DECLASSIFIED

HW-56914

This document consists
of 133 pages. Copy No. 1
of 1 copies. Series A

HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT

HW--56914

DE93 009915

JULY, 1958

Classification Cancelled (Change to

Declassified

By Authority of *CC-PR-2*

Robert M. Gou 4/1/90

W. Kricher 5/13/92

PM Eck 5-12-92

Compiled by
Operation Managers

August 15, 1958

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

~~This document contains information which is exempt from release under the Atomic Energy Act of 1954. Its transmission or disclosure of its contents is prohibited by law.~~

PRELIMINARY REPORT

This report was prepared only for use within General Electric Company in the course of work under Atomic Energy Commission Contract W-31-109-Eng-52. Any views of opinions expressed in the report are those of the authors only.

Route To:	P. R. No.
<i>CC 400</i>	
<i>E. Travis</i>	

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DECLASSIFIED

MASTER

DISTRIBUTION RESTRICTED TO U.S. ONLY

DISTRIBUTIONCopy Number

1	W. E. Johnson
2	H. M. Parker
3	R. J. Schier
4	F. W. Albaugh
5	C. A. Bennett
6	J. L. Boyd
7	L. P. Bupp
8	P. F. Gast
9	A. R. Keene
10	H. A. Kornberg
11	T. G. Marshall
12	L. H. McEwen
13	W. Sale
14	R. W. Benoliel
15	J. W. Healy
16	H. P. Shaw - V. R. Cooper
17	H. A. Paulsen
18 - 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

DECLASSIFIED

TABLE OF CONTENTS

	<u>Page</u>
Staff	iv
Force Report and Personnel Status Changes	v
General Summary	vi through xi
Reactor and Fuels Research and Development Operation	A1-1 through A1-24
Plutonium Recycle Program	A2-1 through A2-11
Physics and Instrument Research and Development Operation	B-1 through B-10
Chemical Research and Development Operation	C-1 through C-22
Biology Operation	D-1 through D-6
Operations Research and Synthesis Operation	E-1 through E-4
Programming	F-1 through F-4
Radiation Protection Operation	G-1 through G-6
Laboratory Auxiliaries Operation	H-1 through H-21
Employee Relations Operation	I-1 through I-7
Financial Operation	J-1 through J-6
Invention Report	K-1

STAFF

Manager, Hanford Laboratories H. M. Parker
Manager, Biology. H. A. Kornberg
Manager, Chemical Research and Development . . L. P. Bupp
Manager, Laboratory Auxiliaries J. L. Boyd
Manager, Operations Research and Synthesis . . C. A. Bennett
Manager, Physics and Instrument Research
and Development P. F. Gast
Manager, Programming. L. H. McEwen
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. Sale

TABLE I. HLO FORCE REPORT AND PERSONNEL STATUS CHANGES

Date July 31, 1958

UNCLASSIFIED

	<u>At close of month</u>		<u>At beginning of month</u>		<u>Additions</u>		<u>Separations</u>			
	<u>Exempt</u>	<u>Non-Exempt</u>	<u>Exempt</u>	<u>Non-Exempt</u>	<u>Exempt</u>	<u>Non-Exempt</u>	<u>Exempt</u>	<u>Non-Exempt</u>		
Chemical Research and Development	128	95	223	127	94	221	2	3	1	2
Reactor & Fuels Research & Development	157	108	265	154	104	258	4	4	1	0
Physics & Instrument Research & Development	65	25	90	63	25	88	2	0	0	0
Biology Operation	36	42	78	35	42	77	1	0	0	0
Operations Research & Synthesis	14	2	16	14	3	17	0	0	0	1
Radiation Protection	39	116	155	39	117	156	0	0	0	1
Laboratory Auxiliaries	44	180	224	44	178	222	2	3	2	1
Financial	16	33	49	15	34	49	1	0	0	1
Employee Relations	81	34	115	13	9	22	69	26	1	1
Programming	15	4	19	15	4	19	0	0	0	0
General	<u>1</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Totals	596	641	1237	520	612	1132	81	36	5	7
Totals excluding Internal Transfers	596	641	1237	520	612	1132	78	33	4	2

Composite Separation Rate ----- .9700
 Separation Rate (based on separations leaving G. E.) ----- .892
 Controllable Separations Rate ----- .1616

HW-56914-

UNCLASSIFIED

SUMMARYBUDGETS AND COSTS

Costs for July were \$1,356,000 or approximately 7% of the interim control budget presently in use by Hanford Laboratories. The interim control budget is based on program totals which are realistically expected to materialize and in some cases exceed the amounts contained in the current HOO-AEC Financial Plan which by its nature is very preliminary.

The total costs for the month are somewhat below the expected monthly average during FY 1959 but considering that July normally represents a low cost month, research expenditures have held up well.

At this very early stage in the fiscal year there are no unsatisfactory cost-budget relationships.

RESEARCH AND DEVELOPMENT1. Reactor and Fuels

Initial laboratory experiments were conducted to determine the thermohydraulic events in a C Reactor process tube following a complete failure of a front hydraulic connector. Preliminary results support the analytical calculations which predicted fuel element temperatures approaching the melting point at present power levels.

Graphite samples were discharged from KE Reactor after exposure to helium for approximately 250 operating days at 685 C. All but one sample exhibited less than 2% oxidation/1000 days exposure.

A uranium slug jacketed in thick-walled aluminum and equipped with thermocouples to measure temperature drops across the water film and corrosion product film has given promising performance in KER Loop No. 2. Additional "thermocouple slugs" of similar design are planned to extend these tests.

A shipment of 1000 I and E fuel elements prepared by American Bearing Company by static casting and beta heat treating has been sampled to determine the soundness and metallurgical characteristics at this stage of development. The material meets density specifications for fuel cores and, most important, the cast slugs do not contain serious voids or casting flaws.

Ex-reactor tests in 225 C water were performed to compare the severity of rupture damage in defected, coextruded, Zr-2 clad, uranium rods which had been beta heat treated with similar rods in the as-extruded condition. In all instances corrosion damage was more severe in the beta heat treated specimens.

Construction of the Phase I portion of the PRTR has reached about 10%, with design of the reactor as a whole 95% complete. The ellipsoidal bottom plate of the containment vessel has been fabricated. The present design of the top and bottom thermal shields of the reactor stipulate mild steel shot cooled by

DECLASSIFIED

DECLASSIFIED

circulating interstitial process water. Design verification testing indicates excessive corrosion rates which must be corrected by changes in shot composition, water composition, or general redesign. Satisfactory calandria dump rates were obtained in the PRTR calandria mockup following the second major modification to the dump chamber in June.

Design for Project CA-747, Plutonium Fabrication Pilot Plant, is 52% complete, and construction is 1% complete. First concrete pour for the shielding was made July 22.

Excessive porosity in aluminum injection cast into Zircaloy-2 tubes appears to be greatly reduced by employing a vacuum outgassing treatment of the tubing prior to casting. Aluminum was employed as a stand-in for Pu-Al fuel material in these experiments.

Ten sintered and ground 8% enriched UO_2 rings were shipped 7/22/58 to Atomics International. This is the initial shipment of fuel cores for two tubular elements to be irradiated in the SRE.

Preliminary analyses of recent ex-reactor creep tests on Zr-2 indicate a strain of fully annealed specimens during primary creep which is two to four times that of 15% cold worked material. Indications are that use of cold worked material for PRTR process tubes is obligatory.

A new microradiographic-metallographic technique has been developed for determining the location of radioactive constituents in a specimen. The definition and contrast obtained far exceed those possible by conventional autoradiographic methods.

2. Chemical Research and Development

Supporting laboratory scale Mini runs were made to provide information for neptunium removal from plant waste sources at Purex. Methods of extracting neptunium in the reduced, IV, state were explored. Simultaneously, anion exchange tests were tailored to determine system behavior for the final recovery, concentration, and purification of neptunium from the plant concentrate.

Neptunium-aluminum alloy was prepared from NpO_2 on a one gram scale by two processes; (1) the cryolite process, and (2) aluminum reduction in molten $KAlCl_4$. Well formed buttons were obtained in both cases, but the efficiency of reduction in these preliminary experiments was only about 50 per cent.

In field tests, simulating loss of high level Redox waste to the soil through a one-inch diameter hole, it was found that neutralized plant wastes would spread horizontally below the tank bottom and readily enter the soil. However, waste that had undergone self-concentration of 83 per cent of the original volume and had a solid content equal to about 20 per cent by volume would enter the soil only at a very slow rate for a few hours before the rate of flow dropped to unperceptible values. This has been attributed to the solids plugging the soil immediately underneath the simulated rupture. Permeabilities of a standard soil were measured for various concentrations of simulated high-level waste solutions at ambient temperature (27 C). Pure water displayed a

permeability of 39 gal/day/ft² through the test soil. Filtered waste at the concentration normally sent to the tanks had a permeability of 13 gal/day/ft², and filtered waste with double this concentration had a permeability of 8 gal/day/ft² through the test soil. The filter cake formed on soil by the passage of unfiltered waste was considerably less permeable than the soil.

Increasing the operating temperature and adding phosphate and borate to the simulated high level waste feed to a laboratory scale spray calciner gave a seven fold reduction in volume of the solid product. Results were encouraging enough to begin design of a pilot scale unit.

The first liter-scale, full-level cesium recovery run on Purex plant 1WW was successfully completed. This utilized the "basic side" cesium zinc ferrocyanide flowsheet and resulted in an over-all cesium recovery greater than 80 per cent, with less than ten per cent cesium loss to the ferric hydroxide precipitate and the cesium precipitation supernate, respectively.

The distribution of either uranium or plutonium between molten aluminum and fused $\text{AlCl}_3 \cdot \text{KCl}$ at temperatures of approximately 725 C was found to be dependent on the AlCl_3/KCl molar ratio. Maximum distribution of uranium to the (reduced) metal phase occurs when this ratio is 1.1. Plutonium remains predominantly in the salt (oxidized) phase although here too, the distribution is affected by the AlCl_3/KCl ratio. Maximum partition of uranium and plutonium in this system of two phases may occur at an AlCl_3/KCl ratio which is not optimum for the distribution of either uranium or plutonium.

The Darex pilot plant was placed on experimental test operation with initial runs on the dissolution of stainless steel tubing by solutions of varying nitric acid - hydrochloric acid concentrations. These initial tests showed the chloride to iron molar ratio in solution must exceed two for complete dissolution. An example of passivation of the stainless steel charge was also observed; a condition which must be elucidated.

Other work on the Non-Production Fuels program included continuing tests in the Zirflex pilot plant. This work has progressed to a point where the initial chemical flowsheet was developed and transmitted to the CPD customer. Tests in the small laboratory scale Hastelloy F dissolver with HNO_3 -HF systems show 347 stainless steel dissolves very slowly and may be a real problem. 304-L material dissolves satisfactorily.

Preliminary tests of a magnetometer showed the instrument will respond on the ground's surface to indicate underlying basalt ridges. Data show relative depths to basalt with no absolute values, however, surface surveys were easy and quick and the method may assist in determining where basalt ridges affect ground water flow.

3. Physics and Instrument Research and Development

Nuclear safety measurements were carried out in the simulated dissolver situation for fuel elements containing 3% enrichment. Critical masses for this material are in the range of 500 to 700 pounds, and plans for processing power reactor fuels must accordingly be scoped to handle batches of this size. Work related to the uranium recovery end of this process indicated that k's of about 1.3 will be encountered and limitations of batch or equipment size will be necessary here also. In a more immediate problem concerning nuclear safety, ORNL has

DECLASSIFIED

~~SECRET~~ **SECRET**

now accumulated sufficient materials to determine critical masses of .95% enriched I and E fuel elements randomly dumped into a Hanford dissolver. Nuclear safety consultations included 234-5 Bldg. problems and a shipment of U-233.

For the Improved Production Reactor Program the series of exponential experiments with fuel clusters consisting of 7 rods of half-inch diameter have been completed.

The difficult work on the temperature coefficients of existing production reactors under extreme conditions is progressing satisfactorily and a pilot-type experiment was successfully run in the PCTR, but much work remains to be done before the needed information will be obtained.

In the Plutonium Recycle Program a re-analysis of the data on the reactivity temperature coefficient of 19-rod clusters indicates that the previous value was slightly high but this is not expected to have any important consequences in operation of the reactor. A profilometer has been developed for examining fuel elements discharged from the PRTR.

The use of a plutonium fluoride source for calibration of neutron monitoring instruments was demonstrated. Calibrations by this method will be more convenient than the use of the Van de Graaff and will allow increased use of the Van de Graaff on research problems.

The work in the field of radiation protection instrumentation made satisfactory progress. For example, an instrument was developed and tested which will do alpha, beta and gamma monitoring and could therefore replace both the poppies and the GM instruments presently used for this work. In addition, the new instrument has increased sensitivity and can reliably detect the low energy beta particles from C-14. It is one of the line of scintillation, transistorized instruments currently being developed by the Instrument Research and Development Operation.

In the basic data field, work continued on cross-section measurements and on the neutron moderating properties of hydrogenous materials. The new neutron spectrometer at KE now produces a satisfactory neutron beam and it is expected that research work using the instrument will get under way in the near future.

Construction has begun on the addition to 305-B Bldg. and the design scope of the Critical Mass Laboratory has been modified to provide concrete shielded construction rather than the previously proposed thin-walled building which utilized earth banks and distance for shielding properties.

4. Biology

Zn^{65} was found to concentrate in the liver and bone of the rats up to 10 times higher than in mature rats.

Several simple solutions are showing promise, in preliminary studies, of hastening the removal of radioactive particles. This may have practical application to local Industrial Medicine.

Another lung cancer was observed in a mouse killed somewhat over a year after intratracheal administration of $2 \mu c$ of $Ru^{106}O_2$. The estimated total dose to the lung (uniform distribution) was only 300 rads.

No important changes in activity densities of wildlife occurred during the month except for minnows, which increased tenfold from last month and were 14 times higher than last year.

5. Programming

A five year forecast by fiscal year was made of the plutonium and uranium requirements for the PRTR. Acquisition of some 35 Kg of reactor grade plutonium for use in PRTR fuel elements would significantly advance the date of demonstrating self-sustaining reactor operation.

A study stage project cost of about \$3,000,000 has been estimated for the installation of Redox feed preparation equipment to accommodate power reactor fuels with both stainless steel and zirconium jacketing. These preliminary estimates were made to get a feel for the relative costs of several processing schemes.

Recommendations were made on pulse techniques for reading pocket ionization chambers, an aerial survey program for the reactor areas, monitoring stations in inhabited areas, and a produce sampling program.

A thermal diffusion process for recovery of a purified Xenon gas fraction containing less than one per cent Xe-131 would require about 20 columns, one foot in diameter and 100 feet tall.

Technical and Other Services

Exposure Record Cards were distributed to all General Electric, AEC, and collateral contractor employees. Early reactions to this extensive communications program indicate good acceptance by employees. Two cases of plutonium deposition were confirmed. Neither case appeared to involve a significant level of deposition.

Statistical and mathematical assistance on 21 separate problems was given within HLO and to other departments and operations. Of particular interest was a study of methods of forecasting reactor production. A special task force including a member from Operations Research and Synthesis has been formed to study information processing in Z plant operations. In addition, the study of spare parts inventory control for Irradiation Processing Department was completed during the month and a report issued.

There were 23 authorized projects at month end with total authorized funds of \$4,839,300. The total estimates project cost of these projects is \$9,468,800. One project was completed during the month. One new project was authorized during the month and one project was requested to be returned by AEC. No new projects are awaiting AEC authorization. Project proposals for six new projects are in preparation.

Installation of the out-of-reactor portion of the 3 x 3 loop in the ETR at Idaho Operations Office was completed and has been operationally tested. AEC-Washington approval is required of the in-reactor portion of the loop from a hazards standpoint.

A proposal requesting authorization of total project funds for the Metallurgical Development facility addition to 306 building was completed. This proposal is based on essentially complete scope design.

DECLASSIFIED

DECLASSIFIED

Supporting Functions

Physical inventory of uninstalled cataloged equipment in the custody of Radiation Protection Operation has been completed.

The amount of underruns on appropriation requests continue to exceed the overruns, however of the 104 completed since July 1, 1957, 60 (58%) have deviated (either over or under) by more than 10% from the original estimate.

A comparison of the HLO Budget for research and development work with the HOO-AEC preliminary Financial Plan for FY 1959 indicates a shortage of about \$1 million. The most recent estimate of funds required for Plutonium Research and Development during FY 1959 indicates \$5,245,000 (includes capital equipment) will be required.

Project Whitney authorizations for FY 1959 have been received.

At month's end, the staff of the Hanford Laboratories Operation totalled 1237, including 596 exempt and 641 nonexempt employees. A major portion of the increase was due as a result of the transfer of technical recruiting and technical training functions from R and U to HLO.

Over one-half the 1958 "Summer Institute on Nuclear Energy - Chemical Processing" program has been completed. Twenty-nine lectures have been attended by the participants; tours were conducted to eighteen separate facilities.

A series of four one-half hour illustrated lectures were prepared and delivered to the Oak Ridge School of Reactor Technology.

There were 7 security violations during the month, bringing the total for the calendar year to 32.

The IBEW's counter-offer to the Company's last proposal in the Regional Monitoring negotiations was completely unacceptable to the Company. The Company has therefore withdrawn its latest proposal dated March 26, 1958, and advised the Council that we would contact them to continue negotiations.

Three unit and one non-unit grievances were received during July. Two were answered satisfactorily at Step I and one is pending Step II discussions.

Five PhD candidates visited Richland for employment interviews and one PhD accepted the Hanford proposal.

The Nonexempt Compensation Study is proceeding on schedule.

HLO personnel worked a total of 194,702 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,339,927 man-hours have been completed with no disabling injuries. Medical treatment frequency for July was 1.18.

P. P. Bupp
for Manager,
HANFORD LABORATORIES

HM Parker:kss

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

Etching and Rinsing of Zircaloy-2. Where large volumes of hot flowing water are available, water rinsing of Zircaloy is sufficient. However, for production use, it may not be practical to get a fast enough turn-over of water through the rinse tank. As a result, drag-over from the fluoride etch causes a buildup of fluoride ion in the rinse water, and this results in contaminated surfaces on the Zircaloy. Aluminum nitrate addition to the rinse tank complexes this drag-over so the rinse stays clean of free fluoride ion.

Further development work has established that:

- (1) The aluminum nitrate rinse solution is not as effective unless in a strong nitric acid solution. The solution in current use is one part by volume 70% concentrated nitric acid to three parts water. A more concentrated acid solution may be more effective. This remains to be evaluated.
- (2) The solution is effective cold, but works much better as the temperature is raised. It is recommended that the solution be used hot.
- (3) The concentration of $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ is not critical. The proper concentration depends to some extent on the volume of etching to be done. When sufficient fluoride ion has been added to complex the available aluminum ion, the solution will become ineffective. Current concentration is 125 g/liter or about 1 lb/gal.

Four stainless steel tanks have been designed and are being fabricated by Technical Shops. These tanks will be used for the etching and rinsing of Zircaloy clad fuel elements as supplied by other components.

New Wrought Aluminum Alloys. Ten new alloys and new melts of 16 previously tested alloys have been tested at 360 C. Corrosion behavior of the surviving samples was similar to that observed for X-8001 after one month. Four failures were noted among the new alloys, all with low iron or nickel concentration. For reliable corrosion resistance a minimum of 0.5 weight percent iron or nickel is required with total iron and nickel 1.5% or greater.

DECLASSIFIED

The samples cut from X-8001 cans extruded from cut blanks have been tested for 10 days at 360 C. The short term results are at least as good as regular material and insensitive to minor differences in metallurgical treatment.

New Aluminum Cermets. Corrosion data based on two months exposure in static 300 C water and in water flowing at 10 fps at 200 C have been obtained. At 300 C after two months the cermets M-54 and M-82 are corroding by a linear process while the corrosion of wrought X-8001 is parabolic. In static 200 C water, M-54, M-82, and X-8001 all corrode linearly. The results of these and previously obtained data are summarized below.

COMPARISON OF APED CERMETs AND WROUGHT X-8001

<u>Alloy</u>	<u>Temp.</u>	<u>Type Test</u>	<u>Corrosion at 2 mos.(mils)</u>	<u>Predicted Corrosion 1 year (mils)</u>
M-54	300	Static	1.25	4
M-82	"	"	1.25	4
X-8001	"	"	~0.53	1.3
M-54	200	Dynamic 10 fps	1.65	5
M-82	"	"	1.88	10
X-8001	"	"	0.62	1.7

This particular lot of cermet samples may not be representative. Better samples are expected for testing at a later date.

Corrosion of Extrusion Clad Fuel Elements. Corrosion tests conducted on Hanford size fuel elements clad in aluminum by a Schloemann cable cladding press indicate the cladding was slightly inferior to our current aluminum cans at low temperature and very inferior at high temperature. Nine cable clad fuel elements and three standard fuel elements were exposed to 25 gpm flow of 300 Area water at 100 C in a standard process tube. One cable clad piece ruptured in seven days. The remaining pieces were exposed for 20 days. Comparison of the standard and the cable clad fuel elements revealed a slightly higher corrosion rate and more pitting on the cable clad pieces.

Several pieces of the extruded cladding together with a standard fuel element can were exposed to 265 C flowing deionized water for 10 days. One piece of the extruded cladding was destroyed. The remainder of the samples were metallographically examined. The average surface of the extruded cladding showed a slightly greater attack than the control piece. All of the extruded pieces showed a localized attack on the seam between the billets. This seam area corroded completely through the metal on several pieces. No reason for the seam attack was apparent.

Jet Impingement Corrosion Tests. New 0.009" jet nozzles have been received from a commercial vendor. These nozzles have screens which should reduce the jet plugging previously noted and give much more reproducible

DECLASSIFIED

results. Conditions in the first test were: temperature, 100 C; pressure drop, 700 psig; flow, 10 l/hr; average velocity, 223 ft/sec; alloy hardness, as rolled. Penetrations on the two alloys tested, 1245 and 8001, were approximately equal and unaffected by water quality (process or de-ionized). The average penetrations observed after one, two, and four hours were 7.7 mils, 10.7 mils, and 17.3 mils, respectively. Further experiments will be done at lower velocities and longer times, more typical of reactor conditions.

Corrosion in 100 Area Process Water. A statistical analysis of corrosion data obtained during an in-reactor comparison of X-8001 and 1245 claddings has resulted in the following empirical corrosion expression:

$$\text{Log C.R.} = 8.21 - \frac{3241}{T_c}$$

where C.R. is the corrosion rate in mils/mo,

T_c is the corrosion temperature in degrees Kelvin.

The quantity T_c may be interpreted as the temperature regulating the corrosion process. For fuel elements under irradiation T_c may be substantially higher than local bulk water temperature. A graphical method for evaluating T_c from corrosion data, water temperature, and slug power has been reported in HW-55045. For standard current production piece geometry, the following empirical relationship has been observed:

$$T_c = T + 1.7P$$

where T = local water temperature,

P = slug power in KW.

Uranium and Zirconium Hydriding in Organics. Uranium samples were exposed to MIPB (monoisopropyl biphenyl) and biphenyl at 150 C and five psi H_2 partial pressure. The corrosion rates were 1.9 mils in both the organics. The corrosion product in both cases was identified by x-ray diffraction as β - UH_3 . Uranium exposed to MIPB under the same conditions at 350 C corroded at a linear rate of 0.27 mil/day.

Zircaloy-2 samples were exposed to MIPB at 350 C and five psi H_2 partial pressure. The rate of hydrogen pick-up was observed to follow a parabolic law, i.e., the hydrogen content of the metal increased linearly with the square root of exposure time. This is to be expected for a diffusion controlled process.

Radiometallurgy Laboratory Studies

Radiometallurgy activities during the month in support of the 2000 Program included diameter measurements of stainless steel clad KER 1-2 rods, and studies of U-Al and U-Asi-Al diffusion couples. The results and conclusions are reported in detail in connection with the respective development programs involved.

DECLASSIFIED

DECLASSIFIED

Al-4

HW-56914

Organic Coolant Phase Diagrams

The melting point diagrams have been determined for all ten ternary systems of biphenyl (B), o-terphenyl (O), m-terphenyl (M), naphthalene (N), and phenanthrene (P). The eutectic compositions (mole percent) and melting points are:

42% O, 32% B, 26% N - 11 C	59% O, 17% M, 24% P - 28 C
59% O, 11% M, 30% N - 20 C	41% B, 35% N, 24% P - 31 C
49% O, 32% B, 19% P - 23 C	42% B, 39% N, 19% M - 32 C
48% O, 37% B, 15% M - 23 C	31% P, 42% N, 27% M - 37 C
50% O, 30% N, 20% P - 24 C	29% P, 45% B, 26% M - 38 C

The first five of the listed eutectic mixtures meet the condition that they are liquid near room temperature. However, for a mixture to be considered an optimum coolant mixture, it must not only be liquid near room temperature, but it must also be in equilibrium with a vapor composition which is also liquid near room temperature. This latter requirement is necessary to prevent fractionation of the mixture by freezing out of the vapors. The vapor freezing point diagrams were calculated for all the ternary mixtures, and it was found that none of them met these optimum mixture requirements.

Basic Metallurgy Studies

Electron and Optical Microscopy. The study of the microstructure of cladding and fuel materials is a direct way of detecting radiation damage in these materials. Two techniques are being used: (1) metallographic examination of polished and etched surfaces, and (2) fractographic studies. A specimen irradiated at a temperature of about 225 C to a burnup of 0.2 a/o, much higher than previous levels, has been studied in the electron microscope. Small voids, 2000 A in diameter, have been detected on a polished and etched surface of the specimen. The microstructure of this specimen differs markedly from that of non-irradiated uranium. Grain delineation and the customary long twins are absent; microstructure similar to that of severely worked uranium is disclosed; impurity inclusions have not disintegrated. In order to establish the validity of the microstructure, the specimen was reground, repolished, and re-etched. No change in the microstructure occurred.

A new microradiographic-metallographic technique has been developed for use on materials. The specimen with an alpha or beta emitting phase or constituent is first etched by ion bombardment to develop microstructural relief. The specimen is then coated with a thin film of plastic, such as Saran, and then coated with Eastman NTB or NTB liquid emulsion. After exposure, the emulsion is processed and is then stripped together with the plastic film. The stripped plastic film is viewed with bright field

illumination to show the microstructure, and the alpha or beta tracks associated with the particular field selected are revealed by polarized light. The method should be of value in determining the location of the radioactive constituents in a specimen since the definition and contrast inherent in the new method far exceed that offered by conventional autoradiographic methods.

A report entitled "Fractography of Non-Irradiated Uranium" has been written for issue as a formal report. The report provides a basis for interpreting current results on fracture surfaces of irradiated impact specimens.

Recrystallization and Recovery of Zirconium Alloys. The kinetics of recrystallization and recovery in zirconium, Zircaloy-2 and Zircaloy-3 are being determined to establish the optimum conditions of heat treatment during fabrication operations. Percent cold work, temperature, time, and heat treat atmosphere have been selected as the independent variables. Rockwell "G" hardness measurements have now been obtained for ten percent cold worked zirconium heat treated in vacuum for 10 and 100 minutes at six temperatures from 300 to 800 C, and a comparison can be made with ten percent cold worked zirconium heat treated in air. The recovery curves for the latter show a gradual decrease from 68 R_G at room temperature to 55 R_G at 700 C with little change at 800 C, while the former show a decrease from 68 R_G at room temperature to 49 R_G at 800 C. In this case the apparent recovery of the air heat treated material is slightly less rapid than that resulting from vacuum heat treatment. Also, the level of final recovery as measured by hardness is less in the case of air treatments than that which occurs due to the vacuum anneals. This behavior is strongly suggestive of a hardening effect in the air heat treated ten percent cold worked zirconium as a result of gas pickup.

Irradiation Effects in Structural Materials. Mechanical property data for irradiated specimens of projected structural metals are necessary for establishing material limitations and optimum conditions for reactor service. A number of potential structural materials for which very limited or no data are available have been prepared for irradiation in a HAP0 reactor. These materials include Zircaloy-2, Zircaloy-3, aluminum alloys X-8001 (M-388) and M-257, AM-350 stainless steel, and magnesium alloys HK-31A-H24 and A-3XA-0. An initial charge of these specimens was exposed to an integrated thermal neutron flux of 7×10^{19} nvt at a maximum temperature of 97 C. The specimens were subsequently stored for six months at room temperature. Specimens of M-388 and M-257 were tested in tension and measured for hardness during the month. The most significant change in property was the yield strength of M-388 which increased from 5500 to 6800 psi. The tensile strength exhibited a small decrease from 16,200 to 15,300 psi, and the percent elongation remained about the same at 30 percent. The range of hardness values overlapped, but the average for the irradiated specimens was 33.6 compared to 31.9 for the unirradiated controls (Rockwell 15-T scale).

DECLASSIFIED

The mechanical properties of M-257 were not greatly affected by this low neutron exposure. The yield strengths before and after irradiation were 28,400 and 28,800 psi, respectively, the tensile strengths 36,200 and 35,300 psi, and the elongations eight and ten percent. The hardness before irradiation was 77.6 compared to 74.7 after (Rockwell 15-T scale), indicating a slight softening.

Diffusion Studies. Diffusion is being studied in U/Ni/X-8001, U/Zr, U/X-8001, (U-Zr)alloy/Al, and U/A-2 aluminum alloy couples. The first phase of the U/Ni/X-8001 diffusion studies has shown that the rate of diffusion of uranium toward the X-8001 surface greatly increases after aluminum reaches the uranium. However, comparisons between the U/Al and U/Ni/X-8001 diffusion rates show that a nickel barrier layer markedly retards the outward migration of uranium, even after the nickel has been completely consumed by the formation of Ni-Al alloys. The effectiveness of nickel as a diffusion barrier during extremely long anneals will require further study because of the complexity of ternary diffusion in the U/Ni/X-8001 system.

Analysis of U/X-8001 and U/A-2 aluminum alloy diffusion couples, annealed five days at 300 C, indicated that the rates of penetration of uranium into A-2 and into X-8001 aluminum alloy are both comparable to the rate of penetration of uranium into AlSi. The same result was found in U/X-8001 couples annealed seven days at 250 C.

New Fuel Element Development

Rod Cluster Fuel Elements. Two three-rod "length test" fuel elements await operation in KER Loop 3. One element is two feet in length. The other is 36 inches long with an intermediate support. These cluster elements contain Nuclear Metals, Inc., coextrusion clad natural uranium.

Four seven-rod cluster fuel elements are being irradiated in the KE Reactor through-hole facility as part of a program to develop a fuel capable of operating satisfactorily at NPR conditions. These fuel elements are operating satisfactorily at 105 kw/ft, and with a measured core temperature of 359 C. From the data collected, the uranium-stainless steel interface bond coefficient was calculated to be 2580 BTU/hr-ft/°F. Last month these fuel elements were operating at 100 kw/ft specific power, 415 C core temperature, and with a bond coefficient of 1350 BTU/hr-ft/°F. By comparison of these values, the uranium rod must be operating with more pressure against the cladding thus denoting possible growth and/or swelling. The goal exposure of this irradiation test is 2500 MWD/T of which approximately 1000 MWD/T has been attained. Two seven-rod cluster elements clad in Zircaloy-2 still await charging in KER Loop 1. These elements contain natural uranium with 0.030-inch clad. Inter-rod spacings are 0.050 inch nominal.

Rod and Tube Fuel Elements. Rod and tube fuel elements have been proposed for a Hanford NPR. As an extended surface element, they have the advantage of symmetrical coolant flow passages and potentially good dimensional stability. Nuclear Metals, Inc., has produced 30 feet of

RECEIVED
JAN 10 1964

DECLASSIFIED

coextruded Zircaloy-2 clad uranium tube. The clad thickness is 0.030 inch. Outer diameter is 1.785 inches, and the inner diameter is 1.375 inches. The first seventeen feet of tube was produced for Nuclear by Revere Copper and Brass Company in Detroit. This material is highly eccentric (0.030-0.040 inch). An additional fourteen feet of tube was extruded at Nuclear and received this month. Eccentricity is less than 0.010 inch. Nuclear has also produced one-inch diameter uranium rod clad with 0.020-inch Zircaloy-2. The components for three, 36-inch length, fuel elements had been cut from available rod and tube during June. The tubes have now been heat treated, welded, and autoclaved. The inner rods have been fitted to the tubes but await end sealing and autoclave testing. End fittings and tube supports are fabricated. Three rod and tube elements will be ready for KER charging by August 1.

End Cap Closure of Coextruded Fuel Rods. The development of extended surface fuel elements from coextruded Zircaloy-2 uranium rods requires a simple yet dependable end closure for the rods. A number of zirconium-cobalt, zirconium-titanium, zirconium-vanadium, zirconium-silver, and zirconium-beryllium alloys have been investigated with the intent of developing a suitable brazing alloy for attaching end caps to these fuel rods. Melting points, mechanical properties, wetability, and braze layer characteristics are being evaluated. Work to date indicates that a zirconium five percent beryllium alloy melting at approximately 1050 C has desirable characteristics as applied to brazing of Zircaloy-2.

