ground water samples collected from wells whose locations promised significantly aged water (such as from Wahluke slope) were found to have hydrogen-to-tritium ratios of 2.3×10^{16} and 1.1×10^{16} , respectively. Additional samples will need to be studied to attempt an explanation of these results.

Disposal to Ground

Samples of two batches of in-farm scavenged waste were tested by standard laboratory techniques. One of these samples displayed a rapid Cs breakthrough, resulting in a recommendation that the waste be discharged to a specific retention ditch. The results of the tests with the second sample are not yet available.

Further research to evaluate crib life of existing Purex and Redox cribs is being started. This study will emphasize multiple column tests to evaluate each site. Initial tests will be made with Redox D-2 wastes, Purex tank condensates, and Purex process condensate wastes. These tests will be performed with standard 40 cm x 1.0 cm soil columns with an effort being made to duplicate field conditions of temperature and flow rate. An effort was made to determine the effect of the limestone bed on the mixture of process condensates disposed to the A-5 crib. The inability to sample all streams concurrently leaves the effect of this bed somewhat in doubt, but there is no evidence of large concentration changes across the limestone bed. The low initial concentrations of radiostrontium in these wastes does not permit a realistic appraisal of the ability of such a bed to remove strontium from the wastes.

The equilibrium distribution constant of I^{131} between 0.1 M NaHSO_3 solutions and Hanford soils was determined to be about 3.5. These data were obtained to evaluate the use of I^{131} as a tracer for water movement in laboratory models. Difficulty is encountered with sublimation of elemental iodine in these samples and this makes the use of I^{131} as a tracer uncertain.

Work is in progress designed to study the influence of soil column variables on the breakthrough of radioisotopes in solutions. The soil used for these tests is a surface material of uniform texture obtained from the 200 East Area. The soil was found to remove by some non-equilibrium reaction a certain fraction of the radiostrontium used. It was found that this material was acid extractable but was not leached by ordinary water or sodium nitrate solutions. Pretreatment of the soil with acid largely prevented the reaction. It is believed that the reaction involves the calcite-phosphate removal of strontium previously discovered. A nominal phosphate content would be expected in this surface soil, although the solutions used in the test are phosphate-free.

Three column tests were performed in the study of the effect of temperature on breakthrough. Preliminary results with magnesium-saturated soil columns vs. radiostrontium indicated a consistently more rapid breakthrough at higher temperatures. Data from tests conducted at 36 C and 58 C demonstrated that a crib receiving waste at the lower temperature had 134 per cent of the capacity of a crib receiving the same waste at the higher temperature.

It is believed that the increased rate of breakthrough at higher temperatures represents the difference in the change of binding energies of Mg and Sr ions with temperature change. In this event the temperature effect would be somewhat different for calcium-saturated soils. Laboratory experiments are planned to test this theory of the temperature influence.

Depth samples were routinely collected from a well about 2500 feet southwest of the abandoned BY cribs in 200 East Area. These cribs received high-salt, scavenged wastes. Water samples collected from the 30-foot depth below the water table have displayed a gradually increasing concentration of radioactive material, while no concentration change was observed in samples from the surface of the water table. A tenfold concentration increase has occurred at the 30-foot depth within the past year. This study is intended to establish the movement of high-density solutions disposed to the ground and to examine the influence of geologic bedding on their movement.

The three batches of in-farm supernates (23, 24, and 25) scavenged this month contained Co^{60} below the recommended test disposal limit of 4×10^{-4} uc/cc. However, since all three batches demonstrated poor cesium adsorption in soil column tests, they were discharged to the 216-BC specific retention trenches. The last five batches of scavenged wastes have demonstrated poor cesium adsorption characteristics which at first were thought to be due to higher than normal salt concentrations; however, the twenty-fifth batch had a salt content slightly below normal which indicates that other factors may be responsible for the poor cesium removal.

Analyses of ground water samples obtained from wells at the 216-BC scavenged waste cribs have shown no evidence that wastes discharged to this site have entered the regional ground water table. To preclude the possibility that wastes may be by-passing these wells, depth samples will be obtained from wells located southeast and southwest of the disposal site. Authorization of funds to allow deepening of the BC-5 well was received, and approval to incur expenses to provide the four new Co^{60} test wells is expected within thirty days.

A survey of inactive cribsites in 200 West Area indicates that several sites may be made available to receive wastes from active plants if the remaining capacity of a crib for a particular waste can be determined. Utilization of these cribsites should result in appreciable savings in new crib construction. In addition, if the necessary routings were provided at this time, continued normal operation of the plants would be insured and construction of cribs on an emergency basis avoided. In line with this survey, arrangements were made with Process Development Operation to evaluate the 216-S-6 crib as a receiver for Redox process condensate in the event that the existing 216-S-7 crib becomes exhausted.

Gelling of Wastes - Field Work

Observation of the aluminosilicate gel in the test disposal pit east of the 300 Area revealed no significant changes in either moisture content or gel-bed depth. The moisture content gradient varies from 80 per cent (wet basis) at the surface of the gel to 73 per cent at the bottom and the present volume of gel is about 60 per cent of the initial volume.

SECRET

1248093

CLASSIFIED

C-13

HW-53961

It was decided to postpone any further field testing of the gelling process until it can be established that the process has definite advantage over the present HPC waste disposal practices. Funds originally scheduled for this work will be

from 10 to 100 per cent of feed, and no correlation with flowsheet or plant operation is apparent. An interesting development during November was the appearance of appreciable quantities of neptunium in the LBP stream. On November 5 this exceeded that in 2DF by a factor of two.

Cesium Recovery and Waste Treatment

A report, HW-53617, "Flowsheet No. 2 - Cesium Isolation and Packaging," was issued. This report defined the hydrolysis process for converting an aqueous slurry of cesium zinc ferrocyanide into a dry cesium chloride product.

The preparation of scope drawings was started on the cesium isolation and packaging facility. This drafting includes the preparation of a process flow-diagram as well as those details which show the general equipment arrangement. It will also define the instrument and electrical circuitry and the piping and valves required to couple this facility into production plant services.

A sampling program was established recently to determine the composition of Purex plant LWW solution and the variation of this composition with time and operating practice. This information is vital to fission product recovery and to waste treatment since the plant solution is known to differ considerably from nominal flowsheet concentrations. Results have now been received on six samples of LWW taken from the Purex plant during late August and early September, 1957. The observed concentrations of iron, aluminum, and sodium were much larger and more variable than expected. Maximum concentrations were 0.8, 0.45, and 3 molar, respectively, and averaged 0.5, <0.23, and 1.6 molar. Acid concentrations ranged from 5.8 to 8.5 molar. Sulfate was fairly constant at about one molar. Calculations based on chromium and nickel analyses indicated that as much as 0.44 M iron could have been contributed by concentrator tube bundle corrosion. This points up the desirability of going to titanium steam coils. The high aluminum and sodium values probably result from incomplete removal of coating wastes prior to uranium dissolution.

Cerium Recovery

Work was reported last month on the recovery of cerium from LWW by precipitation as the iodate after oxidation with persulfate. It was thought that silver, chloride, and neodymium were in part responsible for the favorable cerium carrying. Further work has shown that silver and chloride have little, if any, effect. It was also found that the iodate could be left out without affecting cerium recovery. Thus the cerium precipitated averaged about 80 per cent when synthetic LWW was simply neutralized to about pH 0 and heated with 0.13 M persulfate. Recoveries increased to about 90 per cent when the slurries were allowed to digest over night prior to centrifugation. The identity and composition of the precipitate is unknown; however, the results are reproducible and are being used as the basis for design of a flowsheet which will receive full level testing.

Other experiments established optimum conditions for ceric iodate precipitation but showed that flowsheet concentrations of iron, uranium, or sulfate would seriously interfere with application to LWW. Iodate precipitation may well be valuable, however, for cerium re-purification. Further experiments also showed

1240095

DECLASSIFIED

that lead iodate is not a satisfactory scavenger for cerium from LW. Recoveries with this reagent were very erratic and non-reproducible. The use of the ortho-phosphates, pyro-phosphates, meta-phosphates, or of phytic acid was also unpromising.

Krypton-85 Recovery

The report on krypton-85 recovery was issued. The process and equipment for the recovery method involving the scrubbing of dissolver off-gases with liquid nitrogen and collection of the rare gases on silica gel at low temperature are described. Further work was being done to establish the economics of the process.

Iodine Chemistry

Information is desired on the effectiveness of mercury(II) complexing of iodine for possible application in the Purex caustic scrubber back-up facility. Dilute nitric acid is the aqueous phase of interest. It was thought that the gas phase could be conveniently simulated by a carbon tetrachloride solution of iodine, that this could then be contacted with aqueous solutions containing nitric acid and mercuric nitrate, and the change in iodine distribution coefficient (D_a^0) used as a measure of mercury complexing. In practice, mercury concentration had very little effect, and it was subsequently found that mercuric iodide itself was soluble in carbon tetrachloride. The planned method of attack is therefore not applicable, and preparations are being made to more closely simulate the plant situation by passing an iodine containing gas stream through nitric acid solutions.

REPROCESSING OF NONPRODUCTION REACTOR FUELS

Survey Study

The number and complexity, both in design and composition, of the fuel elements from power and propulsion reactors will require unusual process flexibility if this reprocessing program is to be conducted most economically. A study of about 20 process alternates which could be used at HAPO was begun. This study covers an investigation of equipment requirements and existing plant utilization. Such factors as mechanical versus chemical treatments for jacket removal, capacity rangeability, timing, construction and operating economics, and integration with the plutonium recycle program were being studied. The alternatives include proposals for minimum dissolution facilities with transfer of solution to Redox for complete decontamination as well as methods involving complete processing at one plant without dependence on Redox.

Stainless Steel Clad Fuel Dissolution. The design of the major equipment pieces for the 321 Building Darex pilot-plant installation has been completed and orders have been placed for the required titanium. The unit, as designed, should prove capable of dissolving approximately 200 pounds of stainless steel clad fuel per day (1/10 to 1/20 plant scale). The system has been designed assuming batch dissolution with dilute aqua regia followed by a chloride removal step involving incremental addition (and boil-off) of concentrated nitric acid.

The installation consists of four major process vessels:

SECRET
DECLASSIFIED

1248896

DECLASSIFIED

C-16

HW-53961

1. A dual-purpose titanium dissolver which also serves as the boil-down vessel during the chloride removal operation.
2. A dual-purpose titanium condenser used during dissolution as a down-draft unit for nitric acid economy. During the chloride removal operations, it is used as a total condenser with the condensate routed to the acid receiver.
3. A titanium acid receiver used to collect the nitric acid and hydrochloric acid condensed during the boil-down operation.
4. A mild steel caustic scrubber which scrubs out either un-recovered oxides of nitrogen during dissolution, or chlorine during boil-down. Although designed primarily for chloride removal using the nitric acid boil-down technique, the system could be used with simple modifications to evaluate the use of other oxidizing agents (e.g., ozone, air sparging) for chloride removal.

Removal of Chloride from Darex Dissolver Solution

By Solvent Extraction. The use of solvent extraction for separation of chloride from desired constituents of Darex Process dissolver solution is being studied as an alternative to azotropic nitric acid vapor stripping. Single and multiple batch contacts of simulated Darex dissolver solutions with TBP-diluent solutions show the following:

1. The chloride distribution ratio (E_{Cl}^0) between 30 per cent TBP-Shell E-2342 and Darex dissolver solutions 3.5 M in total hydrogen ion is essentially constant at about 0.08. Simulated Darex solutions used contained 0.95 M U and 0.36 M stainless steel (304) dissolution products. They ranged from 1.5 to 3.3 M in HNO_3 and from 0.19 to 1.9 M in HCl in combinations giving constant total acidity about 3.5 M.
2. Chloride distribution ratios were not significantly affected by extraction at 60 C (vs. room temperature) or change in diluent (Atlantic Odorless, Amsco 125-90W, Soltrol, Ultrasene).
3. Successive extractions readily removed >99.9 per cent of the uranium from any of the Darex solutions. Chloride distribution ratios decreased markedly after the first extraction contact and remained essentially constant through succeeding contacts.
4. About 99 per cent of the extracted chloride is removed from the organic phase by five successive scrub contacts with 1/5-volume portions of 3 M HNO_3 -16 g/l UNH. Residual chloride concentrations in the organic phase after five such scrub contacts ranged from 0.049 to 0.0124 g/l depending on the initial Darex solution used.
5. Chloride remaining in the scrubbed organic phase is essentially quantitatively removed by stripping with 0.01 M HNO_3 . The relatively poor

SECRET

1240097

scrubbing and complete stripping of chloride indicate a need for improved chloride scrubbing to produce a final aqueous uranium product solution containing a low chloride concentration.

By Direct Boil-Off of HCl and/or Cl₂. Removal of chlorine from Darex dissolver solution by direct boil-off (total condensation of vapors) is also under study as an alternate to azotropic distillation. The synthetic dissolver solution used contained 1.92 M HCl, 1.0 M HNO₃, 1.0 M UNH, 0.27 M Fe(NO₃)₃, 0.08 M Cr(NO₃)₃, and 0.036 M Ni(NO₃)₂. The solution (with and without concentration) was boiled at a boil-up rate of 2.5-3.5 ml/min. Make up nitric acid was added to maintain constant volume of the bottoms. Chloride removal as a function of boil-off volume for a series of runs in which air sparging and added oxidants were tried to hasten chloride removal is shown in the following tabulation.

	Runs ⁽⁵⁾						
	1	2 ⁽¹⁾	3	4	5	6	7
Concentration Factor	4	4	5.3	4	1	1	1
Boiling Point	130 C	131 C	157	130	107	107	107
Air Sparge	No	No	No	Yes ⁽³⁾	Yes	Yes	Yes
Make-up HNO ₃ , M	15.7	15.7	15.7	15.7	4.0	4.0	4.0
Oxidant	-	-	-	-	(NH ₄) ₂ S ₂ O ₈	(6)O ₃	(4)
Chloride Concentration,							
g/l in bottoms	0 ml.	31.2	14.5	29.8	33.5	68	68
after indicated	250 ml.	7.25	3.11			13.	52
boil-off volume	500 ml.	-			1.2	6	21
following	750 ml	-	0.05	0.25	0.6		6.8
initial	1000 ml	-			0.06	0.34	2.8
concentration ⁽²⁾	1250 ml	-	0.005				1.3
	1500 ml	-					0.58
	2000 ml	-					0.88
							0.16

- Notes: (1) Initial solution contained 1/3 as much chloride as in other runs.
 (2) Corrected to initial solution volume in all cases.
 (3) Sparge rate - fine solution volumes per minute.
 (4) Contained 1.9 wt. % O₃ in air.
 (5) Runs 1, 2, 3, and 4 initially 1 l. of solution. Runs 5, 6, and 7 initially 250 ml of solution.
 (6) Concentration varied from an initial 0.1 M to a final 0.5 M.

Air sparging and sparging with an air-O₃ mixture showed little improvement over boiling alone. Ammonium persulfate increases the chlorine removal markedly but the sulfate formed is not desirable for further processing the bottoms in the Redox plant. Data so far obtained indicate that the chloride removal at constant boil-off rate is approximately first order with respect to chloride concentration. Chlorine half-lives were about one-half hour for the runs at high nitric acid concentration and about one hour for those at low nitric acid concentration. Further procedure modifications and other oxidants are under study.

Zirflex Process

The desirability of adding ammonium nitrate to the ammonium fluoride dejacketing solution in order to insure simultaneous dissolution of both the zirconium and the tin in Zircaloy-2 was pointed out last month. Recent work indicates another beneficial effect is obtained with mixed ammonium nitrate - ammonium fluoride solutions, viz., substantial reduction in the quantity of hydrogen evolved during dissolution of Zircaloy-2.

Experiments were performed in which the gases evolved during dissolution of Zircaloy-2 in boiling mixtures of ammonium nitrate and ammonium fluoride were passed through an updraft condenser, then through a trap containing hydrochloric acid, and were finally collected over water in a gas buret. The results obtained in these experiments may be summarized as follows.

<u>Dissolving Medium</u>		<u>M Zr in Final Solution</u>	<u>Moles Gas Collected per Mole Zr Dissolved</u>
<u>M NH₄F</u>	<u>M NH₄NO₃</u>		
6.0	-	0.87	2.2
6.0	0.25	0.84	0.8
6.0	0.33	0.86	0.5
6.0	0.50	0.95	0.1
6.0	0.50	0.94	0.07
6.0	1.0	0.86	0.05

Since the gas collected in the water-filled buret may contain other water-insoluble gases in addition to hydrogen, the above data give only upper limits for the quantity of hydrogen evolved during the dissolution of the Zircaloy-2. Grab samples taken during the course of the experiment employing 1 M NH₄NO₃, 6 M NH₄F were analyzed by mass spectrographic techniques. The gas leaving the condenser at the end of the experiment was predominantly ammonia but contained detectable amounts of hydrogen, nitrogen, nitric oxide and nitrous oxide. The gas collected downstream from the hydrochloric acid trap contained about 25 per cent nitrogen and 75 per cent hydrogen.

Addition of ammonium nitrate to the ammonium fluoride apparently expedites the dissolution of Zircaloy-2. For example, dissolution of ten grams off a 13 gram Zircaloy-2 coupon required only 60 minutes in boiling 6 M NH₄F, 1 M NH₄NO₃ saturated with U (IV) but required 150 minutes in boiling 6 M NH₄F saturated with U (IV). This is to be expected since the addition of nitrate ion will solubilize the tin and prevent the formation of the insoluble uranium-tin deposit which was observed in earlier experiments with Zircaloy-2 clad uranium metal and which inhibited the dissolution of the Zircaloy-2 at low fluoride to zirconium ratios.

Some attention has also been given to attack of core materials by mixtures of ammonium fluoride and ammonium nitrate. Uranium metal wafers were exposed to boiling 6 M NH₄F, 1 M NH₄NO₃ for 5.5 hours in a stainless steel vessel. Samples of the hot solution were removed at intervals and analyzed for uranium. After cooling to room temperature the samples were again analyzed for uranium. Uranium concentrations in both the hot and cold solutions were somewhat lower in the experiment employing 6 M NH₄F, 1 M NH₄NO₃ than in a parallel experiment employing 6 M NH₄F alone.

The amount of uranium which reacted to yield an insoluble fluoride salt was greater by a factor of about two in the experiment employing nitrate ion, however. (ca. 14 per cent conversion in 6 M NH_4F , 1 M NH_4NO_3 versus ca. 7 per cent conversion in 6 M NH_4F).

The fluoride residues obtained in these parallel experiments were washed with water prior to air-drying. A total of 112 mg U were lost to the wash water in the case of the residue formed in the 6 M NH_4F , 1 M NH_4NO_3 solution, as compared with 73 mg U in the case of the residue formed in 6 M NH_4F .

Rough estimates were obtained of the solubility of uranium (VI) in ammonium fluoride solution by mixing uranyl nitrate and ammonium fluoride solutions, precipitating uranium and then adding water dropwise with stirring until a clear solution was obtained. Values found ranged from 0.4 g/l U at 5.7 and 3.3 M NH_4F to 1.7 g/l U in 1.4 M NH_4F , and 4.3 g/l U in 0.9 M NH_4F . These results indicate that uranium (VI) is less soluble than uranium (IV) at high fluoride (above ca. 2 M NH_4F) but is more soluble than uranium (IV) at lower fluoride. Thus it should be possible to hold uranium losses to the jacket solution at low levels by dissolving to excess fluoride even if oxidation to uranium (VI) does occur.

The attack of irradiated uranium metal by ammonium fluoride solution was studied in an experiment in which a rectangular coupon of irradiated uranium was exposed to boiling 6 M NH_4F for seven hours. Attack of uranium occurred at a rate of ca. 0.1 g/hr., cm^2 which, in view of uncertainties in the surface area of the irradiated uranium sample, is in fair agreement with the value of ca. 0.05 g/hr., cm^2 observed for unirradiated uranium in boiling 6 M NH_4F .

Dissolution of Type 304 L Stainless Steel in Sulfuric Acid

The use of dilute sulfuric acid to selectively dissolve stainless steel cladding from power reactor fuels is being studied as a possible alternate to the Darex process.

Studies completed during the month investigated the effect of sulfuric acid concentration and temperature on the rate of dissolution of type 304 L stainless steel. Samples used for these studies, which were performed in glass equipment, were one-inch lengths of 0.25 inch diameter rod. Dissolution rates were measured in boiling sulfuric acid solutions of initial concentrations 2, 4, 6, and 8 M H_2SO_4 , and in 3 M and 6 M H_2SO_4 at temperatures of 21, 43, 60, and 75 C. The results obtained are correlated by the following expression

$$R = 3.12 M^{1.6} e^{0.0824(t-t_b)}$$

where R is the average rate of dissolution (mils/hr) during the interval required for penetration to a depth of 20 mils, M is the initial molarity of sulfuric acid, t is the temperature in degrees centigrade, and t_b is the boiling point of the solution in degrees centigrade.

