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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT
AUGUST, 1957

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Compiled By
Operation Managers

September 15, 1957

[redacted]

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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PRELIMINARY REPORT

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TABLE OF CONTENTS

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TABLE I. HLO-FORCE REPORT AND PERSONNEL STATUS CHANGES

Date August 31, 1957

FORCE REPORT

	At close of month			At beginning of month			Additions		Separations	
	Exempt	Non-Exempt	Total	Exempt	Non-Exempt	Total	Exempt	Non-Exempt	Exempt	Non-Exempt
Chemical Research and Development	127	90	217	129	90	219	1	1	3	1
Reactor & Fuels Research & Development	154*	91*	245	153	91	244	5*	2	4	2*
Physics & Instrument Research & Development	56	25	81	58	25	83	0	0	2	0
Biology Operation	33	41	74	33	42	75	0	0	0	1
Operations Research and Synthesis	13	3	16	12	3	15	1	0	0	0
Radiation Protection	42	185	227	42	188	230	1	2	1	5
Laboratory Auxiliaries	44	180	224	43	186	229	2	0	1	6
Financial	15	34	49	15	34	49	1	1	1	1
Employee Relations	13	11	24	13	12	25	0	0	0	1
General	1	1	2	1	1	2	0	0	0	0
TOTALS	498	661	1159	499	672	1171	11	6	12	17
Totals excluding Internal Transfers	498	661	1159	499	672	1171	10	5	11	16

* 1 Reassignment from Non-Exempt payroll

Composite Separation Rate -2.243
Separation Rate (based on separations leaving G. E.) -1.984
Controllable Separation Rate- .604

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PERSONNEL STATUS CHANGES (1)

TABLE II. PROMOTIONS AND TRANSFERS

Date August 31, 1957

Component	PROMOTIONS			EXEMPT TRANSFERS (2)				NON-EXEMPT TRANSFERS	
				To HLO		From HLO			
	Exempt	Non-Exempt to Exempt	Non-Exempt	From Other HAPO	From Other G. E.	To Other HAPO	To Other G. E.	To HLO	From HLO
Chemical	0	0	3	0	0	0	0	1	0
Reactor & Fuels	2	1	3	2	0	0	0	1	0
Physics & Instrument	0	0	0	0	0	0	0	0	0
Biology	1	0	0	0	0	0	0	0	0
Operations Res. & Syh.	0	0	0	0	0	0	0	0	0
Radiation Protection	0	0	2	1	0	0	0	1	0
Laboratory Aux.	0	0	3	1	0	0	0	0	2
Financial	0	0	1	1	0	1	0	1	0
Employee Relations	0	0	0	0	0	0	0	0	0
TOTAL	3	1	12	5	0	1	0	4	2

(1) Data through 8/31/57
(2) Transfers within HLO not included

SUMMARY

BUDGETS AND COSTS

The operating budget has been completed. The deficit in funds for Washington Designated Programs was made good (in September).

The over-all expenditures were in good balance with the budget; they were respectively 6.7% and 14% of budget at the end of July and August (approximation).

RESEARCH AND DEVELOPMENT

1. Reactor and Fuels

Outstanding resistance to intergranular corrosion in hot water or steam at temperatures up to 400-500°C offers hope for use of one of the new "super" aluminum alloys (containing small quantities of nickel, iron, and titanium) as fuel jacket material in high-temperature water-cooled reactors such as an IPR or PRPR. Further tests will evaluate their uniform corrosion rate at high water surface-velocity flow conditions, and include considerations of neutron economy and metallurgical formability.

Two stainless steel clad 7-rod cluster elements were successfully discharged from the K thru hole facility after an exposure of 1000 MWD/T. Preliminary visual examination revealed no evidence of warp, swelling, growth, or hot spots.

A series of hydraulic flow laboratory tests of the flow dynamics in Hanford reactor outlet fittings has provided precise new data which will be used for reactor process control.

An alloy of two weight percent U-235 in metallic thorium has attained a calculated exposure of 10,000 MWD/T in the MTR with no indication of weight loss or density change.

Good end-closures have been produced experimentally on co-extruded Zircaloy-2 uranium fuel elements by welding on a plug-type Zircaloy cap employing an electron-beam vacuum welding technique.

The high temperature graphite irradiation experiment in the MTR has successfully completed two out of the four planned MTR cycles with temperatures being controlled at 975°, 750°, 750°, and 600°C for the four samples. Employment of new vitreous alumina insulation for the thermocouples has solved a previous problem of thermocouple failure.

All design criteria for the PRPR have been issued, and the detailed design for Phase I is 79% complete. The Preliminary Safeguards Analysis for the reactor has been issued.

[redacted]

Ball-milling of PWR-grade uranium dioxide has permitted sintering to 92% of theoretical density at 1500°C vice the previous 1750 C temperature employed. This can lead to substantial savings in furnace operation and maintenance.

Hot swaging of sintered and ground uranium dioxide in a stainless steel jacket resulted in a density 94% of the theoretical.

A promising new low-cost technique is being evaluated for jacketing plutonium-aluminum alloy. This involves employing atmospheric pressure to force the molten plutonium-aluminum into the evacuated jacket tube. Experimental equipment has also been designed to inject the Pu-Al into the can by means of a hydraulic piston.

Three test fuel assemblies containing PuO_2-impregnated graphite are being fabricated for PCTR testing.

Plutonium fuel cycle analysis studies have pointed out that different reactor designs may be required to optimize for burning plutonium instead of U-235. Since Pu-240 is a fertile material analogous to uranium-238 except that it has a 100-fold greater cross-section, a reactor designed to operate efficiently with plutonium elements containing Pu-240 should have a higher resonance escape probability than one designed for U-235 elements.

2. Chemical Research and Development

Studies related to Purex included:

(a) demonstration of economic status of present simple clean up of the solvent; neither fresh solvent nor extravagantly cleaned solvent adds much to decontamination.

(b) proof of radiation stability of the cesium zinc ferrocyanide in the process for cesium isolation.

(c) an improved cesium scavenging process that reduces costs in several ways.

(d) further satisfaction with tri-n-octylamine as compared with TBP. This has interest for Np isolation, for the Recuplex process, and for PRP.

(e) Amberlite IRA-401 resin shows adequate radiation stability.

In handling UO_3, there is an improved scrubber system for taking out UO_3 in calciner off-gas. The reactivity of the oxide is improved by addition of ammonia to the process; some limitations such as risk of precipitation were studied.

In support of PRP, a continuous production method for Pu-Al alloy, by reaction of PuO_2 and Al in cryolite shows promise. The great difficulty in dissolving Pu-Al-Si fuels reduces our interest in such materials. Reject UO_2 elements can be recovered simply by heating in air to UO_3. This is restored to fuel grade UO_2 by hydrogen reduction.

The Zirflex process for dissolving Zircaloy is quite sensitive to presence of an oxide film. Exploratory work on a possible UF_4 product shows that ultra-violet light catalysis occurs in the presence of formic and hydrofluoric acids; there might be some reluctance, however, to using much formic acid in a plant process.

In the work supporting regional monitoring, substantial improvements in measurement of Ru^{106}, Sr^{90}, and Y^{90} were achieved.

Appropriate protection of titanium against corrosion in the Darex process was demonstrated.

In service work for the benefit of IPD, controlled use of a detergent to decontaminate the reactor rear face and thus reduce personnel exposure was shown feasible; this technique would not release the activity held up in retention basins.

Trace contamination of a Hanford townsite well was due to a water mound at 100-F Area from effluent piping leaks. It was important to be sure that this contamination did not come from the separations area.

Earth sciences activities included a demonstration of specific retention which is only 60-70% of the previously used value. This will limit some disposal practices.

Lining of a crib with calcite or limestone may be a good way to remove the troublesome strontium isotopes.

3. Physics and Instruments

In experiments for design of a dissolver for enriched slugs a large decrease in reactivity was observed when water was replaced by uranyl nitrate solution indicating that partial dissolution of the slugs leads in the direction of substantially increased safety margins. Up to this time the possibility that partial dissolution would be less safe could not be ruled out.

For the IPR, the program of buckling measurements has progressed to the point where the maximum buckling and the "cross over" point may be specified for 1.66" solid natural uranium metallic elements. Contrary to expectations, the buckling at small lattice spacings using MIPB coolant was not intermediate between water and air, but was higher than either.

The temperature coefficient of the 19-rod oxide cluster lattice for the PRPR was found to be negative with a numerical value 80% of that used for design scoping.

Atmospheric Physics Operation has made substantial progress in developing improved methods for predicting diffusion in stable atmospheres from a knowledge of observable meteorological parameters.

The mathematical rigour of the methods used to calculate one reactor physics parameter, the thermal utilization, has been studied with the result that a series formulation for an exact calculation has been developed which is applicable in certain limiting cases and which allows an estimate of error in non-limiting cases.

A hazards study, for indicating containment and isolation requirements, has been made for the Critical Mass Laboratory.

4. Biology

Zn^{65} showed a 150-day half-life in bone of rats. This is about six times longer than the value used in deriving the MPC.

The "observed ratio" used to relate Sunshine Unit measurements to strontium hazards was found to be a variable. This observation brings further question of the legitimacy of the S.U.

A new complexing agent seems to be more effective than EDTA in removing plutonium. However, it is somewhat more toxic than EDTA.

Technical and Other Services

Four cases of suspected tampering with personnel meters have occurred in the last four months. In each, unexplained and unlikely doses were detected on the film badge.

The new film badge in current use throughout HAPO permitted the re-evaluation of exposures received in plutonium work. The over-all effect was a 15 percent reduction in the dose recorded to file. This eased the tight position CPD was in in their Finished Products Operation relative to our annual working limit.

Other industrial uses of the Columbia River require careful review of their potential inter-action with HAPO operation. These include the dam under consideration near the 300 Area; the pulp and paper plant planned for location at Attalia; and the uranium ore refinery at Ford, Washington.