Alternate End Closure for Coextruded Fuel Elements. Swaged elliptical ends were produced on a 5/8-inch diameter coextruded Zircaloy-2 clad uranium rod. Elliptical ends were produced with one swaging pass and no intermediate anneals. Future effort will be directed at reduction of thinning of can wall over the ends and effecting a corrosion resistant welded point closure.

Coaxial Fuel Element. The coaxial tube fuel element is of interest because it may offer a better split failure resistance than a corresponding sized cored fuel element. The third MTR irradiation of coaxial elements is currently in progress, and reliable temperature data are being obtained. At initial startup of the fuel elements at the MTR, temperatures during stepwise power increases up to reactor power of 40 mw were obtained. The general shape of the temperature-power relationship was as anticipated; however, the temperatures at given power were less than anticipated. At the initial startup the temperature reached 690 C, dropped back to 670 C, and has subsequently increased gradually to about 740 C after about one month of operation. During subsequent stepwise power startups the form of the temperature-power relationship has changed slightly as anticipated, presumably as a result of creep or stress relaxation in the inner uranium tube. At the latest startup the ultimate temperature reached was about 740 C, or an increase of about 70 C over the initial equilibrium startup temperature of 670 C. These fuel elements will continue to be irradiated during the next MTR cycle but may not attain high temperatures or powers since during the next cycle the MTR may be operated with an experimental loading of Pu-Al fuel elements at lower power levels.

Self-Supported Fuel Elements. Supports attached to fuel element jackets are designed to accurately position the fuel elements in a process tube which should improve the coolant flow pattern and reduce the effects of localized overheating on fuel element jackets. Further, the system should reduce process tube damage in case of a fuel element rupture. A test of this concept is now in progress in B Reactor. Three tubes have been discharged, and three tubes are to be discharged early in August. The goals of 400, 500, and 600 MWD/T should be obtained at that time. Eight more tubes of solid self-supported fuel elements are required to complete this evaluation.

Hot Press Process. A method of end closure has been conceived to permit the jacketing of I & E cores in sections of tubing rather than preformed cans and caps. If successful, this will afford a large reduction in the aluminum component cost. The closure method simply combines the OD and ID hot work closures on both ends of the element. One such closure has been made and shows promise. A slight change in the punch design is necessary to obtain proper thickening of the OD and ID jacket in the weld zone.

Effect of Alpha Phase Treatment of Cold Closure Elements. The fuel core of cold closure elements is slightly deformed during the closure operation leading to permanent barreling of the core that amounts to one to two percent area change along the length of the core and an average of approximately one percent height reduction. Subsequent bonding methods require the element to be heated to 500-600 C, and it is necessary to know if the residual strain and heating cause any adverse changes in grain structure or properties. Sections were obtained from two cold closure elements and heated for 10, 20, and 60 minutes at 500 and 600 C. These treatments would cover the time and temperature range employed in bonding the elements. The hardness and microstructure of the heat treated sections were compared with untreated sections of these elements. The hardness of the material was decreased by the heating, resulting in a maximum change of approximately five points Rockwell G for both 500 and 600 C treatments. No excessive grain growth occurred, and the only microstructure change observed was a sharpening of sub-grain boundaries and development of equiaxed recrystallized grains. These results indicate that no adverse changes are to be expected in subsequent bonding of elements produced by the cold closure process.

Evaluation of Cast I & E Elements. A shipment of 1000 I & E fuel elements prepared by American Bearing Company by static casting has been sampled to determine the soundness and metallurgical characteristics at this stage of development. Samples representing the following melting stock were obtained: (1) castings prepared from slug charges, (2) charges of slugs and derbies, (3) charges of derbies and headers from previous casting, and (4) charges of headers only. Density was obtained on full slugs for six elements from each of the above conditions. These results are given in the following table.

DECLASSIFIED

Density of Cast I & E Elements

<u>Melt Stock</u>	<u>Density - gm/cm³</u>		
	<u>Average</u>	<u>Maximum</u>	<u>Minimum</u>
1. Slugs only	18.956	19.028	18.916
2. Slugs & derbies	18.960	18.968	18.947
3. Derbies & headers	18.951	18.960	18.927
4. Headers only	18.909	18.926	18.898

These values show that the material meets density specifications for fuel cores and, most important, that the cast slugs do not contain serious voids or casting flaws. The elements as received were cast, given a single beta heat treatment, and machined to size. Additional tests that are partially completed are determination of chemistry, microstructure, crystallographic orientation, and mechanical properties.

Effect of Clad Stiffness on Corrosion Behavior. The study to determine possible relationships between clad stiffness, bond strength, and rate of corrosion of defected clad rods was continued. Six coextruded rods, three beta heat treated, were machined to obtain clad thicknesses of 0.030, 0.020, and 0.010 inch. All samples were defected by drilling a 0.025-inch diameter hole through the cladding. The samples were exposed to 225 C water for four hours. Examination of the rods showed the same results as achieved in the previous test. In the beta heat treated samples the rod with the thinnest wall suffered the greatest damage. In the as-extruded samples the rod with the thickest wall suffered the greatest damage. All beta heat treated samples suffered more corrosion damage than did the as-extruded rods. It can be concluded that beta heat treating alters the properties of the fuel rod to increase its corrosion rate. Preliminary microscopic examination showed that in the beta heat treated rods, a zirconium hydride layer was present along the bond interface just preceding the corrosion area indicating the formation of hydride prior to actual corrosion. This hydride layer was not as prominent in the as-extruded rod. Further investigation of the corrosion phenomena will be made to determine the effect of beta heat treatment upon the mechanical properties of the bond and cladding.

Restraint of Uranium Swelling by Zirconium Cladding. Swelling rates of unrestrained uranium irradiated in the 400-800 C temperature range have been measured, but to date no swelling data are available for unalloyed clad uranium with a 250-350 C cladding surface temperature and a maximum fuel temperature in the range 450-600 C. To provide initial swelling data from the above temperature conditions, two unalloyed natural uranium fuel rods coextruded with a Zircaloy-2 cladding are being irradiated in the MTR. One fuel rod, GEH 3-31, has an estimated exposure of 1750 MWD/T at an average center uranium temperature of 400 C. The other fuel rod, GEH 3-32, charged on July 7, has an exposure of 200 MWD/T, and a maximum center uranium temperature of 340 C. Neither fuel rod has approached the desired uranium temperature of 600 C. The second rod was charged in a low flux position by the Phillips Petroleum Company despite a specific request that a capsule not be charged in that flux. A series

DECLASSIFIED

Al-10

HW-56914

of capsule experiments designed for irradiation in Hanford reactors to obtain further information on the dependence of uranium fuel element swelling upon cladding and uranium temperatures, cladding thickness, and exposure are in the initial stages of assembly. A single capsule irradiation to be charged at Hanford is being prepared to test the applicability of the physics and heat transfer calculations.

Thermal Contact Conductance. The thermal contact conductance between sintered UO_2 and its metallic jacket has a significant effect on the core temperature of a UO_2 fuel element. In order to evaluate the temperature drops involved, the following systems are under study: UO_2 -aluminum, UO_2 - UO_2 , UO_2 -Zircaloy-2, and UO_2 -304 stainless steel. Thermal conductances obtained between lapped surfaces of UO_2 in contact with aluminum are tabulated below:

Run No.	Unit Pressure on the Joint psi	Aluminum Temperature at the Joint °C		Thermal Flux, BTU/hr/ft ²	Average Contact Conductance BTU/hr/ft/°F 1/2 (hot joint + cold joint)
		Hot	Cold		
1 & 2	323	320	170	163,000	1500 to 1700
3 & 4	232	175	95	92,000	1500 to 1700
5	424	280	180	155,000	3000
6	424	155	100	76,000	2600
7	*64	320	150	11,400	950

*Run made after the 424 psi run without breaking joint.

A one-inch diameter by 0.070 inch thick wafer of UO_2 was sandwiched between the ends of two one-inch diameter aluminum cylinders. The combined conductance of the two UO_2 -Al contacts was measured.

An independent measure of the thermal conductivity of materials tested in the contact conductance apparatus would improve the accuracy of these measurements. A "thermal comparator" based on a design described by R. W. Powell in J. Sci. Instruments, 34, 485 (1957) was constructed, and calibration against twelve materials of known conductivity was begun. If the six percent accuracy claimed for this instrument is achieved, it will provide a rapid non-destructive measure of conductivity. The instrument could also be easily used on radioactive materials.

ETR Piping Calculations. An elastic-plastic solution is formulated and evaluated for a pressurized pipe internally cooled and mechanically cycled by alternating pressure loading and heating. The numerical calculations are for the conditions of operation to be encountered in the pipe used for the ETR 6x9 core facility. As the pipe thickness is increased, the numerical calculations show that the pipe undergoes greater plastic yielding per cycle and has larger residual tensile stresses upon cooling. A report has been written which described the method of calculation. The 650 IBM program for this calculation is available for use by HAPO personnel.

2. REACTOR PROGRAM

Coolant Systems Development

Aluminum Corrosion in Process Water. The various tests to compare corrosion behavior of 1245 and 8001 aluminum alloys are continuing. So far no difference has been noted in the alloy behavior; in no case was there any evidence of accelerated attack. It appears that the 100 Area process water, even with added solids and reduced dichromate, is not sufficiently corrosive to pit the aluminum out of the reactor. Additional tests under more drastic conditions are being started.

Decontamination Studies. The best method for decontamination of stainless steel surfaces currently appears to be the three-step Turco process. In this process the surfaces are contacted successively with two proprietary compounds (Turco 4501 and 4502), and then with a solution containing 25 volume percent of nitric acid. In complex systems, such as a loop, it is necessary to rinse thoroughly after each step. Some work is being done to modify this process to make it suitable for carbon steel surfaces. Other research is being aimed at finding some process for decontaminating stainless steel surfaces without using nitric acid.

An acid-persulfate solution has been used. This is a simple one-step process, but because the solution is relatively corrosive, it will be useful only if a suitable inhibitor is found. Sodium silicate did inhibit the attack to a certain extent and other compounds are being tested.

In-Reactor Thermocouple Test. The correlation between in- and out-of-reactor corrosion tests is still unsatisfactory, principally because several important effects are not known quantitatively. One unknown area is the temperature drop through the various corrosion product and water films. Neither the initial temperature drop nor the change in this temperature differential with time is known. In order to obtain this answer a thermocouple slug assembly was placed in the KER-2 tube. The fuel element in this assembly originally had three thermocouples imbedded just below the outer aluminum surface. One of the three thermocouples is reading a reasonable cladding temperature while the other two thermocouples are reading lower than bulk outlet temperature. This indicates either a direct short or presence of moisture in the junction at the extension leads on the rear face. The junctions will be inspected at the next reactor shutdown to determine the source of error and to make new junctions. The good thermocouple indicates a cladding temperature from four to ten degrees higher than the bulk outlet temperature. From an analysis of the data obtained so far, it appears that the positions of the two control rods bracketing the loop 2 tube have a marked influence on the temperature differential.

Raw Water Heat Exchanger Tests. Examination of the raw water cooled heat exchangers in ELMO-1 after about ten months operation showed no obvious increase in scale buildup on either the stainless steel tubes or on the carbon steel baffles. A scale buildup about 1/64-inch thick inside the outlet tubing of the demineralized water side of both exchangers was.

DECLASSIFIED

noted. Similar results were obtained in the heat exchanger facility using Dowtherm to heat the tube walls. After one-month run at seven fps, inlet temperature 62 F, outlet temperature 212 F, and hottest pipe wall temperature of 285 F, no appreciable scale was formed from the raw water. The overall heat transfer coefficient across the exchanger did not change during this period. On 7/11/58 one of the four heat exchangers was removed from the system and the Dowtherm operating temperature raised to 700 F to raise the water pipe wall temperature to 310 F. One week of operation at the higher temperature produced only about a one-mil increase in the raw water rust layer on the highest outlet water pipe wall. Inspection of the immersion heaters operating in Dowtherm, with a density of 18 watts/in² and Dowtherm velocity of 0.6 fps, showed them to be in excellent condition with no tars on the outside of the heater rods. The stressed carbon steel coupons placed in the outlet water pipe have a large amount of rust stringers and whisker formation. A variable velocity carbon steel specimen also placed in the outlet water section shows considerably more scale as the water velocity decreases. Stressed stainless steel coupons also in the outlet water have only a thin (about two mils) uniform rust scale.

High Temperature In-Reactor Exposure of Aluminum Clad Fuel Elements. The maximum heat flux in the Elephant Slug tests at 195 C completed last month was 0.77×10^6 Btu/hr, ft² in the annulus and 10^6 Btu/hr, ft² in the hole. The total corrosion after one month was so low that it could not be measured.

Dichromate Inhibitor for High Temperature Water Systems. Solutions of 50 ppm sodium dichromate at a pH of 4.5 have been subjected to gamma rays. This solution is of interest as a corrosion inhibited water for recirculating reactor systems. The radiolytic decomposition rate is such that about 15 lbs/day of dichromate would be reduced in a K-size reactor. It has also been determined that dichromate can be stabilized against reduction by radiation at high pH conditions by the addition of H₂O₂ to the solution.

The results of a corrosion test in ELMO-9 (pH 7.0; 50 ppm sodium dichromate) showed that dichromate inhibited the corrosion of carbon steel but did not protect the aluminum. An examination of this loop showed that it was not safe to operate and will no longer be used. Further evaluation of dichromate as an inhibitor in high-temperature water systems is planned in another loop, ELMO-2, which is now being conditioned.

Organic Coolant Studies. The low-temperature in-reactor loop was shut down to examine the coupons and slugs. They had an accumulated exposure of 2046 hours at 700 F in MIPB. The slugs appeared no different than was reported the previous month. They were all in excellent condition. The aluminum (X-8001 and M-257) and Zr-2 coupons showed no signs of attack. The magnesium coupons again showed some attack from the water, but their condition was much better than others previously tested due to a better control of the water content.

DECLASSIFIED

AI-13

HW-56914

Process Assistance - Coolant Systems. A Parker type flared inlet fitting is being installed in EIMO-7 for thermal cycle testing. Three types of temperature detectors are being prepared for testing on EIMO-7. Response time, rate of response, variation with change of ambient temperature, and general reliability will be determined.

The Barco flexible jumper for the NPR failed after about three and a half months total operation on EIMO-7. A Marmon-Conoseal Cap failed after 500 hours and six cycles from 100 to 500 F. A Marmon-Conoseal Jumper and a bell ring sealed cap cycled 1830 and 2100 times, respectively, between 300 and 500 F with no leakage.

Nonmetallic Materials Development

Graphite Development. During the past year the graphite manufacturers have become increasingly interested in the development of improved graphites for nuclear applications. A cooperative program of development and irradiation testing with these companies was established at Hanford several years ago. Recent meetings were held with the research and sales personnel of Great Lakes Carbon Corporation, National Carbon Company, and Speer Carbon Company for the purpose of: (1) furthering the understanding of fundamental radiation damage mechanisms in graphite; (2) evaluating new materials, fabrication techniques, and purification processes; (3) developing special processes to obtain optimum properties for reactor use. Long range cooperative programs for the development of graphites with optimum properties for reactor applications were of interest to all the companies contacted. Definite plans for the course of these studies will be established after forthcoming discussions at Hanford.

In discussing a possible production effort for the NPR, it was determined that each company has alternative cokes which could be used. Samples of graphite made from these cokes will be shipped for evaluation. Although at least eight months are required for adequate determination of irradiation stability, the tightest NPR schedule would allow sufficient time to complete these studies. Speer Carbon Company and Great Lakes Carbon Corporation have developed new purification processes which will be evaluated through purity measurements made in the 305 Test Reactor.

X-Ray Diffraction Studies of Irradiated Graphite. X-ray studies of radiation damage in graphite have been confined to the determination of the apparent crystallite size and the lattice spacing which are derived from the integral breadth and peak position of the diffraction line. More elaborate analyses based on the diffraction line shape have been initiated and are continuing. Theoretically, additional information can be derived from the relative intensity of diffraction lines from virgin and irradiated material. It is predicted that a reduction in crystallite size should lead to an increase in the intensity of the diffraction line while the inclusion of imperfections should lead to an increase in the background intensity. By the use of an internal standard such as powdered NaCl, the relative integrated intensities of the diffraction lines can be determined, and in addition, the relative background intensity can be monitored.

A sample irradiated to 735 MD/AT at 30 C was found to yield an integrated intensity 20% less than that of a virgin sample, indicating that some 20% of the crystal volume no longer possesses the requisite order to produce a diffraction line. The lattice spacing of the irradiated sample increased from 6.71 Å to 6.98 Å, but the apparent crystallite size remained nearly constant at about 700 Å. No increase in the background intensity was noted. Apparently, the natural background is of much larger magnitude than the background arising from incoherent scattering in the sample. In order to obtain a better understanding of these effects Fourier analyses of x-ray line shapes on selected samples have been performed and are now being programmed for 650 IBM computation.

Graphite Oxidation. Graphite samples for the high temperature graphite oxidation experiment at KW Reactor, production test IP-110-A, were discharged on July 16. The purpose of the test was to obtain graphite burn-out data in an operating reactor in the temperature range 600-700 C in a gas atmosphere of 70% helium-30% carbon dioxide to 100% helium. Twelve tubes in a diamond array adjacent to channel 3065-KW were charged with J-N pairs to attain higher heat generation in the surrounding graphite. The maximum sample temperature was continuously monitored with a chromel-alumel thermocouple and averaged 685 C. The oxidation rate of all samples was less than 2%/1000 days except one sample which had an indicated rate of 31%/1000 days. The central two-inch surface of this sample was uniformly eroded, and no explanation for the high oxidation rate is apparent. This sample will be ashed and analyzed to determine whether metallic impurities were present which could have catalyzed the oxidation rate.

Thermocouple Development. The zirconium oxide, stainless steel sheath, iron-constantan couple which had developed a severe temperature drift in laboratory life tests was removed from the furnace, and a spectrochemical analysis was made of the thermocouple wires. The results showed zirconium contamination of the wire, supporting the conclusion that a reaction between the wire and insulating material had occurred and was probably responsible for the failure. The resistance of a similar couple operating at the same conditions (100 days in CO₂ at 800 C) increased from 3.6 ohms to 5000 ohms. It is concluded that zirconium oxide is not a satisfactory insulating material at 800 C for this thermocouple system.

Five Geminol couples insulated with porcelain have been prepared for test in 105-KE. These will be placed in a standard stringer adjacent to iron-constantan couples in the center of the reactor and the performance of each type will be compared.

Irradiation Damage to Plastics and Elastomers. The separate effects of gamma radiation and heat are now known for most heat resistant elastomers. The first experiments on the combined effects of heat and radiation have been completed on four silicone elastomers representing different chemical types. They were subjected to: (1) 150 C air for six weeks, (2) gamma radiation to a dose of 10⁸ r in air at 25 C, (3) gamma radiation to a dose of 10⁸ r in air for six weeks at 150 C. The effect on changes in hardness of (3), the combined gamma exposure and heat aging, was the

DECLASSIFIED

same as (1) plus (2). The effect of (3) on the elongation of the silicones was approximately the same as (2). Changes in tensile strength varied with the different materials, and it is not possible from the experiments done so far to predict the combined effects from (1) and (2).

Structural Materials Development

Creep Deformation of Zircaloy-2. A preliminary analysis of the results of creep tests on Zircaloy-2 specimens at 550 and 650 F has been completed. The strain during primary creep of 15% cold worked material was $1/4$ to $1/2$ the strain during primary creep of annealed Zircaloy-2 when tested at the same stress. The increased strength of 15% cold worked material did not recover during tests up to 5000 hours. Additional tests to determine the deformation at the initiation of third stage creep and at rupture are being performed.

Thermal Hydraulics Studies

Reactor Flow Hazard Studies. The low pressure heat transfer apparatus was modified so that experiments could be performed which would simulate the thermal hydraulic events within a process tube after a complete failure of a front hydraulic connector. The results of these experiments, which have taken on increased interest since a recent connector failure on an empty tube at C Reactor, will be valuable in determining power levels at which fuel element temperatures would reach the melting point in event of a connector failure at one of the reactors.

The experimental apparatus was so modified that a valve would instantaneously stop the flow of cooling water from the pump and allow the coolant within the process tube to reverse and discharge to atmosphere at a point upstream of the venturi. The heat generation was programmed to decay off simulating a reactor scram shortly after the "connector failure".

Initial experiments simulating a front hydraulic connector failure within a "C" process tube with I & E fuel elements at a tube power of 1000 KW and an outlet water temperature of 125 C indicated that probably the most crucial moments would occur some time after the initial failure. At this time the generated heat must be removed by the flow of hot water from the rear header and, although the heat generation is only a fraction of original, the pressure available at the rear header to cause the reverse flow is small. The general results of the initial tests supported previous analytical calculations that indicate fuel temperatures quite close to melting are probable following a front connector failure at present power levels.

Water Loss to an Entire Reactor. Calculations were continued to predict the temperatures within Hanford reactors following a complete water loss. Initial calculations, for example, indicate that at C Reactor melting of the process tube initially at 1200 KW would take 18 seconds following a complete water loss. Other calculations have been made for various power and for all reactors.

DECLASSIFIED

AI-16

HW-56914

It was determined that rate and amount of buildup of UAl_3 at the junction between the fuel element and its aluminum jacket are important in predicting when the process tube would melt. Should the compound UAl_3 form before the uranium melts, the time to destroy the process tube would be delayed.

Hydraulic Studies. Hydraulic laboratory data were documented in HW-56677 to show the Panellit pressure changes which occur if a front nozzle insert should come loose and lodge against a column of I & E fuel elements. It was concluded that if the inserts were drilled the hole flow would not be seriously restricted should an insert lodge against the fuel column, and that the change in Panellit pressure would not be great enough to detect the event.

Analytical and laboratory studies have resulted in the selection of suitable orifice combinations for four new orifice zones in D Reactor.

To assist Reactor Operations in determining if a Poison Column Control Facility tube has been completely discharged, laboratory data were obtained which show front ball valve nozzle pressure as a function of the front header pressure, the position of the pigtail throttle valve, and the number of slugs in the tube. The data, presented in HW-56854, may help prevent reactor scrams caused by rapid flux changes which have been experienced when poison slugs were inadvertently flushed from a tube thought to be empty.

High Pressure Heat Transfer Apparatus. A test section was designed to give information on the operation of a heat exchanger with surfaces at temperatures between 500 and 600 F in contact with raw Columbia River water. The test section will use the heat output from the high pressure heat transfer apparatus in 189-D as a source for the primary fluid.

Thermal Stress Cycling Tests. Further discussions were held with engineers from ANP concerning their request that HLO perform thermal cycling tests on a specimen of a process tube scheduled for installation in the ETR. It appears the two-week test will be approved by all concerned and will be conducted during the middle of August.

Miscellaneous. A study showing the comparison of operation of the KER pumps in parallel or series was presented in HW-56676. The document points out that the series arrangement of pumps allows the greatest number of fuel elements for a given flow but that the parallel arrangement provides the greatest flow backup in case of the failure of one pump.

A study of a casualty consisting of the inadvertent opening of the 1706 KER-1 emergency dump valve during full power loop operation was completed. It was concluded that no damage would occur to either cylindrical or I & E fuel elements, and that the surface temperature of an outside rod of a seven-rod cluster fuel element would not exceed 1100 F with a maximum of 30 percent restriction of the dump valve port area. It was found that the reactor will be scrammed by high flow and boiling point suppression - low

pressure trips approximately three seconds after the accident. At 44 seconds (full port area), the fuel elements will be subjected to water-steam cooling and at 173 seconds, the loop pressure will have decreased enough to allow cooling by reactor process water.

Evaluation was made of the electrical resistance properties of a special paint used for high temperature application. The paint, Markal Company No. D-A-8, was applied to samples of 304 S/S pipe which had first been coated with zirconium oxide and aluminum oxide by the flame spray technique. After autoclave treatment at 340 F for 72 hours and at 570 F for 48 hours, the sample consisting of the paint on top of the zirconium oxide layer was still in excellent condition. The electrical resistance of the coating was checked and found to be approximately 50,000 ohms after the sample was heated to 600 F and then plunged in cold water, and 40,000 ohms after the sample was immersed in cold water for five days.

Mechanical Equipment Development

Organic Cooling System Components. The MOTS-1 facility resumed operation upon the completion of the majority of planned modifications. The testing of the two-inch compression fitting and flared fitting jumpers was completed. These fittings operated approximately 800 hours and were thermocycled 92 times without any signs of leakage. Mechanical seal testing is continuing.

Organic Fire Tests. Open pan fire tests were conducted using biphenyl, ortho-terphenyl, meta-terphenyl, and santo wax. All appear to be less combustible than MIPB and were easily extinguished with a spray of water. Elevated pressure and temperature tests are scheduled for August.

Shielding Studies

Attenuation Studies. The final irradiation of ordinary concrete baked at 100 C was completed, and foil counting is under way. The ordinary concrete test slabs are now being baked at 200 C. After being baked at 100 C, the ferrophosphorus concrete test slabs were placed in the DR test well for irradiation.

Thermal Shield Studies. One of the 6061 aluminum irradiation samples was discharged from the F Reactor, and it gave a dose rate of 16 mr/hr at one foot after ten hours cooling. The calculated dose rate (based on the maximum percentages of impurities) was 34 mr/hr for the same conditions.

A partial disassembly of the C Reactor shield plug was made during the last shutdown. The objective was to determine any operational or mechanical difficulties. The disassembly was not completed because the large bolts holding the nose-piece could not be removed. Insufficient shutdown time was available to remedy this trouble. A second attempt will be made during the next reactor shutdown.

DECLASSIFIED

DECLASSIFIED

A1-18

HW-56914

Fast Neutron Spectrometer. The one hundred channel analyzer unit is unstable, making normal maintenance work difficult. The manufacturer has been asked to send an engineer to HAPO to assist in finding the cause of the marginal performance.

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. REACTOR DEVELOPMENT - 4000 PROGRAM

Gas Cooled Power Reactor

Graphite Studies. The construction and volume calibration have been completed on the vacuum line for filling quartz ampoules containing graphite samples with known amounts of liquid carbon dioxide. The ampoules will be irradiated in a Hanford reactor at about 500 C for one month, and changes will be determined in the gas composition, pressure, and sample weight.

A study by the Process Design Operation, IPD, to determine the feasibility of installing a high pressure recirculating gas loop in one of the Hanford reactors is nearly complete. The purpose of this study is to estimate the costs, construction time, and determine the location of a loop to study the in-reactor oxidation of graphite under conditions expected in the gas cooled power reactor. Shortly before this work was completed, it was decided that the prototype GCPR would begin operation with helium as the coolant. Because there is still sufficient interest in a research program which could lead to the use of carbon dioxide as the coolant, an in-reactor gas loop may still be needed. In view of the change to helium, a revised R&D proposal is being prepared for graphite studies in support of this program.

H₂O Fluidized UO₂ Pebble Bed Reactor

Re-evaluation of this conceptual design has been completed. Two reactors, sized for 70 MW and 646 MW, were evaluated for 1000 MWD/T and maximum attainable exposure. Results are presented in a forthcoming report on this work.

D. CUSTOMER WORK

Radiometallurgical Examinations

Examination of Heavily Corroded Enriched Elements (RM-235). Examination of the first 1245 aluminum jacketed, enriched, internally and externally cooled fuel element has been completed. Tubes 5157 KE and 0873 KE were prematurely discharged at an exposure of 67 MWD/T because calculations indicated that operating conditions would produce accelerated corrosion of the slug jackets. A slug from each tube was selected for detailed examination.

Intergranular attack was observed on the upper one-fourth of the external can wall, directly opposite the rib marks, and extended the full length of the slug with the exception of approximately one-half inch of each end. In the central portion of the intergranular attack the average thickness of the can wall, including the 0.009-inch thick AlSi, was 0.030 inch. However, the can wall had been penetrated by the coolant as evidenced by a small undercut area under the thinnest portion of the can wall. The AlSi had been spheroidized in an area that was larger, but nearly coincided with the area of intergranular attack. Metallography of a wafer removed from the area of greatest disturbance showed the internal can wall to be normal. Some grain growth in the uranium had occurred, but no evidence of recrystallization was noted. It was interesting to note that this slug showed a marked similarity to the "hot spot" failures which have been occurring recently.

I & E Natural Failure (RM-243). Examination of a natural uranium I & E fuel element failure from tube 3849-KE was started. The element failed 5/20/58, after an exposure of 624 MWD/T. It was a hot spot failure with a deep crater in the uranium located a short distance from the male end and diametrically opposite the tube rib marks. Sections of the jacket from the edge of the crater and one-half inch from the crater have been taken for metallographic examination.

IP-70-A I & E Natural Failure (RM-237). Two natural uranium I & E fuel elements from tubes 3051 KE and 3655 KE have been examined. The can wall sample from the 3051 KE element showed that the aluminum grain structure at the break point had been worked and that the break was a tensile failure. The tensile break, caused by the undercutting corrosion action, occurred after the temperature of the can wall had returned to normal because of the insulating effect of the corrosion formed uranium oxides. The observed spheroidization of the silicon grains in the AlSi gave evidence of high temperature operation.

A section of the can wall from the hot spot area of the 3655 KE element has been examined. The can wall showed intergranular corrosion, spheroidization of silicon grains in the AlSi. At its thinner cross section, the can wall is folded back on itself several times with large pieces of both can wall and AlSi missing.

RM-228 (IP-81-A) Blunt Nosed True Line Solid M-388 Rupture from 105-DR. The blunt-nosed true line, M-388 jacketed, solid production element, which failed as a side "hot spot" rupture in tube 3376-DR, was sectioned to remove three wafers. Two wafers were obtained from the hot spot area near the center of the slug; a third was removed one inch from the female end, out of the hot spot area. The etched wafers from the hot spot area revealed an oval-shaped area of recrystallized uranium approximately one-half inch in width, with one edge of the oval bordering the external surface of the slug at the center axis of the slug. A severe Y-shaped crack was propagated at the center of the recrystallized area, each of the three legs of the crack extending to the surface of the uranium. Microscopic examination of the wafers showed severe and widespread microcracks. Metallographic examination of the M-388 can wall indicated an extremely high operating temperature in the hot spot area. At

DECLASSIFIED

~~DECLASSIFIED~~

Al-20

HW-56914

the center of the hot spot the silicon in the AlSi bonding layer was missing for over one-half inch around the circumference. Heat-affected AlSi was seen for over one-third of the circumference of the wafer.

The corrosion attack of the can wall was outlined by the hot spot. The can wall was thinnest at the center of the hot spot (approximately 0.010 inch), with the thickness gradually increasing until it reached the normal at the edge of the hot spot. No intergranular attack was observed.

Metallography Service

The information collected to date on AlSi compound layers was presented at a meeting of all those known to be interested in slug quality. Representatives of FPD, IPD, Radiometallurgy Laboratories, Metallography Laboratories, and Physical Metallurgy Operation were present. A report containing minutes of this meeting is now being prepared and will be distributed to those who were present. It was suggested that a similar meeting held at some future date would be helpful in reporting new information and the in-reactor effects of recent canning process changes, if they were available at that time. It was recognized that present information is not adequate to allow correlation of out-of-reactor tests with in-reactor results. It was generally conceded that the canning process would have to be controlled closely to allow such correlation. Work is continuing on attempts to individually identify each compound which occurs in the AlSi-uranium interface.