Since Carpenter-20 would be a probable choice for a dissolver for this operation, studies were also performed with Carpenter-20 equipment to determine if the same

SECRET

1248100

~~SECRET~~ **CLASSIFIED**

passivation effect would be noted with 304 L as was observed in KAPL studies with type 347 stainless steel (cf. KAPL-933). It was found that the reaction was more difficult to initiate in Carpenter-20 than in glass. With boiling 2 M H_2SO_4 no reaction occurred unless the 304 L sample had been previously etched. With 4 M H_2SO_4 the reaction could be initiated by introducing the stainless steel sample into the boiling solution but not if the sample were introduced into the cold solution and the solution then raised to the boiling point. A sample which had been exposed to water at 300 C for four days reacted spontaneously with 4 M H_2SO_4 when the sample was introduced into the cold solution and the solution raised to the boiling point. With 6 M H_2SO_4 the reaction could be initiated simply by raising the temperature to ca. 95 C. Once initiated the dissolution reaction in the boiling solutions preceded at a rate approximately 30 per cent faster than had been observed in glass equipment.

Integral dissolutions at reflux temperature were made to determine the effect of dissolved stainless steel components on the rate of dissolution. Instantaneous rates were plotted against the concentration of dissolved stainless steel, and concentrations which would reduce the rate to zero estimated by extrapolation. These concentrations are tabulated in the accompanying table, along with concentrations which correspond to dissolution rates of 3 mils/hr.

<u>M H_2SO_4</u> <u>(Initial)</u>	<u>g/l Stainless Steel Corresponding to</u> <u>Dissolutions Rates of</u>	
	<u>3 mils/hr</u>	<u>"Zero"</u>
2	57	61
3	96	100
4	106	110
5	115	120
6	124	130

From these data it appears that best utilization of sulfuric acid is obtained with 3 M H_2SO_4 , with a fifty per cent excess of acid being required.

ANALYTICAL DEVELOPMENT AND INSTRUMENTATION

Emission Spectroscopy

A study was made of the feasibility of using a direct reading spectrometer for quality control in the Fuels Preparation Department laboratory. It was concluded that a direct reading spectrometer of the type marketed by the Applied Research Laboratories, known as the "Quantometer," could readily assume the present routine spectrographic analysis load of the laboratory. This load is about 100 determinations per day. The labor saved by using the more rapid direct reading method was estimated at about \$12,000 per year, which permits an instrumental payback period of about four years. A further benefit of direct spectrometry is a significantly higher analytical precision. A report discussing the conclusions is being issued.

SECRET

Mass Spectrometer

Isotopic analyses of the plutonium samples from the first three Chalk River shipments were performed. The isotopic ratios were used to calculate the specific activity of the plutonium, thereby permitting intercomparisons of plutonium concentration in dissolver solution by alpha counting with chemical analysis results by the Chemical Processing Department personnel. Very satisfactory agreement was obtained. It was noted that the plutonium-238 and plutonium-240 ratio for Chalk River plutonium is about twice that of Hanford plutonium.

An instruction and maintenance manual for the surface ionization mass spectrometer was issued.

Controlled Potential Coulometry

Plutonium in full-level dissolver solution was successfully titrated by controlled potential coulometry by the method previously discussed. The accuracy of the results obtained to date is at least within ten per cent, and there is no evidence of significant interference from fission products. However, a more detailed study is needed. Nitrite must be removed (by sulfamate or its equivalent) and an iron correction may be necessary if the amount of iron impurity is very high relative to the plutonium content.

Studies of the high precision macro titration of plutonium by controlled potential coulometry were continued. A stock plutonium solution was titrated by three analysts with a precision of at least ± 0.1 per cent (95 per cent confidence level), and with no evidence of bias between operators. Variations in acid concentration within the normally expected range caused no errors. A new blank run must be made for each new batch of citrate buffer. It was found that an iron correction must be applied, since the half-wave potentials of plutonium and iron in the system are close together (0.185 and 0.092 volts, respectively, against a saturate calomel electrode).

Analytical Services

Neutron activation analysis is being provided. Constituents to be analyzed must form active isotopes which can be measured. Results are quantitative to semi-quantitative for solids and liquids. Gas results are qualitative.

Accurate Cs-137 measurements can be made in the presence of Cs-134. A two-channel gamma energy analyzer is used. For 1000 MWD/T material Cs-134 corrections have about a 2 per cent error. The error is higher for high exposure. The technique immediately helps to determine fuel burnup.

The analytical procedure has been shortened for Sr-90 occurring in soil column effluent and Purex waste. Removing ruthenium by distilling was a bottleneck. Now, suitable decontamination comes from carbonate-nitrate precipitations and iron-cerium scavenging.

1248102

SECRET

DECLASSIFIED

C-22

HW-53961

Flame photometry was used for measuring magnesium (an oxygen scavenger) in UO_2 - Bi alloys. Uranium interference was overcome by initially removing it by solvent extraction.

Nickel-zirconium-beryllium alloys (from Hunter-Douglas Aluminum Corporation) were assayed. Nickel was determined by weighing the glyoxime and zirconium, the phosphate. Beryllium was measured from the 515 mμ intensity of the p-nitro-phenylazo-orscinol complex.

EQUIPMENT AND MATERIALS

Pumps

Pogo Stick Pump No. 3 - Transfer Pump. The pump developed excessive air leakage (blow-by) after 3500 hours of operation pumping water at 5 GPM. The plunger face was indented by impact with the seat along one side. A slight burn on the end of the plunger prevented square seating of the extension face and caused the leakage. A Teflon disc has been fitted over the end of the extension face and the unit was placed on test again.

Deepwell Turbine Pump Conical Deflector Liquid Seal. Evaluation of the conical deflector seal for deepwell turbine pumps has been completed. Use of a conical deflector below the liquid throttle bushing reduces leakage past the throttle bushing by a factor of 3 to 1000. The amount of leakage reduction is dependent on the physical condition of the liquid throttle bushing and pumping conditions. A report, HW-53530, will be issued at an early date.

Valves

A plastic solenoid valve with a tantalum seat has been placed on test. The valve appears to seat securely and when closed will prevent flow at pressures up to 125 psig. On the other hand the valve will not open against pressures greater than 35 psig. Operation through 43,200 cycles has been smooth.

HAP0 Plug Valve. A modification of the valve originally designed by Process Design and Development (Dwg. H-2-3253) has given erratic operation during the last 300 hours of operation. On disassembly, the actuator (a reciprocating rotary device) was found to be badly worn under the ball bearing end and the chrome-plated screw was pitted and scored. Leakage of air became evident because of failure of the O-ring seal and also of the "Quad-ring" seal on the piston. In addition to failure of the operator, defects were found in the valve portion. The O-ring seal around the stem was worn severely and the valve plug was scored and worn. A sheet of dirt was built up on the Teflon liner and a second sheet was found on the plug. These sheets were tenacious and could be peeled from the valve parts. Further testing is not contemplated at this time. Operation involved approximately 98,000 cycles prior to failure.

Corrosion Studies

Pertinent to Zirflex Process. Erratic results have been obtained in short-time (48 to 100 hours) exposures of 304-L stainless steel to simulated Zirflex

SECRET

1248103

decladding solutions under heat transfer conditions (bulk metal temperatures of 125 to 145 C, glass equipment). Corrosion rates varied from less than one to four mils/mo. with occasional pitting. Further tests in stainless steel equipment, both heat transfer and capsule, are in progress.

Sensitized, intergranularly corroded 304-L coupons (previously exposed to boiling 65 weight per cent HNO_3) exhibited corrosion rates of < 0.1 mil/mo. when exposed to boiling $6 \text{ M NH}_4\text{F}$ or $0.95 \text{ M (NH}_4)_2\text{ZrF}_6 - 0.3 \text{ M NH}_4\text{F}$.

Titanium corrodes rapidly in ammonium fluoride solutions. However, the attack is markedly reduced in the presence of small amounts of sodium ion. The inhibition appears to be due to the formation of a protective film of Na_2TiF_6 . Localized attack at corners and sharp edges occurs even in the presence of sodium ion.

Preliminary experiments show Haynes 25 has satisfactory corrosion resistance under Zirflex decladding conditions. To simulate core dissolution conditions, Haynes 25 coupons were exposed to boiling (1) 12 M HNO_3 , (2) $10 \text{ M HNO}_3 - 0.3 \text{ M UNH}$, and (3) $6 \text{ M HNO}_3 - 1.0 \text{ M UNH}$. Corrosion rates after 420 hours of exposure were about four, two, and one mil/mo., respectively, with no increase in rate with time observed. In other tests, Haynes 25 has been exposed alternately (with only a water rinse between) for 24 hour periods to boiling $4 \text{ M NH}_4\text{F}$ and 12 M HNO_3 . Eight cycles have been completed. Corrosion in $4 \text{ M NH}_4\text{F}$ has been negligible and, in 12 M HNO_3 , about four mils/mo. with no preferential attack.

Pertinent to Flurex Process. Haynes 25, when exposed (for 144 hours) to simulated Flurex catholyte ($0.2 \text{ M UO}_2\text{F}_2$, 1.0 M HF , $0.05 \text{ M NH}_4\text{F}$) at 145 C in a sealed glass capsule, corroded at about two mils/mo. With 0.2 M HNO_3 also present the rate was about four mils/mo.

Pertinent to Sulfex Process. Carpenter 20 was exposed to $6 \text{ M H}_2\text{SO}_4$, with and without varying amounts of dissolved stainless steel and phosphate, in sealed glass capsules at 125 and 145 C. Erratic and high (seven to 120 mils/mo.) corrosion rates were observed at 145 C while surprisingly low rates (one to two mils/mo.) were obtained at 125 C. The presence of dissolved stainless steel and phosphate had no appreciable effect on the rates. In Huey type tests (atmospheric pressure boiling) corrosion rates for Carpenter 20 in $6 \text{ M H}_2\text{SO}_4$ were about 80 mils/mo. These were reduced to about two mils/mo. in the presence of dissolved stainless steel (56 g/l.). Haynes 25 fails rapidly in boiling $6 \text{ M H}_2\text{SO}_4$.

Plant Assistance. In connection with investigation of the use of titanium for connector nozzles, samples of hard-faced titanium have been submitted for corrosion testing. These are being subject to Huey type testing. Preliminary data indicate the hard-facing may accelerate corrosion in HNO_3 . Stress corrosion cracks were observed around numbers (apparently made with a Vibra-tool) placed on the hard-facing of one of the samples.

Cast Carpenter 20 circulators in the slug pickling tank, Fuels Preparation Operation, have shown poor service-life (60-90 days). They are used in 60 per cent HNO_3 (containing some UNH) at about 60 C. Failures have been characterized by extensive cracking in the region where the shaft sleeve and the body of the circulator meet. Preliminary investigation indicates failure is due to a

DECLASSIFIED

1249104

DECLASSIFIED

combination of stress and corrosion. Use of 304 or 304-L stainless steel properly heat-treated and modification of the design would reduce the problem.

Materials of Construction

Flex tests of Hercules Powder Company's "Hi-Fax" polyethylene (a high density, linear polyethylene) indicate that the radiation tolerance of this material is equal to that of Super Dylan or Marlex 50.

CA 9R cement, a product of Charles Engelhard, Inc., was static emersion tested at room temperature. It will not tolerate carbon tetrachloride or nitric acid.

NEW PROCESSES

Anion Exchange Process

The chemical stability of Dowex-1, X-4 (50 to 100 mesh) in 7.2 molar nitric acid has been studied under conditions approximating those which will exist in the Purex installation. In this experiment 7.2 molar nitric acid was passed, at a flow rate corresponding to a hold-up of 10 to 15 minutes in the resin bed, over a column of resin for three weeks at 60 C followed by two weeks at 50 C and a week at 25 C. The resin bed expanded by about ten per cent during the first week at 60 C but showed no further change in volume during the subsequent five weeks. The resin was then loaded with plutonium out of 7.2 molar nitric acid at 50 C. Although the resin shrinkage in this step was about twice that normally experienced with fresh resin, the pressure drop in the loading step was no greater than usually seen with fresh resin.

Elution behavior was normal except for the increased expansion reflecting the greater shrinkage observed in the loading step. Capacity of the resin for plutonium was only about 20 per cent less than for new resins.

From these findings it is expected that under normal conditions in the Purex installation alpha radiation from plutonium will be a greater factor in determining resin life than will chemical damage.

It has also been observed that when Dowex-1 is loaded with plutonium and allowed to remain in contact with 7.2 molar nitric acid at 60 C for prolonged periods of time (12 hours) or at higher temperatures for shorter periods, an organic material precipitates out of the first fraction of the dilute nitric acid eluate. In a continuous contactor it is expected that any of this material which forms will be mainly in the slip water stream. In order to estimate the behavior of this material in the plutonium product concentrator, a 500 ml sample of plutonium product (48 g/l Pu) recovered from a column which had been held at 60 C for prolonged periods was decanted leaving a 90 ml precipitate-containing fraction. This fraction was made two molar in nitric acid and then evaporated at the boiling point until a constant boiling mixture resulted (ca. four hours). The constant boiling solution contained 250 g/l Pu. During this evaporation the organic material converted to a viscous organic liquid which floated on top of the aqueous solution. This material appeared to be completely destroyed on continued evaporation after an acidity of about eight molar nitric acid had been reached. In view

SECRET

of the fact that the concentration of this organic material in the Purex plutonium product will be much lower than was used in this experiment, little difficulty is expected from this material in the product concentration step.

It is of interest to note that when Dowex-1 and Dowex-21 K were employed in identical loading, digestion (20 hours at 60 C), and elution cycles, only about one-half as much of this organic material was formed with Dowex-21 K as was formed with Dowex-1. The Dowex-21 K used in these studies is apparently not uniform, however. Only about 95 per cent of the plutonium can be eluted from this resin with 0.35 M HNO_3 at elevated temperature. The remaining five per cent is retained at high concentration in some 5 to 15 per cent of the resin beads.

The radiation stability of Dowex-21 K (50 to 100 mesh) has also been studied, with the aim of determining its suitability for recovering plutonium from Purex LW. Four samples of this resin were immersed in synthetic LW of composition 7.0 M HNO_3 , 0.05 M $\text{Fe}_2(\text{SO}_4)_3$, 0.38 M NaNO_3 , 0.06 M Na_2SO_4 , 0.01 M UNH , 0.05 M H_3PO_4 and were irradiated at room temperature in a cobalt-60 source to levels of 1.0, 1.8, 3.0, and 4.0×10^8 R. The resin irradiated to 4×10^8 R was damaged to the extent that the beads became soft and packed so solidly as to effectively plug the column during the loading cycle. No serious physical damage was noted in the resin sample irradiated to 3×10^8 R, however, and this resin exhibited a plutonium capacity of 52 g Pu/1 resin as compared with a capacity of ca. 120 g Pu/1 for the fresh resins. On the basis of these studies Dowex-21 K appears somewhat inferior to Amberlite IRA-401, which in earlier studies showed a loss of only about 27 per cent in plutonium capacity on irradiation to 3.5×10^8 R. The Amberlite resin used in the earlier studies was a coarser resin (20 to 50 mesh versus 50 to 100 mesh for the Dowex-21 K), however, and this may account for the somewhat greater radiation stability which it exhibited. Further, the Amberlite IRA-401 resin had an initial capacity of only 60 g Pu/1 or about one-half that of Dowex-21 K initially.

Flurex Process Development

The transfer rate of nitrate ion from the feed compartment of a Flurex cell across a Permutit 3142 cation membrane to the catholyte compartment was studied as a function of feed compartment operating variables. At 25-30 C, the transfer rate was approximately 1.6×10^{-3} gm/amp.min. and was independent of uranium concentration in the range 0.25 to 1.0 M and of membrane current density in the range 0.5 to 1.0 amp/in.² These rates are a factor of about six higher than preliminary numbers previously reported. The reason for this discrepancy is not certainly known but is believed due to refinements in techniques of determining nitrate ion in catholyte solutions.

Further studies of current efficiency for uranium transport (across the cation membrane) as a function of feed acidity have been made. In a cell operated at 30 C with feed compartment UNH concentration 1.3 - 1.6 M, and membrane current density 0.5 amp/in.², transport of uranium decreased linearly from 0.069 to 0.062 g.U/amp.min. as feed acidity increased from -0.03 to 0.15 M HNO_3 . These values correspond to 95 per cent current efficiency at -0.3 M HNO_3 and to 85 per cent

DECLASSIFIED

1248166

at 0.15 M HNO_3 based on 119 as the equivalent weight of transported uranium. Increasing the cell temperature to 60 C results in a slight increase in current efficiency and also increases the water transported through the cation membrane from ca. 2.2 g/g U observed at 30 C to 3.2 g/g U.

Experiments designed to determine average equivalent weight of uranium transported through the cation exchange membrane produced values ranging from 150 to 178 depending on feed compartment pH. Thus calculation of current efficiency based on 119 as the equivalent weight of uranium transported may be misleading depending on the meaning attached to the result.

Direct current measurement of membrane resistances under expected process conditions were made for comparison with data previously reported which were obtained with A.C. conductivity equipment. The A.C. data are valid for all anion membranes studied and for Permutit 3142 cation membranes in UNH solutions from 0.5 to 2.0 M and for Nalfilm 1 cation membrane in 0.5 M UNH. The direct current resistances for Nalfilm 1 membrane in 2.0 M UNH and Ionics CR-61 cation membrane in both 0.5 and 2.0 M UNH were many fold higher than measured with the A.C. equipment and reflect the peculiar behavior of these membranes in use as reported previously.

Anodic corrosion rates, in 0.1 M NH_4NO_3 containing 0.0003 M HF and excess NH_3 to give pH > 9 (simulated anolyte), were measured for sixteen materials. Cast iron, 312 and 309-L stainless steels, Carpenter 20, and aluminum corroded at rates in the range 400 to 700 mg/amp hr. Carbon (battery grade) sloughed off badly losing weight at about 290 mg/amp hr. Hastelloy C, Duriron, 316-L stainless steel, nickel, and gold corroded at rates in the range 4.5 to 20 mg/amp hr. The most satisfactory materials were 304-L and 347 stainless steels which corroded at rates of 2.9 and 1.8 mg/amp hr., respectively. Although these rates are much higher than for platinum on a weight basis, they are competitive on a cost basis and further study of these materials is in progress. Zircaloy 3 and tantalum corroded slowly (< 2 mg/amp hr.) but a high-resistance coating formed on them rapidly.

Alternate Uranium Products

A survey was begun on fluid-bed processes under development at other sites that produce UF_4 and UF_6 starting with UNH or UO_3 . Included in these processes is Flurex which partially converts UF_4 to UF_6 with air or oxygen instead of costly elemental fluorine. The objective of the study is to explore the economic potential of such process combinations at HAPO.

Another study of such processes is concerned with determining their potential in combination with a one-cycle solvent extraction process for uranium decontamination. In such a combination, the fluorination step would be used for final decontamination with direct production of UF_6 .

Surface Chemistry

Micronitized talc has been found to be an excellent scavenger for organic material from aqueous solutions as evidenced by its effect on liquid-liquid dispersions. There is some indication that the talc adsorbs the nonpolar end of the molecule in contrast to "normal" adsorption. Further studies are planned including the effect on the scrubbing of fission products.

1248107

SECRET

4000 PROGRAM - REACTOR DEVELOPMENTReprocessing of PRP Fuels by Amine Extraction

The effects of amine concentration and acidity on plutonium extraction by tri-n-octylamine were reported last month. Three phase formation, a comparison of various diluents and amines, and the results of some extraction scrub studies were also reported. This study has now been extended to include the effect of a number of variables on the separation factor of plutonium from fission products. It is expected that these data will aid in the selection of optimum flow-sheet conditions for the amine reprocessing of PRP fuels.

Briefly, increasing nitric acid concentration from one to eight molar had little or no effect on the separation of plutonium from zirconium-niobium or cerium (separation factors of about 2×10^4 and 5×10^4 , respectively), however, the separation factors from ruthenium increased from 1.5×10^3 at 1 M nitric acid to 2.9×10^4 at 8 M. Increasing temperature from 25 to 55 C decreased the separation from ruthenium slightly but increased separation from zirconium-niobium and cerium, the latter by a factor of sixteen. Unexpectedly, varying tri-n-octylamine concentration from one to ten volume per cent increased the separation factors from all three fission product activities by factors of five to ten, i.e., the separation factors were roughly proportional to amine concentration. However, the use of tri-n-octylamine concentrations greater than 10 to 20 volume per cent is probably not attractive due to sluggish phase separation. Saturating the aqueous phase with uranium had little or no effect on cerium or ruthenium decontamination but was deleterious with respect to zirconium-niobium.