One case of minor plutonium deposition was confirmed in August. The total number of cases of plutonium deposition on record is 206.

The average weekly emission of I^{131} was 7 curies.

Contributions from statistics included:

(a) design of an experiment to select an aluminum alloy with minimum corrosion in reactors

(b) study of accuracy and precision of fuel element inspection, and

(c) coordination of the attitude survey

Progress on the Laboratories' projects was substantially on schedule, with the exception of CA-658 - Shielded Personnel Monitoring Station. That delay is affecting our general scheduling of improved measurements of radioactive deposits in the body.

There was a substantial cut-back in the Technical Information force to achieve cost reduction.

Supporting Functions

1. Financial

Preliminary work in connection with the paperwork problem in HLO is almost complete.

Measurements data required for the balance of this calendar year includes a firming up of 1957 goals by early September with a reporting of accomplishments for 1957 and a forecast of goals for 1958 to be submitted before the end of the year.

APED, San Jose, is seeking approval of a procedure whereby HAPO will be billed for consultation services billed by APED. The rate is expected to be $100 per day and an approved procedure is expected in the near future.

Physical inventories of uninstalled catalogued equipment are proceeding on schedule with the equipment in the custody of Physics and Instruments Research and Development Operation scheduled for September 1. Also to be inventoried in September are precious metals and special materials.

(See also Budgets and Costs)

2. Employee Relations

At month's end the staff of the Hanford Laboratories Operation totaled 1159 including 498 exempt and 661 non-exempt employees.

The Hanford portion of the AEC-ASEE Summer Professors Institute and the AEC Radiological Physics Fellowship Training Program concluded during the month.

Courses attended by HLO personnel during the month included "Understanding People", "Data Processing", "Instructor Training for PMS and L", "Written Communications", and "Secretarial-Clerical Training".

Seventeen suggestion awards amounting to $150 were paid to 16 HLO employees. For the year to date HLO has paid 70 suggestion awards totaling $2990 and representing a savings of $35,098.

Regional Monitoring negotiations are continuing with the primary problem currently that of seniority as a result of the Company's latest proposal to the HAMTC.

There have been no further developments in the Wonacott arbitration case or the Maki grievance.

Three grievances were received during August: two pertaining to mis-assignment of work and one to distribution of overtime.

There were 25 medical treatment injuries with a frequency of 1.34 as compared with 2.15 last month.

Ten security violations in August brought the unsatisfactory total for 1957 to 74.

H. M. Parker/lt

Manager
HANFORD LABORATORIES

HM Parker:lt

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TECHNICAL ACTIVITIES

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. METALLURGY PROGRAM

Corrosion Studies

Performance of New High Temperature Alloys. At temperatures of 350 C in water or saturated steam, M-388 or M-400 alloys provide adequate resistance to intergranular attack. The alloys M-388 and M-400 are low nickel alloys, relatively insensitive to metallurgical history and readily formed into cans by impact extrusion. Several other alloys are approximately similar in corrosion resistance at this temperature, but are less desirable from the standpoints of neutron cross section or metallurgical properties. However, even more resistant alloys are required in applications where temperatures might rise over 350 C even locally. Tests are currently being conducted to evaluate the resistance to intergranular attack of candidate aluminum alloys in steam at temperatures up to the melting point of aluminum. Tests at 400, 500, and 650 C are summarized in the following table:

RESULTS OF STEAM PHASE CORROSION TESTS

Alloy	400 C, 800 psi		500 C, 800 psi	650 C, 500 psi
	48 Hrs	120 Hrs	24 Hrs	24 Hrs ‡
M-388	OK	Failed	-	-
M-400	OK	Failed	-	-
A-203X Alcoa	OK	OK	-	1 of 2 failed
A-203X ANL	-	-	OK	OK (1 sample)
192263 Alcoa	OK	Failed	-	Failed (2 samples)
192264 Alcoa	OK	Failed	-	Failed (2 samples)
192265 Alcoa	OK	OK	-	OK (2 samples)
10182 Chalk River	-	-	-	OK (2 samples)
10197 Chalk River	-	-	-	OK (1 sample)
Aereal 4	-	-	OK	OK (1 sample)

‡ General indications of sample melting.

[redacted]

Composition, (nominal*)

Alloy	Cu	Fe	Si	Mn	Mg	Zn	Cr	Ni	Ti	Be	Zr
M-388*	-	0.5	-	-	-	-	-	1.0	-	-	-
M-400*	-	1.0	-	-	-	-	-	1.0	-	-	-
A-203X ANL*	-	0.3	-	-	-	-	-	5.5	0.2	-	-
A-203X Alcoa	-	0.3	-	-	-	-	-	5.5	0.2	-	-
192263	0.03	1.44	0.08	0.06	0.03	0.02	0.02	1.38	0.02	-	-
192264	0.02	0.34	0.10	0.05	0.02	0.02	0.35	2.64	0.02	-	-
192265	0.75	0.38	0.08	0.05	0.02	0.02	0.02	4.34	0.03	-	-
10182*	-	0.5	0.2	-	-	-	-	0.5	0.2	0.05	-
10197*	-	0.5	0.2	-	-	-	-	2.0	0.2	0.05	0.05
Aereal 4	-	0.75	0.15-0.3	-	-	-	-	1.75	0.2	0.05	-

Preliminary conclusions from these tests are as follows: (1) some of the new aluminum alloys are significantly more corrosion resistant (to intergranular attack) than M-388 and M-400, (2) differences exist in the corrosion resistance of A-203X alloy made at different laboratories, (3) requirements for titanium (e.g., 0.2 wt %) exceed the nominal 0.01 to 0.03 wt % normally believed adequate to effect grain refinement (see 10182 and 192263-4), and (4) quantitative tests of longer duration are desirable.

Zirconium in Organic Fluids. Zirconium alloys are candidate materials for tube and jacketing materials in an organic cooled reactor. The main disadvantage of zirconium is its affinity for hydrogen which is one of the decomposition products of an organic fluid. However, in an organic cooled reactor the partial pressure of hydrogen in the system would normally be kept low.

Tests are being run with zirconium alloys in MIPB in pressurized refluxing systems feeding and bleeding with helium to maintain low partial pressures of hydrogen in the system. Gas samples taken from the system at the end of 22 days showed 0.05% H_2. The first zirconium samples were removed from the 375 C test at the end of 22 days and showed no appreciable weight gains. Analysis of these zirconium alloy samples showed only 9 ppm hydrogen compared with 12 ppm before testing, indicating no pick-up of hydrogen by the zirconium. Samples were also removed at 54 days and show no appreciable weight gains (0.0004 gm). The results of the H_2 analysis on these samples have not yet been received.

Radiometallurgy Examinations

Post-Irradiation Testing of Depleted Uranium Tensile Samples (GEH-3-22)(RM-186). Two preformed, depleted uranium tensile samples, canned in NaK-filled Zircaloy-2 capsules, were irradiated in the MTR to 1.7 x 10^{19} nvt according to GEH-3-22. After irradiation the samples were tensile tested to determine the change in mechanical properties of uranium. The tests at room temperature showed embrittlement and loss of ductility. The elongation had decreased 54 percent over the one inch gauge length; the 0.2 percent yield strength had increased 40 percent, and the ultimate strength had increased 5.7 percent from the unirradiated control samples.

up to 6.7 x 10^{18} nvt (integrated fast neutron flux). Annealing appears to remove damage by two mechanisms. Damage removable by the first mechanism is completely recovered in this low temperature range. This damage accounts for less than half of the total irradiation induced damage as measured by changes in the lattice parameter. DPH hardness values for samples representing the total range of exposure levels (integrated fast neutron fluxes of 6.5 x 10^{16} to 1.2 x 10^{20}) have been obtained which correlate well with lattice parameter and line broadening data.

Exposure Guide for Fast Neutron Radiation Damage in Metals. A study is being made for the purpose of publishing a guide which can be used for fast neutron damage studies in the Hanford uranium-graphite or the MTR reactors. The damage incurred by non-fissionable metals, such as reactor structural parts, is the result of the fast neutron flux, rather than the thermal flux, which is the principal cause of fission damage in the fissionable fuel materials. For this reason the experimental approach to radiation damage in non-fuel metals is necessarily different from that used in testing fuel elements. It is generally recognized that the biggest experimental problem in the field is the measurement of the fast neutron flux and the flux distribution in energy. Recent attempts have been made to measure the flux distribution in energy by means of fast threshold (n, p) and (n,α) reactions [see J. B. Trice (CF-55-10-140), and C. A. Bruch (KAPL-M-CAB-2)]. Although the method is quite good in principle, the thresholds for the reactions are so high that the method is insensitive to the flux distribution in the important energy range below 2 Mev.

Neutron diffusion (Fermi Age) treatment to calculate the flux distribution has proven successful in the neutron energy range from thermal up to 10 Mev. This method has been applied to obtain the contour of the neutron energy spectrum in an empty process tube in uranium-graphite reactors. Document HW-51751 shows the shape of the flux distribution in energy in a flexible weighting function form. It is to be used in conjunction with data from fast neutron monitors, which are sensitive to the magnitude of the integrated flux in a short region of neutron energy (2-10 Mev) for a short period of time up to two weeks. The fast flux monitor data for a particular experiment are used to normalize the differential flux distribution spectrum.

Internal Friction. Internal friction depends on the capacity of a solid to convert mechanical energy of vibration into internal energy. This causes damping of the oscillations of a solid. It is possible to use internal friction as a research tool to study irradiation damage, grain growth, cold work, etc. A torsional pendulum capable of measuring the internal friction of wires smaller than 0.062 inch has been assembled. The internal friction of several annealed zirconium wires has been measured. The apparatus gives reproducible results for each wire, but a comparison of results from one wire to another shows as much as 40 percent variation. A closer examination of the variables associated with the history of each wire is being made. Six zirconium wires were irradiated at room temperature in the TTR to a total integrated flux of about 7 x 10^{11} nvt. The internal friction of the first wire was measured at

Rupture GEH-4-20-G (RM-195). Two ceramic uranium oxide I & E fuel elements were returned from the MTR after an exposure of one MWD/T to determine the nature of the rupture which occurred in one, or both of these pieces. A crack was found in the inner weld of the cap end of piece GEH-4G-3 while the other piece GEH-4G-1 appeared to have no defects.