Samples Processed During the Month

Total samples processed: 284

Photographs:

Micrographs	385
Macrographs	<u>42</u>
Total	427

The following Trips and Visits Reports apply to activities on 2000, 3000, and 4000 programs. Technical activities on the 4000 Program - Plutonium Recycle Test Reactor are reported separately in HW-56914 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
JC Fox	7/17-18	General Mills, Minneapolis, Minn.	PRTR fueling vehicle design.	GC Kelly	No
RH Purcell	7/25	Byron-Jackson Pump Co., Los Angeles, Calif.	Discuss pump delivery dates	W Martin S Weinstein, et al	No
HE Hanthorn	7/7	Northwest Copper Works, Portland, Ore. Product Engineering, Portland, Ore.	Inspect hood manufacturing facilities Consult on cost reduction for plastic glove ports.	Mr. McGilvary O Garrison	No No
JL Bates	7/1-4	Gordon Research Conf., Meriden, N.H.	Discuss solid state studies in ceramics, attend conf.	--	No
JJ Cadwell	7/4-14	UK-AE Authority, Risley, Harwell & Springfield, England.	Discuss Calder Hall fuel element technology.	HR Johnson	Yes
JC Tobin	7/7-11	Ames Laboratory, Ames, Iowa	Discuss HAPO slug program at Ames.	FH Spedding	Yes
FE Young	7/9-11	Phillips Pet. Co. & AEC-IOO, Idaho Falls, Ida.	Witness instrument check on high pressure loops.	S Cohen	Yes
DC Kaulitz KR Merckx	7/10-11	GE-ANP, Cincinnati, Ohio.	Discuss ETR high pressure loops & HAPO irradiation program at ETR & MTR.	R Perry	Yes
RS Kemper	7/17	Oregon Metallurgical Corp., Albany, Oregon.	Discuss development contract.	SH Shelton	No
EA Evans	7/24-31	GE-APED, San Jose, Calif.	Reactor fuel studies.	PH Reinker LH McEwen	No

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
RE Nightingale	7/6-11	UK-AEA and Harwell, London, England.	Discuss graphite technology re gas cooled reactors.	HR Johnson EL Brady	Yes
	7/14-18	French AEC, Paris; Sacle' Labs., Sacle', France.	Discuss graphite purity & materials.	Dr. Gueron MM Herron	Yes
EM Woodruff	7/13-14	Natl. Carbon Co., Parma, Ohio	Discuss cooperative graphite development work.	W Eatherly	No
	7/15	Natl. Carbon Co., Columbia, Tenn.		P Hastings	"
	7/16-18	Natl. Carbon Co., Niagara Falls, N.Y.		RL Mansfield	"
		Speer Carbon Co., Niagara Falls, N.Y.		W Elston	"
		Niagara Falls, N.Y.		B Bailey	"
JM Davidson	7/14-16	GE-ANP, Cincinnati, Ohio	Attend conference on MTR-ETR reactor utilization.	R Perry WG Baxter	Yes
C Groot	7/14-18	Gordon Research Conf., New London, N.H.	Attend conference	--	No
RL Dillon		GEL, Schenectady	Discuss corrosion of aluminum.	WA Tragert	No
KD Hayden	7/11	American Locomotive Co., Cincinnati, Ohio.	Inspect high pressure water loop	RC Hanks	No
JA Ayres	7/2-3	KAPL, Schenectady	Discuss carbon & stainless steel systems; Navy loops; new decontamination agents.	FC Steiner	Yes

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
HP Oakes	7/14	Damascus Tube Co., Greenville, Pa.	Discuss fabrication of zirconium.	BB Burd	No
	7/15	Carpenter Steel Co., Union, N.J.		N Cherik	"
	7/16	New Rochelle Tool Co., New Rochelle, N.Y.		CA Tudbury	"
	7/17	Allegheny-Ludlum Watervliet, N.Y.		RE Rohrabaugh	"
	7/18	Wolverine Tube Co., Detroit, Mich.		EA Wright	"

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
FA Geraldson CA Gukeisen	7/2	ANPD, Idaho Falls, Ida.	Discuss thermocycling stress tests.	JM Batch	Yes	100-D, 1707, 189
A Flynn P Davis E Oppenheimer	7/21-22	NDA, White Plains, N.Y.	Discuss PRTR design	WA Burns FH Shadel JC Fox, et al	No	700, 713
H Deem	7/18	BMI, Columbus, O.	Discuss KAPL Assistance Program at BMI	JJ Cadwell SH Bush	Yes	300, 303, 326
T Rudow	7/22-23	Scientific Supplies, Seattle, Wn.	Consult on equipment purchased	WV Cummings	No	300, 325, 326
J Ciborski E Blasch A Stewart, Jr.	7/23-24	Natl. Lead Co., Nuclear Metals Div., Albany, N.Y.	Consult on fuel development problems	JJ Cadwell	Yes	300, 326, 303 100-K, 105-KE
JW McFarlane	7/28-31	Minneapolis-Honeywell, Spokane, Wn.	Service potentiometers.	DR Green	No	300, 326

VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
G Panter	7/24-25	Allis Chambers, Milwaukee, Wisc.	Discuss corrosion of aluminum	C Groot	Yes	300, 326
RS Dalrymple	"	Reynolds Metal Co., Louisville, Ky.	"	JA Ayres	"	100K, 1704
AJ Hodges	7/1	UCRL, Livermore, Calif.	Discuss Project Whitney	OJ Wick	Yes	200W, 231Z
JT Ewing	7/1 & 8			RW Stewart		300
JJ Delapena	7/1-2	"	"	ID Thomas	"	700
JB Bryan	7/9-11	"	"	"	"	"
E Holland	7/9-11	"	"	"	"	"
JT Ewing	7/16-18	"	"	"	"	"
JJ Delapena						
WJ Ramsey	7/22-24	"	"	"	"	"
JT Ewing	7/21-25	"	"	"	"	"
JJ Delapena	7/22-25	"	"	"	"	"
E Reisman	7/22-25	"	"	"	"	"
GR Mallett	7/28	Rocky Flats Plant Denver, Colo.	Discuss Pu fabrication	"	"	"
JT Ewing	7/28-31	UCRL, Livermore,	Discuss Project Whitney	"	"	"
R Waldron						
L Germain						
MJ Sinnott	7/30-31	U. of Michigan, Ann Arbor, Mich.	Consultant Agreement No. 169	OJ Wick	"	"
				JJ Cadwell	"	300, 303, 326
				SH Bush		325, 328
				FW Albaugh		

PLUTONIUM RECYCLE PROGRAMMONTHLY REPORT - JULY 1958REACTOR & FUELS RESEARCH & DEVELOPMENT OPERATIONPlutonium Fuels Development

Al-Pu Alloy Clusters for KER Irradiation. Two, four-rod clusters containing Al - 8 w/o Pu and Al - 12 Si - 8 w/o Pu alloy cores were assembled and autoclaved. One cluster was delivered as scheduled to the KER loop facility prior to final approval of the production test (IP-186-A) for the Loop 3 fuel charge. The second cluster is scheduled for delivery before August 15, 1958, for possible use in Loop 2.

Dynamic corrosion tests on the Zircaloy-clad dummy cluster elements are still under evaluation.

Stainless Steel Fuel Jacketing. Arrangements are being made to obtain extremely thin wall (0.005 inch thickness) 304-L stainless steel tubing fabricated from vacuum-melted material for evaluation as jacketing material.

Air Pressure Injection Casting. Porosity has been a major problem with air pressure injection castings of 2S aluminum into Zircaloy tubing. It was found that the macro porosity was significantly reduced by vacuum outgassing the inside of the Zircaloy tubing immediately prior to injection casting with atmospheric pressure only. It is believed that with the improved vacuum and the higher injection rate and pressure that will be attainable with the prototype "A", glove-box-enclosed injection casting equipment, presently being installed, it will be possible to make fuel rods of acceptably high density.

Preparation of Irradiation Capsules. A method is being developed for preparing injection cast fuel elements in existing glove boxes. One capsule was made in which Al-Pu (2 w/o Pu) was cast into a six-inch long PRTR size Zircaloy tube by the following procedure: (1) A 0.020-inch wall steel tube was drawn onto a Zircaloy tube for contamination protection. (2) A 1/2-inch diameter, 3/4-inch long, aluminum freeze plug with vent slots around the periphery was secured near one end of the composite tube assembly by a staking operation. (3) An aluminum cup was soldered to the opposite end of the steel outer tube to make a vacuum tight seal. (4) The tubing was then evacuated from the vented freeze plug end, and the end with the aluminum cup was immersed in molten Al-Pu. When the aluminum cup melted, atmospheric pressure forced Al-Pu into the evacuated tube.

One-half inch of Al-Pu core was removed from each end of the tube. (When actual irradiation capsules are fabricated, it will be necessary to obtain pre- and post-irradiation core length measurements.) After the ends were machined, the contaminated steel outer tube was removed with nitric acid, and the open Zircaloy tube ends were decontaminated so that the can lips were nonsmearable.

With end caps in place, the assembly was surveyed and found contamination-free before welding; however, in the welding operation contamination from the inner tube lips was carried into the welds so that the weld areas contained nonsmeearable contamination.

Two more capsules were prepared and machined, with 0.010 inch of the inside tube wall removed for 1/4 inch in depth. It is hoped that with the counterbored tube ends and with a different weld joint design, which will allow less weld penetration, it will be possible to make contamination-free welds.

Fabrication of Plutonium Fuels by Extrusion. A number of uranium, 304 stainless steel, aluminum, U-Al, Zircaloy-2, Al-UO₂ compact, U-Al-1100 aluminum clad, 2100 aluminum - 6061 aluminum clad, uranium - Zircaloy-2 clad, 304 - UO₂ compact - 304 clad, and Ni-UO₂ compact - Zircaloy-2 clad billets were either fabricated or were in the process of fabrication. These billets were intended for tests to determine extrusion constants and to evaluate extrusion and coextrusion techniques for use in protective enclosures (hoods). In addition, several die geometries were fabricated to study the effects of entrance angle, throat radius, and length of throat land on the extrusion defect and finish quality. The coextrusion end cap designs were those previously developed at other sites.

Powder Compact Preparation. Powder mixtures were blended which were composed of Al-UO₂, Ni-UO₂, and 304 stainless-UO₂. Future compaction and extrusion of this material is planned as soon as the extrusion press is available. One hundred forty-four Al-UO₂ compacts were ordered from Fuels Fabrication Development Operation. Detailed studies were planned to determine the effects of composition, Al mesh size, compaction pressure, and extrusion ratio on the density, dispersion, mechanical properties, thermal properties, and dimensional stability of Al-UO₂ fuel element cores. Concurrently with the Al-UO₂ experiments, limited tests were planned for Al-PuO₂ cores in order to determine the similarity in behavior of the PuO₂ and UO₂ dispersions. Temporary equipment is being fabricated for producing Al-PuO₂ irradiation test capsule cores.

Plutonium Fuels - Welding Development. Eight preliminary Zircaloy-2 end cap closures have been made on KER irradiation test elements in the vacuum welding box. Each element was bubble leak tested, and all proved to be satisfactory. The final closures on the Al-Pu bearing elements were completed with no contamination difficulties. Using the information gained from these final closures, an inert gas, vacuum welding chamber is being designed for the plutonium pilot plant.

19-Rod Fuel Element Cluster Engineering

An improved wire wrapping fixture has been completed and will be used to fabricate the first full length Mark I-B. Basically, it is the same fixture used in fabricating the 30" Mark I-B; however, changes were made in the design to increase production of wire wrapped fuel element rods. This was done by using faster acting clamps and a foolproof method of aligning the spot welding gun for accurate, reproducible wire attachments.

A fixture has also been fabricated to insert the interference fit end caps into the fuel element tubing. It also aligns the holes in the wire wrapped rods and the holes for the roll pins in the center rod. This fixture was found to be

needed when it was proven that an interference fit between end cap and tube was necessary to get good welds.

A full length Mark I-b will be delivered to 100-KE for testing by August 1. This cluster will contain 16 type 304 stainless steel jacketed rods with aluminum cores. Two rods will be fabricated entirely of Zircaloy-2 except for the aluminum core. Each will be wire wrapped with Zircaloy-2 also. This element will be tested for pressure drops along the length and the total pressure drop, then it will be thermal cycled in high temperature water.

Assembly-Disassembly of 19-Rod Clusters. The design work has begun on a project to remotely disassemble hot clusters for inspection and reassemble after inspection for return to the reactor for further irradiation.

UO₂ Fuel Development

Swaged UO₂ Fabrication. It has been demonstrated that powdered UO₂ can be simultaneously compacted and clad by swaging to form relatively inexpensive fuel elements. During the past month the effect of particle size distribution on UO₂ density was investigated. Arc-fused UO₂ was crushed into a powder and graded into several size fractions. These fractions were combined in various percentages and the effects upon density determined. The use of two size fractions combined in size ratios of 10:1 gave the highest packed densities before swaging; densities after swaging were only slightly greater. Surprisingly, a higher density of swaged material was obtained by using a single size fraction of relatively large particles. Densities also were increased by the use of cotton end plugs, which allow entrapped air to escape during swaging. With rubber end plugs, the same result was obtained by evacuating the air from the fuel rod before swaging. The following table lists examples of the densities obtained with arc-fused UO₂ swaged in 0.75-inch Zircaloy tubing.

Swaged Density of Arc Fused UO₂

<u>Particle Size</u>	<u>Packed Density</u>	<u>Swaged Density</u>	<u>Remarks</u>
0.0328 - 0.0015	69	88	Rubber End Plugs
(0.0328-0.0164 (60%)) (0.0029-0.0017 (40%))	72	88.5	" " "
(0.0328-0.0164 (60%)) (0.0029-0.0017 (40%)).	72	89.5	Vacuum
(0.0328-0.0164 (60%)) (0.0029-0.0017 (40%))	72	89.5	Cotton End Plugs
0.328-0.0164	58	91.5	" " "

Swaged UO₂ Irradiation. Seven swaged fuel element capsules were delivered to the MTR for irradiation at exposures up to 15,000 MWD/T. Three of the elements contain UO₂ of 2.44 w/o U-235 in Zircaloy jackets. A molten core is anticipated at the requested power generation of 32 kw/ft. Six four-rod, stainless steel clad clusters 18 inches long and two four-rod, Zircaloy-2 clad clusters 12 inches long are awaiting irradiation in KER-1 and KER-3, respectively.

Inverted Cluster. The feasibility of fabricating a section of an inverted cluster fuel element was demonstrated, as requested by E. A. Eschbach of the Programming Operation. The core of sintered UO₂, 2-1/4 inches in diameter, is pierced by six 3/8-inch OD, 0.020-inch wall, 304 stainless steel cooling tubes spaced 60 degrees apart on a 1-7/16 inch diameter circle. The enclosing tube of ceramic insulation material is 3.0 inches OD and 2-1/4 inches ID. This ceramic sleeve is pierced by thirty-two 5/32-inch OD, 0.010-inch wall, 304 stainless steel tubes equally spaced on a 2-5/8 inch diameter circle. The entire assembly is enclosed in a 3.0-inch ID x 3.060-inch OD Zircaloy-2 tube.

Mechanical Stability of Tubular Fuel Element. To study pressure and temperature effects on the cladding of a nested tubular fuel element, a full-size outer fuel tube of a Mark II-a element was fabricated and autoclaved in 1200 psi, 295 C saturated steam for seven days. The finished tube was 3.060-inch OD and 2.152-inch ID, containing 88 inches of sintered UO₂ rings clad in 0.030-inch 304 stainless steel having end caps heliarc welded into place at each end of the element. Steel cladding was employed because Zircaloy-2 tubing of one size is not available. Visual inspection then revealed no warping, twisting or cladding intrusion into cracks in the fuel. The element was replaced in the autoclave for further testing.

SRE Irradiation. UO₂ for a tubular fuel assembly to be irradiated in the SRE of NAA-AI was fabricated. The UO₂ pieces were 2.310" OD x 1.786" ID, and the density was 93 percent of the crystallographic density of UO₂. The oxide contained eight percent U-235. Fabrication consisted of ball milling, binder addition, preforming, isostatic pressing, sintering and grinding. Six more feet of core material is being prepared, half of which will be drilled with three 0.033-inch diameter holes for thermocouples.

Corrosion Studies

Inhibitors for PRTR Shielding Corrosion. Filming amine type corrosion inhibitors were received from several vendors during the month. A corrosion test was begun to evaluate the effectiveness of continuous addition of inhibitors to the water. Preliminary results indicate the corrosion rate is reduced by this method, but probably not to the extent necessary to prevent radioactive effluent and/or shielding plugging problems in PRTR over a period of years. If efforts to find a satisfactory once-through inhibitor are not successful, a recirculating cooling system may be the only sure solution available by the time the design must be fixed, and it has been recommended that preliminary studies be started on the costs of a recirculating cooling system for the PRTR shield.

Radiometallurgy Laboratory Studies

Radiometallurgy activities in support of the 4000 Program included the examination of Zr-3 clad, UO_2 fuel elements; dissolution of samples from other prototype UO_2 fuel elements for burnup analyses; and the obtaining of replicas of the Al - 1.65% Pu alloys for electron microscope studies. Results and conclusions of the above contributions are reported in more detail in connection with the respective fuels development programs.

Thermal Hydraulics Studies

Heat Transfer Experiments. Fabrication of the electrically heated mockup of the Mark II-B fuel element was 90 percent complete with only the assembly, application of the electrical resistance coating, and installation of the thermocouples remaining. Design was also started on a half-scale model of the Mark II B element.

PRTR Calculations. A study has been made of the air cooling of Mark I and II-B fuel elements for the PRTR reactor. During optical examination of these elements immediately after reactor shutdown sufficient heat will be generated within the element to require cooling. It was found that an air rate of approximately 1500 cfm would be required for this service. Suggested baffling arrangements and specifications for the air supply have been computed. A report of this study is being prepared.

The rate of decrease of level and the amount of decrease of level of D_2O in the pressurizer vessel on the PRTR after a full scram have been evaluated. The reduction in volume of the D_2O in the primary coolant circuit is due to contraction on cooling. The fall-off in D_2O level requires a corresponding make-up of high pressure helium in order to maintain pressure in the system. The sizing of lines and valves in the helium supply system is, therefore, dependent on the rate of contraction of the D_2O .

The heat transfer from the tube outlets and jumpers on the PRTR to the concrete cover assembly has been the subject of study. The tube outlets and jumpers are at a temperature level approximating 530 F. Considerable heat is transferred by radiation to the concrete cover assembly. Temperature differences in the concrete will result in thermal stresses being established. Temperature levels at various points in the assembly have been calculated.

Special Study. A conceptual design of a supercritical pressure power reactor with a thermal efficiency of 40% at temperatures of 1150 F and pressures of 5500 psi was completed.

The supercritical pressure power reactor is a 300 MW unit employing a heavy water moderator, a light water coolant, and enriched uranium dioxide fuel. The core is comprised of 300 ten-foot long fuel elements arranged on an eight-inch square lattice. A flow of about 1350 gpm (68 F) circulates through the internally cooled multi-pass fuel elements. The fuel elements are suspended vertically in a cylindrical tank (the calandria) about 15 feet in diameter. The calandria has

a moderator level control and dump system similar to the PRTR for controlling the reactor and effecting reactor scram. The coolant is introduced to and removed from the fuel elements through a circular header-jumper arrangement located at the top of the reactor.

The fuel element assemblies are internally cooled UO_2 elements, three inches in diameter and ten feet long. Each element contains twelve axial coolant channels, and the internal jacket material is 0.020 inch of inconel-X. The coolant channels are arranged in two circular patterns of four tubes and eight tubes, respectively. The coolant flows downward in six of the tubes and returns in the other six. An intermediate collection header and a distribution header are contained in each fuel element between the active section and the top of the element. The uranium dioxide surface is scalloped between coolant channels to maintain a more nearly uniform surface temperature. With uranium dioxide densities of 93 percent of theory, maximum fuel temperatures of 4000 F are expected. To restrict the transfer of heat from the fuel assembly to the moderator, the exterior of the assembly, a 20-mil wall Zr-2 tube, is maintained at about 500 F by means of an insulating layer of sintered granular zirconia.

Mechanical Equipment Development

Design Test PR-20 - Calandria Characteristics. Dump tests following the second extensive modification of the calandria dump chamber gave satisfactory results. A time of 0.96 second for the first two-foot drop was obtained with three gas lines in service, and a time of 0.86 second was obtained for the corresponding drop with four gas lines in service. Additional tests are scheduled using the recently arrived prototype dump valves.

Design Test PR-24 - Shroud Tube Bellows. One of the two bellows being corrosion tested in steam developed a convolution leak after three months of testing. It was removed from the test. No leaks have developed in the simulated bellows with cast aluminum ends. The bellows from the Parts Engineering Company were rejected after the shrink-fit aluminum ends loosened during welding of the aluminum end flanges for flexing tests. Additional bellows for testing were received from the U.S. Flexible Metallic Tubing Company.

Design Test PR-25 - Shroud Tube Collapsing Pressures and Installation. Testing has been completed and final report is being written.

Design Test PR-32 - Biological Shield Moat Rupture Diaphragm. The test equipment has been fabricated and the aluminum foil received. Testing will begin immediately.

Design Test PR-50 - Reactor Piping Seal Testing. The flanged process tube inlet fitting utilizing a solid "O" ring has undergone 428 temperature cycles without noticeable leakage. A similar joint using a flexitaillic gasket has been thermocycled 420 times without any noticeable leakage. The inlet gas seal leakage has increased from 43 cc/min after 77 temperature cycles to 442 cc/min after 272 temperature cycles. Gas pressure was maintained at three inches of mercury.

The flexitaillic gaskets in nozzle cap assembly "A" were leaking badly during the cycling tests. External back-up rings were installed to reduce the clearance around the gasket and testing resumed. The leakage with the new arrangement was

a total of 45 cc after 320 temperature cycles for one end and zero cc for the other end.

Process tube assembly "A" has been thermocycled 428 times with no noticeable leakage. Process tube assembly "B" was received from the Marman Division of the Aero-Quip Corporation. Testing will begin upon the receipt of the proper gaskets for this assembly.

Aluminum rings are being tested in the outlet gas seal test assembly. The first test was ruined by a failure of the baking furnace. The assembly is being re-worked and the test repeated. Three new packings were received for testing.

Design Test PR-51 - Reactor Piping Structural Integrity. Inlet header jumpers were modified as required by the revised drawings and the inlet jumpers have been fabricated. The inlet flanges and venturiers were fabricated and assembly is now 30 percent complete. The fabrication of special bending shoes for outlet jumper fabrication is 50 percent complete. The fabrication of the outlet jumper has started.

Design Test PR-63 - Process Channel Leak Detection Facility. All helium leaks around the thermocouple wires have been sealed and testing resumed. A new method of water injection is being used which results in faster detection. The injection of a single drop of water is being detected by a change in exit gas dew point in approximately three minutes.

Single Tube Prototype Facility. Construction of the facility was approximately 80 percent completed. The Aldrich injection pump was installed and preparations completed for initial testing of the pump. Phase I piping and valves were satisfactorily hydrostatically tested at 3600 psi.

PRTR Inlet Valves. The shrouded, 1-1/2 inch, inlet valves were installed on ELMO-7 for leak rate tests.

Test Shaft. Construction of the test shaft was completed. The thermocycling facility has been moved and is now in operation. Movement of the tube rupture facility is approximately 50 percent completed.

Seal Test Facility. The installation and the acceptance testing of the facility were completed. The mechanical seals are now being installed for testing.

Shielding Studies

PRTR Shielding. A review of certain parts of the PRTR shielding, based on the latest design changes, is in progress. Attenuation provided by the top and bottom primary shields and the spiral-filled 10" holes in the bottom primary shield has been investigated.

PRTR Instrumentation. One of two wrap-around Resistance Temperature Detectors furnished by Aero-Research has received 250 thermal cycles and has been removed for calibration checks. The second unit is being fitted into the 1706 KER loop. The third prototype has not been received. Three strap-on units have arrived from

Charles Engelhard, Inc. Initial tests on two of them showed that the insulation from sensor to case was not acceptable. The vendor will be contacted.

Two flow monitors with a zero to 10 psi differential were received. Static tests were completed on one unit, and the second is being modified to permit testing. Measurements made on the flow test loop indicated that the 0-25 psi flow indicators have a satisfactory response to a step change in flow.

An investigation of an 85-point power calculator is in progress. Preliminary information has been obtained from three manufacturers known to provide computing equipment.

PRTR Design Development

Design and Construction Schedule for PRTR. The Phase I PRTR contract is estimated to be about ten percent completed versus about 20 percent scheduled. The major portion of the delay has arisen because the containment vessel steel plate was delivered 15 days late. The ellipsoidal bottom portion of the containment vessel has been welded. Weld radiography and leak tests are currently being completed on that portion of the vessel.

The Phase II PRTR contractor has commenced well digging operations at the site.

The Phase III PRTR design is estimated at about 90 percent completed. Total design completion on the PRTR project is about 95 percent.

Reactor Piping. Revised outlet nozzle designs have been completed and reviewed. Design is now essentially completed on all the reactor piping.

The apparent low bidder on the ring headers was the Dravo Corporation of Pittsburgh with a bid of about \$30,000, which was within the original project estimate of \$37,000.

Fuel Transfer System. Alterations are being made to the fuel transfer system design to: (1) provide for storage of 10 fuel elements in the water pit inside the containment vessel, (2) make the water pit conveyor removable, and (3) furnish piping and control panel layout drawings.

Core Components. The second major revision of the calandria mockup dump chamber gave a satisfactorily low dump time. The rate achieved was two feet of level drop in approximately 0.9 second. Analysis of the calandria fabrication problem indicated that rebid on the revised package by the two lowest bidders would probably result in quicker delivery than negotiation with the low bidder. The revised bid assembly was submitted to the Struthers Wells Corporation and Consolidated Western Corporation for rebid. The latter company is the apparent low bidder with a bid of about \$285,000. This corresponds to a previous low bid by the former concern of about \$250,000.

Process Piping. Bids from five vendors for the fabrication of the reflector, moderator and primary system purification heat exchangers were received and analyzed during the month. The apparent low bidder was Struthers Wells Corporation with a bid price of \$36,490. This may be compared to the approximately

\$63,000 estimated cost of three heat exchangers, one flash tank, and one flash condenser which were replaced by the three heat exchangers.

Six bids for fabrication of the boiler feedwater preheater-deserator were received and are being checked for conformance to engineering specifications. Bid prices for the unit range from about 35 percent to 66 percent of the original project estimate.

Invitations to bid on the pressurizer vessel were extended to eight manufacturers during the month.

A scope revision covering the installation of a fourth moderator coolant circulation pump was issued. This revision was required to reduce the power demand on the emergency diesel generator unit.

Helium Gas System. A purchase order for the helium gas holder has been placed with the General American Transportation Corporation for a sum of \$5,653.00.

The purchase specifications for the two helium heat exchangers, HX-6 and HX-7, were issued for rebid during the month. No bids were obtained from the original inquiry.

Shielding. Preliminary test results on using corrosion inhibitors in the top and bottom primary shield cooling water indicate that this will not yield satisfactory corrosion rates on the iron shot. Initial test results using untreated water as originally planned in the PRTR design showed intolerably high corrosion rates. An investigation of the possible use of high silicon alloy iron for the shot is in progress.

Fueling Vehicle. Design of the fueling vehicle by General Mills is scheduled for completion during August. Minor revisions to the design are being made to avoid interferences at the fuel examination pit location. The cooling system was revised to use a water cooler at the blower inlet. Several sub-assembly drawings have been received from General Mills.

Fuel Element Examination Facility. Development work was continued on the optical equipment. An operating mockup of the proposed wide angle viewer was set up and tested in the optical shop.

A Phase I scope revision covering minor structural changes necessary for the installation of the examination facility was prepared.

The project proposal revision to the PRTR to include the Fuel Element Examination Facility as part of the project was completed and is being circulated for the necessary approvals.

PRTR Physics. Multigroup calculations using the three group VALPROD IBM-650 code to obtain the reactivity value of spike plutonium loading configurations are continuing. Xenon poisoning and Doppler broadening have now been incorporated in the reactor core parameters. This more complete representation of reactor operating conditions improves the accuracy of calculated reactor flux distributions. The effective multiplication constant for annular spike loadings

as a function of radial position has been investigated for both H_2O and D_2O reflectors. From these results the reactivity value of any number of spike tubes at any radial position can be determined. The spike loadings considered thus far utilized only fresh plutonium. Further studies are now under way to obtain similar results for plutonium at several stages of burnout.

Gamma and neutron intensities at the shim drive mechanisms have been calculated. It was found that the radiation penetrating the lead plug at the bottom of the shield was relatively small compared to the radiation scattered into the shim channels from the adjacent shield. Heat generation in the lead plug was shown to be of the order of 50 watts.

Instrumentation and Control. Negotiations with Minneapolis-Honeywell for the design and construction of the PRTR automatic controller on a CPFF contract were completed on July 11. Currently, the contract has been signed by the AEC and sent to Minneapolis-Honeywell for their signatures. The amount of the contract was \$93,735; the completion date was set for eleven months from final execution of the contract.

Re-runs of control dynamic studies on the 300 Area analog computer have yielded acceptable data on the moderator level system and the neutron kinetics system in both the sub-critical and critical ranges. This information will be forwarded to Minneapolis-Honeywell for their use in the controller design as soon as the evaluation of the various sets of runs is completed. All the information on the dynamics of the reactor proper which is needed for the controller design is expected to be available to Minneapolis-Honeywell by the time the contract becomes effective. Additional computer runs are planned to extend and verify the information described above before a document describing the behavior of the reactor under control action is issued.

Vendor information concerning the accuracy of the primary coolant flow measuring device revealed that while a Dall tube cannot give the accuracy required for use in the power calculator, several other venturi type elements available can give the required accuracy under PRTR conditions.

Design of the PRTR shim assemblies was completed by APED, General Electric Company, on July 25. Irradiation tests were made on several models of prototype limit switches for these elements. The design-preferred switch, a subminiature switch encased in diallyl phthalate resin, was unaffected upon gamma irradiation to 2.5×10^8 r. Complete results of the tests will be published in a report by the Nonmetallic Materials Development Operation.

Because of the extreme difficulties involved in replacing failed resistance thermal detectors of the "wrap-around" design, the outlet header jumper piping has been modified to accommodate elements of the "strap-on" or "clamp-on" design.

Plutonium Fabrication Pilot Plant

Phase II Design. Phase II design is substantially complete. Regular reporting of this phase will be discontinued.

Phase II Construction. Notice to proceed on the Phase II (Building) of Project CA-747 was mailed to Hoffman Construction Company June 27, and was signed by them on June 30. The contractor commenced excavation on July 7, and poured

the first concrete for the air tunnel foundation pad July 21. About 192 cu yd of concrete had been poured by July 29.

Phase III Design. Phase III (Process Equipment) design is approximately 33% complete.

Two scope revisions were prepared and approved during the month. One of these increased the capacity of the hydrogen supply system for the sintering furnaces to 1000 cu ft/hr; the other added a pellet press for the rapid production of small compacts to the oxide line.

A design information trip was in progress at month's end, with consultations planned on the 200-ton hydraulic press, the 30 kw melting furnace, the draw-bench, the extrusion press, the rolling mill, and the internal grinder. The principal purposes of the trip were: (1) to obtain all remaining information necessary for the installation drawings for the Group 1 equipment; (2) to obtain information on the method of making stroke adjustments on various makes of hydraulic presses and to obtain as complete installation information on them as possible at the present time; and (3) to obtain preliminary design information on the heavy Group 4 equipment, the rolling mill and the extrusion press.

At the request of several of the best qualified firms, the proposal period for a design contract for the horizontal hydrogen sintering furnaces was extended to August 15. An invitation for contract negotiations for design of a vertical hydrogen sintering furnace installation was issued to Pacific Scientific Company.

Detailed scope of the welding equipment was completed. Design of a group of four hoods was completed, and procurement was initiated.

Procurement. Only about one-fourth of the estimated total number of requisitions has been issued to date. A procurement schedule was prepared during the month, and major emphasis will be placed on issuing requisitions during the next six to eight weeks.

Bids were received and evaluated on the autoclave system. Two bids were received, both of them giving evidence of careful study, and reasonably close in total amount. The value of functional specifications is confirmed by the bidding on this order.

Draft specifications and vendor information drawings have been prepared for the 200-ton hydraulic compacting press, and a requisition will be issued by August 8.

DECLASSIFIED

B-1

HW-56914

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATION

MONTHLY REPORT

JULY 1958

FISSIONABLE MATERIALS - 2000 PROGRAM

METALLURGY

At the request of the Hanford Operations Office of the AEC an appraisal was made of the nuclear safety of shipping uranium-233 metal together with plutonium metal. The results of the appraisal are given in HW-56889, "Nuclear Safety in Uranium-233 Shipments."

Consultations on nuclear safety problems in handling metals were held with members of Fuels Fabrication Development Operation and with Radiometallurgy Laboratory Operation.

REACTOR

STUDIES RELATED TO PRESENT PRODUCTION REACTORS

Data analysis continued on the temperature coefficient of natural and simulated 1000 MWD/T and 2000 MWD/T uranium in a graphite lattice. The normalization of Pu and U-235 detection pins was completed.

A feasibility study was completed on a PCTR experiment to measure how far a neutron diffuses in shifting from a distribution characterized by a moderator temperature T_1 to a distribution characterized by moderator temperature T_2 . The results indicated a high probability for success of the experiment and work was begun in the PCTR core oven. A central graphite slab in the oven was heated to 250°C while adjacent slabs on either side were held near room temperature. One foil irradiation was made with this setup, but no results are available as yet. Considerable experimental difficulty is being encountered with rod type heaters which are burning out.

Theoretical work continued on the precise evaluation of the universal constants which arise in the analytical solution of the above problem. The iteration scheme for numerical solution of this problem was tested further.

Instrumentation

Application work started for applying magnetic core storage elements to radio-isotope analyzation circuits for a stack gas monitor. The core-driving circuitry is transistorized and has been tested.