In extraction-scrub runs reported last month, the stripping of plutonium from the amine solution with ferrous sulfamate was much less efficient than expected, i.e., in one case the plutonium distribution coefficient (E_a^0) was 0.7 when stripping with 0.03 M ferrous sulfamate, 0.1 M nitric acid. Additional experiments have shown that an excess of sulfamic acid is very beneficial. In fact, stripping with 2 M sulfamic acid, 0.03 M ferrous sulfamate gave a distribution coefficient of only 5×10^{-6} .

Pu-Al Alloy Production

The semi-continuous preparation of alloy by the cryolite process was demonstrated in a top-pouring induction furnace at a rate of one kilogram of nominally eight weight per cent master alloy per hour using uranium as a stand-in for plutonium. The 1000 cc capacity graphite reduction crucible was operated with a charge of 2 kg. of metal and 0.47 kg. of salt; the cryolite layer and half of the metal being poured into separate molds at one hour intervals followed by recharging with aluminum and oxide-cryolite mixture. With a five-fold dilution during a subsequent remelting and casting step, the demonstrated production rate is equivalent to 40 kg. per eight hour day of fuel-element-composition alloy. The yield of massive alloy recovered was 99.7 per cent based on quantities charged. The uranium loss to cryolite averaged 0.47 per cent based on chemical analyses of the dross. It is believed this value could be lowered by contact with fresh aluminum.

SECRET

DECLASSIFIED

1248108

Dissolution of Pu-Al-Si Alloy

Rate of dissolution of Pu-Al-Si alloy in boiling 8.0 M HNO_3 - 0.003 M Hg^{++} has been further studied with additions of fluoride-aluminum complex to the reagent. With an initial composition corresponding to 0.5 M AlF_6^{3-} a one-half inch diameter rod was 50 per cent dissolved in approximately 30 minutes and completely dissolved in about four hours. With the initial reagent composition made 0.5 molar in AlF_3 , the time for 50 per cent dissolution was about two hours. In either case, the rate of corrosion on the Type 304 L stainless steel dissolver was severe: 138 and 55 mils per month, respectively. The silicon present was largely converted to silica residue under these conditions, and the resulting solution would require filtration prior to subsequent processing.

Solubility of Oxides in Cryolite

Chemical analyses of the fused UO_2 - Na_3AlF_6 mixtures previously studied by differential thermal analysis have indicated that the solubility of the oxide is rather limited in the region of 1000 C. A correlation of melting points with the compositions determined chemically indicate that an eutectic may occur at about six mole per cent UO_2 with a melting point of about 900 C.

Non-Rigid Fuel Core Studies

Further examination of bismuth- UO_2 slurry specimens has produced further encouraging evidence as to the stability of the slurry. One sample prepared by reaction of uranium metal with bismuth sesquioxide was vertically sectioned, and one section was divided into five pieces for chemical analysis. The uranium analyses, in order from the top were 12.2, 12.5, 11.3, 11.2, and 10.6 weight per cent, representing a 101 per cent recovery. The slight degree of segregation observed is encouraging since it is estimated that the contents were molten for at least fifteen minutes during the cooling period. Microscopic examination of a polished sample of this specimen disclosed a highly uniform dispersion with an average particle size for UO_2 of about 3.5 microns.

Pyrochemical Processing Studies

Continued studies have concerned the use of KAlCl_4 as a solvent for various fuel materials. Hanford UO_3 (pot type) readily dissolved to yield a red solution at 600 C which cooled to a fluorescent yellow solid, soluble in hydrochloric acid to yield a clear yellow solution of UO_2Cl_2 . Alumina was not observed to precipitate in the melt as was observed in the case of powdered UO_2 dissolution previously reported. The uranium present in both melts was reduced with excess aluminum (but not quantitatively) to yield aluminum-uranium alloy. This approach may hold promise for production of Pu-Al alloys for FRP use.

Further test of the dissolution rate of massive sintered UO_2 disclosed a much slower rate than reported in HW-53299-C, p. C-19, about 1 mg/min, cm^2 at 750 C. Reaction is apparently inhibited by an adherent alumina coating. The rate is much improved (to 6 mg/min, cm^2) by introducing carbon tetrachloride vapor which results in pitting attack and no evidence of alumina formation. The use of carbon tetrachloride is thus a possible regenerant for the spent dissolving medium.

SECRET

1240109

Uranium is also aggressively attacked by $KAlCl_4$ in the presence of air at 650 C probably via an oxidation intermediate since exclusion of oxygen causes a marked reduction in dissolution rate.

Flowsheets for PRPR Fuel Processing

A report on study flowsheets for plutonium recycle program fuel processing in the Hot Semiworks was issued. Flowsheets for UO_2 and Pu-Al alloy elements were proposed. To minimize capital costs, flowsheets were designed to be compatible with most of the existing equipment and to require minimum additional equipment. A Purex-type flowsheet is to be utilized for partition and decontamination. The head-end step for dissolution assumes the use of NH_4F for zirconium jacket removal and the mercury-catalyzed HNO_3 treatment for dissolving the Pu-Al alloy and straight HNO_3 dissolution for the UO_2 material. Three plutonium decontamination and two uranium decontamination cycles are involved.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Measuring Radioisotopes

Techniques were developed for measuring Sr^{85} and Sr^{90} mixtures in soil, vegetation and aqueous samples without chemical separation. These techniques will be applied in the dual tracer studies of strontium uptake now under investigation by the Biology Operation to evaluate the hazard presented by Sr^{90} from fallout and plant wastes. The Sr^{85} is determined by gamma spectrometric measurement of the 0.51 mev gamma rays. The Sr^{90} is determined from measurements in the 0.09 to 0.18 mev energy range of the bremsstrahlung radiation from its equilibrium mixture with Y^{90} . This method is suitable for samples with ratios of Sr^{85} to Sr^{90} from 1:10 to 1:1000 with a detection limit of about 200 d/m for Sr^{90} on samples small enough to fit into the well of the 5" x 5" scintillation crystal. In the case of soil about 25 grams can be counted.

Some preliminary results were obtained on sensitive "one shot" analyses of reactor effluent water in the study to determine the relative abundances of all the radioisotopes present so that routine analytical requirements may be established. Values obtained to date are tabulated below.

<u>Radioisotope</u>	<u>Concentration (uc/ml x 10⁶)</u>
Y^{48}	< 0.24
Zr^{95}	0.34
$Zr^{97}-Nb^{97}$	1.5
Ag^{105}	< 0.1
Rh^{105}	< 0.18
$Ru^{105}-Rh^{105m}$	< 0.33
$Ru^{106}-Rh^{106}$	< 0.1
Au^{198}	< 0.045

~~SECRET~~
DECLASSIFIED

DECLASSIFIED

C-30

HW-53961

Recent studies of reactor effluent water radioisotopes have shown that Y^{90} , La^{140} , Eu^{152} , and Sm^{153} are present in quantities such as to make their inclusion desirable in dose estimations for persons using Columbia River water downstream from HAPO. Analytical methods were developed to chemically isolate the rare earth group from reactor effluent water and determine the La^{140} , Eu^{152} , and Sm^{153} by gamma spectrometry. Beta absorption counting is being investigated for the determination of the Y^{90} .

In development studies for new bioassay procedures, the detection limits for ten fission products and Mn^{56} , Co^{60} , and Zn^{65} were calculated for a gamma spectrometric procedure on ashed urine salts representing a 24 hour collection period. Contemporary urine samples contain about two grams of potassium (with naturally radioactive K^{40}) and about 30 d/m of Cs^{137} from bomb fallout. In the presence of these "background" radioactivities, and for a ten minute count using a 5" x 5" sodium iodide well crystal with a multichannel analyzer, the detection limits (99 per cent confidence level) for the radioisotopes investigated are about 20 to 150 d/m depending upon the gamma energies and decay scheme characteristics of each isotope. The detection limits may be lowered by increasing the sample size or by counting for a longer period. Increasing the sample size by a factor of four would reduce the detection limit to about one-third its former value, and increasing the counting time by a factor of ten would also reduce the detection limit to about one-third of the ten minute value. This method of bioassay would require no chemical separation.

Application of X-ray-gamma or beta-gamma coincidence counting was successfully made to the standardization of Fe^{59} , Co^{60} , and Ce^{141} radioisotope solutions. This work is part of a continuing project to provide accurately standardized solutions for calibrating spectrometers and other counters used in hazard evaluation studies.

S,2-aminoethylisothiuronium dibromide (AET) which has been used to successfully protect animals from ordinarily lethal dosages of ionizing radiation was compared with the dye erioglaucine as to speed of reaction with the radicals formed by the radiolysis of water. The reaction speed of AET was doubled by changing the pH of the solution from five to seven indicating structural differences in the protective substances in the two cases. At the higher pH, the magnitude of its reaction rate constant was similar to that for other compounds which offer good radiation protection to animals.

The protective effects of several inorganic anions on the radiation-induced decomposition of erioglaucine were measured. Iodide, bromide, and nitrate ions in decreasing order of effectiveness were found to offer protection to the dye while fluoride, chloride, and sulfate ions were without effect. This study shows that part of the overall radiation protection offered by amine salts of HBr, HI, and HNO_3 is due to the inorganic anion present.

The G-yield of the ferrous sulfate dosimeter composed of 10^{-3} M $Fe(NH_4)_2(SO_4)_2$, 10^{-3} M $NaCl$, and 0.8 M H_2SO_4 was found to be 14.9 ± 0.3 using S^{35} beta radiations with $E = 0.0491$ Mev. This yield will be of value to the Plant Nutrition and Microbiology Operation in determining the relative biological effectiveness for this radioisotope. It is also the only experimental determination of this yield known for this type of radiation.

SECRET

1248111

Environmental Analytical Services

Gamma energy spectrometry was used to measure Co⁶⁰, Mn⁵⁶, and Cr⁵¹ in fish 30 minutes after their removal from an environment of 100-KE reactor effluent water.

Geology and Hydrology

Data from new wells drilled deep into the basalt east of the Columbia River in the Irrigation Project continued to confirm the very low permeability of the basalts there. Flow rates of water from the basalts in four recently drilled wells ranged up to only about 50 gal/m for wells penetrating up to 500 feet of basalt. This indicates not only the lack of significantly open joints in the basalt, but a lack of interbeds which are significant artesian aquifers beneath the Hanford project. The interbed aquifers therefore pinch out eastward.

Research is in progress to study the flow distribution beneath a model crib constructed in a miniature-scale laboratory model. The crib flow is collected in compartments built into the bottom of the model and the measured flow from these compartments represents the distribution of vertical water movement across the model. These initial studies are intended to develop model technique and to measure the influence of the model walls on the vertical flow distribution. To date the data have exhibited an extreme sensitivity to model design, particularly the method used to drain the bottom flow collectors. The results have not, however, reflected any significant wall effect. The water movement throughout the model appears to be by unsaturated flow.

Five drive samples of dry soil were obtained from the Touchet formation during the construction of a well in the 200 East Area. This formation comprises a significant fraction of the sediments above the water table at 200 East waste disposal locations. These samples were found to have an average porosity of 21.6 per cent. The soil appeared dry and powdery, having an average measured moisture content of about 2.2 per cent by weight and an average specific moisture retention of 3.9 per cent (volume of water per unit volume of soil). This latter value represents essentially the equilibrium moisture retention; the value for retention of moisture for a finite time interval, such as ten years would be somewhat greater than this.

The correlation of data from recently drilled wells in Cold Creek Valley tends to confirm the presence of a buried basalt ridge extending from the Yakima Ridge to Horn Rapids on the Yakima River. The data also indicate that the synclinal trough in lower Cold Creek Valley is probably 100 to 150 feet deeper than previously supposed, with a bottom elevation no more than 50 to 100 feet above sea level. The presence of this ridge has a profound influence on the regional hydrology and affects the interpretation of water elevations in many wells.

Gelling of Wastes

Further laboratory research was performed to study the conditions affecting the retention of radioisotopes in sodium aluminosilicate gels formed from synthetic coating wastes. The work was concerned with three problems: the retention of

DECLASSIFIED

1248112

DECLASSIFIED

radiostrontium and radiocesium by gels, the drainage of liquids from gels, and the decomposition of gels. A previous experiment was repeated in which the soil retention of Sr^{90} and Cs^{137} in liquids drained from a gel was measured. The rather poor removal of these isotopes from such solutions was verified.

Gels were formed from samples of an actual coating waste solution to study chemical combinations producing the most satisfactory gels. The solution tested required the addition of 0.5 to 1.0 part of 50 per cent NaOH to a 2:5 mixture of sodium silicate and an aluminum waste to produce a satisfactory gel.

Experiments were performed to study possible causes for the liquefaction of gels that often takes place in about two weeks. It was demonstrated that the presence of CO_2 or water vapor in the air in contact with the gel does not lead to this decomposition and the cause has not yet been established.

It was found that washing the gel with ordinary water immediately after it formed leached 2 per cent of the radioactive strontium and 32 per cent of the radioactive cesium from the gel. The resulting material displayed much less tendency to drain than unwashed gels.

Soil Chemistry and Geochemistry

It has been previously observed that the curve relating the per cent yttrium ion adsorbed by soil and the pH undergoes a pronounced minimum between pH 9 and 12. Experiments were performed to study the soil-solution reaction in this pH range to identify the cause of this reduction. Yttrium solutions having pH 9 to 12 were contacted with an anion exchange resin and nearly complete removal of yttrium was achieved; the yttrium therefore occurs in an anion, probably $\text{Y}(\text{NO}_3)_5^{++}$, in this pH range. This formation of complex anions in the presence of alkali nitrates may be expected with other tri-valent ions such as those of the rare earths, and will influence their removal by soils from many waste solutions.

A laboratory column of crushed limestone that has been receiving synthetic high salt waste containing 0.2 M phosphate ion and 2 ppm strontium traced with 13,000 c/m/ml Sr^{90} received 260 column volumes of waste before a detectable breakthrough of strontium was observed.

Research was continued to study the reaction mechanism whereby strontium is removed from phosphate solutions by calcite crystals. There is evidence that two mechanisms effect the removal of strontium on calcite. The first is a chemisorption of strontium on crystal faces; this is sensitive to the calcite surface area available and is of particular significance at low total strontium or calcium concentrations in solution. The second reaction probably involves the formation of brushite, $(\text{Ca}, \text{Sr}) \text{HPO}_4 \cdot 2\text{H}_2\text{O}$, on the surface of the calcite; this material was tentatively identified optically on a sample of the limestone bed previously described.

Field Apparatus Development

Rework of the field truck was started to improve safety and ease in field equipment handling. The wooden bed was replaced with steel plate. A hydraulically-

SECRET

powered hoisting frame will replace the present inadequate "A" frame. The truck engine will be used to drive a take-off winch and the bulky air compressor and generator will be replaced by a compact gasoline-powered compressor. The new equipment will permit greater flexibility, safety, and easier handling of test equipment.

Preliminary studies were begun to determine the advantages and merit of using analog computers in hydrology research. Computers available locally show promise of assisting in obtaining solutions to complex hydrology problems.

Improved performance of a commercial peristaltic action low-volume feed pump resulted from increasing the power of the drive, keeping the tube under some longitudinal tension, and maintaining a reasonably constant head. Daily checks were found to be within ± 2 per cent of the average flow. The modified pump was applied in soil research. Components were received for the four-unit plunger feed pump and design and assembly will be completed as soon as possible.

Research continued on the development of in-well techniques for ground water velocity measurements. Some of the anomalous results obtained previously with the well-dilution technique were probably caused by polarization of the electrodes. The possibility of using some type of alternator or manual switching device to correct this problem is being examined.

Application of thermistors to measurement of very low liquid flow rates was investigated further. Merits and disadvantages of self-heating and external heating were studied. Higher sensitivity is possible with external heating, however the convection currents created and air bubbles collecting on the probe limit the sensitivity of the method. It appears that a velocity of about one cm per minute would be the greatest sensitivity obtained.

Fission Products from Ruptured Fuel Elements

Water samples were obtained from a header giving 75 per cent of full scale reading on the rupture detector. The sample was analyzed for Ba^{140} and Sr^{89} , and found to contain about 100 times the Ba^{140} and Sr^{89} content of a sample taken from an adjacent "background" header. The concentration found in the header containing rupture debris would result in a fission product entry rate to the Columbia River (at Pasco) of about 8 per cent of the 0.3 curies per minute suggested as a working limit. In this particular rupture, which was unique in certain respects, the rupture detector appeared to be adequate to detect a rather small fraction of the suggested working limit. The concurrent release of fission product from all ruptures in all reactors, too, should not exceed the working limit, hence, the

DECLASSIFIED

C-34

HW-53961

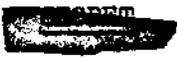
detector should be much more sensitive if several reactors, rather than one, are involved. The probability of two or more ruptures existing simultaneously each in separate reactors will be estimated to evaluate the necessity for summing rupture detector responses from the several reactors to obtain total fission product release rate at the River at a given time.



Acting Manager
Chemical Research & Development

LP Bupp:bp

1248115



VISITS TO HANFORD WORKS

Name Dates of Visits Company or Organization Represented and Address Reason for Visit HW Personnel Contacted Access to Restricted Data

J. M. Fletcher 11/4-5/ A.E.R.E. Harwell, England Discussions on general aspects of chemical processing & development. RJ Brouns, WH Reas, RL Moore, AS Wilson, EE Voiland, MT Walling, LP Bupp No

W. K. Davis 11/18/ Division of Reactor Development, A.E.C. Washington, D.C. PRP Discussions WH Reas, LP Bupp No

U. M. Staebler
R. C. Dalzell
R. C. Lovington 11/22/ Division of Production Washington A.E.C. Washington, D.C. Discussions on Krypton-85 production at HAPO. LP Bupp No

J. J. Sabo
J. M. Strong 11/22/ Aircraft Nuclear Pulsion, G.E. Idaho Falls, Idaho Discuss the continuous monitor for gas activity. GJ Alkire, RD Dierks Yes

S. V. Saginor
Mr. LeClereq 11/20/ Gladding-McBean Los Angeles, Calif. Discuss Ceramic materials and radio-active waste disposal. DW Pearce No

C-35

HW-53961

VISITS TO OTHER INSTALLATIONS

Name Dates of Visits Company Visited and Address Reason for Visit Personnel Contacted Access to Restricted Data

E. Holt 11/2-7/ ORNL Conference on Analytical Chemistry in Nuclear Reactor Technology Gatlinburg, Tennessee Obtain information for use by the Analytical Laboratories No

1248116

CONFIDENTIAL

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
F. E. Holt	11/8/	Monsanto Chemical St. Louis, Missouri	Discussion on analytical techniques, Organic Coolants.	M. McEwen	Yes
W. Y. Matsumoto	11/7-8/	Bioassay & Analytical Chemistry Conference Mallinckrodt Chemical St. Louis, Missouri	Attend conference and discuss analytical problems.		No
W. R. DeHollander	11/4-5/	University of Washington Seattle, Washington	Recruiting.		No
J. M. Nielsen	11/6-7/	Mallinckrodt Chemical St. Louis, Missouri	Attend meeting on analytical & bioassay chemistry.	MG Mason	No
M. C. Fraser	11/4-7/	Attend AIME Meeting Chicago, Illinois	To present paper.		No
	11/8/	Battelle Memorial Inst. Columbus, Ohio	Discussions on corrosion work in connection with fuel element reprocessing.	C. Pipton	Yes
R. E. Burns	11/10-12/	Iowa State College Ames, Iowa	Recruiting.		No
	11/13-14/	University of Iowa Iowa City, Iowa	PhD Recruiting.		No
R. G. Geier	11/13-15/	Penn State University State College, Penn.	PhD Recruiting.		No
R. J. Brouns F. P. Brauer	11/12-14/	A.E.C. Washington, D.C.	Technical discussion of Washington Designated Programs.	D. Miller	Yes