Production Test IP-32-A Irradiation of Insulated Slugs (RM-176). Three four-inch cored insulated natural uranium fuel elements were exposed to about 600 MWD/T in KW Reactor. Post-irradiation examination and measurement revealed pit-type corrosion in the can surface, and that the slugs had elongated 0.6 percent (0.025 to 0.030 in.), and the diameter had increased from zero in one case to 0.015 to 0.020 inch in the others.

Basic Metallurgy Studies

Electron and Optical Microscopy. Radiation damage to reactor cladding and fuel materials causes pronounced changes in the properties and performance of such materials. Since the mechanics of neutron bombardment and fission are atomic in scale, the composite interactions very likely manifest themselves on a microscopic scale. Optical and electron microscope studies of the microstructure of irradiated materials are, therefore, being conducted.

A device for remotely breaking irradiated impact specimens has been put into operation in Radiometallurgy. Replicas of the fracture interfaces of a 150 MWD/T (0.02a/o) and a 300 MWD/T (0.03 a/o) impact specimen of uranium have been successfully prepared. A 600 MWD/T (0.07 a/o) and a 1000 MWD/T (0.11 a/o) specimen will be fractured and replicated next. On the basis of prior electron microscopy of fracture surfaces of irradiated uranium, this study should supply fundamental information contributing toward understanding the embrittlement of uranium as a result of reactor irradiation.

Considerable optical microscopy has been conducted on replicas of a metallographic specimen of uranium which had been irradiated to a total atom burnup of 0.1 percent. Comparison of the same area of the specimen in the pre- and post-irradiation states shows a general increase in the extent of micro-twinning. The macro surface roughness appears to increase with increasing reactor exposure. Replicas of this specimen will be studied in the electron microscope. The densities of a control specimen and three specimens irradiated to total atom burnups of 0.03 percent, 0.07 percent, and 0.1 percent have been determined. The respective values are: 19.01, 19.01, 18.99, and 19.00. It would appear that the densities are not significantly changed. Hardness values for the specimens will be determined shortly.

Annealing of Radiation Damage in Molybdenum. Molybdenum and zirconium are being studied by x-ray diffraction after irradiation to improve the basic understanding of irradiation damage in metals. Low temperature (100 C to 200 C) annealing studies of irradiated molybdenum have been successfully completed. The specimens annealed had received exposures

room temperature about 40 minutes after irradiation was completed. Reactor irradiation apparently affected the internal friction since several measurements showed an increase of internal friction with time for approximately 1-1/2 hours after the first measurement. Subsequent measurements indicated no further increase in internal friction.

An insulated container capable of maintaining the wires at a temperature of about -80 C during irradiation, by means of refrigerated helium, was fabricated. This should "freeze in" a higher equilibrium number of defects produced during the irradiation. The wires will be stored at liquid nitrogen temperature until their internal friction can be measured in order to retain a maximum amount of the irradiation damage. Tests were made to determine the importance of temperature fluctuations around room temperature and the effect of variable depths of oil in the oil dashpot used to dampen extraneous vibrations.

Fission Product Mobility Experiments. The diffusion and agglomeration of the noble gases, krypton and xenon, produced by fissioning of uranium have resulted in pronounced swelling of irradiated fissionable materials. This swelling appears to be markedly dependent on irradiation temperature and U-235 burnup. Due to the possible effect of such swelling on fuel elements used in proposed reactors, a basic study of the diffusion rate of those gases in pure metals and alloys either in single phase or bi-phase has been initiated. The effect of a second phase is of very basic interest because of the possibility of this phase acting as a precipitating site for the gas atoms. Alloys currently under study are Ag-Cu, both in single phase and bi-phase. Diffusion of the gases in these alloys will be compared to that in pure silver. These alloys have been prepared and rolled into 0.10" thick foils. Before making the diffusion studies, the metal will be heat treated to meet three criteria: viz., (1) the copper should be precipitated in a uniform dispersion, (2) the secondary phase particles should be of approximately uniform size, and (3) the grain size of the continuous phase should be uniform in the different alloys. The heat treatment is necessary since there must be no precipitation of new secondary phase sites, nor growth of some of the existing particles at the expense of others. In other words, the alloys will be brought to an equilibrium in the three processes: (1) precipitation of copper, (2) coarsening of the copper precipitate, and (3) coarsening or refining of the grain size, before the diffusion test begins at any one of the three temperatures 500, 600, and 700 C. This will separate the precipitation effect of the gases from the "sweeping-out" effect by moving grain boundaries and precipitating secondary phase. Heat treatment of an Ag - 8.8 percent Cu alloy at 700 C to "over-aging" gives a very uniform dispersion of the secondary phase and the grain size. This has been shown by a series of metallographs. However, after five days at this temperature, there is still some evidence of coarsening of the precipitate at the expense of smaller particles. The heat treatment will be carried out for longer times in order to establish the equilibrium microscopic structure of this alloy at 700 C. Then, the alloy will be further heat treated at 600 C and 500 C until the equilibrium structure is established at these temperatures. It is hoped that the further precipitation at the lower temperatures will take place on the existing secondary phase particles and increase the size but not the number of particles.

Thermocouple Irradiations. A knowledge of the errors in temperature measurements using thermocouples in a neutron flux is essential for the quantitative evaluation of the results of neutron irradiation. Due to a lack of such information, a program of measuring thermocouple stability in-reactor is currently in progress.

A fourth aluminum lead capsule has been fabricated and is being bench tested. Certain inadequacies discovered in initial tests are being corrected at present. A program of testing the wire-leads to be used in-reactor has been started in a controlled atmosphere muffle furnace. These tests are for the purpose of establishing life expectancy of the various couples in a number of atmospheres.

In-reactor testing of sheathed leads is currently awaiting the arrival of quartz fiber insulated wire on order from the Revere Corporation.

Compound Layer Formation. A study is being made of the reactions and alloying occurring in the U-Pb system. Oxide-free uranium specimens were dipped in a 600 C lead bath producing a slushy or semi-solid, adhering coating which remained on the specimen upon removal from the bath. Microscopic examination revealed pyrophoric UPb_3 particles dispersed in what appeared to be UPb_3 + Pb eutectic. A plot of the thickness of the layer against time produced an exponential curve increasing with time. Oxide-free uranium specimens were oxidized for varying times at 110 C and dipped in the 600 C lead bath for 1500 seconds to study the effect of the oxidized surface on the Pb-U reaction. Results were erratic and inconclusive. A study of the effects of a heat treating salt bath on the surface of uranium was conducted. A two-phase layer was formed on the uranium by the salt which inhibited a reaction between the uranium and a 600 C lead bath. A detailed report is in progress on the foregoing studies.

Dissolution Rate Studies with High-Carbon Dingot Uranium. Carbon additions were made to dingot uranium by vacuum casting, using a high-frequency electronic heater. This was done to determine the effect of carbon content on the dissolution rate of dingot uranium in nitric acid. The rates obtained were combined with those determined for production samples of ingot and dingot uranium as well as that for a high-carbon (400 ppm) dingot sample prepared at FMPC. Although these rates vary considerably, a relation was not observed between the rate of dissolution and the carbon content. However, a power function does exist between the rate of dissolution and the grain size. It was concluded, therefore, that although carbon does have a significant effect on the grain size of uranium, this effect depends upon the fabrication and heat treating history; whereas, for like heat treatment, the dissolution rate varies with grain size regardless of prior fabrication history.

Study of High-Carbon, High-Silicon Centrifugally-Cast Uranium. Five specimens of centrifugally-cast uranium varying from high-carbon, low-silicon to low-carbon, high-silicon contents were examined metallographically. It was determined that in the as-cast condition, silicon

had an effect 2-2/3 times that of carbon in grain refinement. A grain size of 0.13 mm diameter was obtained with 1360 ppm silicon and 284 ppm carbon additives. Although some microcracks were observed in all of the specimens, the highest density of these occurred in the high-carbon samples.

New Fuel Element Development

Seven-Rod Cluster Fuel Elements. As part of the program to develop a cluster fuel element, seven-rod cluster fuel elements were irradiated to 1000 MWD/T in the KE Reactor. The two fuel elements were discharged last month and were examined during the past week through the 20-foot level periscope at the KE Reactor basin. The fuel element seemed to be in perfect condition. No sign of rod failure was observed nor was there any sign of warpage, growth, or swelling. All welds holding the spider support together were intact. A further irradiation of 1.3 percent enriched uranium rods in cluster geometry is planned to be charged into KE Reactor through-hole facility. Exposure goal for this irradiation will be 2500 MWD/T.

Self-Supported Fuel Elements. Fuel elements with supports attached to the fuel element jacket are designed to accurately position the fuel elements in smooth bore process tubes. The fabrication of 288 self-supported standard fuel elements for Production Test IP-84-A is now ninety-five percent complete. Eighty-eight KER size self-supported fuel elements were fabricated during August to meet the continuing requirement for fuel elements for the KER facility.

I & E Wafer Element Irradiation in the MTR. The I & E wafer element is of interest for present and future HAPO application because the increased surface area permits higher power operation and the wafer feature provides increased failure safety in a hot water environment. Examination of a specimen of this design that was irradiated to 800 MWD/T at 70 kw/ft in the MTR has been completed. No evidence of damage other than that resulting from mechanical handling was observed.

Coaxial Tube Fuel Element. The coaxial tube fuel element is of interest for reactor application because it offers promise of having the increased split failure resistance of a large inner diameter cored element but without the accompanying reactivity deficiency. The examination of a specimen of this design that was irradiated to 200 MWD/T at 70-75 kw/ft has been essentially completed. Uncertainty in the estimate of the temperatures that existed in the central tube during operation has not yet been resolved. Planning of the next experiment will, therefore, include thermocouple temperature measurement.