STUDIES RELATED TO FUTURE PRODUCTION REACTORS

The series of buckling measurements on seven-rod clusters of 0.5-inch uranium rods was completed. Measurements were made this month on two lattice spacings, 8-3/8 inches and 6-3/16 inches. A little analytical work remains before the results will be complete.

A report summarizing analytical work aimed at determining resonance escape probability in natural uranium lattices is being prepared as Report HW-56848.

An IBM-650 program has been written for the calculation of PCTR reactivity from observed elapsed time for the reactor flux to increase by a factor of two.

Addition to 305-B Building (Project CA-778)

Construction of the addition to 305-B Building was started during the month. Footings and foundations have been completed. A hole was knocked through the north wall of the 305-B Building for a connection between the old building and the addition.

STUDIES RELATED TO SEPARATIONS PLANTS

Subcritical multiplication measurements were made on 1.6 and 3 percent enriched uranium in water moderated lattices. One 1.6 percent experiment was done which like preceding experiments gave a critical mass which agreed with a critical mass value predicted from exponential experiments to within 5 percent. Three 3 percent uranium fueled lattices were measured using 0.925-inch-diameter rods, 24 inches long. The results give critical masses in the range 500 to 700 pounds.

Experiments started in the PCTR to determine the maximum k_{eff} of hydrogen moderated 3 percent enriched uranium oxide and the hydrogen-to-uranium ratio for which k_{eff} is less than or equal to unity. An H/U ratio of four was used and a preliminary value of $k_{eff} = 1.32$ was obtained. This compares favorably with a calculated value of 1.36.

A revision to the project proposal for the critical mass laboratory was prepared by Laboratory Auxiliaries. The revision requests authorization to use conventional heavy wall construction for the laboratory rather than a remotely located thin shell structure shielded by earth barriers. Design of the facility is in the advanced planning stage.

About twelve tons of 0.95 percent I and E type fuel elements were shipped to Oak Ridge Critical Mass Laboratory for criticality studies. The critical mass will be measured in a uniform array and in random distribution in a mock-up of a Hanford-type dissolver.

Two neutron age measurements in water have been completed, one with each of two sizes of neutron source. The results are not yet available.

The electrical power distribution system for the mass spectrometers is about 75 percent complete. Component testing of the spectrometer awaits completion

DECLASSIFIED

A large number of nuclear safety consultations were held this month in connection with 234-5 Building processes. Other nuclear safety work included a study of the effect of moderator density on critical parameters. This work will be presented in HW-56938, "Criticality Parameters of Highly Enriched U-235 Fuels."

STUDIES RELATED TO THE PLUTONIUM RECYCLE PROGRAM

A calculation of resonance escape probability was made for 19-rod clusters of UC_2 rods in an 8-inch D_2O moderated lattice. The result agrees with experimentally inferred values to better than 0.5 percent.

The use of an improved method to speed up convergence was proposed for the multigroup calculations on the RBU code, and it will be included on an experimental basis.

The theoretical study of neutron leakage described in previous monthly reports has encountered difficulties in situations involving only moderately complicated geometry and further progress in its use now appears unlikely.

High resolution neutron fission cross section measurements were made on Np-237 and Am-241 in the energy range 1 ev to 1.5 ev. Further data are being taken to determine the shape of a resonance at 1.25 ev in Am-241. The counting rates on Np-237 are very close to background levels, so that little information will be obtained on this isotope.

The new three-crystal spectrometer at KE is beginning to shape up nicely. A beam shutter which has been operating poorly has been repaired and now operates satisfactorily. Most of the instrumentation has been fabricated and installation is proceeding. Neutron detectors have been installed to monitor the monoenergetic beam and to detect neutrons scattered in future experiments.

ENVIRONMENTAL STUDIES

Atmospheric Physics

Major effort was devoted to the conduct of diffusion and deposition studies at

[REDACTED]

DECLASSIFIED

B-4

HW-56914

the University of Washington Friday Harbor Laboratories, and to the reduction and analyses of data derived from these experiments. Observations of the vertical and horizontal distribution of concentrations of a tracer material were made successfully at three distances, 300, 600, and 1200 feet, downwind from a continuous point source located about three feet above water level. All measurements were made over water and under unusually steady meteorological conditions. Only preliminary analyses of the very large quantity of data have been completed but these suggest estimates of the vertical flux of tracer material can be obtained within reasonable uncertainty limits. Estimates of deposition rates should also be possible.

Simultaneous measurements of vertical profiles of water vapor, air temperature, and horizontal wind speeds were made by the University of Washington at the experimental site. From these data comparisons of the vertical flux of momentum, mass, water vapor, and heat can be derived. These data will provide important guides in the treatment of deposition phenomena.

Discussions were held with Air Force Cambridge Research Center personnel and one of their contractors, Texas A and M College, regarding the long-range diffusion experiments which have been proposed for the Hanford site in 1959. Acquisition of experimental equipment and site preparation necessary for the diffusion experiments were held in abeyance pending approval of the proposed program.

DOSIMETRY

A motor drive was provided for the door of the rock shield so that it could be operated by a female technologist.

A finger wound containing plutonium nitrate was examined for the third time about three months after the first examination. A biological half-life of 15 to 16 days was found for the material in the finger.

More steel parts for the Body Monitor were examined and found to be acceptably low in radioactivity.

A satisfactory method was found for cementing mylar windows to stainless steel grids for use in large proportional counters.

A study is being made of the detection of uranium in the lungs. Uranium in different states of aggregation is being used in a phantom in the rock shield.

The positive ion Van de Graaff was out of operation for three days due to trouble with the alternator. Nuclear Physics used the machine for a week for time-of-flight studies of $\text{Be}^9(d,n)$. Part of the changes for a new analyzing chamber were made.

The procedure for calibrating neutron instruments was changed to employ a plutonium fluoride source possessed by Calibrations Operation. This change was the culmination of many laboratory and field studies aimed at finding a suitable source for this work. The studies were made possible by the double moderator detector. The use of plutonium fluoride followed the discovery last

year that it possessed a neutron spectrum very similar to sources encountered in plant operation. Characteristics of the source such as angular asymmetry total emission, and dose rate were determined for Calibrations Operation.

Three electrode structures were tested for a spherical BF_3 proportional counter for use in spherical moderators. None gave what was considered really good pulses.

Calculation was completed of the neutron energies expected from $\text{C}^{13}(\alpha, n)$ and $\text{Be}^9(\alpha, n)$. Thick target calculations for $\text{D}(d, n)$ were half completed.

A source holder was constructed of Mallory metal (tungsten alloy) to be used in the gamma-ray calorimeter. This will make handling and shielding of small sources easier. A Mallory metal pot was designed to replace the lead one now in use. The new pot is expected to increase the sensitivity and decrease the losses from the system.

A method of automation of calorimeter readings was designed that should eliminate the need for a recording digital voltmeter.

A new electrode was completed and installed for the condenser-divider voltage measuring system for the electron Van de Graaff. The effects of insulator strain were eliminated. Ion current in the insulating gas of the Van de Graaff was found to interfere during normal X-ray operation; such interference was eliminated by absorbing the beam in beryllium. It was found that a rapid change in Van de Graaff voltage left a spurious charge on the system; for slow changes there is no difficulty. The system was calibrated with the $\text{Be}(\alpha, n)$ reaction. It was found possible to locate and reproduce the threshold of this reaction to about 0.1%.

INSTRUMENTATION

Fabrication continues on the transistorized circuitry for the scintillation transistorized alpha, beta, gamma hand and shoe counter. Fabrication of the probes has also started.

Complete HAPO-type drawings have been made on the successful scintillation transistorized alpha hand counter and the instrument, after reassembly from use for making the drawings, will be sent to Purex for demonstration. This instrument will reliably detect less than 100 d/m of Pu^{239} contaminant on the hands. This is a factor of 5 to 10 times better than the present Four-Folds.

The vacuum tube model alpha, beta, gamma hand and shoe counter was removed from service for one day for routine adjustments and G-M tube replacements. The instrument operated successfully in general use in the 329 Bldg. for about six months with only 15 minutes of down time. The instrument is now back in service.

A portable scintillation transistorized alpha, beta, gamma survey instrument was developed and tested. This single instrument can replace both the present alpha poppies and G-M instruments. A switch is provided to enable the user to determine the "alpha only" reading and secondly, the "combined alpha, beta, gamma reading." The instrument will reliably detect C^{14} and S^{35} betas. This

DECLASSIFIED

DECLASSIFIED

B-6

HW-56914

has not been previously possible with easily portable instruments. The counting efficiencies are as follows: Pu²³⁹ alpha, 15%; C¹⁴ or S³⁵ betas, 0.1%; Cs¹³⁷ gammas, 5%; Sr⁹⁰ betas, 20%. The instrument weighs 3.75 pounds and is completely transistorized.

Development work was continued on a portable, battery-operated Dose-Rate Integrator for field use. The device will indicate total dose received by an individual if the dose rate is established.

Investigations were continued concerning different types and assemblies of radioisotope detectors. Work continues on a scintillation-type neutron-activated foil detector. The process is to determine a satisfactory detector which is relatively insensitive to gamma radiation.

The pyroheliometer instrument for the Atmospheric Physics Operation was modified to eliminate night spurious readings and to give a closer correlation to the previous methods employed for data taking and calculating.

The zinc sulfide particle detector for the Atmospheric Physics Operation has now operated successfully for two months.

A laboratory model system for the scanning of fish for the location and extent of various radioisotopes was successfully demonstrated to the Aquatic Biology personnel. The system was designed to keep the fish alive during the scanning while employing techniques to have as little water shielding as possible. It is essential that the fish not die. Successful use with live fish of various sizes was accomplished. Approximate minimum detectable amounts of various radioisotopes were as follows: Cs¹³⁷, 0.005 μ c; Zn⁶⁵, 0.01 μ c; Ru¹⁰⁶, 0.01 μ c; Pu²³⁹, 0.02 μ c; Sr⁹⁰, 0.1 μ c. The minimum detectable amounts depend to a degree upon the size of the fish. Improvements, by a factor of 5, can be expected with a more complete lead shield than was employed for the tests.

Evaluation tests continue on the portable scintillation transistorized gamma energy analyzers. All tests to date have been satisfactory. The instruments have been found to be capable of working satisfactorily over a temperature range of +10°F to +100°F.

Evaluation tests were completed on some commercial self-reading "pencil" dosimeters. Failure rate was 50% due principally to high leakage rates.

The portable, scintillation, transistorized, slow and fast neutron count-rate and dose-rate meters have been successfully evaluated in the laboratory. These instruments work satisfactorily from -10°F to +120°F. They are now being sent to the field for general field testing.

Evaluation investigations were carried out concerning established plant warning devices designed for alarming in the case of criticality or high, short-term radiation level increases.

WASHINGTON DESIGNATED PROGRAM

Component testing of this mass spectrometer awaits completion of electrical distribution work.

CUSTOMER WORKAnalog Computing

A series of computer runs were completed on the transient response of the reactor kinetics and control system for the PRTR. Because of the urgent need for these runs they received a priority over other computer programs. It is estimated that during the next three months, five weeks of computer time will be devoted to this program.

The computer techniques and equipment necessary to perform two-group multi-region flux calculations were investigated. Preliminary runs indicate that solutions obtained from the computer are satisfactory, but that additional equipment will be necessary.

As time permits, personnel are becoming acquainted with the programming and operation of Litton Digital Differential Analyzer.

Weather Forecasting and Meteorology Service

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	93	85.9
24-Hour General	62	88.8
Special	156	89.7

July was the hottest month ever recorded in the Hanford Area. Records have been kept since 1912, and the closest approach to last month's mean temperature of 81.2 was in July of 1941 when temperatures averaged 80.0. On all but three days of the past month, the temperature climbed to at least 90 and, on ten days, it went to 100 or above with a peak of 107 reached on the 28th. There were also eleven nights in which the minimum temperature was 70 or above with a peak minimum of 77 observed on the night of the 16th and 17th.

July was dry as well as hot with only .02 inch of precipitation recorded at the station. Some portions of the reservation, however, received some heavy showers on the 2nd.

Instrumentation

Fabrication is progressing on an experimental sensitive alpha particle air monitoring system for the Biology Operation. The laboratory model has worked successfully for two months, and it will alarm on a 60 mpc level of airborne Pu^{239} in 20 minutes with no false radon-thoron background alarms.

Fabrication continues on a dual unit alpha air monitor of the scintillation type for use at Purex. The instrument employs a circuit giving a differential indication for better sensitivity.

Fabrication of the transistorized circuitry for a large crystal and phototube monitoring system was completed. The receiving of the phototube will permit completion of this project. The instrument is for the Regional Monitoring

DECLASSIFIED

~~DECLASSIFIED~~

B-8

HW-56914

Operation and will be used for routine, sensitive, surveying on the river, in the air, and on the ground.

Fabrication has started on an AC-operated completely transistorized, scintillation monitor for use at 234-5. This device will replace the present obsolete and insensitive alpha "Cart-Poppies," and it will be only one-fourth as large and cost three-fourths as much as the "Cart-Poppies."

A new, more sensitive scintillation probe was designed and is being assembled for use with the single probe alpha-beta-gamma detection and aurally-indicating monitor in use at the Calibrations Operation. This unit permits proper, reliable monitoring for alpha, beta, gamma surface contamination in one operation. Previous instruments used required three separate and distinct operations for the determination of the contamination.

Optical

Installation of the mechanical portions of the Purex periscopes is about 95% completed. Installation of the optical parts will follow cleanup and painting.

Routine Optical Shop work included testing of eight lead glass windows for 105-F and 105-D, design of a camera attachment for Polaroid camera use on the Lenox Borescope, fabrication of a microscope stage and mount to permit use of the Model L Camera as used with the stereomicroscope, fabrication of several sapphire lenses for IPD, modifying the Weld-Bead inspection device for IPD, fabrication of a lens mount for the testing of lenses for the PRTR wide-angle viewer, and modification of a three-power periscope at Redox.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

FF Gast:mcs

~~DECLASSIFIED~~

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
D. M. Johnson W. J. Dodson	7/8	Kaiser Engineers Oakland, Calif.	Discuss shielding and heat generation problems.	DE Wood	Yes	700: 762
P. A. Egelstaff	7/8-9	Chalk River and Harwell, England	Discuss cross-section work.	BR Leonard	No	700: 703
F. I. Badgley	7/21-22	University of Wash. Seattle, Wash.	Consultation on meteorological problems.	GR Hilst JJ Fuquay PF Gast	No	200-W: 622 300: 326
M. L. Bared	7/29-31	Air Force Cambridge Research Center Boston, Mass.	Discuss proposed diffusion experiments.	GR Hilst PF Gast HM Parker	No	200-W: 622 300: 326 3760
Donald Stevens	7/29-31	Air Force Cambridge Research Center Boston, Mass.	Discuss proposed diffusion experiments.	GR Hilst	No	200-W: 622
P. W. Mummery	7/28-29	Harwell, England	Discuss reactor physics.	PF Gast	No	300: 326
P. W. Mummery	7/28-30	Harwell, England	Discuss reactor physics.	RE Heineman ED Clayton BR Leonard	No	300: 326
W. H. Clayton	7/30-31	Texas A and M College Station, Texas	Discuss proposed diffusion experiments.	GR Hilst	No	200-W: 622

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JJ Fuquay RJ Engelmann PW Nickola MF Scoggins	7/6-14	Univ. of Wash. Friday Harbor, Wash.	Conduct diffusion experiments with Univ. of Wash. personnel at Friday Harbor Labs.	RG Fleagle	No

HW-56914

B-9

DECLASSIFIED

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
R. E. Heineman	7/24-25	Argonne Nat'l Lab. Lemont, Ill.	Attend UK/US classified discussions on graphite temperature coefficients and Xenon instability.	--	Yes
G. R. Hilst	7/29	CONVAIR, NRTS Idaho Falls, Idaho	Witness diffusion experiment and confer on meteorological problems.	J. Gallimore	Yes

DECLASSIFIED

Chemical Research and Development

ORGANIZATION AND PERSONNEL

D. W. Bensen, Soil Chemist, was hired and assigned to Chemical Effluents Technology Operation.

J. C. Langford, Chemist, was transferred in from Chemical Processing Department and assigned to Analytical Laboratories Operation.

W. H. Adams, Engineer I - L, terminated to accept employment elsewhere.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Decontamination of Carbon Steel Components

The dissolution of UO_2 by solutions compatible with carbon steel has been under study as a part of the general problem of decontaminating mild steel reactor components. Qualitative tests indicated hydrogen peroxide, bromine, periodic acid, and potassium permanganate were satisfactory oxidants for dissolving UO_2 in alkaline solution. A uranium complexing agent is also necessary. Carbonate-bicarbonate solutions proved superior to versene, sulfate ion, or ammoniacal ammonium citrate solutions.

Although analytical precision was poor, indications are that at room temperature -325 mesh UO_2 can be dissolved within one hour and 100-200 mesh UO_2 within three hours in 0.25 M NaHCO_3 - 0.25 M Na_2CO_3 solutions containing a 100-fold stoichiometric excess of hydrogen peroxide. These solutions contained 0.25 g/l acetanilid to suppress hydrogen peroxide decomposition.

An interim report, HW-56875, has been prepared on the laboratory investigations of carbon steel decontamination.

Automatic Analyzing Monitor

The monitor was operated only a short time during the month in deference to more urgent equipment development problems.

The abstract of a paper describing the monitor was accepted for presentation at the Instrumentation in Nuclear Reactor Technology session of the Analytical Chemistry Conference in Gatlinburg, Tennessee, September 29, 1958.

Uranium Oxidation Experiments

Experiments on oxidation in air were continued. Rates were measured at temperatures up to 1450 C. The temperature versus rate curve is linear on semi-log paper, but shows a sharp break point at a furnace temperature of 620 C. It is believed that below this temperature the specimen exists in the alpha phase, but that above this

DECLASSIFIED

C-2

HW-56914

temperature it is in the beta phase due to the heat of reaction. Heat of reaction also causes temperature peaks of 500 F magnitude about every 20 minutes at this temperature. Although the mechanism of the oxidation reaction is not understood, the principal objective of the investigation, which was to provide fundamental data for the fission product volatilization studies, was accomplished and the experiments on air oxidation are being terminated. Oxidation in steam atmospheres will be studied next, after which the investigation of fission product volatilization from heated irradiated uranium will be started.

Reactor Effluent

The corrosion tests in which pH was varied by varying the sulfuric acid added to three pairs of KE tubes were terminated. Six sets of samples had been taken to determine the variation of As⁷⁶ and P³² concentrations in the reactor effluent with the sulfuric acid. Similarly, P³² showed about a 40 per cent increase in concentration at pH 6.5 as compared to 7; however, there was no essential difference in P³² concentration between a pH 6.0 and 6.5.

SEPARATIONS PROCESSES

Feed Preparation

Dissolution of Dingot Metal. Considerable variation has been noted in instantaneous and integral dissolution rates of different batches of dingot metal. Spectroscopic analyses indicate such variations could be the result of differences in impurity (particularly C and Si) content. Dissolution rates decrease as the impurity content decreases.

Because of such variations the concentration of additive required to increase dissolution rates to where they equal those for ingot metal depends on the particular batch of dingot metal used. For the purest dingot metal tested even 0.025 M (NH₄)₂SiF₆ or 0.02 M H₃PO₄ were not sufficiently high additive concentrations. For more impure metal either 0.005 to 0.01 M (NH₄)₂SiF₆ or 0.02 M H₃PO₄ were previously found sufficient.

The corrosion rate of 304-L stainless steel in boiling 6.1 M HNO₃, 0.5 M UNH, 0.025 M (NH₄)₂SiF₆ is about 10 mils/mo - about five times an acceptable value. At 0.01 M and 0.005 M (NH₄)₂SiF₆ corrosion rates for 304-L stainless steel were about 5.8 and 3.5 mils/mo respectively; both of these rates also appear too high to be acceptable. Under conditions simulating waste concentration from these feeds, corrosion rates are very high. The corrosion rate during dissolution is less than one mil/mo with 0.02 M H₃PO₄ as an additive, but this phosphate ion concentration may interfere with plutonium recovery.

Integral dissolution tests simulating process conditions were made on dingot and ingot uranium and on dingot - 0.13 w/o silicon alloy. The integral dissolution time ratios were 1.00/1.18/1.44 for the alloy, ingot, and dingot uranium, respectively.

Preparation of U(IV) in Nitrate Solution

Laboratory investigation of the production of U(IV) by photo-activated formaldehyde reduction in UNH solutions has been terminated. A summary report describing results and conclusions obtained to date is being prepared.

Anion Exchange Processes

Plutonium Loading and Elution Kinetics. Absorption and elution diffusion coefficients of plutonium complexes in Dowex-1 have been measured. For absorption from nitric acid diffusion coefficients decrease as the cross linkage increases and as the loading increases, both changes resulting in an increase in activation energy for diffusion. The very low values found in plutonium-loaded resins probably result from the large shrinkage which occurs as loading increases. Measured diffusion coefficients for the elution process are higher and essentially independent of loading.

Absorption from metal nitrate solutions is much slower than from nitric acid as was previously indicated by column experiments.

Fission Product Separation. Questions regarding the fission product analyses of anion exchange experiments of the purification of LBP plutonium have been resolved now and the results of the earlier experiments can be summarized. With nitric acid alone as the wash solution a zirconium-niobium decontamination factor of slightly greater than 10^3 was observed and for ruthenium approximately 10^4 . Adding 0.1 M H_3PO_4 to the wash did not improve the decontamination factor. Adding low concentrations (0.005 - 0.05 M) of hydrofluoric acid to the wash nitric acid improved the separation greatly giving a zirconium-niobium decontamination factor of approximately 10^6 . The feeds for each successive run were made by adding plutonium to the used feed from the previous run. The validity of general conclusions from such experiments is supported by the fact that the fission product wash-off curves remained essentially the same after 11 experiments and resulted in the same δ/AT ratio for the recovered plutonium. However, the experiments using hydrofluoric acid washing will be repeated with virgin LBP.

Radiolysis of Resins. A method of obtaining infra-red spectra of the anion exchange resins of interest has been developed. The resin, pumped free of much of the normally held water is mill-ground to a fine powder then mixed with potassium bromide and pressed into a pellet. Some infra-red data on Dowex 1, X-4, Amberlite IRA-401, and Permutit SK have been obtained by this technique.

Higgins Ion-Exchange Contactor. Study was continued of the resin flow characteristics in the 321 Building Higgins contactor utilizing a 4-inch I.D. glass adsorption column in lieu of the 5-inch schedule 10 stainless steel column used in previous studies. The resin movement in the glass system was characterized by an intermittent, or jerky, flow with the pressure fluctuating rapidly during the entire push period. In the stainless steel pipe, the flow was fairly smooth and steady.

A conical-shaped resin redistributor located in the center of the adsorption column at the XAW collector did not change the typically parabolic resin flow pattern.

Flurex Process

The stability of ion exchange membranes under operating conditions is being checked in long-term runs in laboratory-scale cells. Permutit 3148 anion membrane has a useful life of about 700 hours when used at one amp/in² membrane current density and 60 C and with 0.5 M NH_4NO_3 , pH 8-9 as anolyte and 1.0-1.5 M UNH in the feed

DECLASSIFIED

compartment. Marked increases in hydraulic permeability and decreases in permselectivity were noted after 700 hours operation. Permutit 3142 cation membrane has a useful life of at least 900 hours under these operating conditions. The cell is now being operated with a fresh Permutit 3148 membrane at 30 C and one amp/in² membrane current density and with 0.25 M NH₄NO₃ as anolyte. It is hoped that these milder conditions will lead to a longer useful life for anion membranes.

Permutit Company cation membranes 3143 and 3155 are being evaluated for possible use in the Flurex Process. The hydraulic permeability of these membranes is about 200 times lower than that of Permutit 3142 membrane, but their resistance is about 10 times greater. Pending evaluation of polarization behavior these new membranes appear to be satisfactory alternatives to 3142 membrane should the low hydraulic permeability of this latter membrane be intolerable.

According to current specifications metal grade UF₄ should contain less than 0.2 weight per cent water. The average water content of NaUF₅ prepared at 60 C from a Flurex catholyte of the composition 0.1 M UO₂F₂, 0.05 M NaF, 1.0 M HF and dried three hours in air at 150 C was 0.13 per cent. The water content of NH₄UF₅ prepared and dried under similar conditions was 0.41 per cent. Decomposition of NH₄UF₅ to UF₄ at 350 C in an inert atmosphere would be expected to yield a product meeting water content specifications.

Platinized-tantalum anode materials such as Tirrelloy B (Ionics Incorporated) are being tested for use as anodes in the Flurex Process. The first specimen of Tirrelloy B tested had only one surface "platinized" and exhibited an anodic behavior characteristic of tantalum, that is, formation of a high resistance film. Material platinized on all surfaces is on order but not yet available.

Pyrochemical Processing

Aluminum Potassium Chloride System. A more detailed study of the reduction of uranium(III) in the system KCl-AlCl₃-Al has explained the apparent low reduction yields reported last month. The reduction yield was studied as a function of the AlCl₃/KCl ratio and was found to peak sharply at a ratio of about 1.1. In the region of an AlCl₃/KCl ratio of 0.8 to 1.0, reduction yields ranged from 55 to 65 per cent, while in the 1.02 to 1.16 region they ranged from 80 to 96 per cent. For three AlCl₃/KCl values between 1.25 and 1.9 the reduction yields ranged from 59 to 67 per cent. The uranium distribution defined as the mole fraction of uranium in the metal phase divided by the mole fraction of uranium in the salt phase is a much more sensitive function than the reduction yield and is approximately equal to the equilibrium constant for the reaction,

since the uranium content of the system is quite low. The distribution coefficient was less than one for Al/KCl ratios of less than one or greater than 1.2. In the region of maximum uranium yield, however, it ranged up to nine.

This behavior can be tentatively explained by assuming the formation of a very strong complex between AlCl₃ and Cl⁻, AlCl₄⁻ which provides the driving force for the reduction reaction. Excess AlCl₃ results in the formation of weaker complexes, perhaps Al₂Cl₇⁻, which may back react with uranium. Excess KCl, on the other hand,

~~DECLASSIFIED~~

C-5

HW-56914

may react with UCl_3 to form a complex UCl_4^- which is weaker than the $AlCl_4^-$ but is still strong enough to adversely affect the reduction process. The question of why the uranium reduction apparently peaks at an $AlCl_3/KCl$ ratio of 1.1 rather than one has not yet been satisfactorily resolved.

In a series of five equilibrations in which 98.6 w/o Al-Pu alloy was contacted with salt phases containing varying $AlCl_3/KCl$ ratios, similar behavior to that of uranium was observed. The reduction peaked at an extrapolated value of nine to ten per cent in the vicinity of an $AlCl_3/KCl$ ratio of one and dropped to about 0.5 per cent at a ratio of 0.5.

The fact that the reduction yield of uranium and plutonium is a maximum at a specific $AlCl_3/KCl$ ratio and apparently drops off at a different rate with changing $AlCl_3/KCl$ ratio may mean that the best partition may be obtained under conditions other than those of maximum yield. It is also probable that the reduction of plutonium will be inhibited by the presence of uranium in the system.

The equilibrium between 85 w/o Al-U alloy and $KCl \cdot AlCl_3$ is apparently attained in less than ten minutes at 725 C as shown by an experiment in which both phases were sampled over a 140 minute period. The material was contained in a tantalum crucible and induction heated.

Analytical Service

Calibration of beta gas flow proportional counters (BPC) continues. Determination of "overall correction factors," defined as the ratio of counts to disintegrations, has been laborious. Factors for seven isotopes have been determined using environmental sample mount geometry. Factors for another 20 isotopes are required for routine use of the counters. The expected greater efficiency of the BPC for counting x-rays was confirmed. Iron-55, 6 Kev x-rays, indicated a 10-fold greater efficiency than the Beta Gamma Offner Counter. The counting of x-rays constitutes an interference and requires correction of apparent beta activity.

The high quality of plutonium isotopic analysis was demonstrated. A sample exchange was arranged (through Chemical Research) with Rocky Flats. One metal sample and one plutonium nitrate sample were analyzed for the isotopes of mass 239, 240, 241, and 242. All results agreed within the precisions reported. Chemical Research cooperated in submitting samples to the Analytical Laboratories to prevent any bias from normal procedure. Remaining sample will be used as a standard material.

Several changes have improved 325 Building activity counting service. The 256 channel gamma energy analyzer has been calibrated for single isotopes with gamma energies from 0.1 - 0.8 Mev. Improvement results from replacement of the less stable "5 Peak" analyzer and an increase in the number of isotopes that can be determined. Calibration conditions require samples submitted for analysis be either 1 or 10 ml and contained in 15 ml vials.

Corrections for coincidence loss in gamma well counters were refined. No corrections are necessary up to 4×10^5 counts/min.

Daily calibration of beta and alpha counters will be checked with recently prepared control charts. The daily chi squared test is thus eliminated at a gain of 2 hours time per counting instrument. Accuracy is not sacrificed.

Anion exchange was used to isolate Th^{234} - Pa^{234} from Z plant process stream and Purex waste stream samples. Isolation is achieved by selective elution from Dowex-1 resin using 8 M HNO_3 and 10 M hydrochloric acid. Analysis is completed by precipitation of thorium hydroxide and multichannel gamma energy analysis. The yield averages 95 per cent.

WASTE TREATMENT

Calcination of Purex Waste

Laboratory study of the volatilization and leaching of fission products from Purex wastes calcined at various temperatures was extended to include neutralized LWV and also the hydrous oxide precipitate which forms when LWV is neutralized. This precipitate carries most of the fission products, except cesium, and represents the principal waste from a cesium recovery operation. Both of these basic materials gave markedly less ruthenium volatilization and products of lower leachability than was the case with acidic solutions. Thus, no detectable ruthenium was volatilized at temperatures ≤ 500 C in the case of the neutralized waste and did not exceed 0.06 per cent up to 800 C with the hydrous oxides. Less than two per cent of the gross beta activity could be leached with boiling water from the calcined neutralized waste and less than ca. 0.1 per cent from the calcined precipitate. The principal drawback to basic side calcination would be difficulty in applying to fluidized bed or spray calciners.

Spray Calciner Development

Further runs were made in the small laboratory unit in an effort to improve the bulk density of the calcination product. Addition of phosphate and borate to the acidic feed and operation at higher temperature (890 C bottom wall temperature) gave a seven fold reduction in volume and a tap density of 0.73 gms/cc. It is now felt that preliminary questions of feasibility have been demonstrated, and effort is being concentrated on design of a larger integrated unit which will give more meaningful results.

A theoretical mathematical analysis was made of the temperature-time relationships of a particle receiving heat by radiation in a radiant heat spray calciner. The resulting equations will be a guide in designing and optimizing operation of this type of equipment.

Nitrate Destruction

Construction of pilot plant equipment for the destruction of nitric acid by formaldehyde is continuing. Installation of equipment is 30 per cent completed.

In laboratory experiments aimed at the electrolytic destruction of nitric acid, current efficiencies of 60 to 80 per cent were measured with a stainless steel cathode under various conditions of nitrate concentration, current density, and temperature. The cell consisted of two compartments separated by a Permutit 3142

DECLASSIFIED

cation membrane. The anolyte was dilute sulfuric acid. Under these conditions, platinum or titanium may be required in the anode, but alternate materials will be investigated.

Observation Wells

Recent samples of ground water from near CPD cribs revealed the presence of Sr^{90} in samples from two monitoring wells near the abandoned 216-S 1 and 2 cribs. The maximum concentration detected was 2.7×10^{-7} uc/cc. No recurrence of radiostrontium in ground water samples from wells near the abandoned 216-BY cribs was found. Earlier reports of Sr^{90} being detected in a sample from a well near the 216-S-7 crib were shown to be false by immediate resampling and reanalysis.

A water level recorder on a Hanford well recorded a 0.03 foot water fluctuation on July 9, 1958, correlating with an earthquake occurring near Juneau, Alaska.

Additional scintillation monitoring probe tests of wells near the 216-A-24 crib revealed measurable gamma emission from a depth of 135 feet beneath the crib. This represents a downward migration of 15 feet within the past month. The "detectable gamma emission" zone being followed by means of relatively insensitive scintillation probe surveys probably follows behind the radioactive contamination front as determined by detectable radioactive material appearing in the ground water.

Special Geological Studies

Well drilling by the Bach Drilling Company on the CA-794 project began during the month.

The data from preliminary test magnetometer surveys across the buried extension of the basalt Yakima Ridge at three localities between Benson Ranch and the Yakima Horn were correlated to available regional geologic data. The continuation of that ridge was confirmed, additionally the two anticlines and intervening syncline mapped west of Benson Ranch in the Yakima Ridge were detected at all three localities. The buried portion of the structure, previously believed to be a single anticline or structural terrace, is apparently a composite structure traceable to a few miles north of the Yakima Horn.