1248117

CONFIDENTIAL

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
B. M. Johnson, Jr.	11/14/	Argonne National Lab. Lemont, Illinois	Discuss fluidized bed technology as applied to separations processes.	S. Lawroski	Yes
	11/15/	Mallinckrodt Chemical St. Louis, Missouri	" " "	RM Edwards EF Sanders	Yes
	11/18-19/	University of Wisconsin Madison, Wisconsin	Recruiting.		No
	11/20-21/	University of Minnesota Minneapolis, Minnesota	Recruiting.		No
L. P. Bupp	11/11/	University of Utah Salt Lake City, Utah	Recruiting.		No
	11/12-13/	University of Colorado Boulder, Colorado	Recruiting.		No
E. W. Christopherson	11/13-19/	University of Missouri University of Tennessee Vanderbilt Oklahoma State University	Recruiting.		No
J. L. Nelson	11/13-15/	Brookhaven National Laboratory Upton, New York	Discuss high level waste disposal research.	LP Hatch FW Cowan	No
	11/17-22/	National Meeting Soil Science Society of America Atlanta, Georgia	Present paper on Sr adsorption on Hanford soils by JR McHenry.		No
J. F. Honstead	11/13-15/	Brookhaven National Laboratory Upton, New York	Discuss high level waste disposal research.	LP Hatch	No



VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
J. F. Honstead	11/17-19/	Savannah River Lab. Savannah, Georgia	Discuss waste disposal problems. Presented paper to local Health Physics organization.	WP Bebington WE Prout H Horten	Yes
R. K. Hilliard	11/11-13/	Oak Ridge National Lab. Oak Ridge, Tennessee	Consultation on fission product volatilization studies.	GW Parker	No
	11/14/	Argonne National Lab. Lemont, Illinois	Consultation on uranium oxidation studies.	RC Vogel	No
C. E. Linderoth	11/11/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Consultation on fission product volatilization studies.	GW Parker	No
	11/12-13/	" " "	Consult on waste disposal research programs, self sintering wastes.	EG Struxness	No
	11/14/	Argonne National Laboratory Lemont, Illinois	Consult on waste disposal research programs, fluidized bed.	S Lawroski	No
L. C. Schwendiman	11/18-19/	Air Pollution Control Association San Francisco, Calif.	Attend semi-annual technical conference.	JH Easthogan RD Cadle GJ Doyle	No
	11/20/	US Naval Radiological Defense Laboratory San Francisco, Calif.	Discuss instrumentation problems.	M. Lipanovich J. Makin P. Zigman A Redmond	No
	11/21/	Stanford Research Institute Palo Alto, Calif.	Discuss particle sampling research and related instrumentation problems.	EM Kinderman CE Lapple Dr. Foos	No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
M. T. Walling, Jr.	11/18-19/	Gatlinburg, Tennessee	Power Reactor Fuel Processing Coordination Meeting.	EL Anderson	Yes
	11/20/	University of Texas Austin, Texas	Technical Consultation.	PD Gardner	No
R. G. Geier A. E. Smith	11/18-19/	Gatlinburg, Tennessee	Attend Power Reactor Fuel Reprocessing Meeting.	AEC Sponsored	Yes
R. G. Geier	11/20/	K-25 Plant Oak Ridge, Tennessee	Discuss Development Problems.	DC Brater	Yes
	11/21/	Argonne National Laboratory Lemont, Illinois	" " "	S Lawroski	Yes
A. E. Smith	11/20/	Y-12 Plant Oak Ridge, Tennessee	Discuss quality assurance & inspection agency operation, instrumentation & gaging.	RD Smith	Yes
		X-10 Plant Oak Ridge, Tennessee	Cesium Packaging	C Watson J Landry	Yes
K. H. Hammill R. L. Moore	11/29/	Penberthy Instrument Company Seattle, Washington	Inspect lead-glass shielding window.		No



1248126

A. Organization and Personnel

No major or significant items relating to personnel changes or personnel activities occurred during November 1957.

B. TECHNICAL ACTIVITIESFISSIONABLE MATERIALS - 2000 PROGRAM

BIOLOGICAL MONITORING

Routine sampling of terrestrial and aquatic organisms was reduced on the basis of statistical analyses of past data to allow more time for research programs.

Atmospheric Contamination

Concentrations of I^{131} in thyroid glands of jack rabbits are tabulated below in decreasing order:

<u>Collection Site</u>	<u>$\mu\text{c } I^{131}/\text{g thyroid}$</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Prosser Barricade	7×10^{-3}	2×10^{-2}	+ 4
Wahluke Slope	3×10^{-3}	4×10^{-3}	- 2
Four miles SW of Redox	2×10^{-3}	4×10^{-3}	- 2

Current values are approximately twice those observed one year ago.

Fission products were present in rabbits in the following concentrations:

<u>Sample Type</u>	<u>$\mu\text{c FP's/g sample}$</u>	<u>Trend Factor</u>
	<u>Average</u>	
Bone	6×10^{-5}	--
Feces	5×10^{-5}	- 2
Liver	1×10^{-5}	- 2

These values are approximately the same as during the same period last year.

DECLASSIFIED

Columbia River Contamination

The contamination levels during November for beta emitters in representative organisms from the Columbia were as follows:

<u>Sample Type</u>	<u>Collection Site</u>	<u>µc/g wet wt. tissue</u>		<u>Trend Factor</u>
		<u>Average</u>	<u>Maximum</u>	
Minnows (entire)	Hanford	1×10^{-2}	2×10^{-2}	- 2
Whitefish flesh	Priest Rapids	2×10^{-4}	1×10^{-3}	+25
Whitefish flesh	F-1	2×10^{-3}	4×10^{-3}	-
Whitefish flesh	Ringold	1×10^{-3}	4×10^{-3}	-

The increased contamination of whitefish at Priest Rapids was due to the annual upstream migration of fish into that area from the Hanford Reservation.

No samples of waterfowl were collected under the revised schedule.

Swamp Contamination

Waterfowl at the 221-U swamp contained the following concentrations of fission products:

<u>Sample Type</u>	<u>µc/g sample</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Waterfowl (game species)			
Bone	3×10^{-4}	1×10^{-3}	+ 4 *
Soft Tissues	3×10^{-4}	2×10^{-3}	• 3 *

* Trend factors compare values with samples obtained in September, because no samples were taken during October.

Present values are less than those of the same period last year by factors of 15 in bone and 3 in soft tissue.

Effect of Reactor Effluent on Aquatic Organisms

A four per cent concentration of reactor effluent slightly increased mortality and retarded the growth of young whitefish. An equivalent amount of effluent fluctuated in concentration to simulated conditions which might result in the Columbia River from power production at Priest Rapids Dam appeared to be less harmful. The test with whitefish was terminated on November 13, and was resumed with chinook salmon eggs obtained from the University of Washington.

~~RESTRICTED~~

A test was started at the 1706-KE laboratory to compare the toxicity of lower pH (6.5) effluent from Tube No. 4963, with that of "conventional effluent".

Results of the temperature test with whitefish were virtually unchanged from last month. A significant increase in mortality has resulted at temperatures 2° and 3° C above "normal" for this section of the Columbia River.

BIOLOGY AND MEDICINE - 6000 PROGRAM

METABOLISM AND TOXICITY OF RADIOACTIVE MATERIALS

Phosphorus

The concentration of radiophosphorus in most tissues of trout fed 0.06 μc P^{32} /g body weight per day approached equilibrium in approximately 10 days. The concentration of P^{32} in these fish was about 0.35 μc /g at three weeks. Fish fed 0.06 μc and 0.6 μc P^{32} /g body weight showed a loss of appetite

Iodine

Preliminary data from the I^{131} study in swine show that the fetal thyroid exhibits significant uptake of I^{131} by the 57th day of a 114-day gestation period. The thyroid burden quadrupled by the 86th day. (When more animals are sacrificed, an exponential rise in thyroid concentration will probably be observed.)

An excellent method of fixation of thyroid tissue for electron microscopy was developed.

Plutonium

In experiments studying the distribution and retention of Pu in the gonads of rats, evidence was seen suggestive of ovarian damage approximately 200 days after plutonium administration. (This is preliminary but very interesting if borne out.)

Efforts to employ massive doses of vitamin A as a therapeutic agent for removal of plutonium deposited in the bone of rats resulted in the death of all animals treated with vitamin A alone. When the vitamin A was followed by zirconium citrate, all animals survived! The therapeutic effectiveness of the treatment has not yet been evaluated.

Radioactive Particles

Examination of mouse tissues for pathologic effects of radioactive particles is continuing. Phagocytosis of particles by macrophages is commonly observed in the lung sections.

Daily inhalation exposure of mice to $Sr^{90}SO_4$ particles is continuing. Preparations are being made for acute exposures of mice to $Sr^{90}SO_4$ particles and I^{131} . The latter will be administered in both vapor and particulate forms.

Results of additional tests on potential agents for removal of lung deposited radioactive particles are inconclusive.

Gastrointestinal Radiation Injury

As much as 750 mg of $Pu^{239}O_2$ has been fed to rats with no acutely toxic effects. This is twice the lethal dose of $Pu^{239}(NO_3)_4$, which suggests that the anion may be the limiting factor in the toxicity of the nitrate.

Previous experiments which seemed to indicate a stimulation of respiration in the jejunum following x-irradiation have been shown to be erroneous.

Studies are in progress to determine the effect of intestinal irradiation on P^{32} uptake by the nucleic acid fractions of the intestine. Since the rapid cell turnover of the intestine is associated with the radiosensitivity of this organ, experiments of this nature should yield basic information about the nature of intestinal radiation injury. It should also furnish a sensitive method of quantitating damage to the various intestinal segments.

DECLASSIFIED

D-5

HW-53961

Relative Biological Effectiveness

Iron dosimeter values determined by the Chemical Research Operation show a G value of 14.4 for S^{35} betas. Their results also suggest that the plastic coating on the stirring magnets may be causing some of the variation observed in dosimeter values.

Individual colony isolates of yeast which are unusually small and biochemically deficient in cytochrome appear to have an increased sensitivity to radiation which is characteristic of the individual isolate. Whether this sensitivity is genetically controlled and dependent on the depressed cytochrome is yet to be determined.

Research Services

A steer bearing an exteriorized pancreatic duct cannula and which had received about 30 mc of Zn^{65} was sacrificed.

HA Kornberg
Manager
BIOLOGY OPERATION

HA Kornberg:es

1208125

C. Offsite Visits and HLO Visitors

<u>Name</u>	<u>Dates of Visit</u>	<u>Company or Organization Represented & Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>	<u>Areas and Buildings Visited</u>
R.L. Bouque	11/1/57	Boon-Allen & Hamilton Mgmt. Consultants, Seattle	Consult on management problems.	HA Kornberg	No	100-F, 108-F
Dr. H. David Bruner	11/14/57	Medical Branch, AEC Div. of Biol. and Med. Wash. D.C.	Consult on current investigations.	HA Kornberg	No	100-F, 108-F 146-FR, 141-M

VISITS TO OTHER INSTALLATIONS

WJ Clarke and LA George	11/1/57	Pullman, Washington WSC	Discuss current cooperative studies on 133I in swine and Zn ⁶⁵ in cattle.	Ensminger and Staff	No	-
WJ Clarke	11/7/57	Veterinarian Conv. Portland, Ore.	Present a paper.	-	-	-
RF Foster and JJ Davis	11/7/57	Portland, Oregon - USPHS	Attend water pollution meeting.	Eldridge	-	-
RF Foster and PA Olson	11/12/57	Applied Fisheries Lab, U. of Wash., Seattle	Obtain chinook salmon eggs	Donaldson	-	-
R. F. Foster	11/13/57	Kiwanis Club, Sunnyside, Wash.	Present talk on "Aquatic Life Studies at HAPO"	-	-	-
D. G. Watson and P. L. Hackett	11/21/57	Fish Nutrition Lab., Cook, Washington	Discuss problems of fish blood analysis	Dr. John Halver	-	-

DECLASSIFIED
CONFIDENTIAL

1249126

DECLASSIFIED

D-7

HW-53961

D. Lectures

Papers presented at meetings:

- W. J. Clarke, "Biological Effects of Radiation on Animals",
Veterinarian Convention, Portland, Oregon, November 7, 1957.
- L. A. George, "Biological and Medical Effects of I¹³¹", Richland
Capter of A.A.U.W., November 5, 1957.
- R. F. Foster, "Aquatic Life Studies at HAPO," Kiwanis Club,
Sunnyside, November 13, 1957.

Seminars:

- D. R. Kalkwarf, "Protection of Aqueous Solutions from Radiation Damage"

E. Publications

Open Literature:

- Dockum, N.L. and R. Borasky, "Shadow Autoradiography of Beta Emitting
Particles," Nucleonics 15, 110 (Nov. 1957).
- Dockum, N.L. and J.W. Healy, "Spot Diameter Method of Quantitative
Autoradiography of Ruthenium¹⁰⁶ Particles in Lung Tissues,"
Stain Technology 32, No. 5, 209 (Sept. 1957).

HW Documents:

- Dockum, N.L., E.J. Coleman and G.S. Vogt, "Detection of Plutonium
Contamination in Humans by the Autoradiographic Method,"
Document HW-51754 (UNCLASSIFIED) Sept. 3, 1957.
- Bair, W.J., "Calculation of Maximum Permissible Concentration in Air,
MPC_(air) for Ra¹⁰⁶ Particles," Document HW-52287 (UNCLASSIFIED).
October 1, 1957.
- Ballou, J.E., "Effects of Age and Mode of Ingestion on the Absorption
of Plutonium," Document HW-52895 (UNCLASSIFIED) October 7, 1957.

1248127

DECLASSIFIED

OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

November, 1957

ORGANIZATION AND PERSONNEL

A. D. Wiggins joined the staff of Experimental Statistics on November 11, 1957.

OPERATIONS RESEARCH ACTIVITIES

Economic Studies

Work continued on the study of the economic evaluation of long term planning with respect to capital expenditures, and the relationship of product value to historical operating and capital costs.

A project outline for input-output and activity analysis of HAPO was completed and the proposal for this project is being prepared.

A series of discussion papers concerning economic concepts relevant to HAPO management problems has been planned, and the first of this series, dealing with economic cost concepts, was completed.

Matrix Method of Cost Allocation

A report has been prepared covering the use of matrix methods to allocate costs to end products, and will be issued in December.

A detailed example serving to illustrate the new cost concepts developed is nearing completion, and subsequent reports will discuss a new systematic approach to providing cost center cost information and related matters.

CPD Control Study

Final arrangements for an intensive study of the CPD measurement and control system have been made. Primary purpose of this study is to define and delineate the control system so as to enable the determination of requirements for satisfactory SS accountability, process control, and product evaluation. The initial effort is being primarily directed toward defining product flows between operating units and evaluating the measurement system in current use.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Reactor

A statistical analysis of numerical integration techniques used to estimate fuel element cross sectional neutron flux from empirical indicator pin values was completed.

1248128

4000 Program - PRP

Further discussions were held with Ceramic Fuels Development Operation concerning the design of an experimental program to investigate the dependency of hot pressed UO_2 powder maximum density on temperature, pressure and time.

A formula for the coefficient of total linear thermal expansion in fuel elements, assuming a lengthwise cosine temperature gradient, was developed for Ceramic Fuels Development Operation.

6000 Program - Biological Research

Second crop data from a Plant Nutrition and Microbiology Operation experiment to investigate the effects of various Ca compounds in the soil on the uptake of Sr^{90} by plants were partially analyzed this month.

The Plant Nutrition and Microbiology Operation also requested assistance on the effects of radiation on the growth of yeast populations. In this connection a bibliography on population growth curves in general, and on the growth of yeast populations in particular, is being compiled.

The Radioecology Operation is interested in the uptake of radioactivity by various organisms in an aquatic community. A bibliography is being compiled on the mathematical aspects of ecology and the concept of the food web.

At the request of Experimental Animal Farm Operation, statistical assistance is being provided in connection with the determination of the effectiveness of Ca as a preventor of the deposition of Sr^{90} .

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTSFUELS PREPARATION DEPARTMENTProcess Control

Discussions were held with personnel of the Quality Control group on the most advantageous use of control charts in general, and the use of such charts on I and E fuel element canning processes in particular. It was emphasized that control charts should be more than a historical picture, and that "out of control" points should indicate the advisability of taking immediate corrective action.

The residual chemical concentration in the fuel element etch machine was related to the number of units processed using past data. Based on the estimated relationship, good estimates of this concentration can be found by knowing the process throughput, resulting in a reduced amount of sampling and analytical work required for control purposes.

Acceptance Sampling

Graphs were constructed showing the relationship between test reactor reactivity values and shipper isotopic analyses for enriched solid slugs. Further work along this line is planned with the intent of eventually setting up acceptance plans for incoming shipments using reactivity values.

Further discussions were held with vendor liaison personnel on various problems associated with the acceptance sampling of incoming materials. Specific attention was given the problem of assuring that the vendors have adequate quality control plans in operation, since the acceptance plans in use here predicate that the material received comes from controlled processes.

Other

Control limits for absenteeism in Fuels Preparation Department are being calculated. These are being found for each component on a monthly basis.

IRRADIATION PROCESSING DEPARTMENT

Rupture Analyses

The study was completed of the feasibility of using certain reject data to predict whether or not a given lot is likely to contain a fuel element which fails in a reactor. Based on ten month's historical data, the particular linear combination of reject rates which maximized the difference between lots which did or did not contain a failure was estimated. The resulting function did not permit a very distinct break between the two types of lots, but some significant results were found with respect to individual reject categories. A complete report will be issued in December.

Assistance was given in the interpretation of data obtained by classifying failures with respect to the immediacy of occurrence after a start-up.

Attempts are being made to use recent data to re-estimate in a quantitative way the combined effects of exposure and power on fuel element failure rates. Preliminary investigation of hot spot failure data indicates that an interaction between the power and exposure effects exists.

Production Test Analysis

An analysis of partial data from Protection Test PT-608 involving dingot metal was completed. This analysis was performed on data from five tubes of alternated charges, with recrystallized dingot metal and regular metal being charged in each tube. Further data from this production test are being gathered. (HW-53930 RD, "Analysis of Dimensional Data from Five Tubes of Recrystallized Dingot Metal (PT-608)," November 26, 1957.)

Other

A sequential test useful in reaching a decision as to what proportion of fuel element failures occurring within the charge-discharge zone at the C reactor will be classified as stuck was designed.

CHEMICAL PROCESSING DEPARTMENT

Final Product Specifications

The tolerance statements which accompany weapons parts shipped to Los Alamos in order to demonstrate conformity with specifications were computed for those parts shipped during the third quarter of Calendar Year 1957.

1248130



Other

A mathematical-graphical routine was developed to aid in determining the number of each type of fuel element present in a mixture, when only the total number and total weight is known.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIESActivities for Other Operations

Further work was done in connection with the activities of the Task Force on SS Accountability problems existing between the Irradiation Processing and Chemical Processing Departments. Based on estimate of variation furnished by other members of the Task Force, an investigation was made of the uncertainties that would be expected to be associated with the parameter estimates in the proposed testing program designed to firm up plutonium yields as a function of exposure. A report on these findings was circulated among the Task Force members.

Bias correction equations, made necessary by the computational use of average values as opposed to individual tube values, were developed for the most recent set of equations for predicting plutonium formation and U-235 consumption as functions of exposure for different slug geometry-reactor combinations. These are being incorporated in a handbook for SS Accountability use, together with their generalized derivation.

Work was done on estimating a calibration curve for the C-1 tank based on three recently conducted calibrations. A table giving tank volume as a function of manometer reading will be constructed. The details of the study will be included in a document to be issued shortly.

The study on methods of giving reliability limits for the amounts of uranium at various stages in the 300 areas is continuing.

A preliminary study was made of the type and amount of mathematical analysis necessary to provide Electrical System Planning Operation, R & U, and Electrical Design Operation, Construction Engineering, with routine electrical network analyses. It is hoped that methods can be developed to make routine load, short circuit, and stability analyses on HAPO's 702 computer, and thus save purchasing these services offsite.

Activities within HLO

Mass spectroscopy data on the U-235 isotopic content of the September composite of UO_2 production were statistically analyzed and the results reported to Spectrochemical Analysis Operation (HW-53676, "Statistical Analysis of September Composite U-235 Data," dated November 20, 1957).

Statistical evaluation of referee and standard analyses was continued for General Chemical Analysis Operation.

A discussion was held with Radiological Development Operation concerning the design of an experimental procedure to calibrate bioassay photometric equipment.

Further discussions were held with interested personnel of the Radiation Protection Operation on the general topic of probabilistic models which simulate retention and excretion of radioactive deposition in humans.

Statistical consultation is currently being provided to Critical Mass Physics on a problem involving linear regression analysis.

In connection with the environmental monitoring study, the evaluation of I_{131} data obtained from stack emissions, analysis of rabbit thyroid, and analysis of vegetation samples continued. A progress report on the interstation correlation of rabbit thyroid data for FY-1957 was prepared.

Statistical and Mathematical Research and Development

Mathematical investigation of the distribution theory of generalized linear estimation in a structural equation was continued this month.

An investigation has been started of the mathematics involved in the extrapolation, interpolation, and smoothing of stationary time series. This comparatively recent branch of mathematical analysis has potentially a wide variety of fields to which it can be applied.