Inspection of Wafer Elements. The C-size wafer I & E fuel elements were evaluated on the basis of uniform heat transfer, closure quality, autoradiograph, and appearance. The inspection was completed without the benefit of the sonobond and penetration tester which have been found inapplicable to wafer type fuel elements. Consequently, the eighty slugs

canned earlier for pile testing are being held, pending the development of a penetration tester that will correctly and consistently assess the degree of penetration on this type of slug. One approach, which has shown considerable promise in experimental trials, is the measurement of the difference in attenuation of a narrow x-ray beam as it intercepts a peak of Al-Si in an aluminum can, versus that of a similar beam passing through an unpenetrated can. A device to explore the possibilities of this method is now being set up.

Bottom Pour Lead Dip Canning. To examine the possibility of eliminating voids in the Al-Si bonding layer due to entrapped air encountered in the lead dip process, a method of admitting the molten Al-Si at the can bottom is being investigated. The can and sleeve must be preheated before introduction into the Al-Si bath. An induction coil is utilized to preheat the can and sleeve, and the time-temperature cycle of the preheat operation has been roughly determined. Work is continuing upon the canning cycle and the containment of the Al-Si within the can on removal of the assembled element from the bath.

Cold Closure Fuel Elements. The cold closure process for fabricating fuel elements requires the removal of material from the can wall after the sizing operation to meet the can wall thickness specification. This has been done in the past by a lathe operation. To improve the economy, production rate, and quality of the finishing operation, a centerless belt grinding machine will be employed to finish the element to the specified outside diameter. The machine has been installed and several elements have been ground down on the machine for familiarization with the operation. The results achieved on tolerance, surface finish, and production rate have been satisfactory. Work is continuing to develop the maximum use from this machine.

ORA-1 Loop Testing of Fuel Elements. It appears that aluminum is the most satisfactory material for cladding of fuel elements for organic coolant service. The major problem with aluminum for this application is interdiffusion at the clad-fuel interface. An aluminum clad uranium fuel element with a colloidal graphite diffusion barrier at the clad-fuel interface is being tested in the ORA-1 loop facility for evaluation of interface stability and service life. A companion piece is being tested in a pressurized autoclave at 450 C.

Diffusion Barrier for Aluminum Jacketed Uranium Fuel Elements. Since aluminum appears to be the most satisfactory clad material for MIPB-cooled fuel elements, work is continuing on Al-U diffusion barriers for both bonded and unbonded aluminum clad fuel elements. A diffusion test was started during July in which one hot-press nickel bonded, one cold-press nickel bonded, and one Al-Si bonded fuel element were held at 450 C under a nitrogen pressure in excess of 1000 psi for 212 hours. At the conclusion of this period the fuel elements were examined. The cold-press nickel bonded fuel element had blistered at four points and was removed from the test. Subsequent examination revealed that the blistering was caused by Al-U interdiffusion at four points on the uranium core

that had very thin or no nickel deposit where the holding fixture contacted the uranium in the plating bath. The remaining two fuel elements were returned to the autoclave for an additional 82 hours at 450 C. At the end of this period the fuel elements were once again examined and found to be unchanged. The two fuel elements and an additional aluminum canned fuel element with a "dag" interface (see ORA-1 Loop Testing of Fuel Elements) were placed in the autoclave and the test is continuing.

Uranium monocarbide, a material that has relatively good thermal conductance, was considered as a possible diffusion barrier material that could prevent the reaction between uranium and aluminum. Reaction of uranium with MIPB organic coolant above 300 C produces UC on the surface, but the reaction progresses intergranularly with UH_3 formation as an intermediate step. The carbide thus formed is loose and not suitable as a diffusion barrier. An attempt was made to produce a UC coat on rods of U sealed in quartz and commercial carburizing compound. Reaction for 24 hours at 800 C, 24 hours at 650 C, and 4 hours at 650 C, increased the carbon content of the uranium homogeneously, but did not produce a satisfactory case on the metal.

The work of M. W. Mallett at BMI indicates that the direct reaction of uranium with nitrogen produces an adherent nitride case on the uranium. An attempt to nitride a rod of uranium in 1000 psi nitrogen at 450 C produced only U_3O_8 on the surface because of oxygen contamination in the gas. Apparatus more nearly duplicating that used by Mallett is being set up for producing a nitride case. Some exploratory tests to determine the feasibility of carburizing and nitriding uranium in a salt bath were started.

Thermal Coefficient of Heat Transfer Between Uranium and Jacket. An apparatus is nearing completion which will permit measuring electrical contact conductance along with thermal contact conductance. Simultaneous measurements are desirable because departures from parallel behavior are interpreted in terms of the film separating areas of perfect metal to metal contact. The electrical conductance between a number of soft metals and a hard metal ball loaded so that the soft metal yielded was measured as a function of time. It was found that the electrical conductance was determined primarily by the initial load and that subsequent creep and increase in the apparent area of perfect contact had little effect on the electrical conductance.

Calculations for the Thermal Stresses in Cylindrical Fuel Elements. In previous documents of this series, a method was described for formulating a material model to represent stress, strain, and temperature-dependent strain rate. The method of utilizing this material model has also been described. Since the model does not factor in the effects of radiation, further refinements in the method of thermal stress analysis are not considered justified. Thus, two terminating reports have been written. One describes the method of formulating a material model(1), and the

(1) Merckx, K.R., "A General Method of Analysis of Primary Creep Data," HW-50363, 1957 (Unclassified).

second describes the final method on analysis for the thermal stresses, and the results of these analyses for fuel elements cooled by various methods(2). The interpretation of such calculations in terms of fuel element failure is quite complex, but a special discussion of the problems connected with this interpretation has been included in the Fuel Element Design Handbook(3).

Th-U Alloy Fuel Material. The first sample of Th - 2.1 w/o U-235 alloy fuel material being irradiated in a NaK capsule at the MTR has been discharged. The fuel specimen has reached its goal exposure of one a/o burnup (10,000 MWD/T), and is being examined at the Radiometallurgy facility. The examination has revealed that the unrestrained fuel material has remarkable dimensional stability having grown only 0.006" in its 1.500" length and imperceptibly in its 0.388" diameter. Weight loss to the NaK in the capsule is negligible (perhaps 1 mg in 34 grams). Self-heating of the sample prevented an accurate density determination; however, the density has obviously not changed appreciably. Bend test data reveals an increase in strength but a marked decrease in ductility. Calculations indicate the initial maximum fuel temperature was 560 C, and the surface temperature was 430 C. Post-irradiation examination is continuing and additional fuel specimens are being irradiated to high exposures.

Welding Development. A program is being carried on to develop the proper design of welded end closure for the co-extruded Zircaloy-2 - uranium fuel elements. Using a plug type cap and welding in the electron beam vacuum welder, end closures were obtained which were leak free when tested in the 350 C autoclave for 24 hours. Microsections of these welds showed complete weld penetration and no uranium contamination in the weld metal. Development is also proceeding with a flat cap which will eliminate the considerable amount of uranium machining necessitated by the plug-type cap.

Electron Beam Vacuum Welding. The system for welding with a beam of electrons in a high vacuum was again put into operation with a new high power output, high voltage supply. The new supply has the output capacity to make fusion weld closures on material 3/32-inch thick or less. This range should be sufficient to cover all proposed fuel element closure requirement. Autoclave corrosion tests of welds made on Zircaloy-2 material with this process have been exposed to 686 F water for a period of 90 days. The results after this period indicate that the weld area is superior to the parent metal from a corrosion resistance standpoint.

Three welding processes for Zircaloy-2 are being evaluated: viz., (1) heliweld torch with trailing gas shield, (2) back-filled inert gas-chamber with heliweld torch, and (3) electron-beam vacuum welding. The items to be evaluated are corrosion rate, tensile strength, ductility, and degree of gas contamination. Zircaloy coupons have been welded by these three processes employing 15, 30, and 60-mil Zircaloy-2 sheets and the coupons are now being tested.

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(2) Merckx, K.R., "The Dependence of Thermal Stresses in Cylindrical Reactor Fuel Elements Upon the Method of Cooling," HW-50364, 1957 (Unclassified).

(3) Evans, T. W.,(Editor), Fuel Element Design Handbook; Merckx, K.R., Chapter 9, "Thermal Stresses in Fuel Elements," HW-51000.

2. REACTOR PROGRAM

Coolant Systems Development

Evaluation of General Corrosion Characteristics of Ni-Al Alloy M-388 Slug Jackets. (PT 105-565-E-68-MT, IP-42-A) Initial analyses of operating data and measured corrosion rates from the six charges of weighed metal exposed under the conditions of this Production Test have been completed by Statistics Operation, HLO. Data from each charge were analyzed individually for each alloy (M-388 and 1245 aluminum alloys) using the Groot and Wilson equation

$$(\text{Log}(\text{Corrosion Rate})) = A + \frac{B}{\text{local water temp.}} + C\ (\text{slug power}) + D(\text{pH})$$

Results from this analysis were not conclusive. While the results did indicate a difference in corrosion due to alloy type, even greater corrosion differences were indicated between the six separate charges.

Further analyses are in progress. Some of these will be based on the Groot and Wilson equation with data from all six charges combined. This combination will increase the probable error of the relation, but may still indicate semi-quantitatively, the effects of alloy on rates of corrosion of these fuel element jackets. Other analyses of these data will involve the use of a modified equation.

PT-105-550-E, Supplement A - Radiation-Corrosion Test. Tube 2943-KE operated on preheated water at 87 C at the inlet of the process tube for 14 days during the past month. The tube will be discharged early in September. This tube contains a special dummy load of four-inch aluminum core dummies and eight eight-inch lead core dummies containing gold foils.