The structure is broader especially in its southeastern reaches than earlier believed, hence several wells are recognized to lie close to or above the structure rather than to the northeast of it. Ground water and contaminants from the Separations Areas will thus more likely pass northeast of those wells toward the Columbia River rather than centering about the wells or passing southwest of them, particularly if the basalt rises to or above the water table. Magnetometric work unfortunately does not readily provide depth values hence drilling is necessary to determine these depth factors.

Disposal to the Ground

Tests were completed to evaluate the removal by soils of radioisotopes from Turco #4501 decontaminating solutions. A 5 per cent solution of the agent was found to have a breakthrough capacity of 3.5 column volumes for an influent concentration

DECLASSIFIED

C-8

HW-56914

of 8×10^{-4} uc/cc of Sr^{90} and a breakthrough capacity of 1.1 column volumes for an influent concentration of 1.5 uc/cc of Cs^{137} . Equilibrium data indicate a soil capacity for Pu^{239} of about 5.5 column volumes for an influent concentration of 8×10^{-4} uc/cc.

A simulation test of the history of the 216-WR cribs was performed in laboratory soil columns. Initially the column received 7 column volumes of simulated 221-U waste, having a Sr^{90} concentration of 1×10^{-3} uc/cc. This solution contained calcium ion to simulate the limestone neutralization of the waste. A column breakthrough of Sr^{90} occurred almost immediately, with a C/C_0 of 0.5 after passage of only 0.85 column volumes. Simulated 224-U condensate waste was then added to the soil column to study its ability to leach Sr^{90} from the soil. Detectable radio-strontium concentrations were found in the first 11 column volumes of effluent from this latter solution.

Simultaneous soil column tests were performed on samples of waste from two different streams by the Chemical Effluents Technology Laboratory (222-U) and the Chemical Processing Department Analytical Control Laboratory (222-S). The results of these tests were all in good agreement, the differences being within the reliability of the technique. For Purex boiling tank condensate the CPD laboratory reported an average column volume capacity of 4.35 for two tests, while the CET laboratory reported an average column volume capacity of 4.75 for two tests. The routine performance of these soil column tests will be transferred to the CPD Analytical Control Laboratory.

Based on the laboratory finding that Sr^{90} is being leached out of the soil beneath the 216-WR cribs (U-8) by the condensate stream from the calcining operation, it was recommended to CPD that this crib site be abandoned as soon as practicable. CPD was further advised that if Sr^{90} is present even at a fraction of the MPC in the 224-U condensate it would be best to abandon the present lime bed neutralization facility and install caustic neutralization in order to maximize the new crib's capacity.

High Level Wastes

A laboratory research study was initiated to study the movement of boiling, high-level Redox waste solutions through soil, simulating wastes which could leak from an underground tank. The study is designed to determine the influence of salts crystallizing out of cooling synthetic waste solutions on the ability of the soils to transmit the solutions. A laboratory device for measuring soil permeability at controlled, elevated temperatures was assembled for this purpose. No quantitative data are yet available with this device, but relative permeabilities of soil for thermally cold (27 C) synthetic, high-level wastes were measured. A soil capable of transmitting 39 gal/day/ft² of pure water had a permeability of 13 gal/day/ft² for synthetic, high-level waste solution having a salt concentration equivalent to that of wastes as they are sent to the tanks. This solution was filtered to remove all visible sludge before the permeability test was performed. A similar test with waste solutions concentrated by evaporation to one-half the initial volume before filtering displayed a permeability of 8 gal/day/ft². These values must be considered as relative permeabilities since they were performed with variable head.

Centrifuge drainage tests were started to evaluate the rate of drainage of synthetic, high-level, waste solutions from soils. The solutions used are filtered, synthetic, Redox waste solutions at various concentrations. Centrifuge drainage estimated to be equivalent to about 100 years at one gravity (one hour at 1000 gravities) resulted in moisture retention of 15 per cent by weight for pure water. Under the same conditions, waste of the concentration sent to underground tanks displayed a moisture retention of 17 per cent and waste solutions concentrated to half-volume by evaporation displayed a moisture retention of 19 per cent.

Two field scale tests were performed to simulate loss of Redox waste through a leak in an underground storage tank. The first test used simulated neutralized Redox waste which had not undergone self-concentration. It contained a precipitate equal to about 5 per cent by volume. This waste entered the ground through a one-inch hole in a 7 foot x 7 foot test plate without giving any indication of developing a flow restriction either by a waste-soil reaction or by the precipitate plugging the soil. The maximum flow recorded was 450 gallons per hour. When the plate was removed, visual examination showed that the precipitate had dispersed in the soil forming a saucer-shaped pattern about two feet deep in the center and with a radius of seven feet. Analytical results, using NO_3 as an indicator, substantiated the visual observations as well as indicating that precipitate-free waste had penetrated to a depth of four feet in the center and had spread to about an eleven foot radius.

The second test employed synthetic Redox waste that had self-concentrated to 83 per cent of the original volume. This waste contained about 20 per cent by volume of a rapidly-settling precipitate. Only 50 gallons of this waste entered the ground before plugging occurred and all measurable flow stopped. The plugging was apparently due to the precipitate settling in the bottom of the stand-pipe. Visual examination of the soil beneath the plate indicated that clear waste had spread to a radius of about 3 feet. Analytical results of the soil will be necessary to determine the depth to which the waste penetrated. Further field tests are scheduled for August.

TRANSURANIC ELEMENT AND FISSION PRODUCT RECOVERY

Cesium Recovery

Hot Cell Experiment. The first liter-scale, full-level cesium recovery run on Purex plant 1WW was successfully completed. This utilized the "basic side" cesium zinc ferrocyanide flowsheet and resulted in an overall cesium recovery greater than 80 per cent, with less than ten per cent cesium loss to the ferric hydroxide precipitate and the cesium precipitation supernate, respectively. The scale of this run effectively saturated any possibly deleterious radiation effects and assures that similar results would be obtained on a plant scale. The next scheduled runs will similarly test the "acid side" ferricyanide and cobalticyanide flowsheets.

Packaging Prototype Facility

Detailed construction drawings for the Cesium Isolation and Packaging Prototype Facility are approximately 85 per cent complete. Detailed drawings of the Packaging Conveyor, Scrubber, Crystallizer, and Neutralizing Tank were completed and submitted to Technical Shops for fabrication. These drawings constitute approximately 20 per cent of the total shop fabrication effort.

DECLASSIFIED

Installation of the prototype centrifuge to be used in the demonstration of the proposed cesium recovery flowsheet is approximately 85 per cent complete. The initial iron removal studies will use "cold" simulated IWW, and later studies will employ a cesium-134 tracer.

The order has been placed for the General Mills Model 500 manipulator. This manipulator will be used both in the Isolation and Packaging Prototype studies and the Non-Production Fuel Reprocessing mechanical head-end studies.

Ion chambers are under development for determination of cesium-137 in the final package. Ceramic insulators on each end of the central rod exhibited excessive current leakage across these insulators. The leakage contributed to high background current and poor voltage plateau characteristics. A chamber using single insulators and a guard ring electrode is now being fabricated for testing.

Mini Runs

Two HA runs were made using a reducing flowsheet with Purex plant 3WB, one with ferrous ammonium sulfate in the scrub and one with ferrous sulfamate. The results were nearly the same for both experiments and showed a very high neptunium reflux, which could not be accounted for by accepted neptunium(IV) E_a^0 values. A possible explanation is oxidation in the organic phase to the V state which is scrubbed back into the aqueous phase. Such a hypothesis would require a subsequent and rapid reduction to the IV state in the high acid extraction section.

Anion Exchange Processes for Neptunium

A successful anion exchange column run was made on concentrated plant 2DW with 20 - 50 mesh Permutit SK resin. Eighty-five per cent of the feed neptunium was recovered from 100 column volumes of feed (1.6 gm/l loading) and eluted in only 1.5 column volumes. A decontamination factor of 2×10^3 was obtained from fission products. A surprising feature of the run was that plutonium was recovered even more efficiently than neptunium - despite the presence of ferrous sulfamate. This indicates that neptunium and plutonium can be recovered simultaneously from plant waste solutions (such as IWW) but also suggests that decontamination of neptunium from plutonium by anion exchange may not be as favorable as had been thought.

TBP Extraction of Neptunium

The use of phosphate and fluoride complexing to improve decontamination from zirconium-niobium in the TBP extraction of neptunium was investigated. Small concentrations of either complexant were effective in reducing the extraction of zirconium-niobium; however, neptunium(IV) recovery was decreased by about the same factor. Therefore, these complexing agents do not appear to be practical for increasing the separation of neptunium(IV) and zirconium-niobium.

Preparation of Neptunium-Aluminum Alloy

Neptunium-aluminum alloy was prepared from NpO_2 on a one gram scale by two processes; (1) the cryolite process, and (2) aluminum reduction in molten $KAlCl_4$. Well formed buttons were obtained in both cases, but the efficiency of reduction in these preliminary experiments was only about 50 per cent.

DECLASSIFIED

C-11

HW-56914

ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Formal Oxidation Potentials of Neptunium

The formal oxidation potentials of the neptunium(V/VI) couple in 1.0 N H_2SO_4 and 1.0 N HClO_4 were measured by the coulometer method discussed in previous progress reports. The values obtained were - 1.074 and - 1.142 volts, respectively, for the H_2SO_4 and HClO_4 systems with 1.36×10^{-4} M neptunium.

The observations reported last month regarding the neptunium(IV/V) couple were in error and this oxidation-reduction reaction has been found to be irreversible at the platinum electrode.

X-Ray Fluorescence Methods

The intensity of the $\text{U}_{L\beta_1}$ fluorescence as measured through aluminum thicknesses of 0.010 to 0.025 inch was found to be independent of the thickness of the underlying 86 w/o Al-U alloy as long as it exceeded 0.010 inch. This means that cladding thickness measurements on MTR type fuel plates by this technique would not be troubled by variations in the core thickness.

EQUIPMENT AND MATERIALS

Pump Development

A Johnston deepwell turbine pump has been modified to permit studies on its possible use as a combined pump-agitator. To produce the agitation effect, holes have been drilled in one stage of the pump. This permits a portion of the pumping energy to be diverted into recirculation and agitation.

A Randolph peristaltic (pinched tube) pump, provided by the 234-5 Development Operation, is being evaluated for its possible use as a metering pump for small flows (30 to 200 ml/min). Studies to date have indicated:

1. Frequent changes (in less than 10 hours) of the flexible tube position are required to minimize permanent tube closure and abnormal wear.
2. Delivery changes with tube wear.

A 5-horsepower, hermetically-sealed titanium-clad motor has been received from the Gaylord Rives Company. Inspection reveals quality workmanship. This motor is to be evaluated for in-line and submerged pump application. This motor is a modification of the General Engineering Laboratory design which gave exceptional operating performance during earlier Hanford testing.

Powder Feeders

Two powder feeders have been scoped for use in transferring 234-5 powders. One has been designed for the vertical transfer of powder through the use of a mechanically actuated plunger. The second is designed to permit dropping of powder from one reaction vessel to another through a powder lock. In the latter, incremental flow

SECRET

of powder is activated by the rotation of two discs. The discs each contain a hole which permits powder flow through the disc. Powder flows through the top disc into the powder lock, then with further rotation of the discs, is emptied from the lock.

Plutonium Oxide Chlorinator

Specimens of gold, platinum, Baker 413 (a gold-platinum-paladium alloy), Hastelloy B, Hastelloy C, and Haynes 25 were exposed for 72 hours to water saturated HCl at temperatures of 400, 500, and 600 C. Gold, platinum, and Baker 413 were essentially unattacked at 400 C (<0.01 mil/month) and exhibited satisfactory resistance (0.2 to 0.4 mil/mo.) at 600 C. The Hastelloys and Haynes 25 experienced excessive pitting attack at temperatures above 400 C.

Non-metallic Materials Testing

Materials are being collected which will permit limited plastic casting development studies within Process Equipment Development Operation. Experimental plastic plug and ring gages have been made for evaluation by Fuels Preparation Department. Fabrication of demonstration punch and die sets for possible shop application is in progress.

Protective Coatings

Document HW-56908, "A Comparison of Several Protective Coatings," by J. H. Kleinpeter was issued. This document presents the resistance of various protective coatings to chemicals encountered in our separations facilities. In addition, approximate cost estimates have been presented for the installed cost of these coatings when surface preparation and actual coating application have been performed according to manufacturer's specifications.

PROCESS CONTROL DEVELOPMENT

Electrodeless Conductivity Measurements

An electrodeless radio frequency conductivity detector described by Stelzner (ISA Journal, October 1957) was fabricated for test and evaluation. Initial tests show a 10 mv change in output signal for a 0 to 0.15 molarity range of nitric acid. The circuit is being modified in an attempt to increase the sensitivity at higher acid concentrations. In static tests changes in solution temperature due to absorption of radio frequency energy causes excessive variation in the output signal. This however should not be a problem with flowing samples. The 955 triodes used in the transmission line oscillator performed satisfactorily after exposure to 10^6 roentgen from a cobalt-60 source. These tubes must be coupled directly to the transmission line in which the sample flows; hence, they must be relatively insensitive to gamma radiation.

Neutron Monitor

A crude pipeline neutron monitor was installed on a 2-inch plutonium transfer line in the Redox Plant. Plutonium transfers were easily detected, and a calibration of counting rate versus plutonium concentration resulted in a semi-quantitative straight line relationship. Due to the ambient temperature being in excess of

DECLASSIFIED

the softening point of paraffin, a polyethylene moderator will be installed as soon as possible in an attempt to obtain quantitative data.

Contact Alpha Counter

A phosphor with a reduced phosphor density was recently installed on the prototype contact alpha counter in the 234-5 Building. The unit performed well for the first few days of operation, but indicated a degradation of the 1/4 mil protective Teflon film in about one week. Contrary to anticipated results, the phosphor with reduced density exhibited a two-fold increase in counting rate for a given plutonium concentration. As soon as production schedules permit, a low density phosphor with a 1/2 mil protective film will be installed.

Looped Tube Densimeter

A device employing a loop in a run of tubing is being investigated as a densimeter. The device employs strain gages to measure the deflection of the loop caused by the density of the solution flowing through it. The device as now operating has a full range (100 chart divisions) for a specific gravity range of 0.80 to 1.00. The unit is sensitive to temperature and flow variations. Effort is being directed towards minimizing the latter effects, and determining the sensitivity and precision of the technique.

Absorptiometer for Ion Exchange Column

An absorptiometer acquired from excess (Sylvania-Corning Nuclear Corporation, Bayside, New York) is being readied for installation on the "C" Column in the Purex ion exchange. It will be used to measure the plutonium concentration on the resin at the "color line" about 2 feet above the product take off point.

NON-PRODUCTION FUELS REPROCESSING

Mechanical Processing Prototype

Components for the 40-ton hydraulic shear to be incorporated in the tentative prototype mechanical head-end system for "chopping" non-production fuels are being assembled in the 321-A Building. The shearing mechanism proper is being fabricated in Minor Construction shops. Initial studies on the shear portion of the mechanical head-end system are contemplated during September.

A crane-bridge is being designed for 321-A Building. Installation of this system will permit use of the General Mills Manipulator on both the non-production fuel mechanical head-end prototype and the cesium isolation and packaging prototype.

Studies have indicated that high speed (22,000 linear ft./min.) friction blade operation is required to cut massive stainless steel representative of that likely to be encountered in fuel element end fittings. When cutting massive steel, the V-blade life is approximately one-third that encountered cutting open-spaced rods.

DECLASSIFIED

C-14

HW-56914

Feed Preparation

Darex. Initial operation of the "cold" Darex installation was undertaken with the dissolution of stainless steel tubing. It was found that a chloride-to-iron mole ratio of greater than two is apparently required to assure complete dissolution of the stainless steel. With the initial molar ratio less than two, the dissolution proceeds only until the molarity of the iron in solution is one-half of the chloride molarity.

Under some conditions not yet fully defined, the stainless steel becomes passive and will not be attacked by boiling aqua regia for a long period of time. After an initial partial dissolution in one test, additional aqua regia was added for a period of 90 minutes before further dissolution occurred at a rapid rate. Laboratory tests to define the conditions causing passivation and to determine means to remove the passive film are planned.

The chloride present in the dissolver product is volatilized (batchwise) by increasing the nitric acid concentration of the solution. After a two- to four-fold concentration, the continuous addition and boil-off of a volume of 60 per cent nitric acid equal to original volume of dissolver solutions reduced the chloride concentration from 35 to 1 g/l. During the experiment, it was noted that over 60 per cent of the chloride was not condensed in the downdraft condenser, but was found in the caustic scrubber. In other tests, increasing the dissolver solution nitric acid concentration to 7 M and boiling under reflux removed 54 per cent of the chloride.

Zirflex. Oxidized (336 hours in air at 400 C) Zircaloy-2 clad uranium dioxide pellets (1/2 inch in diameter by 5 inches long) were subjected to Zirflex dissolution under tentative flowsheet conditions. The cladding dissolved slowly through pitting attack by the ammonium fluoride solution. More than 95 per cent of the zirconium was dissolved in 12 hours and essentially complete exposure of the core was secured. Uranium losses in the centrifuged cladding solution were 1.3 per cent of the uranium charged (solution contained 2.6 g U/l). The centrifugation step recovered 0.1 per cent of the uranium charged. The off-gas contained 1.6 to 1.8 per cent hydrogen.

Alternate exposure (seven cycles) of 304-L stainless steel and Hastelloy F were made to boiling 6 M NH_4F - 0.5 M NH_4NO_3 , with and without 0.01 M $\text{Cu}(\text{NO}_3)_2$, (8 hours) and to 10 M HNO_3 (16 hours) in Teflon containers using an air-cooled polythene condenser followed by a water-cooled glass condenser. The average corrosion rate of 304-L stainless steel in the decladding solution was 12 mils/month in the absence of copper(II) nitrate and 2.4 mils/month in the presence of copper(II) nitrate. The presence of copper(II) nitrate decreased the corrosion rate of Hastelloy F in the decladding solution from 3.3 to 0.9 mil/month. Both materials exhibited a corrosion rate of about 0.6 mil/month in 10 M HNO_3 .

The rate of destruction of zirconium oxide films by ammonium fluoride-hydrogen fluoride melts has been found to decrease as the hydrofluoric acid content increases over the range, $\text{HF}/\text{NH}_4\text{F}$ of 2.2 to 3.2. It has been found that the rate of attack of the underlying metal is greatly decreased as the melt becomes saturated with zirconium thus affording some basis for optimism that a melt such as $\text{NH}_4\text{F} \cdot 2\text{HF}$ saturated with zirconium could be safely used to selectively remove passive zirconium oxide films prior to the Zirflex decladding operation.

Nitric-Hydrofluoric Acid Dissolution. A number of dissolutions were performed in a one-liter dissolver constructed of vacuum melted Hastelloy F simulating the dissolution of stainless steel clad fuel elements. 304-L stainless steel was dissolved in 1 M HNO_3 - 2 M HF to a concentration of about 0.4 M. The solution was then butted with nitric acid and aluminum nitrate, and uranium metal added. Final solutions varied from 0.26 to 0.56 M in stainless steel, 0.44 to 0.76 M in uranium and 0.9 to 1.5 M in aluminum nitrate. The higher concentrations were achieved by partial evaporation of the solution subsequent to the addition of aluminum nitrate and prior to the addition of nitric acid. The corrosion rate of Hastelloy F during decladding (one to two hours exposure) varied from 22 to 30 mils/month. In a single run the hydrofluoric acid concentration was butted to a total of 3 M at the point where the stainless steel dissolution rate began to decrease. In this case the Hastelloy F exhibited a corrosion rate of .42 mils/month. The Hastelloy F corrosion rate during core dissolution varied from two to five mils/month (one to three hours exposure) except in the case when silica (vice aluminum nitrate) was added to complex fluoride. In this instance the Hastelloy F corrosion rate was doubled and the uranium dissolution rate halved.

Preliminary uranium dissolution rates were obtained during the simulated core dissolution studies. The initial uranium dissolution rate for ingot metal is about 5 g/cm²/hr. As dissolution proceeds and the nitric acid concentration approaches zero, the rate decreases to about 2.5 g/cm²/hr.

The dissolution of 347 stainless steel in nitric acid-hydrofluoric acid is difficult. In the single run made to date with 347 the maximum stainless steel concentration obtained in 1 M HNO_3 - 2 M HF was only 0.1 M.

One-month exposures of vacuum melted Hastelloy F to 50 and 40 weight per cent nitric acid were made under heat transfer conditions (bulk metal temperature 135 C) in both the "as received" condition and after a full solution anneal (one hour at 2150 F, water quenched). Corrosion rates (about 0.4 and one mil/month in 40 and 50 weight per cent nitric acid, respectively) were essentially unaffected by the solution anneal. Attack was intergranular.

Solvent Extraction

Redox Processing of Darex Feeds. Studies of chemical problems associated with Redox processing of Darex feeds are underway. Initial efforts have been directed toward establishing gross salt concentration ranges required for stable Redox-type IAF, IAFS, and IAW solutions. These different types of solutions are being prepared at uranium to stainless steel ratios of 5, 2.5, 1, and 0.5. Particular attention is focused on the ability to prepare stable (7 days at 25-29 C) acid-deficient solutions.

TBP Processing of Darex Feeds. Studies of the TBP-diluent solvent extraction characteristics of Darex feed solutions in support of projected service runs to recover uranium from feeds prepared in the Cold Semiworks (321 Building) were completed. At low acidities (0 to 1 M) the greater amount of stainless steel dissolution products obtained at low uranium to stainless steel ratios helps salt uranium into the organic (30 per cent TBP-Shell E 2342) phase. This effect is not evident at higher acidities where nitric acid salting predominates. Thus at

DECLASSIFIED

both uranium to stainless steel ratios of 2.5 and 5 uranium distribution ratios at 1.4 M U, 2.0 M HNO_3 (typical Purex plant extraction conditions) are in excellent agreement with the published value. Chloride ion distribution ratios for feeds spiked to 0.1 g/l chloride ion were about 0.06, indicating that chloride ion will not favor the organic phase if by some chance the Darex feed is slightly out of chloride ion specifications. Spectroscopic data show excellent decontamination from stainless steel dissolution products under all conditions tested. It is concluded that Cold Semiworks extraction runs should proceed satisfactorily and should produce a product suitable for direct calcination.

Packed TBP Solvent Extraction Columns. The performance of packed solvent extraction columns under Purex Process conditions is being studied to evaluate the potential of applying a TBP solvent extraction process to the Redox plant. Capacity and efficiency studies of a Raschig ring-packed 3-inch-diameter by 20-foot-tall glass column operating under Purex Phase II conditions were continued. With a 3/8-inch stainless steel Raschig ring packing and a top interface position, an A-type column had a capacity of 1290 gal/hr/ft². At a volume velocity of 1130 gal/hr/ft², a 2.2-foot HTU was measured. Increasing the packing size to 1/2-inch stainless steel rings, increased the column capacity to 1610 gal/hr/ft². A 1.7-foot HTU was measured at 1210 gal/hr/ft².

Under C-Column conditions and a top interface position, the flooding volume velocity was increased from 600 to 700 gal/hr/ft² when the stainless steel Raschig ring size was changed from 3/8 to 1/2 inch. HTU's of 1.5 to 2 feet were measured with both packing sizes. Lowering the interface to the bottom of the column increased the HTU to about 18 feet.

Redox Processing of HNO_3 -HF Feeds. Studies of problems associated with Redox processing of the dissolver solutions produced by nitric acid-hydrofluoric acid dissolution of the various non-production fuel elements are also underway. Initially, processing of solutions that would result from dissolution of stainless steel clad U or UO_2 elements is being studied. Simulated Redox type IAL, IAFS, and IAW solutions at various uranium to stainless steel ratios and aluminum nitrate concentrations are being prepared to ascertain conditions for stability. Possible attainment of acid deficiency is being emphasized.

Instrumentation

Conductivity of Zirflex Dissolver Solutions. A conductivity cell (cell constant 9.8) for possible use in the Zirflex dissolver has been designed and fabricated. Laboratory tests with the cell using boiling Zirflex solutions show that at the start of dissolution the conductance is 0.143 mho and decreases to 0.038 mho at completion. Tests are continuing to evaluate the usefulness of this technique as a measure of zirconium dissolution rate.

Weighing System for a Dissolver Basket. Tests are underway on a direct current bridge system for connecting to a strain gage load cell. A precision of ± 1 per cent appears attainable with this system. The proving ring force transducer (Daytronic) appears unsatisfactory for any weighing application due to excessive hysteresis in the proving ring.

DECLASSIFIED

C-17

HW-56914

REACTOR DEVELOPMENT - 4000 PROGRAM

Reprocessing of PRP Fuels by Amine Extraction

Additional experiments have been done at high plutonium concentrations with tri-laurylamine diluted with the aromatic diluent xylene. In no case was a second organic phase observed. Tri-laurylamine concentrations ranged from 10 - 20 volume per cent and aqueous acidities from 2 - 6.7 M HNO_3 . Maximum organic plutonium organic loading was about 30 grams/liter. There was evidence of a slight amount of organic decomposition at the highest acidity.

In another experiment, a series of extraction-scrub-strip studies was run on Purex dissolver solution with ten volume per cent tri-laurylamine-xylene. Results were similar to earlier ones with tri-n-octylamine-Amsco, the decontamination factors from zirconium-niobium and ruthenium being about 2×10^4 .

Analytical Service

A colorimetric method was adapted to the determination of 1-5 dihydroxyanthraquinone in water. The material is used as a scavenging agent by Coolant Systems Development. A colored product is formed by adding sodium hydroxide to pH 12. The colored product is soluble. Accuracy of light absorption measurements at 530 m μ is ± 5 per cent in the microgram range. Other quinones interfere.

Analytical chemical service requirements for the gas cooled reactor program were scoped for Reactor and Fuels Research and Development. Analyses will identify changes in gas phase composition under development tests. Analysis of the gas from 100 static tests, irradiation of sealed capsules containing coolant and moderator, will require $3/4$ of a man year. A control program for a recirculating test loop (CO_2 coolant) was devised. A combination of laboratory service and in-line monitoring was visualized. The in-line portion of the program was developed jointly with Process Control Development. Orsat, mass spectrometric, infrared absorption, and gas chromatographic technique were considered. The latter method appears most attractive.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Analysis of Reactor Effluent Water

Preliminary results have been calculated from a series of activation analyses of possible source materials for some of the radioisotopes in reactor effluent water. These results show that parent isotopes for P^{32} and As^{76} are present in the process water largely from contaminants in the river not removed in the water treatment process. As^{76} source material from sulfuric acid was calculated to be less than one per cent of the total present, while the alum was found to contribute about ten per cent of the total. The calculated contributions to the P^{32} source material from sulfuric acid and alum were about 10 per cent and 25 per cent, respectively. Further information concerning the chemical and physical form of these various source materials may be necessary before it can be known which particular chemical species enter the film where they are strongly activated. At the present state of this study the presence of source isotopes in the water or an

additive does not prove conclusively that the reactor effluent radioisotopes come from that given source, since it must be known which source or sources provide the material which enters and resides in the film, a process greatly influenced by chemical and physical form. Calculations based on activation analyses of reactor process tube aluminum and an assumed value for the aluminum corrosion rate estimated to be accurate to within a factor of ten indicates that contributions from aluminum tube and can source materials are small (less than about five per cent) for Na^{24} , P^{32} , As^{76} , and Np^{239} . Significant quantities of Mn^{56} and Cu^{64} may arise from corrosion of activated materials from the aluminum tubes and cans.

Analyses were completed for Fe^{59} and Ba^{140} in Turco purge samples for which data on other radioisotopes were previously reported. Such a purge releases as much Fe^{59} and Ba^{140} as 100 and 0.8 days normal operation.

New Counting Instruments

Assembly of two new specialized counting instruments was completed and testing is underway. The alpha energy analyzer was found to have adequate resolution, but not as good as should be possible. A large sodium iodide crystal Compton-cancelling spectrometer gave a background reduction of 50 per cent and a Compton reduction of 75 per cent. Although these reductions are good, further reductions should be possible.

Geology and Hydrology

Preliminary magnetometer surveys provided additional information concerning the structure of the Umtanum Ridge-Gable Mountain anticlines. A basalt outcrop area northwest of Gable Butte and west of 100-B Area was surveyed; the results suggested either a separate, small sharply folded anticline north of the Umtanum Ridge structure or a fault, rather than a sinuous anticlinal axis of the Umtanum Ridge fold. Thermally hot waters (130 F) encountered within the basalts beneath 100-B Area at a depth of about 750 feet in well 199-B3-2 at time of drilling (1953) also suggested a fault but direct evidence is still lacking. The complexity of the formations in this area may account for some of the anomalies which have appeared in ground water monitoring data from wells located on the flanks of these structures.

A pumping test was completed on well 699-26-15 to evaluate aquifer coefficients. The aquifer at this location is believed to consist in part of lower glaciofluvial gravels and in part of the upper Ringold conglomerate formation. A drawdown-recovery test of the undifferentiated aquifer gave a field transmissibility of 65,000 gal/day/ft, and an average permeability of 1,450 gal/day/ft². This well thus lies north of the zone of very highly permeable sediments trending southeast from the 200 Areas. Step drawdown tests were made on this well before and after re-perforating the casing with the jet perforator. It was originally perforated with two slots per round, one round per foot, with a knife perforator. After jetting an additional 96 perforations in the 45-foot aquifer zone, the casing resistance to water flow was reduced 87 per cent.

Soil Chemistry and Geochemistry

The capacity of a 50g bed of crushed calcite for removing Sr^{90} from 0.05 M phosphate solutions was tested further. The bed tested is continuing to receive solutions

DECLASSIFIED

containing 3.2×10^{-2} uc/cc of Sr^{90} with no apparent breakthrough (as indicated by increasing C/C_0) of radiostrontium after passage of 1500 column volumes of solution. The test column is providing solution decontamination factors ranging from 10^5 to 10^6 .

Other carbonate minerals were tested and found to remove strontium from alkaline phosphate solutions in the same manner as calcite. Those tested include siderite (FeCO_3), smithsonite (ZnCO_3), and rhodochrosite (MnCO_3). These minerals would be useful for processes in which recovery of radiostrontium was intended because of the chemical dissimilarity between strontium and the mineral cations. It was found that the phosphate-calcite reaction would remove uranium and zinc from solution, although not as efficiently as it does strontium.

Additional mineral reactions are being studied that are suitable for removing fission products directly from acid solution and therefore avoiding the aluminum and alkaline earth precipitates which would be formed if the solution were made alkaline. Other objectives include possible reactions for the simultaneous removal of Sr^{90} and Cs^{137} from solution, and reactions involving anions other than phosphate to avoid premature precipitation of insoluble phosphates. Preliminary tests with vermiculite (a weathered magnesium-iron mica) indicated good removal of both strontium and cesium from solution. Vermiculite is known to have a large ion exchange capacity which may account for the observed reaction. X-ray examination of the mineral will be necessary to determine the possible formation of a new crystal structure in phosphate solutions.

Field Apparatus Development

A major effort was devoted to the design, fabrication, assembling and testing of laboratory apparatus for measuring the permeability of soil to simulated thermally hot high level wastes. Preliminary tests pointed out the need for improved feed pressure control if the apparatus is to be used as a constant pressure permeameter. Changes in vapor pressure produced by slight changes in temperature near the boiling point were greater than the pressure differential required to maintain a desired flow. Improvements are being sought.

Additional surveys using a vertical field magnetometer gave further indication of its applicability.

Assistance was given in preliminary experiments to determine the feasibility of neutron moderation as a measure of soil moisture. Results of these experiments gave encouragement that, in models of certain configurations, soil moisture can be determined with requisite accuracy without disturbing the soil.

Additional tests of the thermistor velocity meter were performed in wells north of Gable Mountain. In this region of relatively high water velocity the thermistor bridge meter was driven off scale and readings fluctuated. Streaming through perforations may explain these readings and effort will be made to substantiate this as a source of fluctuation.

DECLASSIFIED

DECLASSIFIED

C-20

HW-56914

Rupture Monitor Calibration

An Sb^{124} source was prepared and tested in a 105-B rupture monitor to determine whether the source 2 Mev gamma (half-life 60d) would be suitable for standardizing the detectors. A 10 uc source produced a significant upscale reading on the monitor which was, however, not adequate to make intercomparisons. More active sources will be prepared.