OFFSITE VISITS AND VISITORS

There were no offsite visits or visitors during the month of November.

C. A. Bennett

C. A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

DECLASSIFIED

RADIATION PROTECTION OPERATION
MONTHLY REPORT - NOVEMBER, 1957

A. ORGANIZATION AND PERSONNEL

Organization

No significant changes in organization occurred.

<u>Force Summary</u>	<u>10-31-57</u>	<u>11-30-57</u>
Exempt	44	44
Nonexempt	<u>177</u>	<u>153</u>
Total	221	197

B. ACTIVITIES

The responsibility for providing radiation monitoring for construction forces was transferred to the respective landlord product departments on November 15. Coverage for these forces was provided up to the transfer date without incident.

High dose rates continued to be encountered during experiments conducted at Biology facilities. A difficult task of removing a six-ton hood in one piece from cell #1 in the 231 Building was accomplished with excellent contamination control. The removal of cell cover blocks from H cell in the Redox plant caused temporary dose rates of 15 to 60 mr/hour to employees in the immediate vicinity of the building. An employee in the Hanford Laboratories Operation lacerated his thumb on a piece of equipment in the 234-5 Building. Contamination in excess of 80,000 d/m Pu was measured on the thumb, but the wound appeared to be free of contamination.

Additional shift coverage was required at the 305-B experimental pile. The increased work load is expected to extend to January. High level skin contamination with americium occurred in the 329 Building. Decontamination was difficult, but successful.

A query from the AEC-HOO was received regarding HAPO's state of preparedness for radiological disasters. A prompt review was made and submitted to the General Manager for forwarding.

Training lectures and demonstrations on various phases of radiation protection were presented to a large number of RPO and customer personnel as well as 60 employees in 300 Area Power and Maintenance. Radiation protection talks were also given to 300 teachers in a curriculum workshop at a Richland school.

A detailed report of Radiation Monitoring is contained in HW-54027.

Regional Monitoring

The average daily stack emission of I¹³¹ was 1.2 curies. The higher-than-normal emission rate was caused by a single release of 13 curies from the Redox plant due to a faulty silver reactor. The concentration of I¹³¹ and other fission products found on vegetation decreased by a factor of 2 to 5 from October and was attributed to a reduction in the fallout of bomb debris.

About 3 square miles southwest of the 200-West Area were contaminated with ruthenium particles as a result of the burial of contaminated equipment from the Redox plant. Particle density ranged from three to six particles per 100 square feet. At month end, particle movement appeared to be stabilized by the rainy weather.

The analysis of raw water at 100-F Area showed an average of 6.5 per cent of the continuous occupational MPC_{GI}. Raw water at the Pasco filter plant showed an average of 1.8 per cent of the continuous occupational MPC_{GI}.

A detailed report of waste disposal monitoring is contained in HW-53429.

Exposure Evaluation and Records

Several CPD employees received some face and nasal contamination from ruthenium contaminants which were released when a burial box was inadvertently punctured during burial operations in 200-West Area. Bioassay and body monitor analysis indicated insignificant body deposition.

One case of plutonium deposition occurred to a CPD employee as a result of a minor injury. Analysis of recovered blood and excised tissue showed a total of about 6,000 d/m Pu. Initial bioassay sample results and a survey with the body monitor crystal indicated an estimated deposition of less than 10% MPL. The total number of cases of plutonium deposition on record is 210.

Two radiation incidents occurred involving technical overexposures to three employees in the product departments. The maximum dose received in these cases was 610 mr.

Arrangements were completed for storing current exposure records, which are now kept on magnetic tape in the 3705 Building. This is a disaster precaution to avoid loss of records in current use.

Procurement of new bioassay sampling equipment was delayed when AEC-HOO withheld approval of the purchase requisition on the basis of excessive costs -- approximately \$18 per container for an order of 1000 containers. An improvement in the container provided for participants in the bioassay program is badly needed. The situation is under re-examination.

Radiological Development

The equipment for the badge processing machine arrived as scheduled. Fabrication of the prototype was initiated in the Technical Shops. A target date of 2-1-58 was established for completion of the prototype. While fabrication of the basic equipment is in progress, development and design of refinements will proceed.

Additional data were collected on alternate aperture sizes in the densitometer used to read badge film. Preliminary results indicated that the use of two apertures, one above and one below the film, decreased the "fringe" effect noted at the edge of the shield locations.

Studies were conducted to determine the effectiveness of some of the conventional skin decontamination agents on organic coolants. Unirradiated MIPB (monoisopropyl-biphenyl) was readily dispersed with Phisohex and water. Tide gave slightly poorer results. The eutectic mixture was not dispersed by soap and water.

1248134

REF. ASSOCIATED

No further work was done and none is presently planned on "equipment" decontamination. A report is in progress on the studies which have been conducted for decontamination of reactor piping. Experience with the reagent recommended, Turco 4306B, in other applications will be noted in the report, along with recommendations for using the decontaminant.

A usable circuit for the low-level pencil reading device was obtained. Tests of pencil meter leakage and other performance characteristics are being conducted with the equipment. Further development of the circuit to improve range and sensitivity proceeded. The present circuit has good sensitivity at a dose of 5 mr or greater. At less than 5 mr there is a variation of about 0.5 mr.

At the request of the Calibration Operation, two prototype fast neutron dose rate meters are being prepared for field testing. The double moderator design of the Radiological Physics Operation was slightly altered and fabrication is proceeding. Partially enriched BF_3 tubes were obtained and tested. In conjunction with Exposure Evaluation and Records Operation, a calibration check of neutron film was initiated using plutonium fluoride as source material.

Calibrations

A revised replacement and retirement schedule for portable radiation monitoring instruments was prepared. The net effect was a reduction in the FY 1959 budget from the previous \$47,000 to about \$7,000.

Drawings and specifications were reviewed and up-dated started for procurement of radiation monitoring instruments for the plutonium recycle reactor program.

Radiological Consultation

At the request of the Irradiation Processing Department, preliminary design criteria for the proposed recirculating-water production reactor were reviewed in cooperation with Biology and Chemical Effluents Technology. Comments were drafted for immediate reply, and additional studies in Hanford Laboratories were instigated for completion by December 31, 1957.

A preliminary review was made of the data from the year 1954 for radiation exposure during diagnostic examination at Kadlec Hospital. This work indicated that further studies on the dosimetry for children under 10 years of age are required in order to provide accurate estimates. If it is assumed that all torso examinations are in the direct beam and values for the dose/examination from the literature are used, an estimated total of 0.6 roentgen to the gonads to age 30 was obtained from the data.

Comments were made on a document on the treatment of plutonium inhalation case studies. An extensive series of notes on the dosimetry of particulate materials in the lung and factors relating to the hazards of such particles was made for transmittal to the Subcommittee on Inhalation Hazards.

A recommendation to institute studies of the nature of the mechanism responsible for the formation of radioisotopes in the reactor cooling water was made to Chemical Research. As the plant approaches the limits which have been set for radioisotopes in the Columbia River, more basic studies on the mechanism responsible for these isotopes are required.

Consultations were held on the proposed AFSWP training program to be started next month on the Radiological Physics Fellows training program and on the proposed short course in radiation protection.

Radiological Disaster Studies

A draft document on the limits to be applied to food and water during fallout conditions was reviewed. An alternate derivation of one of the equations and some suggestions on the philosophy of application of permissible limits to emergency conditions were included.

A brief discussion of the consequences of a reactor disaster and the needs for biological experimentation was forwarded to Dr. D. Bruner of the Division of Biology and Medicine in Washington, D. C.

Internal Exposure Studies

A rough draft document prepared by Dr. S. R. Bernard of the Oak Ridge National Laboratory was reviewed. This document derived new maximum permissible limits for uranium based on the studies with human patients. It was indicated that the retention and excretion equations, which were derived in this work, were mutually inconsistent. A review of the basic data indicated that this was probably due to variation between individuals in the retention and excretion of uranium. Since only five cases were available, the use of conventional statistical methods in arriving at the conclusions caused bias in the final answer. Consistent excretion and retention equations were derived which represented the experimental data adequately. Some calculations were made with these equations to provide a method of interpreting uranium bioassay in terms of the quantity of uranium in the body. These calculations are not as yet completed.

C. EMPLOYEE RELATIONS

Safety and Security

There were two medical treatment injuries for a frequency of 0.65. No security violations occurred.

Suggestions

Eleven RPO suggestions were adopted with the awards totalling \$165. Eight suggestions were received for evaluation by RPO.

Relations

An evening meeting was held for all exempt personnel. The attitude survey and salary plan were discussed.

1248136

DECLASSIFIED

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Buildings Data	Areas and Buildings Visited
H. D. Bruner	11-15-57	Division of Biology and Medicine, ABC Washington, D. C.	Discuss biology and medicine program at Hanford.	JW Healy	No	3746:300
Preston Brimhall	11-21-57	Atomic Energy Commission Idaho Falls, Idaho	Review current developments in dosimeters and processing.	RL Junkins LF Kocher IC Nelson EC Watson HA Melloeny	No	3706:300 3705:300

VISITS TO OTHER INSTALLATIONS

J. W. Healy	11-1-57	Division of Biology and Medicine, ABC Washington, D. C.	Discuss information relating to radiation protection.	GV Beard	Yes	
B. G. Lindberg	11-7-57	Portland Disaster Relief and Civil Defense Portland, Oregon	Give lecture.	H. J. Watts CD Coordinator	No	
G. D. Brown	11-7, 8-57	Mallinckrodt Chemical Co. St. Louis, Missouri	Attend meeting on Bioassay and Analytical Chemistry.	----	No	

SECRET

1246137

REGIONAL MONITORING

The general findings are summarized in the following:

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Average Activity Density /uc/cc</u>	<u>Trend* Factor</u>
<u>Drinking Water and Related Materials</u>			
Benton City Water Co. Well	alpha	1.0×10^{-8}	--
100 Areas	beta	$(0.01 \text{ to } 1.3) \times 10^{-5}$	--
200 Areas	beta	$(0.8 \text{ to } 1.3) \times 10^{-6}$	+7
Pasco, Kennewick, McNary Dam	beta	$(0.05 \text{ to } 3.9) \times 10^{-6}$	--
<u>Backwash Solids -</u>			
Pasco Filter Plant	beta	0.23 /uc/gm	--
<u>Backwash Liquids -</u>			
Pasco Filter Plant	beta	4.3×10^{-6}	--
<u>Anthracite, Sand Filter -</u>			
Pasco Filter Plant	beta	3.8×10^{-4} /uc/gm	-2
<u>Other Waters and Related Materials</u>			
200 West Wells	beta	$< 2 \times 10^{-7}$ to 3.0×10^{-3}	--
200 East Wells	beta	$< 2 \times 10^{-7}$ to 5.5×10^{-2}	--
Wells Near 200 Areas	beta	$< 2 \times 10^{-7}$ to 1.4×10^{-6}	--
Outlying Wells	beta	$< 2 \times 10^{-7}$ to 3.3×10^{-7}	--
<u>Columbia River -</u>			
Hanford Ferry	beta	5.1×10^{-5}	--
<u>Columbia River -</u>			
Below Reactors	beta	4.3×10^{-5}	--
<u>Columbia River -</u>			
Paterson to McNary	beta	8.0×10^{-7}	-2
Columbia River - Mud	beta	$(0.2 \text{ to } 4.8) \times 10^{-4}$	+2
Raw Water - Operating Areas	beta	$(0.008 \text{ to } 3.2) \times 10^{-5}$	--
Reactor Effluent Retention Basins to River	beta	14,000 to 45,000 /uc/sec/reactor $(0.4 \text{ to } 1.2) \times 10^{-2}$	--
Reactor Effluent Retention Basins to River	alpha	< 0.04 /uc/sec/reactor $< 5 \times 10^{-9}$	--
I-131 in Farm Wastes to River	I-131	1.0×10^{-6}	--
I-131 in Columbia River - Hanford	I-131	9.6×10^{-8}	--

* The trend factor shows the n-fold increase (+) or decrease (-) from last month, where the values of n less than 2 will not be noted.

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Average Activity Density</u> <u>/uc/cc</u>	<u>Trend*</u> <u>Factor</u>
<u>Atmospheric Pollution</u>			
Gross Alpha Emitters	alpha	(<0.2 to 6.4) x 10 ⁻¹⁵	--
Gross Dose Rate - Separations Areas	beta-gamma	0.7 to 4.1 mrad/day	--
Gross Dose Rate - Residential Areas	beta-gamma	0.4 to 1.7 mrad/day	--
Active Particles - Separations Areas	beta	(1.9 to 5.2) x 10 ⁻¹³	-3
I-131 Separations Areas	I-131	(2.0 to 3.8) x 10 ⁻¹³	-5
I-131 Separations Stacks	I-131	1.2 curies/day	+3
Ruthenium - Separations Stacks	Ru-103-106	< 0.02 curie/day	-2
Active Particles - Wash., Idaho, Ore., Mont.	--	0.006 to 0.028 ptle/m ³	-30
Active Particles - Project	--	0.006 to 0.034 ptle/m ³	-3
<u>Vegetation</u>			
Environs of Separations Areas	I-131	5.0 x 10 ⁻⁶ /uc/gm	-3
Residential Areas	I-131	7.0 x 10 ⁻⁶ /uc/gm	-2
Eastern Washington and Oregon	I-131	1.6 x 10 ⁻⁶ /uc/gm	-10
Fission Products Less I-131 Wash. and Ore.	beta	1.1 x 10 ⁻⁴ /uc/gm	-2
Alpha Emitters - Separations Areas	alpha	(0.04 to 1.0) x 10 ⁻⁵ /uc/gm	+2

* The trend factor shows the n-fold increase (+) or decrease (-) from last month, where the values of n less than 2 will not be noted.

1248139

SECRET

<u>RADIATION MONITORING</u>	<u>Hanford Laboratories</u>	<u>Minor & Major Construction</u>	<u>Others</u>	<u>Nov.</u>	<u>Year to Date</u>
Special Work Permits	2000	234	167	2401	28,923
Routine and Special Surveys	1080	224	225	1529	25,018
Air Samples	2144	107	256	2507	25,855
Skin Contamination	5	2	0	7	202
*Class II Radiation Incidents	0	0	0	0	1
**Class II Radiation Incidents	0	0	2	2	8

EXPOSURE EVALUATION AND RECORDS

<u>Gamma Pencils</u>	<u>Pencils Processed</u>	<u>Paired Readings 180-280 mr</u>	<u>Paired Readings Over 280 mr</u>	<u>Lost Readings</u>
November	134,362	12	5	9
1957 to Date	2,226,734	137	115	94

300-L Area

November	14,206	6	2	0
1957 to Date	107,764	28	14	11

Beta-Gamma Film Badges

	<u>Badges Processed</u>	<u>Readings 100-300 mrad</u>	<u>Readings 300-500 mrad</u>	<u>Readings Over 500 mrad</u>	<u>Lost Readings</u>	<u>Average Dose Per Film Packet</u>	
						<u>mrad(ow)</u>	<u>mr(s)</u>
November	22,101	546	17	1	70	2.19	5.68
1957 to Date	452,988	7,411	287	67	805	1.75	3.95

Slow Neutron Pencils

	<u>Pencils Processed</u>	<u>Paired Readings 4-12 mrem</u>	<u>Paired Readings Over 12 mrem</u>	<u>Lost Readings</u>
November	3,844	45	6	4
1957 to Date	31,212	401	123	23

Fast Neutron Film Badges

	<u>Badges Processed</u>	<u>Readings Above 50 mrem</u>	<u>Lost Readings</u>
November	1,000	3	2
1957 to Date	10,784	9	13

Bioassay

		<u>November</u>	<u>1957 to Date</u>
Plutonium: Samples Assayed		1,575	13,418
Results above 2.2×10^{-8} $\mu\text{c}/\text{sample}$		42	71
Fission Product: Samples Assayed		1,650	14,607
Results above 1.3×10^{-5} $\mu\text{c FP}/\text{sample}$		4	19
Uranium: Samples Assayed		427	4,489

*HLO Radiation Monitoring Customers

**Other Plant Components

1246140

DECLASSIFIED

<u>Uranium Analyses</u>	<u>Following Exposure</u>			<u>Following Period of No Exposure</u>		
	<u>Units of 10^{-9} μc U/cc</u>			<u>Units of 10^{-9} μc U/cc</u>		
<u>Sample Description</u>	<u>Maximum</u>	<u>Average</u>	<u>Number Samples</u>	<u>Maximum</u>	<u>Average</u>	<u>Number Samples</u>
Fuels Preparation	21.80	5.15	53	7.05	2.53	39
Hanford Laboratories	31.10	7.93	19	11.50	3.73	19
Chemical Processing	41.10	7.59	116	32.80	5.63	105
Chemical Processing*	175.70	25.20	40	17.80	5.76	17
Special Incidents	11.90	4.07	3	--	--	--
Random	2.03	0.68	16	--	--	--

*Samples taken prior to and after a specific job during work week.

<u>Tritium Analyses</u>	<u>November</u>	<u>1957 to Date</u>
Samples Assayed	0	59

Thyroid Checks

Checks Taken	42	360
Checks Indicating .01 μ c	0	1

Hand Checks

Checks Taken - Alpha	53,537	572,401
Beta-Gamma	51,524	526,216

CALIBRATIONS

	<u>Number of Units Calibrated</u>	
	<u>November</u>	<u>1957 to Date</u>
CP Meter	1,022	11,388
Juno	352	3,894
GM	1,357	15,001
Other	208	1,968
Total	2,939	32,251

Personnel Meters

Badge Film	792	22,098
Pencils	9,716	70,286
Other	362	2,427
Total	10,870	94,811

Miscellaneous Special Services	42	5,862
<u>Total Number of Calibrations</u>	13,851	132,924

A. R. Keene
A. R. Keene, Manager
RADIATION PROTECTION

ARK:bh

1248141

SECRET

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - NOVEMBER, 1957

General

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 2.44 per cent which is substantially the same as October experience.

The absenteeism rate was 3.68 per cent, a decrease of about 1.13 per cent below October experience.

There were no security violations charged to the Operation for the fourth consecutive month.

No grievances were filed and the grievance involving craft jurisdiction submitted by the sheet metal craft last month was considered settled at Step I.

Facilities Engineering Operation

Responsibilities for performance of work on Project CG-747, Plutonium Fabrication Pilot Plant, are being turned over to the Manager, Reactor and Fuels R&D effective December 2, 1957. Our efforts on this project to that date have consisted of all work necessary to obtain AEC authority and to perform liaison functions for scope and detail design--with an interim authorization of \$100,000 for this project of total estimated cost of approximately \$4,000,000. The scope work is 100% complete and detail design is estimated to be approximately 10% complete as of December 2, 1957; funds expended for work to this date will approximate \$117,000.

There are currently 31 active projects in HLO excepting the PRPR. Twenty of these are fully authorized. Two are authorized in part. Six are awaiting action of the Commission and three are in project proposal preparation stage. Authorized funds amount to \$3,910,000 for total current project activity estimated at \$14,635,000.

Work is underway on all FY-1958 budgeted line items.

Data is being compiled and arrangements being made with HLO components for initiating budget study work.

The current status of HLO project activity is summarized on the attached report.

The following is the status of job items currently active in FEO:

- a. Contaminated Waste Chute, 327 Bldg. - Construction Operation will start work on 12-9-57.
- b. Thermal Expansion Layout - Sponsor's Contact Engineer tied up on other work. Requests to be contacted again 12-5-57.
- c. X-Ray Diffraction Sample Holder - Completed by sponsor.
- d. Impact Tester - Sponsor requests job be held in abeyance until after 1-1-58.
- e. Hot Microscope - Sponsor requests job be held in abeyance until 1-1-58.
- f. Modification of Elevator, 327 Bldg. - Inactive at present.

- g. Vacuum Air Sampling System, 108-F Bldg. - Project proposal written. Held up pending study of availability of funds.
- h. Hood Repair and Relocation, 329 Bldg. - Work proceeding.
- i. Fabrication and Installation of Pig Feeder Stalls, 141-F Bldg. - Work complete. Job closed out.
- j. 100-F Pasture - Work complete. Job closed out.
- k. Winterize 108-F Train Shed Air Conditioner - Installation of conditioner 95% complete and system in operation. Pipe lagging and housing insulation scheduled for completion by 12-9-57.
- l. Installation of Heating Cable and Insulation of Manure Auger, 141-N Bldg. - Work Order issued to 100-F Maintenance. Work proceeding.
- m. Whole Body Animal Counting Room, 141-F Bldg. - Work Order A-57831 issued to Construction Operation.
- n. Re-route Steam Line, 141-F Bldg. - Estimate received from IPD Maintenance - \$464. By agreement of the tenants this work will be deferred until FY 1959 due to lack of funds.
- o. Dog Pen Drainage and Kennel Repair - Work complete.
- p. Controlled Temperature Room - Deferred until FY 1959.
- q. Correct Leaking Pump Seals in Plating Laboratory, 306 Bldg. - A Work Order has been received to specify and procure two mechanical seals. The specification is being prepared.
- r. Hot Mop, 146-FR Roof - Complete.
- s. Correct Noisy Heating Coil in 3760 Bldg. - A venting system was installed after which it was apparent that back pressure was building up in the condensate return piping. This piping was cleaned out and some sections replaced. The noise has stopped.