Tube 3043-KE - Single Pass High Temperature Facility. The instrumentation for 3043-KE has been revised for high temperature studies and is being designed for installation in the reactor. It is scheduled to be completed in approximately two months.

Water Chemistry. At the present time there is no information available on particle size of impurities in the KER loops. Chemical analyses have given data on the anions and cations present in these loops but it is not known whether these impurities are in ionic form, a colloidal state, or as massive aggregates transported by high velocities in these loops. The installation of hot crud probes in the near future will provide some data on this problem. The electron microscope is also to be used. With this tool it should be possible to determine particle size and also the particular compounds present by the use of diffraction shots. This information coupled with data concerning the chemical structures of wall deposits may assist in decontamination of these loops.

The mock-up tube Turco test is still being run. The purpose of this test is to evaluate the effects on a reactor tube and components of a Turco 4306-B decontamination flush. A test flush of Turco 4306-B on one crossheader of H Reactor reduced activity readings on the crossheader from 300 mr to 150 mr (background). A concentration of 4 to 6 oz/gal at 85 C

was used for eight minutes. Results of this test are so promising that a flush of the entire rear face of H Reactor is planned, provided that no adverse findings are turned up in the KE mock-up tests, in the stress tests to be conducted by Corrosion and Coatings Operation, or in the disposal of the Turco to the river.

ELMO-2. Following installation of a canned motor pump and other revisions to the loop, a new test was started in ELMO-2. The conditions of the test are 180 C and pH 4.0 with H_3PO_4. Coupons of M-257, M-457, M-400, M-388, X-2219, Zircaloy-2, and Type 304 stainless steel are being exposed. The 304 stainless steel consists of both sensitized and unsensitized samples. The purpose of the test will be to measure the corrosion rates of aluminum alloys as a function of pH and temperature, and to determine whether sensitized stainless steel corrodes intergranularly at this low pH value.

Out-of-Reactor Corrosion Tests at High pH. One test in the ELMO-5 loop has been completed. The water was adjusted to pH 8.5-9.5 with NH_4OH. The temperature was 290 C and the duration of the test was about eight weeks. The stainless steel and carbon steel had negligible corrosion rates. The aluminum alloy(M-388) corroded quite severely. Again the corrosion rate in this loop was higher than as reported for similar conditions in off-site loops. This is presumably due to the low ratio of aluminum surface area to water volume. In previous tests it has been found that a high ratio produces lower corrosion rates. Off-site loops have a ratio of around 400 square centimeters of aluminum surface per gallon of water while ELMO-5 has a ratio of only four square centimeters per gallon. The aluminum ion was continuously removed from the water by being passed through an ion exchanger. Modifications have been made on the make-up system in preparation of the next test conditions. These changes included installation of a make-up tank and connection to the loop. The loop is scheduled to begin operation during the next month at pH 9.0 with dissolved sodium silicate. The effect of the silicate as an aluminum corrosion inhibitor will be investigated.

ELMO-6. The current test at 300 C, pH 4.5 with H_3PO_4, and 150 ppm $PO_4^{\equiv}$ has been operating for five weeks. M-388 and M-400 coupons exposed in the dynamic portion of the loop are exhibiting pitting. The M-388 pits are around the edges and work-hardened areas and appear regular and smooth. The M-400 pits are over the entire surface and have a round appearance. Alcoa alloy 192263 also shows several pits per coupon. As yet alloys 192264 and 192265 are unaffected. Since M-388 coupons in a semi-static portion of the loop show no pitting, the phenomenon appears velocity dependent. An erosive attack due to the high total solids content may be occurring.

KER Operation Status. Loop #2 - the regular cored fuel elements were discharged and Cow slugs were charged. The loop was on process water several times during the month due to (1) charging of Cow slugs, (2) removal of a rear crossheader in order that a ruptured tube nozzle could be removed, (3) failure of primary pump transformers, (4) high activity in Loop #3, and (5) replacement of a leaking thermocouple well. Loop #3 - caused a scram of the reactor because of high activity trips on 8/13/57. On 8/16/57, while attempting to start recirculation of the loop, the primary pump #2 began drawing 25 amps instead of the usual 20 amps. The pump was also making an excessive amount of noise. The upper bearings appeared normal after removal for inspection. The pump is to be operated again to determine whether the lower units should be removed. Loop #4 - the impeller on primary pump #2 has been repaired. The loop was charged with Cow slugs on 8/19/57.

ORA-3. The candidate KER air operated valve continued to be tested. Since the Crane Super Seal Plastic Packing #4 is soft and tends to work out around the stem when the valve is exercised, it was decided to precede this packing with a ring of aluminum foil (Durametallic style DD), next the Crane packing, and finally an end ring of the aluminum foil next to the packing gland.

The loop operated until August 10 (1300 hours) at which time the valve was removed and the packing inspected. The results were excellent. This combination of packings seems superior to all others tested for leak free service and easy movement of valve stem.

Revisions are being made to replace the valve with a Barco expansion joint. It will be evaluated for organic use in September.

Gamma Damage to MIPB. The rate of gamma damage to MIPB has been measured at about six percent per 10^9 R. This means that about 25 percent of the total damage done by reactor radiation in K Reactor can be attributed to the gammas. This information is useful in translating damage rates from one reactor to another.

KER Testing. Two elements each of four-rod cluster, Elephant and Cow slugs were discharged after running 1350 hours in the ELMO-7 loop at 300 C, 1600 psi, in 4.5 pH water. No significant defects were detected except for bending of the rails on the Elephant and Cow slugs. Tests are currently being run in ELMO-7 on two Elephants, two Cows, and two standard-size KER slugs at 200 C, 4.5 pH to determine whether the rails will bend at this temperature. Blisters were noted to have developed where the rails were attached to the Elephant and Cow slugs. These are probably the result of gases trapped while welding on supports which expanded in the hot water to form the blisters. Macrographs of the blister sections are being made to determine whether this was the case.

Mechanical Equipment Development

Fabrication of the mechanical portions of the Organic Test Facility (MOTS-1) has been completed. All material used in the fabrication meets the Code for Pressure Piping and was welded according to applicable HAPO welding specifications. Supporting stands for the facility's piping, pressure vessel, and pump were designed and fabricated. The instrument panel design was completed and fabrication was started. The facility is now being installed in 314 Building.

Design and fabrication of special test assemblies for MOTS-1 were begun. Special coolant jackets to simulate pump stuffing boxes will be used for the testing of mechanical pump seals. Orders have been placed for metallic static seals for testing and evaluation.

Thermal Hydraulic Studies

Flow Hazard Studies. The experimental heat transfer studies of the transient response of a reactor process tube to imposed hazardous

operating conditions were continued. A check was made on the ability of the laboratory apparatus exactly to simulate the plugging of a tube inlet screen. The pressure-flow characteristics of the valve which is used on the heat transfer apparatus to simulate screen plugging were compared to the characteristics as determined by plugging of an actual screen on a process tube in the hydraulics apparatus. It was found that the valve did not exactly simulate what could be expected during a screen plugging on a reactor process tube. However, the conclusions reached from the transient heat transfer studies as reported in HW-50325 are conservative in relation to reactor safety.

Organic Heat Transfer Coefficient. Additional data were obtained of heat transfer coefficients for clean MIPB. These data, which were obtained at bulk temperatures up to 600 F, showed coefficients up to 50 percent higher than those predicted by the Dittis-Boelter correlation. However, it is suspected that the measured values were somewhat high due to errors in measurement of surface temperature and heat flux. This was later confirmed by using a test section of an improved design.

Hydraulic Studies. The hydraulic characteristics of "C" I & E slugs which are 0.020 inch undersize on the outside diameter were determined. The temperature at the top of the annulus of such slugs is expected to be reduced to values near the bulk temperature. The results were reported in HW-51769.

Flow characteristics of long barreled secondary orifices which are scheduled for K Reactor were determined. The characteristics of four of these orifices which were produced by the vendor were essentially identical to the brass prototype which was developed by Thermal Hydraulics Operation.

Irradiation Test Engineering

Shielding Studies. Attenuation tests of magnetite concrete heated to 200 C are continuing. Counting of foils from the first test is essentially complete. Data from the tests at 100 C were prepared for IBM corrections to saturated foil activity.

A loading of foils for the second test on ordinary concrete (unheated) was prepared.

An automatic sample changer and print out system was installed in the counting room. This system will count up to 35 foils automatically and permits foils to be counted on a 24-hour basis. Ultimately, this system is expected to reduce manpower required in the counting room by at least a factor of two.

To achieve the large increase in sensitivity needed to extend the use of sulfur foils through the last two feet of shield, it will be necessary to improve the sensitivity of the sulfur foil measurement, increase counter efficiency, and/or design a counter with very low background. An attempt to increase the sensitivity of the sulfur foil measurement

was made using a sulfur burning technique. Several foils were burned to eliminate the beta-absorption in the sulfur which now limits the available counting rate for foils exposed to a specified flux. Improvement by a factor of two in counting rate was obtained; however, Oak Ridge has claimed a factor of four improvement using this technique. Work will continue in an attempt to obtain the degree of improvement claimed by Oak Ridge.

Irradiation Testing

Document HW-51990 describes the "Status of Production Tests of Special Interest to Hanford Laboratories Operation, August 15, 1957." An irradiation test of seven-rod cluster fuel elements, IP-46-A, was completed and the elements were discharged from front-to-rear test hole 3674-KE at an exposure of about 1000 MWD/T.

During the B Reactor outage of August 4, 1957, diameter measurements of tube 1066-B and channel 0981-B were made. Tube 1066-B was slightly elliptical at the 14'8" graphite block junction where the horizontal diameter increased 0.014 inch and the vertical diameter decreased the same amount. The data have been reported in HW-52007, "Diameter Measurements of Tube 1066-B and Channel 0981-B."