Manager
Chemical Research & Development

LP Bupp:bp

UNCLASSIFIED

C-21

HW-56914

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. J. Davenport	7/1/	AEC, Division of Reactor Development Washington, D.C.	Consult on consequences of a reactor disaster.	CE Linderoth RK Hilliard	No
A. Giambusso	7/15/	AEC, Division of Reactor Development Washington, D.C.	Discussion of HSW processing for PRTR and scheduling.	OF Hill LP Bupp	Yes
E. A. Bernhard	7/16-18/	Applied Research Laboratories Glendale, Calif.	Inspect and/or repair B&J Spectrograph	HJ Anderson	No
D. Langenwelter	7/17/	GEL Schenectady, N.Y.	Discussion of GEL analogy study.	LP Bupp	No
M. H. Studler E. N. Sloth R. R. Walters T. L. Collins W. O. Haas H. W. Alter A. E. Cameron	7/22-23/	Various AEC Sites	Technical discussions on Washington Designated Programs.	RJ Brouns FP Brauer LP Bupp JM Nielsen MT Walling	Yes
J. W. Ruch	7/29/	ORO-AEC Oak Ridge, Tennessee	Dingot metal problems.	OF Hill	Yes

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
A. S. Wilson	7/7-10/	Northwestern University Evanston, Illinois	Attend symposium on the Mechanism of Inorganic Reactions in Solutions.		No

UNCLASSIFIED

VISITS TO OTHER INSTALLATIONS

UNCLASSIFIED

C-22

HW-56914

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
K. H. Hammill	7/9-11/	B. D. Bohna Company San Francisco, Calif.	Consultaion regarding High-Level Radiochemistry Facility.	JJ Brezina	No
A. S. Wilson	7/11/	Argonne National Lab. Lemont, Illinois	Confer.on extraction of plutonium by organic solvents.	JJ Katz	Yes
B. M. Johnson M. D. Alford K. J. Schneider	7/14-15/	Phillips Petroleum Idaho Falls, Idaho	Technical consultation on fluid-bed technology; inspection of R&D facilities.	CE Stevenson	Yes
R. E. Burns A. M. Platt	7/29-30/	Phillips Petroleum Idaho Falls, Idaho	Discussions between AEC Contractors representatives on non-production fuels.	CE Stevenson	Yes
C. R. Cooley	7/17/	Oregon Metallurgical Corporation Albany, Oregon	Discussion of development contract.		No
J. L. Swanson	7/28-31/	ICPP Idaho Falls, Idaho	Attend meeting to review information on the non-production reactor fuels processing program.	CE Stevenson	Yes
D. R. Kalkwarf	7/31/	ORNL Oak Ridge, Tennessee	Discuss radiation protective agents & paramagnetic resonance measurements on organic compounds.	DG Doherty ML Randolph	No

UNCLASSIFIED

~~RECLASSIFIED~~

D-1

HW-56914

BIOLOGY OPERATION

A. Organization and Personnel

John D. Stewart joined the Plant Nutrition and Microbiology Operation on July 3, 1958.

B. TECHNICAL ACTIVITIES

FISSIONABLE MATERIALS - 2000 PROGRAM

BIOLOGICAL MONITORING

Atmospheric Contamination

Concentrations of I^{131} in thyroid glands of jack rabbits were about the same as one year ago. Values were as follow:

<u>Collection Site</u>	<u>$\mu\text{c/g}$ thyroid</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Wahluke Slope	2×10^{-3}	3×10^{-3}	-
Four Miles SW of Hedox	1×10^{-3}	3×10^{-3}	-
Prosser Barricade	1×10^{-3}	2×10^{-3}	-

Fission products were present in tissues of rabbits in the following amounts which were about the same as one year ago:

<u>Sample Type</u>	<u>$\mu\text{c/g}$ tissue</u>	<u>Trend Factor</u>
	<u>Average</u>	
Bone	1×10^{-4}	-
Feces	5×10^{-5}	-
Muscle	1×10^{-5}	-
Liver	9×10^{-6}	-

Columbia River Contamination

Contamination levels for beta emitters were as follow:

<u>Sample Type</u>	<u>Collection Site</u>	<u>$\mu\text{c/g}$ wet wt. tissue</u>	<u>Trend Factor</u>
		<u>Average</u>	
Minnows (entire)	Hanford	1×10^{-2}	+ 10

This value is 14 times higher than that reported for July, 1957. The increase is largely caused by the early increase in water temperature.

~~RECLASSIFIED~~

Effect of Reactor Effluent on Aquatic Organisms

Effluent from the 100-F reactor at a strength of 3 per cent was monitored with juvenile rainbow trout. This concentration of effluent caused a slight retardation in growth and increase in mortality of the fish.

Young trout held in well water now continuously supplied to the laboratory had a mortality rate very slightly greater than trout held in Columbia River water. This is a tentative result since mechanical difficulties still beset the well water supply.

BIOLOGY AND MEDICINE - 6000 PROGRAM

METABOLISM, TOXICITY, AND TRANSFER OF RADIOACTIVE MATERIALS

Phosphorus

Histological specimens from trout chronically fed P^{32} have been interpreted. No definite pathologic damage was observed in fish fed 0.006 μc and 0.06 μc P^{32} per gram body weight per day although a reduction in growth rate occurred at the 0.06 μc level. Pathologic damage was evident at the 0.6 μc feeding level which was lethal. Damage to the G.I. tract involved all segments with equal frequency and ranged from mild damage to the epithelium at three weeks to severe damage and breakdown of the mucosa after 15 weeks. Pathologic changes in the anterior kidney occurred after the third week and severe cellular degeneration in the posterior kidney was present during the terminal phase of the experiment. After four weeks there was a progressive decrease in the number of lymphocytes in the spleen. There was vascular congestion in the liver during the later stages. Both the liver and spleen were invaded by foci of fungus growth, probably as a result of reduced resistance during the later stages.

Zinc

Communities of aquatic plants were maintained in flowing water which contained a constant level of 0.1 $\mu\text{c}/\text{l}$ of Zn^{65} . Other environmental factors were kept constant.

There was a rapid accumulation of the isotope by the plants during the first day and then a gradual increase during the following three weeks. After three weeks the concentration of the isotope in algae and vascular plants (water cress) were about 5000 and 300, respectively, times the concentration in the water.

Rats were sacrificed after 300 days of chronic Zn^{65} feeding. Tissue distribution of the Zn^{65} was essentially similar to that observed after 200 days feeding.

Weanling rats (28 days) retained approximately 15 per cent of orally administered Zn^{65} after 24 hours. This is comparable to the findings in adult rats. However, the concentration of Zn^{65} in the bone and liver of the young rats was approximately 10 and 3 times higher than in mature rats.

DECLASSIFIED

Strontium

The experiment designed to study the effects of dietary calcium on the absorption and turnover of Sr^{90} fed to ewes with suckling lambs has ended and tissue and excreta samples from these animals are being processed for radioanalyses.

Considerable success has been experienced in the accelerated miniature swine breeding program inaugurated last fall. Forty-nine miniature pigs have been raised from nine breeding sows during the past ten months. This will permit starting the proposed radium and strontium experiments on schedule this fall.

Uptake of Radioactive Substances by Growing Plants

Immature barley plants sampled from the Sr^{90} plots show greater uptake of Sr^{90} from those plots which were cultivated compared to plots not cultivated. There was again a relatively greater uptake from plots containing 1 mc Sr^{90} than from those containing 10 mc Sr^{90} .

A test to study Sr^{90} uptake as a function of plant yield was inconclusive due to poor growing conditions in the greenhouse.

Iodine

The Q/D (quantity of I^{131} in the thyroid divided by the daily quantity of I^{131} fed) for the month of July continues to reflect the effects of lactation in the experimental sheep. The effects of continued low-level I^{131} feeding to swine on a high or low level of nutrition give Q/D values which compare favorably with those of one year ago, considering the extremely hot weather of this past month.

Cesium

A plankton bloom developed in the pond spiked with Cs^{137} . During the development of this bloom high concentrations of Cs^{137} were maintained in the plankton while concentrations decreased in other components of the community.

Radioactive Particles

Incomplete experiments suggest that sodium chloride, silver nitrate, hydrogen peroxide and alpha-naphthyl-thiourea administered as aerosols may show promise of hastening the turnover of intratracheally injected $\text{Ru}^{106}\text{O}_2$ particles in mice.

An alveolar cell carcinoma was observed in a mouse killed 422 days after intratracheal administration of two μc $\text{Ru}^{106}\text{O}_2$. Assuming uniform distribution in the lung and exponential retention with an effective half-life of 36 days the total dose to the lung during this period was 300 rads. Two other malignant tumors in $\text{Ru}^{106}\text{O}_2$ treated mice were reported earlier.

DECLASSIFIED

~~DECLASSIFIED~~

D-4

HW-56914

Gastrointestinal Radiation Injury

The last of a group of approximately 100 rats that had survived for long time periods following various intestinal radiation treatments were sacrificed for histological analysis. Grossly, these animals showed little difference from controls. There was some carcinogenesis that may take on greater significance after pathological examination.

Relative Biological Effectiveness

A preliminary test was made using Po^{210} plated on finely divided platinum as a radiation source. The absorbed dose could not be measured directly since the iron dosimeter responds to platinum as well as to radiation. Using a calculated value, an apparent RBE of 10 was obtained. This value is assumed to be near maximum since slight amounts of Po^{210} appeared to have moved from the platinum particles to the cells.

Both alkaline and acid phosphatases were identified in yeast. With doses of 240,000 r there was only a 10 per cent decrease in activity of acid phosphatase located on the cell surface. These data show that the phosphatases are radio-resistant and that phosphatase inactivation cannot account for phosphorus loss from irradiated cells.

Normal yeast cells contain twice as much catalase as do cytochrome deficient cells. The correlation of increased sensitivity in cytochrome deficient cells with lower catalase is consistent with the theory of H_2O_2 as an intermediate in producing radiation damage.

General

Blood volume determinations in Palouse swine of different weights were made with the assistance of Dr. Verner Johnson, a visiting professor from the State College of Washington. A double-tagging technique was used in which the red cells were tagged with Cr^{51} and the plasma volume determinations made with radioiodinated serum albumin. The blood samples collected are being processed and analyzed at this time.

More than 450 sea gulls which were reared on islands within the Hanford reservation were banded to study their dispersion.

HA Kornberg
Manager
BIOLOGY OPERATION

HA Kornberg:es

~~DECLASSIFIED~~

C. ON-SITE VISITS AND HLO VISITORS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company or Organization Represented & Address</u>	<u>Reason for Visit</u>	<u>H.W. Personnel Contacted</u>	<u>Access to Rest'd. Data</u>	<u>Areas, Buildings Visited</u>
<u>VISITS TO HANFORD WORKS</u>						
Wafford Conrad	7/10/58	Spokane Chronicle, Spokane, Wash.	Press tour.	WJ Clarke, RF Foster	No	100-F, 141M, 146-FR
20 Summer Institute Personnel	7/14/58	Various Universities	Tour	DE Warner, WJ Clarke, RF Foster	No	100-F, 108-F, 141M, 146FR
Schefelman, King, Balmer, Bullitt	7/16/58	Univ. of Washington Board of Regents	Tour	HA Kornberg and staff	No	100-F, 108-F, 141M, 146FR
5 Univ. of Wash. Professors	7/17/58	Univ. of Washington Seattle, Wash.	Tour	RC Thompson, WJ Clarke, JJ Davis	No	100-F, 108-F, 141M, 146FR
Dean Roger Ray and Prof. Orlin Biddulph	7/23/58	WSC, Pullman, Wash.	Tour	HA Kornberg and staff	No	" "
Dr. Erhling Ordal	7/18/58	U. of Wash., Seattle	Tour, discuss microbiology	HA Kornberg, RT O'Brien	No	100-F, 108F, 141-M, 146-FR
About 80 Tri-City Business Leaders	7/24/58	Various businesses	Tour	RF Foster, JJ Davis, VG Horstman	No	100-F, 146FR, 141M
W. Singlevich	7/24	AEC, Wash. D.C.	Discuss current investigations	HA Kornberg	No	100-F, 106-F
Dr. Brownell	7/24	Dept. of Radiol. Engr. U. of Mich., Ann Arbor	Tour and discuss food irradiation	DE Warner	No	100-F, 108-F, 141M, 146FR
Dr. J. W. Porter	7/29	U. of Wis., Madison	Discuss current investigations	HA Kornberg, RC Thompson, LA George, RF Foster	No	" "
12 Summer Institute employees	7/30	Various Universities	Tour Biology			
<u>VISITS TO OTHER INSTALLATIONS</u>						
RC Pendleton	June 16-19	Radiobiol. Lab, U. of Utah, Salt Lake, & Logan	Confer on Csl37 in Drs. Stover and Mays paper at Ecol.Soc.		No	
FP Hungate	7/16	Mortana State Univ., Flathead Lake, Mont.	Lecture summer institute at Biological Station.	Harvey	No	
RC Thompson	7/21-23	" " "	" " "	"	No	
DE Warner	7/22-23	" " "	" " "	"	No	
RF Foster and JJ Davis	7/27-30	" " "	" " "	"	No	
RF Palmer	7/14-22	Meriden, N.H., Lemont, Illinois	Attend Gordon Research Conf. and discuss research	WP Norris	No	
WJ Bair and FP Hungate	7/29-8/1	Oregon State Coll. Corvallis, Oregon	Lecture summer institute.	EC Bubl	No	

HW-56914

~~DECLASSIFIED~~

D-6

HW-56914

D. Lectures

a. Papers presented at meetings

Pendleton, R. C., "Absorption of Cesium¹³⁷ by Components of an Aquatic Community", June 17, 1958, Ecological Society of America, AAAS, Logan, Utah.

b. Off-Site seminars

Hungate, F. P., "Biological Effects of Radiation," Summer Institute, Montana State University, Yellow Bay (Flathead Lake), Montana, July 14, 1958.

Thompson, R. C., "Effects of Radioactive Fallout," Summer Institute, Montana State University, Yellow Bay (Flathead Lake), Montana, July 21, 1958.

Warner, D. E., "Autoradiography in Biological Research," Summer Institute, Montana State University, Yellow Bay (Flathead Lake), Montana, July 22, 1958.

Davis, J. J., "Radioecology," Summer Institute, Montana State University, Yellow Bay (Flathead Lake), Montana, July 28, 1958.

Foster, R. F., "Aquatic Radiation Biology," Summer Institute, Montana State University, Yellow Bay (Flathead Lake), Montana, July 29, 1958.

Bair, W. J., "Manner of Interaction of Radiant Energy with Living Matter," and "Radiobiological Research at Hanford," Oregon State College Summer Institute, Corvallis, Oregon, July 30, 31, 1958.

Hungate, F. P., "Genetic Effects of Radiation," and "Uses of Radiation in Biology and Agriculture," Oregon State College Summer Institute, Corvallis, Oregon, July 30-31, 1958.

E. Publications

a. HW Documents

Palmer, R. F., "Accumulation of radionuclides in rats chronically exposed to reactor effluent water," HW-53362 (CONFIDENTIAL) May 13, 1958.

Ballou, J. E. and R. C. Thompson, "Buildup of Cs¹³⁷ in rats during chronic feeding," Document HW-56040 (UNCLASSIFIED) May 13, 1958.

b. Open Literature

Smith, V. H., "Removal of Internally Deposited Plutonium," Nature 181, 1792 (1958).

OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

July, 1958

ORGANIZATION AND PERSONNEL

There were no changes in personnel during July.

OPERATIONS RESEARCH ACTIVITIES

Economic Studies

Work on the program description suitable for the evaluation of capital expenditures was continued. In connection with this evaluation a report is being prepared on uranium pricing in which the various methods are related to the fundamentals of a business system.

Work in connection with the HAPO input-output response simulation model was continued.

CPD Control Study

The interim report on the CPD control study pointed out the difficulty in extracting pertinent control and accountability information from the available data and discussed the need for improved data processing. During the month a proposal that a special team be formed to study the information system in Z plant was accepted by the Manager, Finished Products Operation, Chemical Processing Department. Three meetings of this team have been held to date and a detailed program is being formulated.

Other work in connection with this study has consisted primarily of following up specific instances of the more general conclusions contained in the interim report. In particular, several instances of the utilization of process control data to improve the precision of accountability information are being studied, and a report on the optimum estimation of ending inventories was issued. (HW-56536, "B-PID and Inventory Estimates with Minimum Variance," 7/28/58.) Studies are also being made of pertinent analytical laboratory data to determine whether or not monthly corrections for laboratory biases should be made for accountability purposes.

Other

Personnel of the Standards Engineering Operation of Irradiation Processing Department recently requested that Operations Research review the spare part inventory control problem, the purpose being to set forth general philosophy concerned with inventory control and to develop practical models which will assist and guide responsible personnel in setting levels and minimizing spare part costs. This study was completed during the month and a report issued. To facilitate understanding and use of the recommended procedures, discussions were held with personnel of the Standards Engineering Operation and also Stores Operation. It is believed that the recommended formal approach will be very useful in guiding spare part inventory control decisions.

DECLASSIFIED

DECLASSIFIED

E-2

HW-56914

Some preliminary scoping work has been done in determining whether the methods of Operations Research have any value in evaluating the effectiveness of communication campaigns or other programs of an employee relations nature.

Consultations were held with personnel of the Manufacturing Operation, Fuels Preparation Department, with respect to the possibility of simulating certain operations in the canning process. Further consultation will be provided as required.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Metallurgy

A regression analysis of aluminum alloy corrosion data was completed which investigated the relative corrosion rates of several aluminum alloys as a function of corrosion temperature.

Further discussions were held with Physical Metallurgy Operation concerning the use of extreme value statistical theory to analyze maximum penetration data from uranium - aluminum silicon eutectic alloy diffusion experiments. Some usable data have been collected and statistical analysis initiated.

6000 Program - Biology and Medicine

A statistical analysis of the data from an experiment to determine the effects on growth of the chronic feeding of P-32 to rainbow trout was completed.

Work continued on the design of an optimum sampling scheme for the detection of malignant tumors in the lungs of mice which have been maintained on an administration of carcinogenic agent.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

Process Control (Fuels Preparation Department)

A suggested method for process improvement, as opposed to process control, was proposed. (Letter to T. D. Naylor, "Proposal for Adoption of Evolutionary Method of Process Improvement," 7/14/58.) The method consists of continuous experimentation about the region of current process operation in order to gradually approach an optimum set of operating conditions.

Consideration was given to an evaluation of the use of various automatic charting devices in an automatic quality control system.

Process Experimentation (Fuels Preparation Department)

Efforts to reduce the void and braze layer integrity reject rates resulted in experimentation designed to determine the effects of a deeper immersion of the fuel element in the lead bath. Resulting data were analyzed as requested. Similar efforts to reduce the extent of braze layer porosity led to experimentation in which the effects of quench rate were evaluated.

Other (Fuels Preparation Department)

Data were submitted by Fuels Preparation Department Analytical Laboratory personnel in connection with the evaluation of a new method of determining zirconium density. Of primary interest was an evaluation of the measurement errors involved. Significant differences between analysts were detected.

A partial "rupture prone" lot consisting of material not yet charged from a lot which had already sustained five ruptures was made available to FPD personnel in order to determine in what ways this lot is unique. Assistance is being given in designing the experimentation to be performed.

Major injury award plans and major injury frequency rates for various size groups, and the probability of going a certain number of days without an injury, were discussed.

Production Tests (Irradiation Processing Department and Fuels Preparation Dept.)

A report was issued in connection with an evaluation of dimensional data from IP-70-A concerned with I and E fuel elements in the K reactors. Very good agreement was found between these fuel elements and solid fuel elements as far as type (if not degree) of dimensional distortion as a function of position within the tube is concerned. (HW-56806-RD, "Analysis of Dimensional Data from IP-70-A: I and E Fuel Elements in the K Reactors," 7/16/58.) Data from IP-95-A, I and E fuel elements at D reactor, are currently being analyzed. These data are of special interest in that they permit a comparison of M-388 and 1245 aluminum components. Also, exposure levels associated with the tubes are quite high.

Rupture Analyses (Irradiation Processing Department)

Preliminary hot spot data from an attempt to collect more objective data through visual examinations by selected personnel only have been submitted. A general lack of fuel element position information plus the paucity of data have not permitted any conclusions to be drawn as yet.

The results of a post irradiation bond testing examination of fuel elements canned with M-388 and 1245 components were analyzed to determine the significance of observed differences in frequencies of poor bonds.

Other (Irradiation Processing Department)

Further work was done in connection with estimating frequencies of excessive bulk outlet water temperatures caused by different phenomena. The most recent evaluation consisted in viewing risks for the reactors as a whole as opposed to basing decisions for operation on a single reactor.

Reactor MWD production was forecast through 1968 as requested. Two approaches were used. In one approach, a logistic curve was fitted to past production data, adjusted to pertain to annual production for an "old" reactor. This curve was then extrapolated, and limits of uncertainty were calculated (which, of course, could not reflect uncertainty in the model chosen). The other approach consisted of collecting expert opinions as to what efficiencies, flows, and temperatures might be realized for each reactor-year under consideration, together with "uncertainty" limits on these opinions. These were then used to calculate production. Results from these two approaches were quite comparable, particularly so through 1963.

DECLASSIFIED

DECLASSIFIED

E-4

HW-56914

Test procedures to evaluate the effectiveness of various tests designed to select reactor operators were discussed.

Final Product Specifications (Chemical Processing Department)

Tolerance statements necessary to demonstrate conformity to specifications of final product parts shipped during the second quarter of CY 1958 were computed.

Parts are now accepted for shipping based on assay results associated with an individual part. A rough draft document was issued setting forth such acceptance limits based on the most recent estimates of the variances involved. It is anticipated that a recommendation will be made during August to replace the existing tolerance statement specification used by the customer by those limits used for shipping purposes, i.e., to accept or reject each individual part rather than a quarter's production.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

Activities for other Departments

Assistance was provided in evaluating a survey to determine the effectiveness of last fall's Asiatic Flu Shot Program.

Consulting services were provided in connection with (1) sampling and sampling philosophy with respect to Construction Engineering Operation measurements and (2) ways and means of analyzing a mass of psychological test data collected in the "Understanding People" course.

Activities within HLO

Work continued on the development of a mathematical model to describe the behavior of a reactor effluent and its passage through an exchange column for the Chemical Effluents Technology Operation.

Discussions were held with personnel of Nuclear Physics Research Operation concerning a proposed statistical methodology series of lectures to interested HAPO physicists. Tentative arrangements have been made to offer a series of six to eight two-hour lectures devoted to basic concepts, tests of significance and confidence interval estimation, linear regression analysis, and the treatment of Poisson distributed data within the framework of the above.

OFFSITE VISITS AND VISITORS

R. C. Burke spent 7/7/58 in Seattle, Washington attending a computer seminar sponsored by the IBM Corporation.

R. Y. Dean spent the week of 7/13 to 7/18 as a guest lecturer at the National Science Foundation Science Institute at the University of Alaska, College, Alaska.

Carl A. Bennett
Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:ewk

PROGRAMMING OPERATION
JULY 1958

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. Waste Treatment

In the study of storage containers for calcined, high-level wastes the great importance of thermal conductivity of the solids which can be stored in a single container has been recognized. Reliable data on this property of these solids are required before further study can provide meaningful results.

2. Non-Production Fuels Reprocessing

The study stage estimate of the installation for head end processing and Redox feed preparation from power reactor fuels with both stainless steel and zirconium jacketing indicates a total project cost of \$3,020,000. This includes equipment in three cells for the Darex process and two cells for the Zirflex process. The latter also requires an existing centrifuge cell. The cost breakdown shows \$1,000,000 of the total for the Zirflex process for separate zirconium jacket removal and core dissolution, and \$2,020,000 for the Darex process for combined stainless steel jacket and core dissolution.

Results of calculations required for design of shipping costs for power reactor fuel elements were submitted to Chemical Processing Department customers.

3. Rare Gas Recovery

The study of the separation of isotopes of Xenon from fission gas was continued. A thermal diffusion process for recovery of a purified Xenon gas fraction containing less than one per cent of Xenon-131 would require about 20 columns, one foot in diameter and 100 feet tall. These would operate at wall temperatures, about 30 C and 880 C.

A review of the literature for figures on the relative volatility of the isotopes show differences which are less than the errors achievable in vapor pressure measurements.

B. REACTOR DEVELOPMENT - 4000 PROGRAM

1. Plutonium Recycle Program

Plutonium and Uranium Requirements for PRTR

A five-year forecast by fiscal year was made of the plutonium and uranium requirements for the PRTR. Recycled plutonium from the initial charge of spike elements is expected to supply about one-third of the FY-1962 requirements. By FY-1963 the reactor should be almost self-sustaining, depending in part on the reprocessing and fabrication yields.

DECLASSIFIED

DECLASSIFIED

F-2

HW-56914

2. Utilization of High Exposure Plutonium

In addition to the irradiation and recycle of plutonium in plutonium-aluminum fuel elements, the PRTR planning calls for the recycle of plutonium extracted from the UO_2 elements. Although much information may be obtained from all stages of this process, the time scale for the program as a whole is determined by the objective of demonstrating self-sustaining, steady state recycle operation with natural uranium feed. Although a true steady state would require several decades to achieve, because of the long time scale associated with the build-up of the plutonium-242 isotope to equilibrium, all other components of the fuel cycle reach their steady state concentrations in a time of the order of five to seven years from start-up. An effective means of advancing the date of demonstration of self-sustaining operation would be the substitution of high exposure plutonium feed for low exposure plutonium during the first two or three years of reactor operation. This would, in effect, fill the entire inventory (reactor, separations, fuel fabrication) with plutonium of composition resembling that being produced in the uranium-fuel part of the reactor. The amount of high exposure plutonium required for significantly advancing the date of demonstration of self-sustaining operation is estimated at about 35 kilograms.

C. OTHER ACTIVITIES

A series of four one-half hour illustrated lectures were prepared and delivered to the Oak Ridge School of Reactor Technology. These lectures described the technological improvements that have been made in the Hanford reactors and their operation through research and development. Films describing K reactors construction, unusual reactor operational problems, and metallurgical research were shown in conjunction with the lectures.

With over half of the 1958 "Summer Institute on Nuclear Energy - Chemical Processing" program completed, 29 lectures have been attended and tours were conducted to 18 separate facilities. Four of the lectures were presented by Programming Operation personnel. All participants have chosen and were working on problem assignments. So far, about 75 General Electric personnel have given direct assistance in the conduct of this program of tours, lectures, and problem assignments.

A brief review of the literature on life shortening by radiation was made. Additional work on the specific data and interpretations leading to the estimates in the range of 7 to 15 days per roentgen is planned. The data from the pocket ionization chambers read by the pulse technique were briefly reviewed and recommendations for additional controls made to Radiation Protection Operation. Recommendations for an aerial survey program, stack monitors on the reactor areas, monitoring stations in inhabited areas and a start on a produce sampling program, were made to Radiation Protection Operation. A recalculation of the genetically significant radiation dose from diagnostic X-rays at Kadlec Hospital was performed based on the data available from the recent survey. These results were given to Dr. W. D. Norwood and a draft of the future paper on this subject was discussed with him. The problems involved in obtaining an irradiation of iridium seeds were investigated.

Comments were provided on draft copies of reports covering future well drilling, a high level waste disposal program, and a program on the reactor effluent. A review of a hazards report on the tank storage of high level wastes was made.

A letter was prepared recommending that some consideration be given to studying bacteria (particularly Columbaris) growth in the river and the influence, if any, of Hanford effluents on these bacteria.

W. H. Lean

for Manager, Programming Operation

WH Reas:mw

DECLASSIFIED

CONFIDENTIAL

VISITS TO HANFORD:

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	HAPO Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
J. J. Davenport	7/1/58	Washington AEC - Division of Reactor Development	Discuss fission product release experiments.	J.W. Healy	No	300 - 3746
W. Singley	7/22 - 23/58	Washington AEC	Discuss analytical problems.	J.W. Healy	Yes	300 - 328 & 325
F. W. Munnery	7/28 - 30/58	Harwell, England	Discuss plutonium recycle physics.	J.R. Triplett	No	300 - 328
D.F. Langevalter	7/17/58	CEI, Schenectady	Discuss application of computers to control of solvent extraction column operation.	E.T. Merrill	No	300 - 328

VISITS TO OTHER INSTALLATIONS:

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
J. R. Triplett	7/24 - 25/58	Argonne National Laboratory Chicago, Ill.	To attend US-UK Conference sponsored by the Div. of Reactor Dev. (on graphite temperature coefficients).	D.P. Rudolph	Yes
E. A. Eschbach	7/17 - 18/58	A.E. Research Lab. Schenectady, N.Y.	Consultation on iron and nickel base alloys.	D.W. Lillie	No

UNCLASSIFIED

HW-56914

4 - 4

RADIATION PROTECTION OPERATION
MONTHLY REPORT-JULY, 1958

A. ORGANIZATION AND PERSONNEL

Audra C. Cox transferred to HLO, Chemical Research & Development on July 21, 1958.

B. ACTIVITIES

Two cases of apparently minor plutonium deposition were confirmed. One case involved personnel exposure to contaminated instrument lines without respiratory protection. The second case was discovered through routine sampling. The large crystal monitor was used on two occasions to determine the amount of plutonium remaining at the site of minor injuries to two employees. In both cases, results indicated only 0.001 to 0.002 μc Pu remaining at the site of the injuries.

One case of localized overexposure resulted from clothing contamination of an IPD employee. The dose to the skin was approximately 1.0 rad including 0.040 r.

Exposure Report Cards for all General Electric, Government, and collateral contractor employees who have area clearance were distributed. Initial reaction and response from this extensive communications on individual exposure indicated generally good acceptance by the employees and very few errors.

The film badge processing frequency was extended from two to four weeks to all groups at HAP0 except those working in the 234-5 Building where the density to dose relationship is high enough to warrant biweekly processing.

A review of the capabilities of the personnel monitoring program was made in response to a query from the AEC concerning the criticality incident at Oak Ridge. The review indicated that the full application of existing technology in measuring high-level radiation doses to individuals is being made at Hanford. Limitations of the existing technology are realized and were pointed out. The upper detection limit of gamma monitoring film is about 500 r using special techniques. The upper detection limit of fast neutron film is about 1.5 rads when large amounts of gamma radiation are present.

The average weekly stacks' emission of I^{131} from separations facilities was essentially unchanged from last month and was below the weekly control limit of 10 curies. Expected minor amounts of I^{131} and nonvolatile beta emitters were detected on environmental vegetation as a result of bomb fallout.

Several days were spent in preliminary flights using the large plastic scintillator to obtain aerial background measurements within the project and to distances up to 60 miles from the project perimeter.

Analyses of produce samples from the Franklin Irrigation District indicated positive amounts of K^{40} , $\text{Zr}^{95}\text{-Nb}^{95}$, Zn^{65} , and Cr^{51} . The items analyzed included green beans, potatoes, carrots, apricots, tomatoes, corn, strawberries, and squash. This produce sampling program is being expanded to complement other environmental evaluation measurements.

DECLASSIFIED

Analyses for Sr and Co in the test wells surrounding the 113-SX tank were negative. This waste storage tank located in the Redox tank farm was suspected to have a possible leak.

The method of calculating the fraction of permissible concentrations in Columbia River and sanitary waters was revised to reduce inaccuracies injected through the use of arbitrary unaccounted-for fractions resulting from differences between isotopic additions and total beta content. Inherent errors in measuring the total beta content of water samples frequently resulted in overly conservative estimation of the fraction of MPC. Analysis of river water now include enough isotopic determinations to avoid injecting the error of unaccounted-for fractions and the arbitrary permissible limit for these fractions into assessment of the radiological evaluation of Columbia River water used as drinking water.

Summaries of analytical results for nonradioactive mineral constituents in Columbia River water were transmitted to CRAG offices. The phosphate ion in this location has increased 2-1/2 fold in the past three calendar years. This increase may be due to fertilization of additional farm lands and could conceivably increase P³² limits to the river in reactor effluent water.

A review of the isotopes found in reactor basins effluent factored with probable revisions of Handbook 52 provided a basis for re-establishment of bone and GI tract MPC's for the rare earths and yttrium group in drinking water. This review indicated no significant change was necessary. The previous calculation for this MPC was 3.6×10^{-4} $\mu\text{C/cc}$. The revised MPC is 4.2×10^{-4} $\mu\text{C/cc}$.

Two water samples were analyzed by request of the Commission from the Lewis and Cowlitz rivers near Kelso, Washington. These analyses were made in order to subdue apparently unfounded claims that the water may have been contaminated from bomb fallout. Results of the analyses indicated no abnormal conditions.

Radiographic testing of welds on the PRTR containment vessel was initiated by a lump-sum contractor. Maximum dose rate at the edge of the PRTR excavation was 7 mr/hr.

The Federal Action Phase II of Operation Alert 1958 was conducted nationally July 14-18. The contribution of the Technical Defense Organization involved consideration of fallout as a limiting factor for operation of our supplier's plants and transportation of those supplies from scattered locations to Richland.

The balance of the order for the new neutron monitoring badges was received. The badges were placed into service replacing the formerly used slow-neutron pencils and the single packet NTA film badge. Necessary modifications of equipment such as badge processes, adjustment of X-ray energy for identification of the packets, magnet modifications, etc. were completed.

The 1 kg PuF₄ calibration source was obtained and calibration of the source was initiated by comparison with the Ra-Be source obtained from the National Bureau of Standards. Calibration and use of the PuF₄ source will remove routine calibration work from the positive ion accelerator.