The following maintenance and building engineering work was performed:

- a. The maintenance and operation cost study for 300 Area HLO properties was completed.
- b. A report on conditions of women's rest rooms was completed.
- c. Plans are being developed for better space utilization in Library and Files Building.
- d. A new propane tank is being installed in the 300 Area. This new tank is a code vessel and will take the place of an existing vessel.
- e. A study and plans are being formulated toward better space utilization in 3707-C Building. This plan will allow for rearrangement of FFD and HLO personnel.
- f. Disposal of P-11 properties is in progress. The contaminated Butler type building and exclusion are fence will remain in place. All other facilities are being removed.
- g. An overload on the electrical system caused a short circuit in 141-F Building system. Damage was confined to the system, resulting in replacement of breaker box and service drop. These new items will be sized for larger capacities. A power demand study will be made on this building.

- h. The procurement and installation of the Shielded Cave in the 325 Building (AR-57-HL2-47) is approximately 95% complete with a total of \$20,393 expended and a remaining balance of \$937. Work remaining consists of installation of lights, placing front brick, nomenclature and diagrams, and cold tests.
- i. Remedial work on the heating system in 306 Building has resulted in replacement of all fan bearings, alterations to the condensate piping in the equipment room and rehabilitation of the building control system.
- j. The engineering survey of HLO code vessels and systems is approximately 30% complete.
- k. A roof has been placed over the gas cylinders on the 326 Building and loading dock.
- l. An investigation of the roof on 146-FR Building after leaks were detected during a rainstorm resulted in resurfacing the entire roof area with a hot asphalt roofing compound.

The drafting operation has a heavy backlog of work. Approximately 290 drawings were produced or revised during the month and about 8700 square feet of prints were produced. Major designs completed or in process are:

- (1) "Cesium Isolation and Packaging". This design to provide equipment for the remote handling and conversion of liquid Cesium to the powdered state, automatic canning and placing in casks ready for shipping. Design 1% complete.
- (2) "15 Ton Cask Dolly". This apparatus designed to handle and transfer 15 ton shipping casks within the 327 Radio-Met Building.
- (3) "Precision Tool Grinding Fixture". Equipment designed for the precision grinding of lathe cutting tools.
- (4) "Press Hood for M.T.R. Fuel Plate Program". Hood was designed to contain 200 ton press.
- (5) "Fluidized Bed for Oxides". Apparatus was designed for increasing the quality of Uranium Oxide reduction (UO_3 to UO_2).
- (6) "Oxide Fuel Welding Elements". Supports and powered rolls for welding nested tubular oxide fuel elements are being designed and drafted. This equipment to be used on conjunction with vacuum welding box.

Technical Shops Operation

Total productive time for the month was 11,269 hours. The total shop work backlog is 22,720 hours of which 50% is required in the current month, with the remainder distributed over a six month period. Overtime worked during the month was 2.1% (326 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
Fuels Preparation Department	1484	13.2
Irradiation Processing Department	1810	16.0
Chemical Processing Department	1002	8.9
Hanford Laboratories Operation	6763	60.0
Construction Engineering Operation	2	-
Miscellaneous	208	1.9

1248144

Customer demands for service remained firm in all components and increased in the Glass Shop. A reduction in requests for priority service and keen, judicious, scheduling of the work permitted a reduction in overtime work from 3.9% the previous month to 2.1% the current month.

Safety and security performance was considered satisfactory with no major violations. A reduction in the minor injury rate has been noted for two consecutive months with no valid explanation as to cause.

Absenteeism decreased from the previous month and is now within the established parameters.

No grievances were filed and the jurisdictional grievance received the previous month from the sheet metal craft protesting work assigned to the millwright craft is considered settled at Step I.

Technical Information Operation

A number of changes were made during the month to further round out the reorganization of the Technical Information Operation which was effected in September. Two members of the technical abstracting staff were assigned new responsibilities and a clerk was transferred from the Document Distribution & Files group to Report Reference & Publication.

The document routing portion of the modified IBM system was put into operation on November 1. Final preparation of the master tape of total site accountability is still pending. A final decision has not been made on where the keypunching of the input data (receipts, file record cards, and certificates of destruction) will be done. The Office Procedures Specialist in Financial Operation has been asked to study the matter.

The AEC's recent proposal that the Patent Branch review all unclassified technical documents prior to offsite release from Hanford continued to require considerable time. The Manager of Technical Information initiated a letter to send to the Patent Branch, asking that the present system be reviewed for adequacy, and if it is not found adequate, that HAFG be given more time to study the proposal. The Technical Information Operation also arranged to obtain information from the Departments regarding a proposed system of categorizing reports for patent purposes. Reports in the suggested categories would not ordinarily result in inventions and would be excluded from the patent review. Most comments had been received by the month's end.

A proposal was received from Relations & Utilities Operation suggesting that classified document delivery be combined with the regular plant mail runs. Although this procedure has been used in the past and was abandoned, it was agreed to study the matter again. The Office Procedures Specialist in HLO's Financial Operation has been asked to review the proposal.

The Manager of Technical Information attended the annual meeting of the Technical Information Panel in Los Angeles. Prior to the meeting the Library & Document Committee, of which he is chairman, met for two days to (1) consider the results of an AEC survey of card catalogs, and (2) assign priorities in updating bibliographies on which TISE is working. Main items on the Panel agenda included procedures for patent review of unclassified documents, technical information packet and exhibits for the Geneva Conference, technical books about and progress reviews of the AEC programs, Russian translation problems, etc.

A task force of personnel from IPD, FPD and HLO have prepared proposals for revising certain AEC classification guides. After the HAPO members of the EOO Classification Committee have studied the proposals, they will be submitted to the entire Committee for approval and transmittal to the Division of Classification in Washington. It is believed that these changes in the basic AEC guides must be made before the AEC can accept revision of the Hanford Classification Guide. In the meantime we are proceeding with the revision of the Hanford Guide on the assumption that the proposed changes in the AEC guides will be adopted.

Work volume statistics for the month of November are as follows:

	<u>October</u>	<u>November</u>
Documents routed and discharged	17,338	17,506
Documents received from offsite	1,651	1,382
Documents issued (includes offsite)	13,806	15,352
Documents sent offsite	6,246	2,593
Documents filed	7,924	6,224
Packages prepared for offsite	1,405	2,593
Documents picked up and delivered	29,517	21,536
Holders of classified documents whose files were inventoried	10	874
Copies of documents destroyed	5,403	4,468
Copies of documents retired to Records Center	424	1,270
Copies of plant manuals revised	353	595
Document titles recalled for correction downgrading, destruction and other reasons		
Recalls in process	192	276
New recalls from offsite	14	41

1248146

	<u>October</u>	<u>November</u>
New Recalls from Hanford	144	43
Recalls completed	80	74
Documents requested by HAPO personnel		
Total requests received	3,140	3,083
Document requests filled	1,973	1,966
Document reserves		
Document requests unfilled and pending	267	167
Requests filled	597	750

Cycle document holding inventories for October and November were run during the month. These inventories are the first since conversion to the modified IBM system. From all indications, the inventory listings are accurate. Discrepancies which have been brought to light are due to Files clerical errors.

The inventory of documents in the Records Center was completed on November 18. A total of 1,314 boxes (63,990 copies) were inventoried.

The Inventory Clerks have been reconciling discrepancies resulting from the recent IBM conversion. The major item was determining what R & D reports were received since January 1, 1957. During the conversion the R & D report information was dropped from the tape. Since an annual inventory of R & D reports is required, it is necessary to reconstruct the lost information before taking the 1957 inventory.

Satisfactory progress was made on the following projects during the month:

1. HW-52271, "Corrosion of Selected Metals Under Radiochemical Environment: A Bibliography" was typed.
2. HW-52736 RD, "Hanford Contribution to the Plutonium Notebook" was issued during the month.
3. Both the July and August issues of the "Summary Report of Hanford Research and Development" were issued.
4. Approximately 1,000 earlier project reports were reviewed for possible abstracting and indexing.
5. The HAPO Series and Periodic file was brought up to date by (a) pasting to open-entry cards, and (b) preparing cross references for newly created reports.

Radiographic Testing Operation

Radiographic Testing Operation activity continued at a high level for November with the number of tests more than double the number made in October. A total of 2601 tests were made of which 499 were radiographic exposures (including x-ray and gamma-ray exposures) and 2102 were supplementary tests. The supplementary tests consisted of work with dye penetrant, dimensional checking, eddy current, magnetic particle, and ultrasonics. Work was done for 16 different organizational components representing all of the operating departments and service operations. A total of 11 reports were issued detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on 15 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated.

Details of work accomplished are as follows:

A. Qualifications and Certifications

Various welders qualification coupons were examined to determine their acceptability. Additional work is being done in this area on samples previously contracted by the AEC for off-site examination.

B. As-Received Material

To meet a Hanford commitment for longitudinally welded stainless steel pipe to be sent to an off-site contractor working on a new vessel fabrication, an appreciable amount of pipe had to be examined to find acceptable pieces. This material appears to be part of a larger quantity existing on-site that will require radiographic examination to be suitable for use in Class I vessel fabrications.

C. Fabrication

Two vessel fabrications were completed this month. The closure welds on the Redox Slug Dissolver Tank were examined radiographically and with dye penetrants to complete the work on this vessel. Similarly, the final welds on the TH-2 Purex Column were examined completing the work on this vessel. On the L-cell package the scope of the original work has been considerably increased because of the discovery of defective longitudinally welded pipe used in the fabrication. In addition, miscellaneous connecting pipe joints are being examined to give as complete knowledge as possible of the quality of this critical vessel. Repair work has been identified for the shop forces and it is anticipated that this work will be completed in December. In the fabrication of a pressurizer vessel at White Bluffs a problem was encountered with run-out of the bore of the principal vessel. The difficulties encountered in machining this vessel put the thickness of the wall in question. Since micrometers and calipers could not be applied to the work, ultrasonic thickness testing was used to determine if minimum wall requirements were met. The fabrication presented somewhat

of a problem because of the heavy wall thickness and the small diameter of the vessel. However, use of a fabricated standard was successful and the wall thicknesses determined with satisfactory accuracy.

D. Research and Development

The main research and development effort was concerned with two major projects. The first is the continuing effort on zirconium process tubes where satisfactory progress is being made in development of the various tests and their interpretation. Considerable effort was expended in obtaining information on a group of 16 BDF-size tubes which are part of a current development order on which more work is to be done. Eddy current results indicated that all of the tubes contained imperfections. Dye penetrant results on the outside surface were negative and only partial correlations were obtained by radiographic examination. Ultrasonic tests made on one tube were also negative, however, close visual examination did disclose a shallow gall mark. Boroscope examinations will be made on the remainder of the tubes to discover if there are surface imperfections existing on the inside diameters. In addition to the zirconium process tubes examined a special tube of carbon steel was given partial coverage to determine its suitability for emergency use in the KER Recirculation Loop. A large number of the dimensional measurements made this month were on this tube. The other major effort this month in research and development assistance was concerned with MTR fuel fabrication being done by the Plutonium Metallurgy Operation. Various castings containing different alloy percentages were examined for soundness. Work was started with unalloyed aluminum, then additions made of uranium and plutonium respectively. Other zirconium tubing examined during the month included miscellaneous lengths and diameters of longitudinally welded thin wall tubing and some small diameter tubing to be used for FRP fuel element development work. Miscellaneous research and development work included an I & E wafer slug for the determination of wafer thickness and orientation, and a GEH aluminum tube containing ceramic wafers and heaters for the MTR testing program.

E. Maintenance

The D-DR Area pressure vessel survey work was completed this month with the findings indicating that the majority of the vessels were not of code quality. Representative vessels in all of the buildings of these two areas were examined. Additional hot shop outage tools were examined for defects. Most of these tools have proven to be satisfactory except for difficulties encountered in the spiral reamers which show a large tendency for cracking. Some of the difficulty here would appear to be improper heat treating. Another crank shaft from a diesel engine was examined as part of the preventative maintenance program of the Heavy Equipment Operation of Transportation. No discontinuities were found in the crank shaft.

F. Construction

The only construction project worked on this month was that involving the charging machine being built at 100-C Area. Various critical parts of the machine were examined for manufacturing flaws. One cast carbon steel cable guide was found to have extensive shrinkage making it unsuitable for its intended use. The other parts examined were of an acceptable condition.

Testing Statistics

<u>Component</u>	<u>No. of Tests</u>	<u>Ft. of Weld or Material</u>	<u>No. of Pieces</u>	<u>Description</u>
A. Chemical Processing Dept.	134	144	85	Stainless Steel process vessels and piping.
B. Construction Engrg. Oper.	180	113	36	Stainless Steel process vessels, piping, and coupons.
C. Fuels Preparation Dept.	11	15-1/2	3	Carbon Steel pressure vessels.
D. Hanford Laboratories Oper.	705	2957-1/2	213	Zr and carbon steel process and PRP tubing. Al, U, and Pu castings. I & E wafer element. GEH Assembly.
E. Irradiation Processing Dept.	1526	782-1/2	139	Carbon steel process tube and pressure vessels. Carbon steel castings and machined parts.
F. Relations and Utilities Oper.	45	18	1	Forged steel crankshaft from diesel coach.
Totals	2601	4030-1/2	493	

Laboratories Administration and Technical Liaison

One new Organization and Policy Guide was issued. Timely revisions were issued on specific sections to four existing guides. The Organization and Policy Guides were reviewed again. Delegations of authority and requirements for mandatory action were summarized for inclusion into a revised OPG No. 02.3.1, Approval Authorizations.

Two letters of delegation of authority for work authorizations were issued as well as specific delegations covered by OPG No. 02.3.1, Approval Authorizations.

The contract DDR-29 with Nuclear Metals, Inc. for the fabrication of zircalloy tubing was approved.

The contract SA-17 with Swedish Hospital which expires December 31, 1957, is being considered for extension.

There were no new requests for Assistance to Hanford and for Service under the KAPL Program.

Transportation and Maintenance Operation has made the following vehicle assignments upon request:

- (a) Five pickup trucks were reassigned within Hanford Laboratories Operation.
- (b) Two pickup trucks, one panel truck, and one sedan were returned.
- (c) Three pickup trucks were assigned to Atmospheric Physics Operation periodically during the month for special work.

The above sedan was added to the 300 Area Motor Pool to alleviate further the inter-area transportation problem. Inter-area transportation has been improved substantially during the month.


Manager
LABORATORY AUXILIARIES

JL Boyd:lt

UNCLASSIFIED

MONTHLY PROJECT REPORT

11M-53961

NOVEMBER

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE		BENEFICIAL USE DATE	PROJECT COMP. DATE
				AMOUNT	DATE	DESIGN SCHED ACTUAL	CONST. SCHED ACTUAL	DESIGN CONST.	DESIGN CONST.		
General AEC-2-23X-56-L-2	Plant Projects - FY 1956	Reactor & Pumps	\$140,000	\$140,000*	4-4-57	100	38	46	5-23-56	AS	9-28-56
CG-664	350° C Flow Loop - 314 Building					100			12-7-56	Completed	5-1-58
	Engineer: R. W. Dascenzo										
General AEC-2-23-57-N-2	Plant Projects - FY 1957	Radiation Protection	\$150,000	\$150,000	2-4-57	100	99	0	2-18-57	2-1-58*	8-15-58*
CA-658	Shielded Personnel Monitoring Station - 747 Building										
	Engineer: D. S. Jackson										
CG-680	Corrosion Testing Facilities 314 Building										
	Engineer: R. W. Dascenzo										
CA-700	Geological and Hydrological Wells - FY 1957										
	Engineer: D. S. Jackson										

REMARKS: Fabrication of loop by Construction Operation is on schedule. Byron-Jackson will be probably two months behind schedule on delivery of the canned motor pump. Minor difficulties pertaining to procurement of stainless steel tubing fittings have been resolved. Fabrication of various components is nearly completed. *Includes \$350 transferred equipment.

REMARKS: The Architect-Engineer transmitted the completed plans and specifications to the AEC on November 27, 1957. They should be reviewed and revised by 12-6-57. *The Commission has not yet prepared a revised project schedule, however the dates shown are our best estimate at present. Procurement time on the outer 3" of cell steel will be approximately 3 months after the construction contractor places his order. The building cannot be completed until the cell is assembled in place.

REMARKS: HLO has requested some additional work in the project which will be included. The latest shipping dates on the Magnatrols and Condensers are 11-15-57 and 11-22-57. The high pressure autoclaves were to be tested the week of 11-25-57, and if acceptable beneficial use could start immediately. Mechanical installation is complete except for installation of the condenser and insulation of the lines and equipment. Testing has been completed on Medium Pressure Autoclaves.

REMARKS: Chemical Research \$122,000 6-27-57 100 100 11-8-56 As wells 1-15-57
 The USGS completed its last well, bringing the USGS total to 15 wells having a total depth of 5869 feet. The fixed price contractor has completed 10 wells and is currently drilling 2 others. His total depth to date is 5872 feet of hole. The original fixed price contract called for 20 wells having an aggregate depth of 5400 feet. Since then two wells were added bringing the total estimated depth to 6100 feet. No extension of time was given at the time these wells were

REMARKS: (CA-700 - Continued)
 added. One additional well having an estimated depth of 540 feet will be added to the contract. At that time the contract and project completion dates will be extended through January, 1958.