Nonmetallic Materials Development

Experimental Graphites. Purity measurements were determined in the 305 Test Reactor for twelve experimental batches of graphite from various sources. The samples ranged in density from 1.30 to 2.0 g/cc. Improved purity was achieved in National Carbon's resin-impregnated impervious graphite by using new lots of resin. Batches GBF-82S and GBF-82T are comparable in purity to early CS and KC material. Imperviousness achieved by pressure molding resulted in purities comparable to recent reactor grade graphites, and relatively high densities in the range 1.75 to 2.0 g/cc.

The 1.4 g/cc Texas coke "F" purified graphite purchased from Great Lakes Carbon Company is of satisfactory purity (dih of 1.02). Speer Carbon Company lower density, unpurified graphite is too impure (dih = 1.80) for reactor moderator use. The low density, 1.3 g/cc, was achieved by using gum rosin in the binder, which introduced the impurities.

BF_3 Reactor Safety System. Boron depositions in graphite from passing BF_3 gas through graphite samples were 2.4 ppm at 600 C and 11.1 ppm at 2000 C as measured in the Thermal Test Reactor. A boron concentration of 2.5 ppm distributed throughout the graphite stack would result in a reactivity decrease which is considered sufficient to control most disaster conditions. In each run a large quantity of BF_3 gas was added after the temperature was reached, then a low flow of BF_3 and the temperature were maintained for two hours. The samples were cooled in a low BF_3 flow followed by three hours of flushing with He to remove unreacted BF_3 gas. The samples were then placed in aluminum cans for purity measurement in the TTR.

High Temperature Graphite Irradiation. The MTR high temperature irradiation of graphite, GEH-9, is now operating satisfactorily after the completion of the second cycle of a four-cycle irradiation. Control temperatures are being maintained ±5 C at 975, 750, 750, and 600 C for the four samples.

Stored Energy of Irradiated Graphite. Additional data are available on total stored energy content for a series of annealing runs on two graphite samples exposed at 400 C in the Hanford reactors. Results indicate a low total value of stored energy for all samples (e.g., in the range 10 to 20 cal/gm). An anomaly appears in the data in that the 4490 MD/AT sample shows less stored energy (13.4 cal/gm) than the 2100 MD/AT sample (18.7 cal/gm). Crystallite data, L_c and L_a, show generally the same effect. Interpretation may be clarified when additional data are available.

Thermocouple Testing. Thermal Emf measurements on a thermocouple used during four cycles of GEH-9-4 experiments in the MTR at ~800 C show that no detectable changes have occurred in the couple. Temperature checks of the couple and 7" of lead wire at 100 C and 327 C agreed with those of new wire of the same type to within the calibration limits. While serving in the MTR experiment the indicated temperature had gradually dropped to 150 C when the actual temperature was believed to have been ~800 C.

These Emf measurements, together with results of examination of the irradiated thermocouple insulation and the success of the new ceramic insulated thermocouples all point to degradation of the insulation by the intense reactor radiations as the cause of previous thermocouple failures.

Irradiation of Candidate Organic Coolants - PT IP-50-D. Quartz ampoules containing biphenyl, monomethyl biphenyl, and monoisopropyl biphenyl were irradiated in the Snout II test hole of KW Reactor to compare the extent of radiolytic decomposition of these materials as a function of the exposure temperature. The measurements of total gas evolution have been completed and are tabulated below as a function of the exposure temperature and the integrated thermal and epithermal neutron fluxes.

TOTAL GAS EVOLUTION FROM ORGANIC SAMPLES

Organic Compound	Expos. Temp. in °C	Φ_{th}(V=2200m/s) in nvt $\times 10^{-18}$	Φ_f(0.52 ev<E<1.5Mev) in nvt $\times 10^{-18}$	Volume of* Evolved gas in Cm^3STP/gm	Norm. Volume** of evolved gas in $Cm^3STP/gm/\Phi$ Total
biphenyl	50	3.34	3.18	1.94	2.98×10^{-19}
	54	4.29	4.08	2.40	2.87×10^{-19}
	60	4.06	3.86	2.38	3.00×10^{-19}
	320	3.99	3.79	3.85	4.95×10^{-19}
	340	4.36	4.15	3.95	4.64×10^{-19}
monomethyl biphenyl	50	3.34	3.18	2.91	4.46×10^{-19}
	54	4.29	4.08	3.86	4.61×10^{-19}
	340	4.36	4.15	6.98	8.20×10^{-19}
monoisopropyl biphenyl	50	3.34	3.18	4.73	7.25×10^{-19}
	60	4.06	3.86	5.72	7.22×10^{-19}
	340	4.36	4.15	12.63	14.84×10^{-19}

*Includes approximately one cu cm (at STP) of helium originally present in ampoule, per gram of organic material.

**$\Phi_{Total} = \Phi_{th} + \Phi_f$; e.g., approximate total neutron flux as the sum of the thermal flux at 2200 meters/sec velocity plus the fast flux between 0.52 electron volt and 1.5 Mev.

As might be expected from the structure of these compounds, biphenyl appears to be more stable than monomethyl biphenyl, which in turn appears more stable than monoisopropyl biphenyl. A more complete evaluation of these results awaits the results of mass spectrometric analyses of the evolved gases and of physical property measurements on the resultant organic compounds.

Infrared Studies of Plastics. One of the effects of gamma irradiation on polyethylene is to decrease the vinylidene ($RR^1C = CH_2$) unsaturation normally present in the original material and increase the trans-vinylene (RCH = CHR) type unsaturation. This is shown for a series of Alathon films in the table below:

RELATIVE VINYLIDENE ($RR^1C = CH_2$) CONCENTRATION OF IRRADIATED ALATHON

Nominal Thickness	Total Dose, R: 0	5×10^6	1×10^7	5×10^7	1×10^8
.003"	1.00‡	0.79	*	*	*
.005"	1.94	1.58	1.23	*	*
.010"	2.12	1.74	1.41	*	*
.015"	2.95	2.41	2.14	1.12	*

RELATIVE TRANS-VINYLENE (RCH = CHR) CONCENTRATION OF IRRADIATED ALATHON

Nominal Thickness	Total Dose, R 0	5×10^6	1×10^7	5×10^7	1×10^8
.003"	*	*	1.06	1.84	3.70
.005"	*	1.00‡	3.16	4.94	8.72
.010"	*	1.81	3.50	12.05	11.82
.015"	*	3.53	6.05	19.51	30.45

‡ Arbitrarily taken as 1.00.
*Not detectable.

Studies on the effect of these chemical changes on the mechanical properties of polyethylene are planned.

Structural Materials Development

Fabrication of Zircaloy Process Tubing. Processes for the fabrication of B-D-F size, ribbed Zircaloy process tubing are being developed by Allegheny Ludlum Steel Corporation and by the Superior Tube Company. The modification of a tube reducing machine to permit longer starting blanks and lower degrees of cold work was completed by Superior. To test new tool designs, six billets were extruded for Superior by the Chase Brass and Copper Company. The extrusions incorporated an external rib to provide a uniform walled tube. The external rib was removed by machining and tube reducing experiments are scheduled for late August or early September. At Allegheny, 15 billets were successfully pierced and some of these have been extruded. Difficulties with glass markings caused by an improper nose contour are to be corrected prior to extruding the remaining billets. The initial tube reducing of these extrusions is scheduled for early September.

A fabricating process for IPR type process tubing is being developed by Allegheny. Despite difficulties during piercing of the billets, extrusion is scheduled for early September. Tube reducing to various degrees of cold work should be completed by October.

Design Criteria for Pressure Tubing. The determination of the creep properties of vacuum annealed Zircaloy-2 in the range of 250 to 350 C is nearing completion at Battelle Memorial Institute. The desirability of small amounts of cold work in Zircaloy process tubing has been indicated by the results of flow stress recovery tests at HAPO and by the large primary deformation of annealed Zircaloy-2 in creep tests at BMI. A second lot of material with 15 percent cold work was prepared for testing at BMI from a Zircaloy-2 ingot to be used for process tubing.

Aluminum alloys M-257 and 6063 are undergoing creep tests at the University of California and at HAPO. The creep rupture test is being used at HAPO to study the notch sensitivity of the M-257 alloy in the temperature range of 350 to 400 C. Elevated temperature tensile tests are being used to determine the effect of various amounts of cold work on the tensile properties of M-257.

The tensile properties of Zircaloy-2 are sensitive to prior fabrication history. The use of vacuum annealed properties for design purposes may be overly conservative depending upon the actual fabrication history of the tubing. To establish the optimum design criteria, facilities are being developed to test tubing under operating temperature conditions. A tube-bursting unit has been constructed and tested up to 220 C and 11,000 psi. Problems associated with electrical heaters and specimen end seals must be solved before the unit can be used for routine testing.

The Effect of Hydrogen in Zircaloy-2. Prior to determining the limiting hydrogen content for Zircaloy-2, it is necessary to develop a method for introducing controlled amounts of hydrogen into Zircaloy-2 specimens. Several hydrogenation experiments were performed at temperatures from 265 C to 750 C. A non-uniform distribution of hydrogen was obtained in each case. Reducing the number of samples in each test group may solve this problem and provide homogeneous samples.

B. WEAPONS - 3000 PROGRAM

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

C. CUSTOMER WORK

Radiometallurgy Service

Cored Ruptures (RM-196). The visual examination of four ruptures from the KE Reactor for purposes of rupture classification was requested by the IPD Process Analysis Operation. All of the slugs were 1/2-inch cored natural uranium, canned in 1245 aluminum alloy jackets. The exposure data of the slugs are summarized below:

Failure No.	Tube No.	Discharge Date	Tube Exposure MWD/T	Tube Power Average - KW
831	1480-KE	4/30/57	532	1092
840	1984-KE	5/11/57	414	1258
848	2881-KE	5/30/57	537	1126
854	3272-KE	6/6/57	475	950

All of the ruptures were characterized by elliptical-shaped hot spots of varying degrees of severity. In each case the appearance of the hot spot indicated intergranular corrosion attack. The hot spots of two slugs (840 and 848) were located near the cap end, while they were more nearly centered in the other two (831 and 854). In addition to the hot spots, it was observed that the caps and bases of three of the slugs were completely, or nearly completely broken off. It is believed that this damage was caused by the entry of water into the core and the subsequent buildup of internal

[redacted]

pressure by the formation of uranium oxides. One or two of the failures will be selected for more detailed examination.