DECLASSIFIED

Preliminary measurements were made with the beta sensitive prototype pencils obtained from KAPL. It was determined that the sensitivity of the pulse reading device for these pencils was approximately the same as for the gamma pencils. Further evaluation is in progress. The pulse reading method was also used to provide assistance to the Biology Operation in measuring dose to animals with the use of the Landsverk ring-size ionization chamber.

The first processing of bioassay results on data processing equipment was completed and initial reports were satisfactory. A re-examination of current needs for the information indicated that minor revisions were necessary.

C. EMPLOYEE RELATIONS

Placement or firm plans for placement of 12 of the 23 exempt and nonexempt employees scheduled for ROF from Exposure Evaluation and Records Operation have been completed.

Notice was given to all Regional Monitoring employees that our best estimate of plans for the next six months indicated that three or four Regional Monitoring employees would be reduced from our force by the end of calendar year 1958. One Regional Monitoring employee was scheduled for transfer in August, 1958.

In 1958 the Manager, Radiation Protection, has held 17 meetings with small groups of RPO employees. The purpose of this program is to provide a mutual exchange of information without compromising intermediate supervision. The program is long range and provides for a meeting with a group of 8 - 10 employees every two weeks.

In the Regional Monitoring negotiations the Company withdrew its outstanding offer as a result of a counter offer received from the HAMTC. No further progress was made.

There was one medical treatment injury for a frequency of 0.39. No security violations occurred during the month.

Three suggestions were submitted by RPO personnel. Two suggestions were received for evaluation and one was completed. Two RPO employees received awards totaling \$25.00.

D. SIGNIFICANT REPORTS

HW-56623 - "Hanford Mid-Year Report to Columbia River Advisory Group" by H. V. Clukey and M. W. McConiga.

HW-56941 - "Monthly Report - July 1958, Radiation Monitoring Operation" by A. J. Stevens.

HW-55593 - "Radioactive Contamination in Liquid Wastes Discharged to Ground at Separations Facilities Through December, 1957" by R. M. Bernard.

HW-56213 - "Waste Disposal Monitoring Activities Summary, May, 1958" by R. M. Bernard.

HW-56539 - "Regional Monitoring Activities, June, 1958" by B. V. Andersen.

HW-56542 - "Waste Disposal Monitoring Activities Summary, June, 1958" by R. M. Bernard.

CONFIDENTIAL
DECLASSIFIED

REGIONAL MONITORING - RESULTS (June 23 - July 27, 1958)

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Monthly Average</u>	<u>Units*</u>	<u>Trend** Factor</u>
<u>Drinking Water</u>				
100-F Area	Isotopic	0.4	% MPC _{GI}	--
Separations Areas	Total Beta	1.9×10^{-7}	μc/cc	--
Pasco	Isotopic	0.2	% MPC _{GI}	--
Kennewick	Isotopic	0.06	% MPC _{GI}	-2
Richland	Total Beta	$<3.0 \times 10^{-8}$	μc/cc	--
<u>Columbia River Water</u>				
Above 100-B Area	Total Beta	$<3.0 \times 10^{-8}$	μc/cc	--
100-F Area	Isotopic	1.0	% MPC _{GI}	--
Hanford Ferry	Total Beta	1.4×10^{-5}	μc/cc	+2
Pasco	Isotopic	0.4	% MPC _{GI}	--
McNary Dam	Total Beta	3.7×10^{-7}	μc/cc	-2
Vancouver, Washington	Total Beta	2.8×10^{-7}	μc/cc	--
<u>Waste Water</u>				
Outlying Test Wells	Total Beta	6.1×10^{-7}	μc/cc	+3
Reactor Effluent Retention Basins to River	Total Beta	21,000	curies/day	--
<u>Atmosphere</u>				
Gross Dose Rate -				
Separations Areas	Beta-gamma	0.7	mrad/day	--
Residential Areas	Beta-gamma	0.7	mrad/day	--
I-131 Separations Areas	I-131	5.5×10^{-13}	μc/cc	-2
I-131 Separations Stacks	I-131	3.1	curies/week	--
Active Particles - Project	--	6.6	ptle/100 m ³	--
Active Particles - Environs	--	6.7	ptle/100 m ³	--
<u>Vegetation</u>				
Separations	I-131	4.8×10^{-6}	μc/gm	--
Residential	I-131	2.6×10^{-6}	μc/gm	+2
Eastern Washington and Oregon	I-131	2.0×10^{-6}	μc/gm	--
Fission Products less I-131 - Wash. and Ore.	Beta	7.3×10^{-5}	μc/gm	--

* The % MPC_{GI} is the percent of the maximum permissible limit for continuous occupational exposure to the gastrointestinal tract calculated from drinking water limits.

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

CONFIDENTIAL

EXPOSURE EVALUATION AND RECORDSExposure Incidents Above Permissible Limits

	<u>Whole Body</u>	<u>Localized</u>
July	0	1
1958 to Date	4	8

Gamma Pencils

	<u>Pencils Processed</u>	<u>Paired Readings 100-280 mr</u>	<u>Paired Readings Over 280 mr</u>	<u>Lost Readings</u>
July	37,528	39	6	3
1958 to Date	309,278	256	36	20

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 mrad(ow)</u>	<u>mr(s)</u>
July	14,551	543	23	7	43	2.20	8.53
1958 to Date	145,918	5,377	176	53	293	2.99	9.28

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>
July	2,512	22	0	0
1958 to Date	25,880	297	94	8

Fast Neutron Film Badges

	<u>Badges Processed</u>	<u>Readings Above 50 mrem</u>	<u>Lost Readings</u>
July	1,060	0	1
1958 to Date	8,029	11	7

Bioassay

	<u>July</u>	<u>1958 to Date</u>
Plutonium: Samples Assayed	1,030	8,751
Results above 2.2×10^{-8} $\mu\text{c}/\text{sample}$	33	282
Fission Product: Samples Assayed	1,095	9,108
Results above 3.1×10^{-5} $\mu\text{c FP}/\text{sample}$	1	21
Uranium: Samples Assayed	282	2,243
Confirmed Plutonium Deposition Cases	2	15*

*Bringing all-time HAPO Total to 227.

Uranium Analyses

<u>Sample Description</u>	<u>Following Exposure</u> <u>Units of 10^{-9} μc U/cc</u>			<u>Following Period of No Exposure</u> <u>Units of 10^{-9} μc U/cc</u>		
	<u>Maximum</u>	<u>Average</u>	<u>Number</u> <u>Samples</u>	<u>Maximum</u>	<u>Average</u>	<u>Number</u> <u>Samples</u>
Fuels Preparation	29	8.1	36	15	1.6	31
Hanford Laboratories	10	3.8	21	12	4.5	16
Chemical Processing	57	5.6	37	66	6.3	24
Chemical Processing*	57	7.5	41	11	2.0	32
Special Incidents	0	0	0	0	0	0
Random	3.1	1.0	44	0	0	0

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

Thyroid Checks

	<u>July</u>	<u>1958 to Date</u>
Checks Taken	0	25
Checks Indicating >0.01 μ c	0	0

Hand Checks

Checks Taken - Alpha	41,511	323,219
- Beta-Gamma	34,834	265,471

Skin Contamination

Plutonium	34	188
Uranium	5	50
Fission Product	47	406

CALIBRATIONS

<u>Portable Instruments</u>	<u>Number of Units Calibrated</u>	
	<u>July</u>	<u>1958 to Date</u>
CP Meter	949	6,727
Juno	351	2,274
GM	1,381	9,238
Other	242	1,558
Total	2,923	19,797

Personnel Meters

Badge Film	1,288	8,024
Pencils	0	27,587
Other	402	2,478
Total	1,690	38,089

Miscellaneous Special Services	248	5,448
Total Number of Calibrations	4,861	63,334

AR Keene
 Manager

RADIATION PROTECTION

AR Keene:kc

UNCLASSIFIED

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - JULY, 1958

GENERAL

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 2.84 per cent which is considerably below average experience.

The absenteeism rate was 2.06 per cent, which is substantially below the year to date experience.

There were no security violations charged to the Operation.

TECHNICAL SHOPS OPERATION

Total productive time for the month was 11,882 hours. The total shop work backlog is 18,970 hours of which 50% is required in the current month, with the remainder distributed over a three month period. Overtime worked during the month was 3.8% (688 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
Fuels Preparation Department	1568	13.2
Irradiation Processing Department	1480	12.4
Chemical Processing Department	732	6.2
Hanford Laboratories Operation	7902	66.5
Construction Engineering Operation	106	.9
Miscellaneous	94	.8

Customer demands for emergency service remained at a high level resulting in a higher than normal overtime ratio. The total backlog remained steady and is expected to increase slightly during the coming months.

Security performance was considered satisfactory with no violations. Safety performance was average with 9 medical treatment injuries and no major injuries.

RADIOGRAPHIC TESTING OPERATION

The work load for Radiographic Testing Operation leveled out at a substantially high level for July. Despite loss of productive hours because of vacations, the number of tests was maintained just 100 below last month's figure. A total of 3,747 tests were made, of which 984 were radiographic exposures (including X-ray and gamma ray), and 2,763 were supplementary tests. The supplementary test work included ultrasonic (thickness measurements and flaw detection), eddy current, dye penetrant, dimensional measurements (micrometric and lay-out), and borescope examinations. The other indices of activity remain at substantial levels, with a large increase in the feet of material examined. Over 10,000 feet (10,420) of material were examined as compared to 7,183 feet examined last month. The number of pieces examined remained about the same - 2,778 for this month compared to 2,670 for last month. Work was done for 15 different organizational components, representing all of the operating departments and service operations. A total of 19 reports were issued, detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on 10 different occasions

for advice and information regarding general testing theory and applications for other than the jobs tabulated in part II.

A change in shift was put into effect this month to meet accelerated work commitments. An alternating swing and graveyard schedule was instituted, allowing both field and laboratory work to be accomplished simultaneously, using two separate crews.

As the MTR fuel plate program neared completion an extra heavy work load was encountered. Maximum through-put of up to 100 plates per day was handled successfully to enable shipping dates to be met. A low finished fuel plate inventory required close coordination of the finished radiographs to achieve speedy fuel plate assembly.

The first major work on the PRTR project was done this month. Radiographic technique and interpretation of field welding on fabrication of the bottom of the containment vessel was worked out with the contractor and project personnel. Some repair was required, and a major problem in distortion of the bottom sections was encountered. Radiographic work had been slowed down at the end of the month while chipping and grouting of the bottom was being accomplished.

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 Department	84	73	15	S.S. pump shaft, S.S. (ammonia scrubbers) vessels.
B. Construction Engineering Operation	132	102 1/2	42	C.S., inconel, 3" sch 40 pipe, welders coupons; S.S. recirculating high pressure gas loop; weld seams on hot water heater; penetrometer standards testing.
C. Fuels Preparation Department	34	43	10	Girth seams on steam autoclaves, 313 Bldg., 300 Area.
D. Hanford Laboratories Operation	3078	9836	2248	.075" diameter zr tubes; Al thermal conductivity test elements; MTR cores, core locations, finished plates, shim and control rods; vac. cast Al in S.S. and Zr. tubes; KER ribless Zr. tubes; 3" O.D. NPR Zr. tubes; 347 S.S. flanges; welds, and ultrasonic survey of Zr. ingots.

<u>Component</u>	<u>No. of Tests</u>	<u>Ft. of Weld or Material</u>	<u>No. of Pieces</u>	<u>Description</u>
E. Irradiation Processing Department	85	39	84	S.S. welders coupons; spot check girth and long weld seams on high pressure He storage tanks, 105-H.
F. Relations & Utilities Operation	334	37	54	Testing of lineman's climbers, belts, rings, spikes, etc.; elect. distribution power pole dry rot survey and standardization.
Totals	<u>3,747</u>	<u>10,130-1/2</u>	<u>2,453</u>	

FACILITIES ENGINEERING OPERATIONProject Activity

The attached monthly project report covers the individual project activity. Also attached is a summary of HLO plant acquisition and equipment projects excluding the Plutonium Recycle Test Reactor and Pilot Plant.

Projects

Following is a summary of project activity:

Number of Authorized Projects at Month End	<u>23</u>
Projects Authorized During Month	<u>1 *</u>
Projects Completed During Month	<u>1 #</u>
Project Proposals Submitted to AEC During Month	<u>0</u>
Projects Awaiting AEC Approval	<u>0</u>
Project Proposals in Preparation	<u>6 **</u>
Total Authorized Project Funds	<u>\$ 4,839,300 +</u>
Total Estimated Cost of Authorized Projects	<u>\$ 9,468,800</u>

* CGH-805, High Temperature Tensile Testing Cell - 327 Building

IR-236, 321 Building Test Pit Enclosure

** Crane Improvements - 327 Building

Biology Facility Addition - 108-F Building

300 Area Waste Disposal Facilities Expansion

Dynamic Test Facilities - 314 Building

Sheetmetal Shop Adjacent to Technical Shops - 328 Building

Alterations to the Positive Ion Accelerator Facility

+ Incorrectly reported last month as \$6,482,300 rather than \$4,857,300.

Engineering ServicesTitleStatus

Modification of Elevator, 327 Building

AEC-HOO will negotiate contract with Security Fire Door Company.

Alterations to Room 313, 3106 Building

Center islands have been removed as has the excess piping. Partition to create Room 313-A is being put in. Work is approximately 40% complete.

Resistance Seam Welder, 325 Building

Work proceeding, approximately 90% complete. Vendor's representative will be on plant the week of August 4 for start-up.

Move Army Hutment and Install near 108-F Building

Job was completed and accepted on July 24. Total cost: \$8,266 or \$8.60 per square foot.

Electrical Service, Basement 325 Building

Roller-Smith breaker was received 7-9-58 and installed on 7-26-58.

Install Hot Water Heater - 327 Building

Installation is complete and in operation. Final lagging remains to be done.

Clean up West End of 314 Building

Construction Operation is working on removal. Job approximately 68% complete.

Service and Outlets - 141-H Building

Work complete. "As Built" drawing work remains.

Installation of New Hood, Lab 14-A, 329 Building

Design of special hood is complete. Fabrication has started.

Fabricate and Install XY Manipulator in Metallographic Cell

Work in progress.

Sprinkling System for Aquatic Biology Building - 100-F

Job is approximately 90% complete.

Extend Annunciator System - 1706-KE Building

Installation drawings have been approved. Installation to start after estimate is made.

Inspect and Make Recommendations for Safe Operability of Reworked Truck, HO 68-B 8195

Truck and equipment have been inspected. Data is being analyzed for safety study.

Heating & Air Conditioning - 141-M Building

Design and preliminary estimates will be ready August 4, 1958.

Provide Operating & Safety Improvements - 340 Building Tank Pit

Facility has been inspected and sketches are being prepared for recommended modifications.

Design and Drafting Services

<u>Title</u>	<u>Status</u>
Cesium Recovery	Based on the present scope of work, design of this job is approximately 80% complete.
Non-Production Fuel Elements	Mechanical shear design 100% complete. Scope design on Friction Saw 90% complete. Shear Feed scope is 10% complete.
Medium Level Chemistry Cell Liner	Comment prints issued - 90% complete.
ETR 6 x 9 Process Loop Project CA-681	Started redesign in-pile portion for ETR High Pressure Loop.
Vacuum Welding	Design continuing on equipment for welding fuel elements in vacuum via remote control.
Capsule for Gamma Measurement	Design was initiated on a capsule for measuring gamma in the 3 x 3 position of the Engineering Test Reactor.
19 Rod Cluster Fuel Element	Design was initiated on a hydraulic mechanism to assemble and disassemble the 19 rod cluster.
Furnace Hood	Design was initiated for a hood with services to contain vacuum annealing furnaces.
5-Ton Cask	Design was initiated for a 5-ton cask to be used in transportation of irradiated metal from 327 Building to burial ground.
Microhardness Tester Controls	Design 19 remote controls for hardness tester. Tester to be operated inside a cell in 327 Building.
Health Badge Examination Equipment	Design was initiated for a mechanism to assemble and disassemble the new plastic area badges.
Project CG-660, Remotize Metallograph	Design is progressing on a mechanical mechanism to operate the metallograph through a cell wall in 327 Building.

Approximately 142 drawings including sketches, work sheets, graphic illustrations, and formal drawings were completed by the Drafting Operation during the month.

Approximately 16,535 square feet of prints were reproduced during the month.

Maintenance and Building Engineering Services

326 and 328 Buildings - The Programming Operation was consolidated in 328 Building. This involved reassignment of personnel from 326 and 328 Buildings and 700 Area. Approximately 38 office moves were completed.

All HLO Buildings - Effort was initiated to standardize the productive maintenance program. This work will cover HLO buildings in the 100, 200, 300, 600, and 700 Areas. Expected completion is January 1959.

3730 Building - A survey of the air conditioning and dust collection system, and completion of minor adjustments have resulted in better comfort conditions. Minor improvements in the dust collection system should result in better dust control.

306 Building - Materials will be available for installation on the water treatment and filter system in this building during August and September. Work should be completed by the early part of October.

306, 325, 327, 328, 3702, 3707-C, and 3760 Buildings - The lump sum contractor is installing storm windows and shade screens on these building. Work will be completed the latter part of August.

3702 Building - The tile floor installation has been completed and the final inspection was made on July 18, 1958.

329 Building - As-built work on this building continued during the month. Also, improvements for maintenance access purposes above the first floor ceiling continued.

325 Building - The laboratory vacuum system pumps are being studied for elimination of oil loss. This may result in replacement of pumps.

3707-C Building - Work remains to be performed on the air conditioning system and interior space work.

Survey and inspection of code vessels is 95% complete.

Survey of liquid helium requirements for HAPO and HLO is 95% complete.

TECHNICAL INFORMATION OPERATION

There were two changes in the exempt staff during the month. B. J. Schmidt, Analyst, Classification-Declassification, resigned to take a position with Boeing Airplane Company as a technical writer. A non-exempt employee, Elizabeth R. Appleby, was promoted to the exempt position of Specialist, Reference II.

A systematic review of the distribution lists for certain publications distributed by Technical Information was started. These publications are distributed throughout the plant to inform HAPO scientists and engineers of new technical developments. Although the cost of distribution is nominal (the publications are received without direct charge, and the cost of addressographing is only \$.007 per impression), it is desirable to periodically review the distribution

list to assure that the publications are going only where they are needed. During July a letter to the Communication Specialists asked them to review the list of persons in their components who receive Nuclear Science Abstracts, and make any additions or deletions needed. We plan to update the distribution list for a different publication each month, using the same procedure.

A letter sent to all Level 2 Managers listed the official security codes approved by the AEC for use at Hanford. Since there are now only three officially approved codes, it seemed desirable to distribute this information by letter rather than by re-issuing HW-24193, Official Security Codes. Obsolete codes will be included in HW-32464, Glossary of Hanford Terminology, when that document is re-issued soon.

Topic 003.1 of the proposed Hanford Classification Guide (HW-55000), covering maps and photographs, was revised and approved by the Division of Classification. It is planned to revise the current Hanford Classification Guide to include the approved topic. This information will be distributed plant-wide in a separate memo.

Topics covering classification of separations plant waste volumes were recommended to HOO for inclusion in the present and proposed Guides. Upon receipt of HOO concurrence, the revisions will be made.

One Research and Development report issued during the month (HW-48800 Rev) was printed on both sides of the paper. This 250-page report had a tight deadline and provided a good test of the practicality of regularly printing Research and Development reports in this manner. As noted in last month's report, potential savings from routine backup printing are estimated to be \$8,500 a year. Experience to date indicates that these savings might be partially offset by the following disadvantages:

1. Additional time is required to prepare the duplimats.
2. In those instances where figures back up figures, Printing must prepare individual masters for each figure rather than using one master for four figures.
3. The sheets must be carefully checked at the time they're collated.
4. There will be a dissimilarity in appearance of the test reproduced at Printing and that done by Duplicating.

Because of the additional time required, the risk factors, and the difficulty of making revisions after reports are reproduced, it does not seem practical at this time to use backup printing for all Research and Development reports.

Work Volume Statistics

JuneJuly

Document Distribution and Files

Documents routed and discharged (copies)	20,360	16,358
Documents issued (copies)	10,197	10,720
Documents sent offsite (copies)	4,230	4,045
Document reserves filled (copies)	949	533
Documents picked up and delivered	22,458	22,594

UNCLASSIFIED

Document Accountability

	<u>June</u>	<u>July</u>
Holders of classified documents whose files were inventoried	406	561
Documents inventoried in Files (copies)	31,376	16,890
Documents destroyed or retired (copies)	7,305	4,307
Documents revised (copies)	2,201	1,190
Documents pulled and documents filed (copies)	9,894	5,938
Documents reclassified	492	632
Accountable copies of SECRET and DOCUMENTED CONFIDENTIAL documents on site	201,688	201,463

Reference and Publication

Books cataloged (new titles)	51	72
Books added to the collection (volumes)	141	297
Ready reference questions answered by professional staff	186	163
Literature searches by professional staff	119	103
Reports abstracted (titles)	186	195
Formal reports prepared (titles)	12	7
Offsite requests for HAPO reports (copies)	279	100
Reports released to CAP (titles)	39	20

Library Acquisitions and Circulation

Books ordered (volumes)	211	462
Periodicals ordered	196	88
Books circulated (volumes)	1,718	1,915
Periodicals circulated (issues)	3,702	4,812
Inter-library loans	72	87
Films borrowed or rented	20	23
Industrial film showings	36	69
Bound periodicals added to the collection	20	*

* To be included in August report.

Library collection:

	<u>Main Library</u>	<u>W-10 Library</u>	<u>108-F Library</u>	<u>Ind. Med.</u>	<u>Totals</u>
No. of books	23,884	8,037	1,342	1,891	35,154
No. of bound periodicals	11,116	1	1,383	92	12,592
	35,000	8,038	2,725	1,983	47,746

Classification and Declassification

	<u>June</u>	<u>July</u>
Documents, including drawings and photographs, reviewed for downgrading or declassification	114	130
Documents submitted to Declassification Branch, Oak Ridge	112	85
Documents and papers (intended for oral presentation or publication) reviewed for appropriate classification	32	11

LABORATORIES ADMINISTRATION

Timely revisions were issued to seven Organization and Policy Guides. Two new OPG's were issued: No. 02.4.1 and No. 02.4.2, Announcement and Authorizations.

Specific delegations of authority were issued as covered by OPG No. 02.3.1, Approved Authorizations.

A request for contract renewal was submitted to replace Contract No. CA-169 with M. J. Sinnott. Design, Development and Research Contract DDR-44, was entered into with Kux Machine Company for the development, fabrication, and testing of certain die blocks and die castings.

The following listing includes active contracts of Hanford Laboratories Operation, July 31, 1958:

<u>Contract Number</u>	<u>Contractor</u>	<u>Services Requested</u>	<u>Completion or Termination Date</u>
<u>Special Agreements</u>			
G-65	Phillips Petroleum Company	MTR Experimental Work	None
SA-34	Future Farmers of America	Care of Sheep	11-30-58
SA-38	Swedish Hospital	Obtaining clinical data on use and application of radioactive materials	12-31-58
SA-40	State College of Washington	Acquisition of swine	2-28-59
<u>Consultant Agreements</u>			
CA-162	Betz Laboratories, Inc.	Provide Engineering services for water treatment methods	
CA-167	George Watt	Consult on research, development and plant technical problems	8-31-58
CA-169	M. J. Sinnott	Consultant services - metallurgical problems	9-30-58
CA-178	R. E. Zirkle	Consulting service - Biological	2-28-59
CA-181	J. L. Powell	Consulting service - Physics	3-14-59
CA-182	P. E. Church	Consulting service - Atmospheric Physics	3-31-59
CA-183	F. I. Badgley	Consulting service - Atmospheric Physics	2-28-59
CA-189	M. E. Ensminger	Consulting service - Animal Husbandry	5-31-59
CA-195	George W. Watt	Consulting service - Research and Development	8-31-59
CA-197	R. Wells Moulton	Consulting service - Development & Engineering	9-30-58

<u>Contract Number</u>	<u>Contractor</u>	<u>Services Requested</u>	<u>Completion or Termination Date</u>
<u>Maintenance and Repair</u>			
MRO-12	RCA Service Co., Inc.	Service RCA Equipment	11-30-58
MRO-13	North American Philips	Servicing a Philips Electron Microscope	12-8-58
<u>Design, Development, and Research</u>			
DDR-4	University of California	Research work on aluminum alloy creep	4-30-59
DDR-5	Superior Tube Co.	Zircaloy tubes	
DDR-6	Allegheny Ludlum Steel Corp.	Zircaloy tubes	
DDR-11	Allegheny Ludlum Steel Corp.	Zircaloy 2 tubes	
DDR-29	Nuclear Metals, Inc.	Zircaloy Tubing	8-1-58
DDR-30	Sciaky Bros., Inc.	Zircaloy 2 Welding	
DDR-38	Battelle Memorial Institute	Properties of Zircaloy 2	
DDR-39	Solar Aircraft Co.	Bellows Assembly	9-15-58
DDR-44	Kux Machine Co.	Die Blocks and Die Casting	
<u>Supply</u>			
SO-7	Aluminum Co. of America	Aluminum tubing	

The following Assistance-to-Hanford authorizations were issued:

No. ATH-HLO-4-58 to Atomic Power Equipment Department, assigning \$8300 for Corrosion Testing of Aluminum Cladding.

No. ATH-HLO-1-58-E Amended to General Engineering Laboratory for the issuance of a report by Professor Myron Tribus. The original authorization of \$800 is unchanged.

The property-management close out was initiated on the following FY-1958 Assistance-to-Hanford authorizations:

No. ATH-HLO-1-58-A Consultation by Dr. Poritsky
No. ATH-HLO-1-58-C Bearing Analysis Study
No. ATH-HLO-1-58-D Fuel Element Failure Detection
No. ATH-HLO-2-58 Solvent Extraction Study

UNCLASSIFIED

H-11

HW-56914

Heavy Equipment Questionnaires required by Transportation and Maintenance Operation were distributed. Only a few completed forms remain outstanding to be returned.

Two new sedans were assigned to replace existing vehicles.

Manager
LABORATORY AUXILIARIES

JL Boyd:jcw

UNCLASSIFIED

UNCLASSIFIED

H-12

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				HANFORD LABORATORIES OPERATION		HW - 56914		
General Plant Projects - FY 1957 - AEC-23-57-N-2						MONTH July, 1958				
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	
			AMOUNT	DATE	DESIGN SCHED.	ACTUAL				DESIGN
CA-658	Shielded Personnel Monitoring Station - 747 Building	\$ 150,000	\$ 150,000	2-4-57	100	65	2-18-57	- - -	12-19-57*	
		USING COMPONENT			100	60	3-11-58	12-31-58	12-15-58	
							FEO ENGINEER			
							D. S. Jackson			
REMARKS: The contractor made only minor progress in the building addition during the month. Poorly laid-out piping in the equipment room is to be removed and reinstalled. Machining of the individual steel cell plates was completed. Shop assembly of the cell will commence early in August.										
* Actual date.										
CG-729	Ventilation System Improvements - 222-U Building	\$ 80,000	\$ 73,000	3-12-57	100	100	4-23-57	6-12-57*	5-28-57**	
		USING COMPONENT			100	100	9-15-57	9-15-58	8-15-58	
							FEO ENGINEER			
							A. W. Hervin			
REMARKS: The work is complete except for installation of thumb latches on 4 doors. Latches are expected on site by August 15, 1958 and will require approximately 1 hour of labor to install. "As Built" drawings have been completed. The contractor's claim for \$1,200. extra is being analyzed. This project will no longer be included in this report.										
* Scheduled date. ** Actual date.										
General Plant Projects - FY 1958 - AEC-2-23-58-L										
CG-760	Expansion of the 3745-B Facility	\$ 193,00	None to date	None	0	N.S.	1*	None	6*	
		USING COMPONENT			0	0	9*	None	16*	
							FEO ENGINEER			
							R. C. Ingersoll			
REMARKS: The project proposal was recalled by HLO and will no longer be included in this report.										
* Months after authorization.										

A M-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-13

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56914	
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION										MONTH July, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	DESIGN	CONST.	
			AMOUNT	DATE	SCHED.	ACTUAL	SCHED.						ACTUAL
CA-765	Additions to the 314 Building	\$ 46,000	\$ 46,000	100	47			10-14-57	- - -	3-7-58**			
		USING COMPONENT	11-15-57	100	47			*	11-15-58	11-15-58			
REMARKS:		<p>Reactor & Fuels R & D</p> <p>The contractor has completed concrete block work and has erected some partitions. Sash frames and sills have been installed. The steel joists arrived on site July 22, 1958 and have been installed. Construction work is on schedule.</p>											
* CPFF Construction Contractor started March 27, 1958. Fixed Price Contractor started May 14, 1958. ** Actual date.													
CA-778	Expansion of the 305-B Building	\$ 55,000	\$ 55,000	N.S.	15**			4-4-58	5-15-58	5-7-58*			
		USING COMPONENT	12-11-57	100	15**			6-7-58	10-15-58	10-1-58#			
REMARKS:		<p>Physics & Instruments R & D</p> <p>The footings have been poured and the foundation wall forms are being placed. The new doorway has been cut into the existing 305-B Building.</p> <p>The Lump Sum Contractor started work July 16, 1958.</p>											
** Includes work performed by GE Plant Forces relocating conduit in the 305-B Building and outside electrical work performed by CPFF Construction Contractor.													
*Actual date. # A-E scheduled date.													
CG-779	Additions to Separations Development Facilities - 321 Building	\$ 27,900	\$ 27,900	100	35			5-26-58	- - -	6-15-58			
		USING COMPONENT	5-22-58	70	45			6-19-58	1-31-59	12-1-58			
REMARKS:		<p>Chemical Research & Development</p> <p>The order for the rectifier was placed by the AEC with L. H. Butcher & Company on July 16, 1958. The supporting beams for the cover over "A" Cell are in place. The steel framework for the outside addition is approximately 70% complete.</p>											

HAM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				HW - 56914 MONTH July, 1958			
General Plant Projects - FY 1958 - AEC-2-23-58 L		HANFORD LABORATORIES OPERATION							
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DATE	DESIGN SCHED.	ACTUAL			
CAH 794	Geological and Hydrological Wells FY 1958	\$ 49,000	49,000	4-16-58	100	N.S.	4-7-58		5-15-58*
		USING COMPONENT	100	3.5			7-8-58	12-31-58	12-31-58
REMARKS:		D. S. Jackson							
		Chemical Research & Development							
<p>The contractor moved one drilling rig and associated equipment onto the project on July 8, 1958. He also unloaded one carload (1,500 feet) of 8 inch, schedule 30 steel pipe. He experienced difficulty getting to the well sites since they are well away from any roads or trails. It was finally necessary to pull the drilling rig about 0.8 of a mile with a bulldozer which was being used for blading access trails and firebreaks. Drilling was started on Well 699-2-33 (#3) on July 16, 1958. On July 23 while trying to drive past a boulder, at a depth of 140 feet, one of the circumferential casing welds failed. This will necessitate pulling the casing string back 70 feet and repairing it. The contractor moved his second drilling rig onto the project on July 29, 1958. It is now located over Well 699-24-46 (#1) ready to start drilling.</p>									
* Actual date.									
CGH-796	Facilities for Isotope Study on Animals	\$ 49,800	49,800	5-22-58	100	N.S.	5-22-58	7-27-58	7-25-58*
		USING COMPONENT	40				6-12-58	11-1-58	11-1-58
REMARKS:		J. T. Lloyd							
		Biology Operation							
<p>The concrete curtain walls and piers have been poured, backfill placed and compacted. Two hutments have been moved in and set on concrete wall. Reinforcing rods tying bottoms of opposite sides together are welded in place. Electrical conduit has been run in from pole. Water connection has been made. Pieces of nutment on hand are being assembled at center building section.</p>									
* Actual Date.									
CGH-803	Alterations - Building 231-Z	\$ 49,600	49,600	6-2-58	0	22	N.S.		
		USING COMPONENT	0	22			7-7-58	11-15-58	11-15-58
REMARKS:		J. T. Lloyd							
		Reactor & Fuels R & D							
<p>The large hood in Cell 4 was removed in one piece, after openings in cell and equipment room walls were provided. The equipment room wall opening is now being closed up and the cell wall is being temporarily closed. All work in Cell 4 will be completed before any work is started in the other cells.</p>									

UNCLASSIFIED

H-15

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 1958 MONTH July, 1958	
General Plant Projects - FY 1958 - AEC-2.23.58-L		EST. TOTAL PROJECT COST		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT		STARTING DATE		DIRECTIVE COMP. DATE		ESTIMATED COMP. DATE	
PROJECT NUMBER	TITLE			AMOUNT	DATE	DESIGN SCHED.	ACTUAL	CONST.	DESIGN	CONST.	DESIGN	CONST.	DESIGN
CGH-804	Ceramic Fuels Press Enclosure - 325 Building	\$ 41,000		\$ 41,000	6-2-58	87	N.S.	0	6-19-58*	10-2-58#	1-15-59	8-18-58#	1-2-59#
REMARKS:		USING COMPONENT Reactor & Fuels R & D Work Release Authorization No. 34, dated June 18, 1958 to CEO released design funds only. A revision to Work Release Authorization No. 34 will be issued upon completion of design.											
* Actual date. # Project Proposal dates.													
CGH-809	Electrical Modifications - 328 Building	\$ 40,000		\$ 40,000	6-30-58	0	0	0	7-30-58	10-30-58	3-1-59	9-30-58	3-1-59
REMARKS:		USING COMPONENT Laboratory Auxiliaries HLO issued Work Release Authorization No. 37 dated July 7, 1958 releasing \$3,300 for design, preparation of purchase specifications, and review of the vendor's drawings. Procurement and construction costing an estimated \$27,000 will be requested of Construction Operation upon completion of sufficient design. Design on the main switch gear started on July 30, 1958. No completion date, on this phase of design, has been estimated as yet.											
IR-236	321 Building Test Pit Enclosure	\$ 19,000		\$ 19,000	2-28-58	100	100	99	3-3-58	5-12-58	8-27-58	5-6-58*	7-18-58*
REMARKS:		USING COMPONENT Chemical Research & Development A. W. Hervin This project was completed on July 18, 1958 and will not again be carried in this report.											
*Actual dates.													