1208152

MONTHLY PROJECT REPORT

UNCLASSIFIED

HW-53961
NOVEMBER, 1957

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE
				AMOUNT	DATE	DESIGN SCHED	ACTUAL	CONST. SCHED			
CA-728	High Level Exposure Facility Addition - 141-H Building	Biology Research	\$ 26,000	\$ 26,000	2-11-57	100	61	100	3-11-57	10-1-57	6-20-57
<p>REMARKS: Customer has beneficial use. Minor differences between items furnished and those specified are indicated to be acceptable by the customer. Final acceptance is scheduled for November 29, 1957.</p>											
CG-729	Ventilation System Improvements - 222-H Building	Chemical Research	\$ 73,000*	\$ 73,000*	3-12-57	100	42	60	4-23-57	1-15-58	5-28-57
<p>REMARKS: The fixed price contractor is working on the existing ventilation unit on the north end of the building and has essentially completed the sheet metal work and approximately 30% of the piping on this unit. The contractor has installed the duct work on the roof and it is complete except for painting. The contractor has set the exhaust unit on south end of building, however, no ductwork has been installed. *An analysis is being made on the existing refrigeration equipment and indications are</p>											
CG-729	Plutonium Metallurgy Facility	Reactor & Fuels	\$ 295,000	\$ 295,000	5-10-57	100	32	60	5-14-57	As Completed	10-1-57
<p>REMARKS: Lump sum contract was awarded to F. H. Johns for \$15,833. This work was started on November 14 - cleaning out lunch room facilities. Also plumbing sub-contractor started work on November 18. Construction Operation has completed Room 42 and it is now occupied by customer. Room 39 is complete. Of remaining rooms 50% are complete except for painting, miscellaneous hardware and floor finishing. Furnace pit and drains are complete. The large contaminated hood in Cell I was removed</p>											
<p>REMARKS: (CG-729 - Continued) that it would be very expensive to repair the existing equipment. As a consequence, a small package unit is being considered as the most economical and satisfactory expedient. There is a possibility of an overrun due to this condition; however it should be well within the allowable overrun of 10%.</p>											
<p>REMARKS: (CG-733 - Continued) without incident through vent room.</p>											

1240153

UNCLASSIFIED

MONTHLY PROJECT REPORT

HW-53961
NOVEMBER, 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS		STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE
				AMOUNT	DATE	DESIGN ACTUAL	CONST. ACTUAL			
IR-224	Biology Controlled Activity Water System - 100-F Area		\$ 19,900	\$ 19,900	6-27-57	100	99	1-2-57 7-22-57	12-6-57*	4-11-57 12-6-57*
<p>REMARKS: All construction and installation is completed. Final pressure adjustment, measurement of flow rates, and winterizing are being performed at present. All work should be complete by December 6, 1957.</p>										
CG-757	Coolant Radio Analysis Laboratory Addition - 1706-KE		\$ 77,500	None to date	None to date	0	0	7*	12*	13*
<p>REMARKS: This project was combined with IPD's Projects CG-755 and CG-781 into Project CG-781 on the 1706-KE Building. The AEC Board of Review rejected this project on 11-21-57 as too expensive. IPD and HLO Contact Engineers will review the estimate for accuracy and possible economies.</p>										
CA-760	Expansion of the 3745-B Building		\$193,000	None to date	None to date	0	0	9*	16*	16*
<p>REMARKS: Project Proposal and Plant and Equipment Analysis Report being revised.</p>										
CA-765	Additions to the 314 Building		\$ 46,000	\$ 6,800	10-3-57	100*	To be estd	10-14-57	10-4-58	3-4-58
<p>REMARKS: AEC Directive No. AEC-117, Mod. I authorized the Commission \$46,000 and by Work Authority CA-765 (2) dated 11-15-57 the General Electric Company was authorized \$6,140 for preparation of design criteria, review of A-E's work, minimum field liaison, and final inspection services. The Commission has awarded an A-E Contract, AT(45-1)-1240, to Carson & Moe for Title II & III services in the amount of \$2,570. Design by the A-E should start December 1, 1957 & be completed on February 15, 1958.</p>										
<p>* Months after authorization.</p>										
<p>REMARKS: (CA-765 - Continued) * General Electric portion only, including only the design criteria and preliminary design.</p>										

1240154

UNCLASSIFIED

MONTHLY PROJECT REPORT

HW-53961

NOVEMBER, 1957

PROJECT NUMBER	TITLE	ENGINEER	USING COMPONENT		EST. TOTAL PROJECT COST		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE		BENEFICIAL USE DATE		PROJECT COMP. DATE	
			AMOUNT	DATE	DESIGN SCHED	ACTUAL	CONST. SCHED	ACTUAL	DESIGN	CONST.	DATE	DATE	DATE	DATE		
CA-769	Additions to the 622 Building	Engineer: J. T. Lloyd	Physics & Instr.	\$ 80,000	None to date	0	0	0	0	0	0	2-1-58*	9-1-58*	2-1-59	8-15-58*	3-1-59*
<p>REMARKS: Project Proposal awaiting AEC Approval. The AEC Project Review Board at the last meeting temporarily deferred action pending further study.</p>																
CA-784	Alterations to the 327 Building	Engineer: J. T. Lloyd	Reactor & Fuels	\$ 80,000	None to date	0	0	0	0	0	0	3-1-58*	7-1-58*	3-1-59*	4-15-58*	3-1-59*
<p>REMARKS: The project proposal was transmitted to the Commission during the last week of November.</p>																
CA-778	Expansion of the 305-B Building	Engineer: A. W. Herwin	Physics & Instr.	\$ 55,000	None to date	0	0	0	0	0	0	1-1-58*	6-15-58*	10-1-58*	5-1-58*	11-1-58*
<p>REMARKS: Project Proposal approved by the AEC-H00 10-25-57 and forwarded to the AEC Washington for approval.</p>																
IR-232	Repair Damage and Additions to Heating System - 747 Building	Engineer: R. C. Ingersoll	Laboratory Auxiliaries	\$ 15,000	8-29-57	100	100	65	80	As Completed	7-1-57	10-24-57	8-12-57	12-29-57		
<p>REMARKS: All 5 steam heaters are in use. All coils except 1 preheat coil is out of service. New coils and sheet metal housing installation has started. Contractor expects steam back on coils by 12-1-57. Additional heat provided by temporary electrical hookup for electrical heaters. Work done by Plant Maintenance.</p>																
CG-779	Alterations to the 321 Building	Engineer: J. T. Lloyd	Chemical Research	\$ 63,000	None to date	0	0	0	0	0	0	2-17-58*	4-17-58*	6-17-58*	4-17-58*	8-17-58*
<p>REMARKS: Project Proposal was given to AEC on 10-17-57. Information on Prototype was given to AEC by document. They will be sent to Washington after local study.</p>																

* Based on AEC Approval by December 1, 1957.

MONTHLY PROJECT REPORT

HW-53961
NOVEMBER, 1957

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE		BENEFICIAL USE DATE		PROJECT COMP. DATE	
				AMOUNT	DATE	DESIGN SCHED	ACTUAL	CONST. SCHED	ACTUAL	DESIGN DATE	CONST. DATE	DATE	DATE
IR-234	Storm Windows and Sun Shades - 326 Building		\$ 14,000	10-31-57	100	0	0	8-1-57	1-2-58*	2-15-58*	11-15-57	2-15-58*	
<p>REMARKS: Specifications were furnished the AEC. Twenty-one Bid Packages were distributed in the Northwest area. Bid opening was on November 25, 1957. The low bidder was Aluminum Screen Company of Seattle, Washington.</p>													
* Estimated.													
CG-620	Vacuum Furnace		\$120,000	2-7-57	100	100*	100*	5-1-56	6-1-57	12-15-57**	4-1-57	9-30-57	
<p>REMARKS: The Physical Completion Notice dated 9-30-57 will be issued with \$18,000 in accruals to complete exceptions. * Exceptions are: 1) reinstallation of M-G set repaired by vendor. M-G set arrived on plant 11-20-57 and reinstallation started 11-22-57. 2) Centrifugal casting mechanism, final inspection test reports were received 11-22-57. Shipment is pending G.E. approval. ** Beneficial use data was changed from 8-31-57 due to delay in delivery of M-G set.</p>													
CG-660	Modifications and Additions to the Metallographic Cell - 327 Building		\$130,000	3-15-57	100	80		3-27-57	5-14-57	2-15-58*	4-1-57	2-15-58*	
<p>REMARKS: A base casting on the metallograph was broken upon arrival. This necessitated returning the instrument to Bausch and Lomb. Because of precision fitting necessary it appears the metallograph will not be returned to HAPD until early January. The metallograph sample manipulator is scheduled for delivery on December 20, 1957. *Because of damage to the metallograph during shipment and subsequent repair time, the project completion date will be extended beyond 12-31-57.</p>													
CG-661	Additional Heat Generation Facility - 189-D Building		\$664,000	9-18-57	39	0		12-6-56	1-15-59	9-30-59	11-1-58	8-31-59	
<p>REMARKS: The Purchase Specification for the Direct Current Power Supply has been issued to prospective bidders. Bids on the heat exchangers are currently being reviewed.</p>													
CG-672	Monochromatic Neutron Beam Facility - 105-KE Building		\$195,000	3-7-57	100	7		5-21-56	11-1-57	5-1-58	10-1-57	5-1-58	
<p>REMARKS: Installation of the Beam Shutter was begun; however, the beam hole dimensions differed from the as-built drawings and modifications must be made to the equipment. Installation will be resumed at the next outage. The spectrometer casting being fabricated at the Puget Sound Naval Shipyard is being tested for tolerance requirements, if satisfactory it will be shipped first week in December.</p>													

Engineer: J. T. Floyd

Engineer: R. C. Ingersoll

Engineer: D. S. Jackson

Engineer: A. W. Herrin

Engineer: H. Radow

MONTHLY PROJECT REPORT

HM-53961
NOVEMBER, 1957

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE		BENEFICIAL USE DATE		PROJECT COMP. DATE
				AMOUNT	DATE	DESIGN SCHED ACTUAL	CONSTR. SCHED ACTUAL	DESIGN DATE	CONSTR. DATE	DESIGN DATE	CONSTR. DATE		
CA-681	Hanford Equipment in the ETR	Reactor & Fuels	\$1,200,000	\$900,000	8-9-57	100	0	0	0	9-17-56	2-15-58	10-15-58	5-29-57 10-15-58
<p>REMARKS: Starting date still quoted by the Commission is 2-15-58. Procurement is essentially complete except for placement of order for 9 x 9 facility tube. Other procurement depends on design modifications that may be required, a major one being the common condenser header change. Phillips has still not furnished the necessary information on this.</p>													

CG-682	High Level Cut-Off and Examination Cell - 327 Building	Reactor & Fuels	\$430,000	\$430,000	8-20-57	100	0	0	0	7-18-56	3-1-58	10-1-58	6-26-57 10-1-58
<p>REMARKS: Drawings on the Hanford Master Slave Manipulator Model #3 to handle increased loads should be ready for approval during the middle of December. The Meekhanite examination cell bid was awarded to The Mosler Safe Company for \$86,500. Bids on the lead glass windows for the cell are currently being reviewed. The motor control center has been received.</p>													

CA-695	Radio Telemetering Network	Physics & Instr.	\$89,000	\$89,000	1-10-57	100	20**	0	0	2-22-57	7-25-57	7-15-58	5-27-57 8-15-58*
<p>REMARKS: Bid Package was sent out November 1, 1957, opening date is December 3, 1957. An estimate was prepared by Hanford Laboratory Auxiliaries for fabrication only of 20 units.</p>													

IR-231	Badgehouse Alterations for 3rd F-Service - 100 and 200 Areas	Radiation Protection	\$15,000	\$18,500	8-29-57	100	0	0	0	7-1-57	12-2-57	As Completed	9-15-57 2-1-58
<p>* Based on award by 1-15-58. ** Wind charger contract only.</p>													

CA-681	Engineer: D. S. Jackson	Reactor & Fuels	\$15,000*	To be Est.	0	0	0	0	0	To be Est.	To be Est.	To be Est.	To be Est.
<p>REMARKS: Project Proposal has been rewritten to add further justification and revise the expenditure pattern. Final approval signatures are being obtained.</p>													

MONTHLY PROJECT REPORT

HM-53961
NOVEMBER, 1957

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE		BENEFICIAL USE DATE	PROJECT COMP. DATE				
				AMOUNT	DATE	DESIGN SCHED ACTUAL	CONSTR. SCHED ACTUAL	DESIGN DATE	CONSTR. DATE						
New Construction - FY 1958		Physics & Instr.	\$2,000,000	None to date	To be Est.	To be Est.	0	0	None Est.	None Est.	None Est.				
CG-731	Critical Mass Laboratory			REMARKS: A project proposal for \$175,000 total design money was submitted to the Commission on 11-18-57 and will be reviewed by the AEC Board of Review on December 5, 1957.											
		Engineer: R. W. Dascenzo													
CG-744	Metallurgical Development Facility			Reactor & Fuels	\$2,600,000	None to date	To be Est.	To be Est.	None Est.	None Est.	None Est.				
		Engineer: R. W. Dascenzo		REMARKS: A revised project proposal is being prepared with a reduced scope of work.											
CG-747	Plutonium Fabrication Pilot Plant			Reactor & Fuels	\$4,000,000	\$120,000	11-12-57*	N.S.	10	0	4-22-57	3-1-58*	5-1-59**	11-1-58**	9-31-60**
		Engineer: D. S. Jackson		REMARKS: * Directive 429, Mod. 1 increased the authorized funds to \$120,000 without allowable overrun. These funds would have only lasted until the end of November at the then existing work rate. Since it was emphasized these funds must last through the end of the cal. year it was decided to reduce the force assigned rather than work the full design force until the funds ran out and stop completely. In this way some design personnel will remain assigned to the project thus reducing the delay in finding sufficient engineers and draftsmen when additional funds are made available.											
				REMARKS: (CG-747 - Continued) ** The shortage of funds will in all likelihood require an extension of the project completion date even if money becomes available on January 1, 1958.											
CG-749	High Level Radiochemistry Facility			Chemical Research	\$1,100,000	\$20,000*	9-27-57	100**	100	0	7-11-57	5-1-58	7-1-59	6-1-58	4-1-59
		Engineer: R. W. Dascenzo		REMARKS: Preliminary design, the design criteria and data for contract services were transmitted to the AEC on 11-22-57. A project proposal is being prepared for total design and construction funds.											
				* Interim Authority. ** Preliminary Design.											

LABORATORY AUXILIARIES MONTHLY REPORT

VISITS TO HANFORD WORKS

<u>Name</u>	<u>Dates of Visit</u>	<u>Company or Organization Represented & Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>	<u>Areas & Buildings Visited</u>
Approximately 50 people.	11/9/57	Puget Sound Chapter, Special Libraries Association	Inspect information services and facilities.	CG Stevenson BB Lane	No	3760 Bldg. 300 Area

VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company Visited and Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
C.G. Stevenson	11-18 through 25, 1957	Atomics International Los Angeles	Attend meeting of Technical Information Panel	F.R. Long	Yes
D. Taylor	11-4-57 through 8, 1957.	World Metallurgical Congress Chicago, Illinois	Attend machine tool utilization and to investigate new processes for welding, machining, & fabrication of titanium & other metals.		No
R.B. Socky	10-31 & 11-1-57	Carpenter Steel Co. Union N.J.	Confer on radiographic, eddy current & ultrasonic testing.	N. Chernick	No
	11-7-57	Trent Tube Co. East Troy, Wisconsin	" " "	H.J. Bowman	No
	11-8-57	Speery Products Danbury, Conn.	Ultrasonic Equipment requirements	F.J. Lynch	No
	11-1-57	Curtiss-Wright Caldwell, N.J.	" " "	W.T. Johnson	No
	11-4-57	Argonne National Laboratory, Chicago	Obtain information of fuel plate non-destructive testing	W.A. McGonagle	No.

UNCLASSIFIED

1240160

EMPLOYEE RELATIONS OPERATION MONTHLY REPORT

UNCLASSIFIED

H-1

HW-53961.

GENERAL

On November 30, 1957 the staff of the Hanford Laboratories Operation totalled 1157, including 504 exempt and 653 nonexempt employees. Of the total exempt employees there were 438 with college degrees including 420 technical degrees as follows:

<u>BS</u>	<u>MS</u>	<u>PhD</u>
222	103	95

In addition, there were 37 nonexempt employees with college degrees.

Distribution among the nine level 3 components is included in Table I.

PERSONNEL DEVELOPMENT AND COMMUNICATIONS

The ASEE Committee on Nuclear Education has recommended to the AEC that Hanford's proposal for the Chemical Processing portion of the 1958 AEC-ASEE Summer Institute of Nuclear Energy for Engineering College Faculty Members be accepted. As yet notification has not been received regarding AEC's action on the proposal.

The Short Course proposal, Agreement No. 31, was returned for modification regarding course outline. A new proposal is being drafted.

Detail planning is underway for the 1958 AFSWP training program. The group of ten armed forces personnel will arrive at Hanford on January 6, 1958 for six weeks of training in radiation protection.

Twenty-seven Technical Graduates and seven Technician Trainees were on assignments within Laboratories at month's end. This is consistent with last month's 27 Tech Grads and 6 Technician Trainees.

Seven exempt people completed "Conference Leading" and 25 people attended "Data Processing".

Ten exempt people began HLO's first session of "Principles and Methods of Supervision and Leadership".

One Manager's luncheon was held for twenty-three nonexempt employees.

Nine HLO employees participated in the November Area Tours for Women.

Sixteen technical papers and articles were processed for publication during the report period.

Final clearance was obtained for copy for the 1958 Research and Engineering Progress issue of the GE Review. Hanford Laboratories will contribute approximately 45 per cent of the Review's coverage of the Atomic Products Division.

PERSONNEL PRACTICES

Employment

HLO openings for nonexempt personnel are extremely limited in number. It is

1240161

UNCLASSIFIED

expected that all will be filled as a result of transfers from other level 2 components.

Nine Radiation Monitors were removed due to lack of work; 11 were transferred by seniority bumping, and 2 were placed in HLO as Engineering Assistants. Two Servicemen were removed from the rolls by senior HAPO employees displacing them. One Calibrator "B" was removed due to lack of work.

Seven transfer requests were received during November.

Three 1-year, three 3-year, and one 4-year Attendance Awards were issued during the month of November.

<u>Service Recognition</u>	<u>5 Years</u>	<u>10 Years</u>	<u>15 Years</u>	<u>20 Years</u>	<u>25 Years</u>	<u>Total</u>
Pins Issued this Month	5	9	-	-	-	14
Total Pins Out	477	228	1	2	1	709

Benefits and Services

At the November HLO Suggestion Board meeting 40 suggestions were reviewed and 36 were approved for awards totalling \$1905. These suggestions represented savings of \$13,159.23. Twenty suggestions were received from HLO employees during the month.

One HLO employee retired optionally at month's end.

Hanford Laboratories participation in the Employee Benefit Plans as of November 30, 1957 is listed below:

Insurance	99.6
Pension Plan	98.3
Savings & Stock Bonus	59.2
Savings Plan	7.9

Military status of HLO employees is as follows:

<u>STATUS</u>		<u>Non-Tech.</u>		<u>Non-</u>		<u>TOTAL</u>
		<u>Other Than 1A</u>	<u>Technical</u>	<u>Technical 1-A</u>	<u>*Critical</u>	
<u>Reservists</u>	Standby	11	33	0	0	44
	Ready	16	21	6	1	44
	Total	27	54	6	1	88
<u>Non-Veterans</u>		28	39	19	40	126
TOTAL		55	93	25	41	214

Deferment Requests Pending	4
Deferments Denied, Appealed and Pending	0
Deferments Pending at Presidential Appeal Level	0

*Critical refers to those employees for whom deferments are currently being requested.

UNION RELATIONS

A meeting was held November 27 with the Council regarding negotiations with the Regional Monitors. The Council presented the Company with a "Y" type seniority arrangement and stated that if we would accept this proposal they in turn would accept the Company's proposal regarding their consolidation with the Radiation Monitors which was made several months ago.

The grievances processed by this Operation since January 1, 1957 total 20. This number includes one non-unit grievance. The following is a breakdown as to the status of these grievances.

Step I

Answered satisfactorily*	11
--------------------------	----

Step II

Pending Step II answer	0
Answered	
Satisfactorily**	7
Pending time limit	2

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step I.

** Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

TECHNICAL PERSONNEL PLACEMENTPhD Recruiting

During the month two candidates visited HLO for interviews, three offers were extended, two were accepted, two were rejected, and two were placed on the roll.

PhD - HLO - 9/1/57 to date

<u>Cases Considered</u>	<u>Visited</u>	<u>Offers</u>				<u>On the Roll</u>
		<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	<u>Rejected</u>	
200	17	25	7	9	9	6

Offer totals include 14 offers extended during the last recruiting season which were open on September 1, 1957.

Offers accepted do not include 7 acceptances received during the last recruiting season from people who were not on our payroll on September 1. Four of the seven carry-over acceptances have reported on the roll to date.

A summary of PhD recruiting statistics appear in Table III.

BS/MS Experienced Recruiting

During the month one candidate visited HLO for interviews, one offer was extended and remains open.

BS/MS - HLO - 9/1/57 to date

<u>Cases Considered</u>	<u>Visited</u>	<u>Offers</u>				<u>On the Roll</u>
		<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	<u>Rejected</u>	
42	6	3	0	1	2	2

Two people reported on the roll during September as a result of offers accepted prior to September 1, 1957.

A summary of BS/MS experienced recruiting appears in Table III.

Technical Graduate Program

Three Technical Graduates were placed on permanent assignment within HLO during the month.

Exempt Transfers

Seven new transfer requests were received during the month. One case was closed by transfer to another HAPO component, effective in October.

Exempt Transfer statistics appear in Table IV.

The attrition of exempt personnel for HLO for November:

Transfers	0
Terminations and Deactivates	1

HEALTH, SAFETY, AND SECURITY

During November, Laboratories personnel worked a total of 172,796 hours with no disabling injuries. Since September 1, 1956, a total of 2,819,097 hours have been completed with no disabling injuries.

Two incidents required special follow-up:

1. One employee was exposed to beryllium dust when gas trapped in a sealed can of beryllium powder expanded and ruptured the can. Medical follow-up indicated the exposure was not at a hazardous level.
2. A drum of cyanide salts broke open when dumped at the 300 N. dry burial ground. Immediate burial with sand was ordered to forestall any hazard to subsequent workers in the vicinity.

There were 26 medical treatment injuries (16 in the last 7 work days) giving a frequency of 1.50 as compared to 1.39 last month. For the year to date, the frequency is 1.67.

For the first time there were no security violations. Total violations this

year are 81.

Consultations were had with and approvals were given to 13 operations as follows:

- a. with Technical Shops on code requirements for gas piping.
- b. with Mechanical Equipment Development on potential vapor problems in test shaft.
- c. with Chemical Engineering Development and Atmospheric Physics on evaluation of 321 Bldg. gas emission.
- d. with Financial on reduction of NH_3 exposure at ozalid machine.
- e. with Landlord on correction of 6 safety hazards.
- f. with Chemical Research and Facilities Engineering on fire protection in 325 hot cell addition.
- g. with Chemical Research Analytical Laboratories and Nuclear Physics Research on toxic chemical disposal problems.
- h. with CEO and Ceramic Fuel Development on approval of sintering furnace plans.
- i. with Biological Analyses on solvent storage.
- j. with Analytical Laboratories on approval of temporary hydrogen gas installation.
- k. with Physical Metallurgy on a medical work restriction and on hydrogen gas piping.