Examination of Corrosion Coupons Exposed in Redox 107SX Waste Storage Tank (RM-148). The SAE 1020 steel corrosion coupons exposed in Redox 107SX waste storage tank for approximately one year have been examined. The average weight loss of samples exposed in the vapor phase of the process waste was 24.4 percent less than the 0.0848 gram average weight loss of submerged samples. The average pit penetration in the vapor phase exposure, however, exceeded the average penetration of 1.83 mils observed in the liquid phase by 55.2 percent. The maximum pit penetrations were 7.26 and 4.62 mils in the vapor and liquid phases, respectively.

Metallography Service

A steel worm gear from a Limitorque valve positioner was examined during the month to determine the cause of failure which occurred during service. The worm was one of many that had failed as the result of fractured gear teeth, although no unusual operating conditions had been encountered to account for the unusual number of failures. Hardness tests performed by the Materials Testing Laboratory gave results of Rockwell C 60 and greater on the gear teeth. Also, macroexamination of the gear revealed numerous cracks on the face of the teeth which, in view of the high hardness, suggested quenching cracks. The microstructure was indicative of a steel that had been improperly heat treated, exhibiting extremely coarse untempered martensite near the surface, and becoming somewhat finer near the bottom of the teeth.

An unusual defect having the appearance of a seam or superficial scratch running the entire length on two eight-inch aluminum jackets was investigated for Fuels Preparation Department. A microscopic examination disclosed that the defect was caused by a lap or fold in the jacket and was probably a carry-over from the blanks from which the jackets were impact-extruded. The jacket defects were of such a magnitude that ruptures might have results during reactor operation. This emphasizes the stringent inspection that must be exercised to insure the integrity of the fuel elements.

Samples Processed During the Month

Total samples processed: 231

Photographs:

Micrographs	378
Macrographs	64
Total	442

The following Trips and Visits Reports apply to activities on 2000, 3000, and 4000 Programs. Technical activities on the 4000 Program are reported separately in HW-52303 A2.

F. W. Albaugh

Manager, Reactor and Fuels Research
and Development Operation

FW Albaugh:kb

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JW Riches PJ Pankaskie	8/1	Chase Brass & Copper, Waterbury, Conn.	Consultation on the fabrication of Zr tubing	A Blanc	No
WJ Gruber	8/7-9	U of Denver, Denver Research Institute, Denver, Colo.	Attend 6th Annual Conference on Industrial Applications of X-Ray	--	No
RL Dillon	8/22 8/23	ANL, Lemont, Illinois Alcoa, New Kensington, Pa.	Consultations on aluminum alloys	JE Draley RH Brown	Yes No
PJ Pankaskie	8/28-29	Superior Tube Co., Norristown, Pa.	Consultation on Zr fabrication	HW Cooper	No
WE Roake	8/5-7	Phillips Pet. Co., Idaho Falls, Ida.	Consultation on irradiation testing	R Neidner	Yes
DL Gray	8/6-11	U of Denver, Denver Research Institute	Attend Industrial X-Ray Conference	--	No
RL Hales	8/16-19	Natl. Bureau of Standards, Boulder, Colo.	Attend Cryogenic Conference	--	No
JE Minor	8/22-23	Atomics Int'l. (N.A.A.) Canoga Park, Calif.	Participate in discussion among BMI, ANL, NAA, & HAPO on behavior of fuel materials	BR Hayward	Yes
GS Allison DC Kaulitz	8/27-28	Sutton Eng. Co., Pittsburgh, Pa.	Discuss fluidized beds for UO_2 preparation	W Larson	No
	8/28-29	ANL, Lemont, Ill.	" "	N Levitz	Yes
	8/29	Kux Press Co., Chicago, Ill.	" "	J Kux	No
RJ Anicetti	8/28-29	ANL, Lemont, Ill.	" "	N Levitz	Yes
	8/30	Norton Co., Worcester, Mass.	Discuss UO_2 fabrication	F Huke	Yes

VISITS TO OTHER INSTALLATIONS (Cont)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
WL Thorne	8/12-15	State College, University Park, Pa.	Attend Natl. Heat Transfer Conference	--	No
	8/16	WAPD (Bettis Plant) Pittsburgh, Pa.	Consultation re heat transfer studies pertaining to thermal burnout	S Green & BW LeTourneau	Yes
PA Scott JO Ludlow	8/15	Bingham Pump Co., Portland, Ore.	Discuss proposal for full size PRPR pump	JT Rayner	No
JA Ayres	8/22	ANL, Lemont, Ill.	Consultation on aluminum alloys	JE Draley	Yes
	8/23	Alcoa, New Kensington, Pa.		RH Brown	No
OJ Wick ID Thomas	8/12-13	UCRL, Livermore, Calif.	Discuss Project Whitney problems	WJ Ramsey	Yes
JM Jefferes	8/15-16	True Trace Sales Corp., El Monte, Calif.	Discuss engineering problems on mill conversion	LM Cross	No

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
PB Bass	8/4-6	ANL, Lemont, Ill.	Discuss design of Pu lab. facilities	OJ Wick ID Thomas	Yes	231, 234-5; 200 W
L Kelman		"				
HB Adler		"				
WH Finkeldey		Singmaster & Breyer, New York, N.Y.	" "	"	"	"
JT Hubbel		"				
J Burgess		"				
H Reh		"				
H Reinig		"				

VISITS TO HANFORD WORKS (Cont)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Area Visited
RF Elk	8/26	UCRL, Livermore, Calif.	Observe & discuss Pu lab. facilities	LG Merker	Yes	231; 200-W
JD Rogers	8/5-6	Phillips Electronics Inc., Mt.Vernon, N.Y.	Service electron microscope	TK Bierlein	No	326; 300
RJ Beeley	8/21	Atomics Int'l., Canoga Park, Calif.	Discuss Plutonium Recycle Program	JR Triplett A Fowler	Access Permit	713; 700
RC Ross	8/23	Nuclear Dev. Corp. of America, White Plains, N.Y.	Consultation re thermal-dynamics	JM Batch WL Thorne	Access Permit	189-D; 100-D
B Tarrant	8/28	Ingersol-Rand Co., Seattle, Wn.	Consultation re heat transfer pump problems	JM Batch ME Shockley	Yes	189-D; 100-D
TW Hunt	8/28 8/30	WAPD (Bettis Plant) Pittsburgh, Pa.	Consultation on various heat transfer problems of mutual interest	JM Batch WL Thorne	Yes	189-D;100-D
KE Kline MH Binstock	8/21	Atomics Int'l., Canoga Park, Calif.	Discuss organic coolant fuel elements	DR deHalas C Groot	Access Permits	326; 300 and 105-KE; 100-K

AL-23

PLUTONIUM RECYCLE PROGRAM

MONTHLY REPORT - AUGUST 1957

REACTOR & FUELS RESEARCH & DEVELOPMENT OPERATION

Plutonium Fuels Development

Al-Pu Alloy Capsules for MTR Irradiations (GEH-3-24). Two capsules of Al - 1.65 w/o Pu and two capsules of Al - 12 w/o Si - 1.65 w/o Pu alloy have been irradiated in the MTR to determine the irradiation behavior of this material. These capsules were Zircaloy clad and unbonded. At the requested flux of 2.9×10^{14} neutrons/cm^2-sec, they would have operated at a specific power about three times that which is expected in the PRPR and at a core temperature of about 340 C. A Co-Al alloy wire was irradiated with the specimens, and the actual flux values, as determined by measurements on the wire, show them to be much lower than the requested flux. The actual fractional burnup of Pu atoms in the capsules ranges from 9 to 25 percent instead of the requested 25 to 50 percent. The two capsules which have the highest burnup, i.e., 15 to 25 percent, will be examined in the Radiometallurgy facility as soon as possible. The other two capsules whose burnups range from 9 to 15 percent will be returned to the MTR for an additional exposure of two cycles. This will give a burnup on these capsules of 40 to 60 percent of the Pu atoms. These capsules are scheduled to begin reirradiation in the next MTR cycle.

Pressure Filled Fuel Elements. Experiments have been initiated to explore the possibility of fabricating Pu-Al fuel elements by a method in which the tube or can is pressure filled with Pu-Al alloy. Mockup elements have been made by filling stainless steel and zirconium tubes by applying a vacuum to one end of the tube and inserting the other end into molten Al, thus sucking the molten fuel material into the tube. A 3/4" OD stainless steel tube with a 0.035" wall and 65" long was filled with molten Al by this method. Also, a 35" long zirconium tube was filled by this method. Bonding between the Al and stainless steel was noted. Radiographs are being made of the filled tubes to check for internal voids and/or piping. This method of fuel element fabrication appears very promising from the standpoint of reducing Pu fuel element fabrication costs.

Casting Directly Into Cans. Several attempts were made at casting Al directly into Hanford sized slug cans with the thought in mind of using this composite billet as an extrusion or rolling blank. Al was successfully cast into slug cans which were surrounded with a steel canning sleeve which had been preheated to 205 C. There was good bonding between the cast Al and the can material. The Al was cast at 815 C. Internal shrinkage pipes were avoided by the use of a hot top. Casting directly into Al cans followed by extrusion or rolling would be an attractive method of fabricating 1/2" diameter PRP fuel rods because the material could be worked in relatively uncontaminated surroundings, thus simplifying the fabrication process.

Die Casting. A development program on pressure injection casting Pu-Al alloy directly into the can is being pursued. This method differs from the vacuum filling method in that a hydraulic piston would inject the Pu-Al into the can

more rapidly and at higher pressures. A design for such an apparatus has been worked out and has been submitted to the shop for fabrication. The first casting will be made into stainless steel jackets rather than zirconium.