AM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

d-10

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT		HANFORD LABORATORIES OPERATION		HW - 50914		MONTH		July, 1958	
General Plant Project - FY 1958 AEC 2 23-58 L		TITLE		EST. TOTAL PROJECT COST		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE	
PROJECT NUMBER				AMOUNT	DATE	DESIGN SCHED.	ACTUAL	DESIGN	CONST.	DESIGN	CONST.
IR-240	Removal of Obsolete Melt Plant Equipment - 314 Building	\$ 19,000		\$ 19,000	6-24-58	N.S.	N.S.	None	None	11-11-58	11-11-58
		USING COMPONENT		Reactor & Fuels R & D				FEO ENGINEER		A. W. Hervin	
REMARKS: Control panel has been removed. Preliminary work on vacuum furnace removal will be complete by August 1, 1958, actual removal will start the first part of August											
	Modification of the 15-Ton Canyon Crane - 327 Building	\$ 49,500		None to date	0	0	0	1*	None	3*	
		USING COMPONENT		None		0	0	5*	None	7*	
								FEO ENGINEER			
REMARKS: The project proposal is being held up pending the sponsor's decision to proceed.											
* Months after authorization											
		USING COMPONENT						FEO ENGINEER			
REMARKS:											

H-17

UNCLASSIFIED

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects Program Class 2900		MONTHLY PROJECT REPORT HANFORD LABORATORIES OPERATION						HW - 6914 MONTH July, 1958		
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE		
			AMOUNT	DATE	DESIGN SCHED.	ACTUAL		DESIGN	CONST.	
CG-661	Additional Heat Generating Facility 189-D Building	\$ 550,000	\$ 664,000	9-18-57	94	0	12-6-56	10-1-58*	10-1-58	
		USING COMPONENT	9-18-57	94	0	1-15-59	8-31-59	8-31-59	8-31-59	
REMARKS:		Reactor & Fuels R & D A. W. Hervin								
Design is lagging due to lack of vendor information. Efforts are being made to speed up receipt of this information. Comment Electrical Drawings on Bus Modifications, Details and Elevations, Conduit Grounding Plan, and one Line Diagram were issued 7-23-58. Comment copies of the Fixed Price Contract Specification were issued July 25, 1958. The two steam condensers were shipped July 25, 1958.										
* Scheduled date.										
CA-681	Hanford Equipment in the ETR	\$1,200,000	\$1,200,000	8-12-57	100	N.S.	9-17-56	12-15-58	10-1-58	
		USING COMPONENT	8-12-57	97	81	4-7-58	1-30-59	1-30-59	1-30-59	
REMARKS:		Reactor & Fuels R & D H. Radow								
Acceptance testing of the 3 x 3 Loop is continuing, with some delays caused by a few minor changes and corrections. The facility tube has been received and will be inserted at the next reactor shutdown. Official notification of the full time use of the 6 x 9 position has been received. Scope and detail design of the 6 x 9 facility has begun. Full scale design has been scheduled for early August.										
*Every effort is being made for completion by January 30, 1959. However, delays caused by the hold-up of the 9 x 9 position, resumption of design on the 6 x 9 position and procurement of 6 x 9 equipment, now make this a difficult date to attain.										
CG-682	High Level Cut-Off and Examination Cell - 327 Building	\$ 400,000	\$ 430,000	8-20-57	100	92	7-18-56	10-1-58	6-26-57*	
		USING COMPONENT	8-20-57	100	75	3-27-58	10-1-58	10-1-58	10-1-58	
REMARKS:		Reactor & Fuels R & D A. W. Hervin								
The concrete for cell foundations and shielding has been placed. The construction schedule for CFFF work now indicates completion by September 1, 1958. Overtime may be necessary during the last two or three weeks to meet this schedule. Delays are attributed to sporadic high radiation in the vicinity of the work on cell foundations. Temporary shielding has been provided to more prolonged construction work. Lead glass for the cell has been received. The can sealer and 13 service plugs are scheduled for shipment from vendors plant August 4, 1958.										
* Actual date.										

AM-7300-010 (5-58)

UNCLASSIFIED

UNCLASSIFIED

d 18

BUDGET CLASSIFICATION Equipment Not Included in Construction Project - Program Class - 2900		MONTHLY PROJECT REPORT HANFORD LABORATORIES OPERATION						HW - 10944 MONTH July, 1958		
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DATE	DESIGN SCHED.	ACTUAL	CONST. SCHED.			
CA-695	Radio Telemetering Network	\$ 105,500	\$ 89,000	1-10-57	100	N S.	25	2-22-57	4-15-57*	5-27-57**
		USING COMPONENT						7-25-57	5-15-58	1-1-59
REMARKS:		Physics & Instruments R & D								
		Fabrication of the repeater station by Motorola is continuing. Components are being received and stored for them. Instrument Laboratories have requested \$1,800 for additional work requested by General Electric Company, as a result of prototype testing conducted by HLO. A letter has been written to AEC citing additional funds necessary for completion of the project. It is now being routed for approvals and signature.								
		*Scheduled date ** Actual date								
CG-785	In Reactor Studies Equipment - 105 KW Building	\$ 240,000	\$ 15,000*	2-12-58	100	0	0	3-10-58	None	8-30-58
		USING COMPONENT						None	None	None
REMARKS:		Reactor & Fuels R & D								
		Following a detailed review of the rough draft project proposal, Financial Operation decided the cost of capsule development cannot be included in this project. Since this is a very substantial part of the total project cost, a meeting will be held within HLO to determine action to be taken.								
		* For preliminary design and necessary services to submit a revised project proposal for detail design, procurement and construction funds.								
CGH 801	X-Ray Diffraction Cell - 327 Building	\$ 120,000	\$ 10,000	6-2-58	5	0	0	6-10-58	None	12-24-58
		USING COMPONENT						None	None	7-30-59
REMARKS:		Reactor & Fuels R & D								
		Design on this facility has been started. Design on the 7½ ton crane with 7½ and 2 ton hooks, is progressing. The structural components of the bay that require strengthening, for the cell and crane, are being investigated.								

AM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-19

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects - Program Class 2900

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56914	
Construction Projects .. Program Class 2900		HANFORD LABORATORIES OPERATION										MONTH July, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT			STARTING DATE	DIRECTIVE		ESTIMATED		
			AMOUNT	DATE	DESIGN SCHED.	CONSTR. SCHED.	ACTUAL		DESIGN	CONSTR.	COMP. DATE	DESIGN	CONSTR.
CGH--805	High Temperature Tensile Testing Cell	\$ 140,000	None to date		0	0	0	None	None	None	None	None	
			None		0	0	0						None
		USING COMPONENT											
		Reactor & Fuels R & D										FEO ENGINEER	
												R. W. Dascenzo	
REMARKS:													

REMARKS: The project proposal, requesting \$10,000 partial design money for this project, was approved by the AEC Board of Review on July 24, 1958. To date the Directive has not been received by HLO.

Equipment Not Included in Construction Projects - Program Class 4900

CG-758	Ceramic Fuels Development Press and Furnace Additions	\$ 172,000	\$ 172,000	100	N.S.*	40	100	8-22-57	2-1-58	2-28-58	1-20-58	10-1-58	10-1-58
		USING COMPONENT											
		Reactor & Fuels R & D											
		R. C. Ingersoll											

REMARKS: AEC Directive No. HW-439, Modification No. 1, dated July 16, 1958, was received. It authorized a change of scope to install the press in the 325 Building and a reduction of \$28,000 in authorized project funds (originally \$200,000). HLO issued Work Release Authorization No. 22, Revision 1, dated July 21, 1958 to CEO, authorizing project management and expenditure of \$172,000. A vendor's representative will be on site the week of August 11, 1958, for start-up of the sintering furnace.

* An overall construction schedule has not been established because the second phase construction (press installation) has not been scheduled.

New Construction - FY 1958		\$ 1,800,000	\$ 175,000	N.S.	0	0	100	5-22-58	2-1-59	2-1-59	2-15-59	10-31-59	10-31-59
CG-731	Critical Mass Laboratory	USING COMPONENT											
		Physics & Instruments R & D											
		D. S. Jackson											

REMARKS: Revision 2 to the project proposal was transmitted to the AEC. This requested approval to change the project scope, from the hemispherical concept described in Revision 1, to one employing conventional reinforced concrete construction. The proposed change was approved July 31, 1958. To date the Directive has not been received. Design is currently about 4% complete.

UNCLASSIFIED
BUDGET CLASSIFICATION

BUDGET CLASSIFICATION
New Construction FY 1958

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

NW - 56914
MONTH July, 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DATE	DESIGN SCHED.	SCHED.	ACTUAL			
CA 744	Metallurgical Development Facility	\$2,600,000	\$	60,000	5	0	0	6-30-58		9-1-59
		USING COMPONENT	4,285.58	5	0	0	N.S.	None	9-1-60	
			FED ENGINEER							
			Reactor & Fuels R & D			J. T. Lloyd				

REMARKS:

REMARKS: The project proposal requesting total project funds is being routed for approvals. Completion of Design and Construction within established schedules is contingent upon AEC approval by October 1, 1958. Economies have been effected, by changes in scope, to provide a contingency fund considered adequate.

CA 749	High Level Radiochemistry Facility	\$1,070,000	\$1,070,000	40	0	6-15-58	10-30-58
		\$1,070,000	4,215,58	55	0	9-1-58	6-30-59
		USING COMPONENT					
		PEO ENGINEER					
	Chemical Research & Development	R. W. Paszenzo					

REMARKS:

REMARKS: Detailed design has been started by the contractor, B. D. Bohna & Company, Inc. Construction is slated to start the first week of August, 1958. Design is considered to be 55% complete, with 30 of 43 drawings started. One drawing, two specifications, 2 purchase requisitions, and one Acceptance Test Procedure have been issued for comment. Two representatives from the General Electric Company and one from the AEC HOO visited the contractor's office, on July 10 and 11, 1958, to clarify and interpret the preliminary design. A Bohna Company representative visited the site, on July 24, 1958, for investigation and discussion of the heating and ventilating design.

CGH-790	High Level Radioactive Receiving and Storage Addition 327 Building	\$ 325,000	15	0	6-23-58	12-1-58
		\$ 325,000	15	0	2-1-59	2-1-60
		PEO ENGINEER				
		A. W. Hervin				
		Reactor & Fuels R & D				

REMARKS:

REMARKS: Detail design is progressing on schedule. Specifications for the crane have been issued and a requisition for procurement will be initiated sometime in August, 1958.

UNCLASSIFIED

H-21

HW-56914

VISITS TO HANFORD WORKS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company or Organization Represented & Address</u>	<u>Reason for Visit</u>	<u>H.W. Personnel Contacted</u>	<u>Access to Restricted Data</u>	<u>Areas & Buildings Visited</u>
Technical graduates, high school teachers & "summer juniors".	7-9-58		Learn more about technical information services.	C.G. Stevenson	No	300 - 3760
D. F. Langenwalter	7-17 & 7-18-58	General Engineering Laboratory, Schenectady, N.Y.	Discuss information retrieval systems.	C.G. Stevenson S.P. Gydesen	No	300 - 3760 & 326
David L. Hake	7-9 & 7-10-58	AEC's Technical Information Service	Discuss GE policy on acceptance of honorariums for published works.	C.G. Stevenson S.P. Gydesen H.M. Parker	No	300 - 3760
K. E. Kolb	7-24-58	B.D. Bohna & Co., Inc. San Francisco, Calif.	Inspection and Consultation	O.W. Priebe R.W. Dascenzo	No	300 - 325 & 328

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>
R. W. Dascenzo	7-10 & 7-11-58	B.D. Bohna & Co., Inc. San Francisco, Calif.	Review design of Project CA-749	E. A. Arndt J. J. Brezina D. D. Bohna	No

UNCLASSIFIED

EMPLOYEE RELATIONS OPERATION MONTHLY REPORTGENERAL

At month's end, the staff of the Hanford Laboratories Operation totalled 1237, including 596 exempt and 641 nonexempt employees. Of the total exempt employees, there were 529 with college degrees, including 505 technical degrees as follows: BS - 289, MS - 110, PhD - 106. There were 34 nonexempt employees with degrees.

A report of the discussions with Physics and Instrument Research and Development people was completed.

AEC-SPONSORED TRAINING PROGRAMS

Training for non-company personnel progressed according to schedule for the month. Informal feedback indicates satisfaction with the program on the parts of both the participants and the contributors.

TRAINING

Eleven employees completed "Principles and Methods of Supervision and Leadership", nine employees completed the "Secretarial-Clerical Training Course", and ten employees began "Understanding People". Two HLO people attended FPD's 4-session, 8-hour course "Statistical Quality Control".

EMPLOYMENT

Nine requisitions were received during the month: ten were filled, leaving eight open.

RADIATION RECORD CARD

The communications program on distribution of the first Radiation Exposure Record Card was approved and implemented. The package, consisting of Management Newsletter items, GE News stories, press releases and an explanatory pamphlet with cover letter signed by appropriate Level Two Managers.

DISPLAYS AND TOURS

Approximately 60 Tri-Cities business leaders visited HLO facilities on July 24 as part of the General Electric Community Relations Program.

Radiation Protection began preparation of a display which will be exhibited at the Benton-Franklin County Fair during August.

HEALTH, SAFETY AND SECURITY

Laboratories personnel worked a total of 194,702 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,339,927 man-hours have been completed with no disabling injuries. The medical treatment frequency for July was 1.18 as compared with 1.86 during June.

There were 7 security violations during the month, bringing the total for the calendar year to 32.

UNION RELATIONS

No further action by either the Company or the Council has been taken in conjunction with the Wonacott case since the meeting of July 1, 1958.

The IBEW's counteroffer to the Company's last proposal in the Regional Monitoring negotiations was completely unacceptable to the Company. The Company has therefore withdrawn its latest proposal dated March 26, 1958, and advised the Council that we would contact them to continue negotiations.

Three unit and one non-unit grievances were received during July. Two were concerning work claimed by the unit and were answered satisfactorily at Step I. One pertained to compensation for lunch period during call-out and the Step I answer was not accepted. The non-bargaining unit grievance pertained to working conditions and the Step I answer was satisfactory.

PROFESSIONAL PERSONNEL PLACEMENT

The Professional Personnel Placement Operation was transferred from R&JO to the Hanford Laboratories Operation effective July 1, 1958. This component is composed of what was previously known as the Technical Recruiting Operation and the Technical Graduate and Technician Training component of Personnel Development and Communications Operation.

During the month, five Ph.D. candidates visited Hanford for employment interviews. Four employment offers were extended and one offer accepted. In addition, four offers were extended to experienced BS/MS candidates, six offers were accepted and four were placed on the roll. Offer action to Program BS/MS candidates for the month included one offer extended, two acceptances, and four placed on the roll.

Plans are being made for the coming recruiting season, including the establishment of interview dates for campus recruitment and arrangements for auxiliary recruiters.

EMPLOYEE COMPENSATION

The Manager, Employee Compensation visited the Technical Military Planning Operation, Santa Barbara, and Atomic Power Equipment Department, San Jose, to conduct salary administration discussions and reconciliations during the month.

The Nonexempt Compensation study is proceeding on schedule. Several interim reports on progress of the specific study groups have been forwarded to appropriate managers.

BENEFITS AND SERVICES

On July 9, 1958, Mr. E. F. Gates of the Laboratory Auxiliaries Operation died.

At the July meeting of the Suggestion Board nine suggestions were approved for awards of \$160.00. To date, 58 suggestions have been approved for awards totaling \$1,570.00, making our average award \$27.06, and our ratio of awards to savings 11.2%

Hanford Laboratories' participation in the Employee Benefit Plans is as follows:

<u>Month</u>	<u>Insurance</u>	<u>Pension Plan</u>	<u>Savings & Stock Bonus</u>	<u>Savings Plan</u>
Jan.	99.6	98.4	60.6	7.5
Feb.	99.7	98.5	61.3	8.2
Mar.	99.7	98.6	61.9	8.7
Apr.	99.7	98.6	61.3	7.9
May	99.7	98.6	61.3	7.6
June	99.7	98.9	61.4	7.6
July	99.8	98.7	60.6	7.0

Manager
Employee Relations

TG Marshall:tr

VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Date of Visit</u>	<u>Company Visited</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
E.P. Galbraith	7/8 and 7/9	Engineering Services	Consultation with Services personnel and consult the Engineering Register	T.K. Koerner C.F. Savage M.W. Simms R. Kress	None
E.P. Galbraith	7/10, 7/11 and 7/12	Engineering Services (Schdy.)	Attend Ph.D. Coordinator's Meeting and consult with Services personnel	W.S. Hill J.K. Wolf J.W. Hall G.B. Crover R. Powers	None
H.A. Paulsen	7/3	Technical Military Planning Operation	Reconciliation and salary administration discussions	S.M. Herman	None
H.A. Paulsen	7/8	Atomic Power Equipment Department	Reconciliation and salary administration discussions	R.V. Fagan	None

UNCLASSIFIED

I-4

HW-56914-

UNCLASSIFIED

TABLE II. PROFESSIONAL PERSONNEL PLACEMENT

A - Technical Recruiting Activity - HAPO - Sept. 1 1957 to Date

Cases Considered	<u>Visits to Richland</u>			<u>Offers*</u>			<u>On the Roll</u>
	<u>Invited</u>	<u>Visited</u>	<u>To Visit</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	<u>% Accept</u>
Ph.D.	799	94	15	64	16	8	29%
Exp. BS/MS	392	17	0	24	15	1	65%
Program BS/MS	490	0	0	50	20	3	43%
Summer Program							
Juniors	70	0	0	10	9	0	90%
Graduates	109	0	0	10	9	0	90%
Professors	40	1	0	9	8	0	89%

*Offer totals include offers open on Sept. 1 1957

Ph.D. 16
Exp. BS/MS 0
Program BS/MS 1

B - Technical Recruiting Activity - HLO - Sept. 1, 1957 to Date

Cases Considered	<u>Visits to Richland</u>			<u>Offers*</u>			<u>On the Roll</u>
	<u>Invited</u>	<u>Visited</u>	<u>To Visit</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	<u>% Accept</u>
Ph.D.	799	94	15	58	14	7	27%
Exp. BS/MS	102	18	0	16	9	1	60%
Program BS/MS				19	19	0	100%
Summer Program							
Juniors	70	0	0	2	2	0	100%
Graduates	109	0	0	5	5	0	100%
Professors	40	1	0	2	1	0	50%

*Offer totals include 14 Ph.D. offers open on Sept. 1 1957

C - Technical Graduate and Technician Training Program
Month Ending July 31, 1958

	<u>TG Program</u>	<u>TT Program</u>
Number personnel on assignment (HAPO TG Program 50) (West. District E.P. 6)	56	12
Distribution of assignments by Depts.		
HLO	16	9
CEO	1	-
R&UO	0	-
FPD	7	-
IPD	27	3
CPD	5	-
Distribution of assignments by functions		
R&D or Engineering	41	12
Other	15	

TABLE III. NONEXEMPT EMPLOYMENT

<u>Nonexempt Employment Status</u>	<u>June</u>	<u>July</u>	<u>Nonexempt Transfer Requests</u>	<u>June</u>	<u>July</u>
Requisitions			Transfer Requests		
At end of month	11	8	Active cases at end of month	53	58
Cancelled	1	1	Cancelled	0	1
Received during month	9	9	New during month	5	5
Filled during month	5	10	Transfers effected	0	2*
Candidates Considered			Planned Transfers		
Total applications	46	14	Effective during month	1	2
Total transfer requests from other at HAPO	5	4			
Total interviewed	0	0			

* 1 not counted on last month's report

TABLE IV. UNION RELATIONSGrievances Processed - January 1, 1958 to date

Total processed 20 (includes 3 non-unit grievances)

Step I

Answered satisfactorily* 10

Step II

Pending Step II discussion 3
 Pending Step II answer 0
 Answered
 Satisfactorily** 7
 Applied for arbitration 1

* 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

As a result of the transfer of Specialist - Procedures to IPD, changes as follows were effected July 1, 1958:

Specialist-General & Consolidated Cost to Specialist - Procedures
Specialist-Technology Cost to Specialist - General & Consolidated Cost
Specialist-Cost Analyses to Specialist - Technology Cost
Specialist-General Books to Specialist - Cost Analyses
Business Graduate to Specialist - General Books

ActivitiesGeneral Accounting Operation

Three Agreement letters and four Approval letters were prepared for processing to the Commission. Two of the Agreement letters were concerned with special work for outside agencies. The majority of the Approval letters was concerned with memberships on various national committees.

An answer was prepared informing SS Accountability Operation of our reaction to Survey 15, Part III. At the request of Contract Accounting a special report on recruiting costs during FY 1958 was prepared.

At the request of Contract Accounting we undertook a review of Agreement letter No. 7 covering related services under the Prime Contract. Contract Accounting was asked to consider the possibility of incorporating in a revision to this Agreement, blanket coverage for memberships in national committees to the extent that this would be feasible.

The Level 2 components have estimated that a total of \$2,271,000 will be requested from the FY 1959 General Plant Projects budget item. The funds which will be made available from this budget item may be as little as \$1,040,000 or as much as \$2,000,000 depending on whether the amount included in the original FY 1959 budget (\$1,500,000) or the revised FY 1959 budget (\$2,000,000) is authorized, and on whether a reallocation of FY 1958 funds is made to provide for projects approved in FY 1958 but not committed at the fiscal year end (amounting to \$460,000). We do not anticipate receiving this information until October.

Since in the past years the mortality rate for these projects has been high, General Plant Project funds will not be allocated to Level 2 component, but will be used on a first come, first served basis. However, if at a later date, requests for authorization exceed the available funds, a study will be made to determine the necessity for an allocation.

The running analysis of estimating accuracy on completed appropriation requests since July 1, 1957 is shown below:

	<u>No. of AR's</u>	<u>Authorized Funds</u>	<u>Actual Cost</u>	<u>(Over) Under-Run</u>
<u>Over-Run</u>				
By more than 10% Supplement Required	25	115,000	157,000	(42,000)
By less than 10%	21	152,000	169,000	(7,000)
<u>Under-Run</u>				
By more than 10%	35	188,000	121,000	67,000
By less than 10%	23	145,000	141,000	4,000

Budget allocation of \$27,000 to Level 3 components for Attendance at Meetings of Professional and Trade Societies was established by the Manager, Hanford Laboratories Operation, and will be shown on July 1958 reports.

Relations and Utilities Operation transferred \$475 of "fee" money in connection with the transfer of the technical recruiting function to HLO effective July 1, 1958.

The Travel and Living Expense Report for July 1958 was prepared on a new format to permit reduced clerical and typing effort. Preparation of the report by standard typewriter eliminates former scheduling problems encountered when preparing the report by micro-elite typewriter. A new summary page format was designed to present travel and living expense information to HLO management.

Field work and the reconciliation in connection with the physical inventory of uninstalled cataloged equipment in the custody of Radiation Protection Operation is complete. A report of results will be issued in August 1958. 1,901 items were inventoried valued at \$741,741 compared to FY 1957 inventory of 1,880 items valued at \$720,274. One piece of equipment was added to record valued at \$135 compared to 146 items valued at \$51,500 in 1957. The item added to record is a transformer which is used as an integral part of another instrument and was overlooked in the 1957 inventory. One piece of equipment, a minometer, valued at \$300 was not located by physical inventory compared to 14 pieces of equipment, valued at \$5,573 missing in the 1957 inventory. A Missing Equipment Report is being prepared for the missing item. In view of the nature of equipment controlled by Radiation Protection Operation, property custodians have done an excellent job in improving and maintaining control of their equipment.

A Property Management Manual for use by HLO personnel was prepared and submitted to Laboratories Operation for formalizing and distribution. The purpose of this Manual is to present in one publication the property management policies, procedures, and requirements of Hanford Laboratories Operation which will replace existing HLO Property Organization and Policy Guides.

The Fuels Fabrication Development Operation (7534) recently made a survey of capital equipment stored in the 305-B Building. The survey resulted in the retirement or transfer to excess of 23 items of capital equipment with an asset value of approximately \$12,500. Declaration of Excess has been issued for 13 of these items and the balance will be disposed of on a PDR. The transactions involved approximately 100% of all the HLO special equipment and materials stored in the 305-B Building.

Cost Accounting

A preliminary Financial Plan for FY 1959 has been received from HOO-AEC. Several HLO programs are considerably below the HLO request, which makes these programs quite restrictive. A letter was written to the HLO Level Three Managers informing them of the program totals and recommending a tentative allocation of HLO Research & Development funds. It was requested that comments on this allocation be forwarded to Cost Accounting by August 1, 1958. Following is a brief summary of the tentative Financial Plan as compared to the HLO budget.

(In Thousands)	Financial Plan	HLO Budget
2000 Program		
IPD Sponsored Funds		
Metallurgy I	\$ 682	\$ 806
Metallurgy II	515	439
Total Metallurgy	<u>1 197</u>	<u>1 245</u>
Reactor I	476	476
Reactor II	690	690
Total Reactor	<u>1 166</u>	<u>1 166</u>
Total IPD Sponsored 2000 Program	<u>2 363</u>	<u>2 411</u>
CPD Sponsored Funds		
Separations Development	949	949
Non-Production Reactor Fuels	929	929
Total CPD Sponsored 2000 Program	<u>1 878</u>	<u>1 878</u>
FPD Sponsored Funds		
Metallurgy	48	-0-
HLO "Purse String" Funds		
Metallurgy I	120	-0-
Reactor II	107	107
Separations Development	391	391
Total HLO "Purse String" Funds	<u>618</u>	<u>498</u>
Total 2000 Program funds available to HLO	<u>4 907</u>	<u>4 787</u>
3000 Program (CPD Sponsored)	<u>10</u>	<u>149</u>
4000 Program (Including Equipment)		
Reactor Recycle	4 420	5 000
Reactor Physics	125	125
Graphite Studies	275	225
CO ₂ Loop	400	400
Swelling Studies	200	250
Waste Disposal	-0-	136
Total 4000 Program	<u>5 420</u>	<u>6 136</u>
6000 Program		
Biological Research	966	1 029
Biophysics Research	453	447
Environmental Sciences	115	255
Dosimetry	179	210
Instrumentation	137	124
Total 6000 Program	<u>1 850</u>	<u>2 065</u>
Total R&D Funds	<u>\$12 187</u>	<u>\$13 137</u>

The CPD sponsored 3000 Program and FPD sponsored Metallurgy Program amounts have been authorized in Work Order form subsequent to issuance of the preliminary Financial Plan. In addition, Chemical R&D has authorization to continue work on the Weapons Program for CPD at the FY 1958 rate until relief can be obtained for the entire program. (CPD requested \$704,000 for this program and the Financial Plan provides only \$350,000.)

A letter was written to Contract Accounting outlining the effect of the preliminary Financial Plan on HLO programs. Also included in the letter was a revised estimate for the Plutonium Recycle Program for FY 1959 which takes into consideration experience and knowledge gained during FY 1958. It is now estimated that the Plutonium Recycle Program will require \$5,245,000 for FY 1959 rather than the \$5,000,000 previously submitted.

Project Whitney work has been authorized by UCRL for FY 1959 as follows:

- \$200,000 operating funds for the period 7/1/58 through 9/30/58
- \$400,000 tentatively for the period 9/30/58 through 6/30/59
- \$ 50,000 equipment funds to provide for:
 - 1 - Installation and improvement of equipment ordered against FY 1958 funds, but not yet delivered.
 - 2 - Miscellaneous equipment to be ordered during FY 1959.

Funds to finance all Washington Designated Programs during the month of July have been obtained either as a carry over of funds from FY 1958 or as an interim authorization until the complete FY 1959 program funds can be obtained.

July cost reports will show only Level 3 program budgets. The Financial Plan data will be used in most cases; however, where the plan differs greatly from HLO's requirements, HLO's estimate will be used on the assumption that relief will be forthcoming in September at the time a firm Financial Plan is received. Work has been initiated to prepare Level 4 component budgets. It is expected this data will be completed in time for inclusion in August cost reports.

Personnel Accounting Operation

Authorizations have been received from 16 exempt and 8 non-exempt employees for mailing payroll checks to out of town banks. Banks in Texas, California and Idaho, in addition to local banks have been selected.

College graduates engaged in research and development activities were categorized according to instructions received from Employee Compensation Service in connection with the Los Alamos Annual Survey of Professional Scientific Salaries. The completed report was forwarded July 28, 1958. Comparison with last year's report indicated close similarity in all categories.

Recent Bureau of Labor Statistics figures indicating a further rise in the cost of living resulted in a .59% wage increase for HLO non-exempt employees. This increase was reflected in salary checks for the week ended 8-3-58. Our annual payroll will increase approximately \$16,000.

As a result of Dr. W. D. Norwood's request of July 3, 1958, sickness hours and hours available by month for October, November, December, 1956 and for each of the twelve months of 1957 was transmitted to him on July 8, 1958. This information was requested to assist in tabulating the results of flu vaccinations given employees.

Auditing

Reports have been drafted for the audits of Property Accounting, Travel, Living and Entertainment and General Accounting and Cash Control. Except for work done on Property Accounting several months ago, coverage on these audits is almost entirely that of the Traveling Auditors.

Several minor Internal Audit steps that appeared desirable to supplement the Traveling Auditor review of Payroll and of Contracting and Procurement were made.

Payroll Statistics
Number of HLO Employees
Changes During Month

	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on Payroll at Beginning of Month	1 133	519	614
Additions and Transfers In	115	81	34
Removals and Transfers Out	(10)	(4)	(6)
Employees on Payroll at End of Month	<u>1 238</u>	<u>596</u>	<u>642</u>

Overtime Payments During Month

	<u>July</u>	<u>June</u>
Exempt	\$ 5 408	\$ 5 648
Non-Exempt	12 564	10 921
Total	<u>\$17 972</u>	<u>\$16 569</u>

Gross Payroll Paid During Month

Exempt	\$458 362	\$415 858
Non-Exempt	279 028	269 174
Total	<u>\$737 390</u>	<u>\$685 032</u>

Participation in Employee Benefit
Plans at Month End

	<u>No. Participating</u>		<u>% Participating</u>	
	<u>July</u>	<u>June</u>	<u>July</u>	<u>June</u>
Pension Plan	1 190	1 120	98.7	98.9
Insurance Plan				
Personal Coverage	1 247	1 162	99.8	99.7
Dependent Coverage	797	745	-	-
U.S. Savings Bonds				
Stock Bonus Plan	751	696	60.6	61.4
Savings Plan	87	86	7.0	7.6

Insurance Claims

	<u>July</u>		<u>June</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee Benefits				
Life Insurance	-0-	\$ -0-	-0-	\$ -0-
Weekly Sickness & Accident	15	1 300	19	1 450
Comprehensive Medical	30	5 111	33	5 742
Dependent Benefits				
Comprehensive Medical	63	6 881	55	4 245
Total	<u>108</u>	<u>\$13 292</u>	<u>107</u>	<u>\$11 437</u>

UNCLASSIFIED

J-6

HW-56914-

Good Neighbor Fund

Number Participating
Percent Participating

July

785
63.4

June

716
63.2

W. Sale/bk

for John B. Rube
Manager - Finance

UNCLASSIFIED

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

J. L. Carroll

TITLE OF INVENTION OR DISCOVERYProduction of Uranium (IV) Ion in Nitrate
Solution (July 18, 1958, HW-56837)

END

**DATE
FILMED**

5 / 4 / 93