Inspections were made of:

- a. gas lines and electrical cord protection in Technical Shops
- b. Chemical Separations Facilities in 325.

Investigation of TMB, an effective new pyrophoric metal fire extinguisher, was made and reported. Coverage to all HLO was given in HL News. The report was also submitted for release in the A.E.C. Safety Information series.

Orientation in safety was given 7 new employees.

The NFPA Subcommittee's work to date on Hazardous Chemical Reactions was submitted to Chemical Research and Development for their review.

Of the current HLO force, 96% have received medical examinations to date. The remaining 4% are scheduled for December.

Supervision was notified of 3 new medical work restrictions, 1 continuation, and 1 discontinuation.

SALARY AND WAGE ADMINISTRATION

Salary Administration

The Salary Plan brochure was distributed to all HLO exempt employees during the month. Included was a personal letter from the Manager, Hanford Laboratories setting forth his views and objectives as he saw them regarding the Company Salary Plan.

Close contact was maintained throughout the month with level 3 managers regarding preparation of employee performance appraisals and preliminary work being conducted on the annual salary review.

A comprehensive salary differential study was conducted during November following the October cost-of-living and better-living increases granted to nonexempt employees. The study showed no cases of improper pay differential relationships between first-line supervisors and those being supervised.

The following position auditing was accomplished during the month:

Laboratory Auxiliaires - 9

At the end of November, 47% of all HLO exempt positions have been audited since the beginning of the current calendar year (46% considered exactly on schedule).

Wage Administration

The Point Score Evaluation Plan for semi-technical jobs was issued in its final form and fully implemented during the month.

A revised up-to-date listing of all HLO nonexempt jobs was completed and issued to HLO managers and supervisors during the month.

The results of the Northwest area nonexempt wage survey were received at month's end. A complete study and analysis of the data pertinent to HLO jobs will be completed in the near future.

Two new positions in the Atmospheric Physics Operation were written and evaluated during the month. The request for approval for use is presently being prepared with Relations and Utilities.

ATTITUDE SURVEY

A detailed analysis of level 3, 4, and 5 component results was made during the month. The entire analysis will be completed during December and will serve as the basis for joint evaluation of the component climate, applicability of the questionnaire, and possible corrective action with components desiring it.



Manager
Employee Relations

TJ Marshall:tr

1248166

<u>VISITORS TO HLO</u>	<u>Date of Visit</u>	<u>Company or Organization Represented</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>	<u>Areas and Buildings Visited</u>
T. H. Koerner	11/13	GE - Engineering Personnel Placement	Discuss engineering personnel placement	R.D. Tillson T.G. Marshall	None	300-3760

TABLE III. EMPLOYMENT - TECHNICAL PERSONNEL STATUSI. Employment

<u>Non-Exempt employment status</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Non-Exempt transfer requests</u>	<u>Oct.</u>	<u>Nov.</u>
Requisitions			Transfer requests		
At end of month	12	4	Active cases at end		
Cancelled	1	0	of month	49	54
Received during month	14	3	Cancelled	0	2
Filled during month	14	11	New during month	1	7
Candidates considered			Transfers effected	3	0
Total applications	14	24	Planned transfers		
Total transfer requests			Effective during month	2	0
from other at HAPO	6	0			
Total interviewed	0	0			

II. Technical Personnel Placement

Ph.D. Recruiting - HLO

	<u>Cases Con-</u>	<u>VISITS TO RICHLAND</u>				<u>OFFERS</u>			<u>On</u>
		<u>sidered</u>	<u>Extended</u>	<u>Visited</u>	<u>To</u>	<u>Open</u>	<u>* Extended</u>	<u>Accepted</u>	
Engineering:									<u>Roll</u>
Chemical	37	14	2	3	7	4	1	2	0
Electrical	7	2	0	2	0	2	0	0	0
Mechanical	13	6	1	2	2	2	0	0	0
Metallurgy & Ceramics	31	15	3	4	7	4	0	3	1
Other	5	0	0	0	0	0	0	0	0
Science:									
Chemistry	107	23	5	7	5	6	4	2	2
Physics	129	46	5	18	19	6	1	2	1
Math-Stat	15	1	0	0	1	0	0	0	1
Other	16	1	1	0	0	1	1	0	1
TOTAL	360	108	17	36	41	25	7	9	6

*Offer totals include 14 Ph.D. open offers as of 9/1/57

BS/MS Experienced Recruiting - HLO

	<u>Cases Con-</u>	<u>VISITS TO RICHLAND</u>				<u>OFFERS</u>			<u>On</u>
		<u>sidered</u>	<u>Extended</u>	<u>Visited</u>	<u>To</u>	<u>Open</u>	<u>Extended</u>	<u>Accepted</u>	
Engineering:									<u>Roll</u>
Chemical	4	2	1	0	0	0	0	0	0
Electrical	6	1	1	0	0	0	0	0	0
Mechanical	9	4	3	0	0	2	0	0	0
Met-Ceramics	2	0	0	0	0	0	0	0	0
Other	4	0	0	0	0	0	0	0	0
Science:									
Chemistry	6	0	0	0	0	0	0	0	2
Physics	3	0	0	0	0	1	0	1	0
Math-Stat	1	1	1	0	0	0	0	0	0
Other	7	0	0	0	0	0	0	0	0
TOTAL	42	8	6	0	0	3	0	1	2

TABLE IV. Exempt Transfer Cases

	<u>Nov.</u>	<u>Oct.</u>	<u>Total</u>
Active cases at <u>beginning</u> of month	19	20	
New cases: Initiated by employee			
Initiated by management*	7		
Cases reactivated	<u>26</u>	<u>20</u>	
Cases closed: Transfers: Within HLO			3
Within HAPO	1	1	4
Other GE			7
Withdrawn			7
Terminated			<u>9</u>
	<u>25</u>	<u>19</u>	<u>30</u>
Active cases at <u>end</u> of month	25	19	<u>25</u>
Total cases - January 1, 1957 to date			55
Initiated by employee	25		
Initiated by management*	30		

*Includes ROF's, transfers proposed by employee's management, and requests from other G. E. departments.

TABLE V. Union RelationsGrievances Processed - January 1, 1957 to date

Total Processed 20 (includes 1 non-unit grievance)

Step I

Answered satisfactorily* 11
Pending time limit 0

Step II

Pending Step II answer 0
Answered
 Satisfactorily** 7
 Pending time limit 2

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step I.

** Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

FINANCIAL OPERATION MONTHLY REPORTPersonnel

There were no personnel changes in the Financial Operation during November.

ActivitiesGeneral Accounting Operation

Two letters seeking Commission approval of specific actions within Hanford Laboratories Operation were prepared and submitted. These letters seek approval for Hanford Laboratories to sponsor a series of Science Colloquia during the coming year, and reimbursement for expenses to be incurred in transferring a non-exempt employee to Idaho Falls.

With the assistance of the Counsel's office a letter was prepared for the signature of the HAPO General Manager addressed to Phillips Petroleum Company at Idaho Falls documenting the arrangements under which our representatives at that site would participate in activities related to Hanford programs.

Following review of several OPG's covering property management and accountability consideration is currently being given to the development of a property management manual which would incorporate all detailed procedures covering property management and accountability. Upon completion, this manual would eliminate the necessity for the current series of OPG's on the subject.

Custodians of SS Materials were notified that their forecasts of requirements for diversion of nuclear materials outside production channels, fourth revision, were due in the office of the Manager - General Accounting by December 6, 1957.

We have been notified that travel reservation service provided by Relations and Utilities Operation Traffic Unit is being discontinued in the near future. We are currently studying the effect of this action on our operation.

The FY 1958 Midyear Budget Review was completed and forwarded to Contract Administration by the due date. The current HLO allocation and requested changes are summarized below for Equipment Not Included in Construction Projects.

	<u>Current Allocation</u>	<u>Requested Increase</u>	<u>Revised Totals</u>
(Amounts in Thousands)			
2000 Program	\$3 376.0	\$ 89.8	\$3 465.8
3000 Program	57.0	-	57.0
4000 Program	500.0	-	500.0
6000 Program	80.0	41.9	121.9
Totals	<u>\$4 013.0</u>	<u>\$131.7</u>	<u>\$4 144.7</u>

At the request of Contract Administration estimates were submitted for HLO charges against the fee during calendar year 1958. Travel variation estimates were based on the assumption that per diem allowance from the Commission will continue at the current rate.

Paperwork reduction during the month resulted from elimination of the file of second copies of notices to Monthly Payroll to withhold Federal Income Tax on travel, living and moving expenses to or for new employees reporting for work.

As a result of the recent publicity on the subject of reporting of expense reimbursements in individual income tax returns, we have had inquiries as to whether we would provide employees with the amounts of such expenses. Indications now are that we will not be asked to provide this information for 1957; however, we are expecting an advice from Tax Accounting Service, New York, that will indicate the requirements for 1958.

Verification of the physical count to accounting records for the physical inventory of uninstalled cataloged equipment in the custody of Reactor and Fuels Research and Development Operation is complete. The inventory consisted of 2,291 pieces of equipment valued at \$3,185,139. The physical count failed to locate 111 pieces of equipment valued at \$95,219. Four hundred and seven items valued at \$229,462 were physically located during the inventory for which no record could be found. A report of findings will be issued and a journal entry will be prepared in December adding to record unrecorded items and transferring unlocated items into a special code to be held until located or until the entire HLO inventory is completed.

A report of findings, in connection with the annual physical inventory of reactor and special materials, in the custody of Hanford Laboratories Operation, was distributed in November. Final results of the physical inventory disclosed an overage of \$205. The overage was due primarily to picking up material previously unrecorded, mainly iridium and rhodium, which was partially off-set by losses in process, cleaning and contamination. The total value of material inventoried was \$871,955.

Field work in connection with the physical inventory of uninstalled cataloged equipment in the custody of Chemical Research and Development Operation is complete and the reconciliation of the physical count to property records is in progress.

Cost Accounting Operation

The FY 1958 Midyear Budget Review was completed and submitted for approval. Personnel requirements were submitted to Contract Administration on November 25, 1957, the operating budget was submitted December 2, 1957 and inventory requirements were submitted December 3, 1957. Following is a brief summary of Midyear Review data as compared to current authorizations.

<u>Personnel (HLO Total)</u>				<u>Number</u>
Actual 10-31-57				1 169
Midyear Review Forecast at 6-30-58				1 176
FY 1958 Revised Budget Forecast at 6-30-58				1 164
Midyear Review Average for FY 1958				1 168
FY 1958 Revised Budget Average for FY 1958				1 167
<u>Program Budget</u>	<u>Midyear Review</u>	<u>Current Authorization</u>	<u>Increase (Decrease)</u>	
Research and Development				
for Product Departments	\$ 4 918	\$ 4 918	\$ -	
Plutonium Recycle	3 563	3 500	63	
Biology & Medicine	1 909	1 740	169	
Other HLO Programs	<u>459</u>	<u>459</u>	-	
Total Research & Development	10 849	10 617	232	
Process Technology	1 138	1 075	63	
Project Whitney	550	550	-	
Washington Designated Programs	419	402	17	
Fuel Elements for MTR	250	-	250	
Assessment and Other Services	<u>4 553</u>	<u>4 777</u>	(224)	
Total Programs	<u>\$17 759</u>	<u>\$17 421</u>	<u>\$338</u>	

The Plutonium Recycle Program was increased \$63,000 to fund the FY 1958 portion of the American Standards Company contract related to the digital computer program.

The Biology and Medicine Program was increased \$169,000; \$80,000 to bring the program up to the FY 1957 level, \$69,000 to provide funds for the Radioecology Operation and \$20,000 for three additional people to be assigned to other areas of Biological Research in the latter part of the fiscal year. A research proposal was submitted to cover the expanded Radioecology work titled "Effects of Radioactive Materials upon Ecological Systems", and another was submitted to revise the program titled "Effects of Process Effluents on Aquatic Organisms". A portion of the latter program, as included in the FY 1958 Revised Budget, is now included in Radioecology effort.

The Process Technology increase of \$63,000 was authorized by IPD for additional Radiometallurgy effort in support of their programs.

The \$17,000 additional funds for Washington Designated Programs is for the Computation and Statistical Analyses Program (Bluenose).

The \$250,000 for Fuel Elements for the MTR represents an estimate of costs to fabricate, finish and assemble plutonium fuel elements.

Assessments and other services decrease \$224,000 in total. The major decrease was a result of Radiation Protection's cost reductions but these reductions were partially off-set by a \$40,000 increase for NPR work authorized by FPD.

Inventories

All HLO budgeted inventories were submitted reflecting no significant variance over current levels with the exception of Zirconium. It was estimated the inventory balance for Zirconium will increase to \$650,000 by June 30, 1958 as compared to a current balance of \$627,000.

The FY 1958 Midyear Budget Review will be reflected on cost reports beginning with December, contingent on approval. Midyear Review Budgets will be published and distributed to the respective managers in the near future.

A graphic presentation of the flow of HLO costs is currently scheduled to be completed with distribution to be made in December. Dollar amounts representing the FY 1958 Midyear Budget Review have been included on the chart.

New titles will be used for Washington Designated Programs on future operating reports and correspondence as follows:

<u>New Title</u>	<u>Old Title</u>
Test Programs on Irradiated Metals	No Change
Computation and Statistical Analysis	Bluenose
Isotopic Analysis	Project Cad
Radiochemical Analysis	Project Crave

Effective November 1, 1957 an assessment will be made to the product departments for HLO radiation monitors who are working directly in support of the 200-W Laundry and Transportation, Electrical and Stores Operations. These costs have previously been absorbed by HLO General Overhead.

Authorizations for FPD Process Technology were reduced during the month from \$200,000 to \$130,000 for FY 1958. October year-to-date costs of \$82,000 allow only \$48,000 expenditures during the remaining eight months of the year. Of this amount \$38,000 has been authorized in the form of two routine work orders with the remaining \$10,000 being held in reserve by FPD. November's Process Technology billing will include detailed costs, both direct and overhead, to each individual work order.

The operating and end function reports issued by Cost Accounting were prepared and distributed by November 15th, the earliest complete distribution accomplished to date.

Personnel Accounting Operation

All employees participating in the Stock Bonus Plan have been informed of the expiration of the five year holding period for bonds purchased in 1952 under the GE Savings and Stock Bonus Plan.

Listings of all exempt employees on the payroll as of November 1, 1957 were prepared by Data Processing containing all information required for proper administration of a salary review. These listings with a transmittal letter explaining the headings shown and the procedure to follow in completing and returning the list were delivered to management on November 13, 1957.

Preliminary listings in duplicate of transfers in, transfers out and refunds for our Pension Unit covering the period January 1, 1957 through August 31, 1957 were received from Schenectady. These listings were checked with our records to verify their accuracy. Except for three cases of transfers out not being recorded, all information shown was correct. One copy of these listings were returned to Schenectady on November 13 as requested.

Envelopes containing a Corporate Alumnus Program folder including forms to be used for matching gifts to colleges were delivered on November 22, 1957 to all college graduates on the payroll as of that date.

A revised Monthly Attendance Report was designed and approved for use beginning with the month of January 1958. The new form as revised provides a more efficient means of recording exempt employees attendance and reduces some analytical work now being performed by Personnel Accounting.

Auditing

The Cost Accounting audit field work is taking longer than budgeted and it now appears the report will be issued in December. Preliminary findings indicate that cost accumulation and reporting are accurate and of good quality.

Follow up audits of Payroll and Contracting and Procurement were completed during the month.

Measurements

All efforts during the month concerned preparation of the HLO measurements report for CY 1957.

Procedures

A summary was prepared in conjunction with the Specialist, Office Procedures, CPD, of the recent Company Advanced Financial Training Seminar for presentation to the council of office procedures specialists at HAPO. Topics covered included work simplification, office systems, office appliances, and data processing equipment; latest trends and developments in these areas were described.

Consultation was continued with Operations Research and Synthesis in the development by that group of a mathematical model for accounting for costs in HLO. The model involves a matrix algebra method of cost accumulation and distribution mechanized using the 702 computer.

Studies are being made of a proposal submitted by Data Processing Operation for mechanizing absence accounting using EDPM equipment. This is, in part, a reply to the several requests submitted by customers (including HLO) for information concerning mechanization in this area. Weekly, monthly, quarterly, and annual statistics are to be included as direct output from the system; it is intended that this program eliminate the need for much manual handling and recording of these data.

Analyses were made for Laboratory Auxiliaries Operation in the design of a revised Work Release Authorization record. A directly reproducible master was developed to be used as initial authorization, and describe the project, its management, and the allocation of funds.

Payroll Statistics

<u>Number of HLO Employees</u> <u>Changes During Month</u>	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on Payroll at Beginning of Month	1 169	498	671
Additions and Transfers In	18	7	11
Removals and Transfers Out	(30)	(1)	(29)
Transfers from Exempt to Non-Exempt	-		
Employees on Payroll at End of Month	<u>1 157</u>	<u>504</u>	<u>653</u>

Overtime Payments During Month

	<u>November</u>	<u>October</u>
Exempt	\$1 208	\$1 386
Non-Exempt (five weeks in November)	<u>6 321</u>	<u>6 736</u>
	<u>\$7 529</u>	<u>\$8 122</u>

Gross Payroll Paid During Month

Exempt	\$376 823	\$366 637
Non-Exempt (five weeks in November)	<u>342 559</u>	<u>272 303</u>
	<u>\$719 382</u>	<u>\$638 940</u>

Participation in Employee Benefit Plans at Month End

	<u>No. Participating</u>		<u>% Participating</u>	
	<u>November</u>	<u>October</u>	<u>November</u>	<u>October</u>
Pension Plan	1 109	1 103	98.3	98.5
Insurance Plan				
Personal Coverage	1 187	1 190	99.6	99.6
Dependent Coverage	729	730		
U.S. Savings Bonds				
Stock Bonus Plan	701	692	60.6	59.2
Savings Plan	90	92	7.8	7.9

Insurance Claims Paid

	<u>November</u>		<u>October</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee				
Life Insurance	0	\$ 0	0	\$ 0
Weekly Sickness & Accident	8	585	12	1 210
Comprehensive Medical	38	3 115	39	5 374
Dependent				
Comprehensive Medical	<u>95</u>	<u>8 495</u>	<u>57</u>	<u>5 862</u>
Total	<u>141</u>	<u>\$12 195</u>	<u>108</u>	<u>\$12 446</u>

1248175

<u>Good Neighbor Fund</u>	<u>November</u>	<u>October</u>
Number Participating	749	759
Percent Participating	64.7	64.8

Other Statistics

	<u>No.</u>	<u>November</u>	<u>No.</u>	<u>October</u>
Accounts Outstanding at beginning		\$20 004		\$15 238
Charges:				
Cash issued - by checks	28	4 842	45	6 291
- by currency	51	5 876	56	6 035
Transportation		18 827		8 681
Other - (Billings from other GE Components, moving expense, etc.)		<u>2 722</u>		<u>682</u>
		<u>52 271</u>		<u>36 927</u>
Less:				
Expense vouchers processed				
Travel expense accounts	80	20 252	53	11 453
Other (moving expenses, conference expense, etc.)	30	2 353	12	79
Refund of advances	78	7 112	55	4 623
Billings to and from HAPO Components-Net		<u>1 006</u>		<u>768</u>
		<u>30 723</u>		<u>16 923</u>
Accounts Outstanding at Close	61	<u>\$21 548</u>	73	<u>\$20 004</u>

W. Sale
December 9, 1957

UNCLASSIFIED

1248176

INVENTIONS OR DISCOVERIES

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

INVENTOR

TITLE OF INVENTION OR DISCOVERY

J. Dunn	Leak-Proof Control Valves
J. Dunn and A. E. Smith	Controlled Leakage Liquid Seal for Process Pumps
O. H. Koski	The Recovery of Cesium from Cyanide Precipitates through the Reaction with Steam
O. H. Koski	The Recovery of Cesium from Cyanide Precipitates through Catalyzed Calcination with Various Metallic Oxides
H. T. Hahn	Metal-Oxide-Liquid Metal Slurry Preparation
B. M. Johnson, Jr.	Chemical Process Equipment - A Variable-Flow, Constant Pressure, Relief Valve
R. H. Moore	Utilization of Alkali Metal Complexes of Aluminum Chloride for Preparation of Aluminum Alloys of Metals Such as Uranium by Reduction of their Oxides
A. S. Wilson	The Recovery and Safe Containment of Fission Gases

Am Parker