Powder Metal Extrusions. Extrusion of powdered mixtures of Al and PuO_2 is being considered as a possible fuel element fabrication scheme. Cold compacting and hot extrusion of 2S Al powder was attempted in the same die. A billet temperature of about 200 C was found to be too low for satisfactory extrusion with the available press facilities. An extrusion ratio of 9 to 1 was used. This work will be continued when the larger extrusion press becomes available. Precautionary experiments will be conducted to investigate the possibility of a thermite type reaction with these types of materials.

Thermal Cycle Experiments. Thermal distortion and ratcheting effects in long fuel elements such as those anticipated for the PRPR could be a very serious problem. Thermal cycling experiments are being conducted with long lengths of prototype fuel elements consisting of pure Al or Al-Si canned in stainless steel, Al, and Zircaloy tubes to determine whether there is a differential growth problem due to thermal ratcheting. A furnace capable of uniformly heating 9-foot long sections of fuel elements was fabricated using a 1" OD stainless steel tube heated by direct resistance heating with a 2000-amp transformer. The tube is insulated with magnesia pipe insulation and temperatures as high as 425 C have been easily obtained. Prototype fuel elements are being fabricated for these experiments.

Fuel Material Corrosion Studies. A capsule 1/2" in diameter by 2" long containing the high temperature water corrosion resistant Al alloy, M-388, with an addition of 1-1/2 w/o U and canned in Zr was defected and exposed to high pressure steam in an autoclave. The defected capsule was autoclaved for 24 hours at a temperature of 350 C. After autoclaving, the specimen showed no increase in outside diameter; however, it did increase 0.0015" in length. The jacket had a circumferential crack about 1/8 of an inch down from the fusion welded cap closure and extended about two-thirds of the way around the cylindrical surface. Metallographic examination of sectioned samples of the can material indicated the presence of Zr hydride, especially in the vicinity of the crack area. It was estimated that the amount of hydrogen present was in the order of 100 to 200 ppm. The Zircaloy cladding which contained about 10 ppm of hydrogen, originally, picked up the hydrogen that was generated from the corrosion of the M-388 to the extent that embrittlement occurred, thus causing the material to crack.

Fuel Element Cluster Studies. A full size NPD type 19-rod cluster fuel element is being fabricated for hydraulic flow and thermal distortion tests in the KE flow laboratory. Type 304 stainless steel is being used for the jacketing material and the end fixtures. The core material is 2S Al rod swaged and drawn to final size. This element will have a fuel core length of 7.3 feet.

Extrusion Press. The 125-ton extrusion press and supporting frame have been received and the press frame alterations which are necessary for hood operation are one-half complete. The necessary tooling for uncontaminated operation of the press is virtually finished and detailed hood design has been initiated. This press will be installed in the 272-Z Building for initial experiments.

hours. Without the activation step, a density of only 74 percent of the theoretical was obtained at this relatively very low temperature. This investigation is being extended to include the compacting pressure as a variable.

Swaging of Uranium Dioxide. The feasibility of swaging as a process of manufacturing uranium dioxide fuel elements probably depends more upon the reproducibility of the product than upon the maximum density achievable. Consequently, a study is in progress to determine the important variables in the swaging process and the reproducibility of the results. Eighty-one percent of the crystallographic density has previously been obtained with density variations along the full length of swaged capsules being less than ±1 percent. Significant among the results of the past month is the observation that although densities attainable with various uranium dioxide powders varied greatly (between 76 and 89 percent of the theoretical), for any given powder, densities were reproducible within ±1 percent. The highest densities were obtained with sintered and ground uranium dioxide. Experiments also were conducted to determine densities obtainable by hot swaging a number of uranium dioxide powders. A notable result was attainment of a density of 94 percent of the theoretical in a sample of powder which had been sintered and ball milled prior to swaging at 600 C. These swaging studies have employed 300 Series stainless steel jacket tubes.

Fabrication of PCTR Fuel Elements. A complete set of nested tubular uranium dioxide fuel elements, each of them consisting of two concentric tubes and an axial rod, was completed and delivered to the Physical Constants Testing Reactor, where they are to be used for reactivity studies conducted in support of the Plutonium Recycle Program.

Fuel Element Mock-Up for Hydraulic Testing. One full-scale mock-up of a three-component fuel element (two concentric tubes and axial rod) was fabricated for hydraulic analysis. The mass distribution of uranium dioxide was simulated by use of isostatically pressed lead rings. Cladding components are stainless steel. The unit has been delivered to Thermal Hydraulics Operation.

Fundamental Studies. Fractographic studies are being conducted on unirradiated uranium dioxide to determine mechanisms of deformation and fracture. These studies will be extended to include irradiated uranium dioxide. Tensile specimens for a special hot stage tensile unit were fabricated. Pre-formed specimens 2.50" long x 0.50" wide x 0.125" thick were isostatically pressed at 45,000 psi and sintered at 1750 C for eight hours in hydrogen to 92 percent of the theoretical density. Preliminary examination of rods fractured by impact at room temperature and by thermal shock from 150 C indicated that the mechanism of fracture in both specimens was identical. Transgranular cleavage predominated and deformation markings, slip lines or twin bands, indicated that some plasticity was present in the specimens. Informal reports were issued pertaining to "Feasibility of a Solar Furnace for Ex-Reactor Thermal Studies," and "Feasibility of a Plasma-Jet Furnace for Ex-Reactor Thermal Studies."

Preparation of Enriched Uranium Dioxide. Fifteen hundred grams of 2.40 percent enriched uranium dioxide was prepared. The enriched uranium dioxide will be used as a substitute for plutonium-bearing uranium dioxide for in-reactor studies of proposed fuel elements. The uranium dioxide was prepared by ball milling enriched

UO_3 containing 3.17 percent U-235 with the required amount of natural UO_3, and reducing the mixture with hydrogen at 1100 C. In order to obtain a free-flowing powder, the uranium dioxide was mixed with an aqueous solution of Carbowax, dried, and granulated. The Carbowax was volatilized at 800 C in a hydrogen atmosphere. These steps resulted in a powder suitable for isostatically pressed fuel elements.

Thermocouple Fuel Element. Four inches of 1/2" thick uranium dioxide wafers having a 1/16" hole for insertion of a thermocouple were prepared for use in a fuel element which will be irradiated to check methods of temperature calculation. The wafers were cut with a diamond wheel from fuel element cores previously ground to the required OD and ID of 1.378" and 0.524", respectively. The wafers were faced on each end until the ends were parallel and perpendicular to the sides, using a specially prepared holder on a surface grinder. The thermocouple holes were drilled with a Carboloy drill, using a template to position the hole accurately. The fuel element incorporating these wafers and thermocouple will be irradiated in the MTR.

Cold Forming Aluminum PRP Components. A drawing die has been designed and installed in the 306 Building drawbench in preparation for the drawing of aluminum rods. To aid the drawing operation by reducing the skin friction and improving the surface quality of the finished material, a phosphate coating for the aluminum was developed. An area reduction of 9.5 percent per draw is possible by this method as compared to six percent achievable with other lubricants.

Mechanical Equipment Development

Construction Operation forces have started the installation of the Single Tube Prototype Facility. All equipment for Phase I of the facility is now on order except the primary pump. Bids for this item and the full size PRPR pump for Phase II Testing are now being reviewed.

The PRPR Process Tube Inlet Assembly was cycled on ELMO-7 at 1300 psig at temperatures from 310 to 530 F. No leaks developed during the first 217 cycles. At this time the connections were loosened and retightened to simulate jumper replacement on the reactor. Testing was continued to over 300 cycles although the assembly leaked during this period. Possible reasons for the failure to reseat upon tightening were:

1. The threads of the assembly were not relubricated before retightening.

2. The loop was filled with particulate matter from a melted dummy fuel element. Some of this material drained into the assembly connections when they were loosened.

The assembly has been reworked to clean up the fitting threads. New tubing with 0.083" wall thickness has been installed to allow a higher testing pressure. The fitting flares are being carefully lapped in order to allow lower torque requirements in tightening the connections.

To determine the design of the Nozzle-to-Process Tube Assembly, two sections of Zircaloy-2 imitation process tube were made and tested to destruction. The process tube shoulder which was built up by welding failed at 105,700 pounds or a stress of 72,800 psi. The spot welded shoulder failed at 85,900 pounds or a stress of 59,200 psi. The actual test assembly will be fabricated with shoulders built up by welding.

The nozzle cap assembly has been revised to agree with the latest design. The cap and nozzle will be made of dissimilar stainless steels to prevent galling. The bottoms of the cap tightening bolts will be rounded and will fit into corresponding indentations of the cap. This arrangement will reduce the torque requirements for tightening the cap.

A working model of the PRPR electrically operated fuel element hook for charge-discharge has been fabricated. Functional tests of this hook with a simulated fuel element will begin shortly.

The calandria mock-up is approximately 10 percent complete. The revised estimated completion date is October 1. Work on the facility was stopped during the latter part of the month due to the emergency need for Construction Operation forces in the 200 Areas. A capacitance probe, shield, and holder to indicate the liquid level inside the calandria are currently being fabricated. This system will be tested for sensitivity, response, and accuracy.

The final design of a wrench to install and remove the jumper to nozzle connection Parker Fitting Nut has been completed. A prototype model is being fabricated in the Technical Shops.

Development work is proceeding on the layout and arrangement of the outlet jumpers. A tentative new arrangement to result in less stress concentration has been formulated. Detailed drawings of this arrangement are being prepared in order that a one-quarter scale model of a portion of the reactor face may be built. This model will be used to check the space arrangement of the jumpers, and as a visual aid. After the completion of the reactor, it will be used for instructing maintenance personnel. Preliminary investigations have started on the possible use of expansion joints and flexible sections in the jumpers.

All tentative design criteria have been surveyed with regard to equipment and material testing to be recommended. Several suggestions for operating procedures have been outlined. The preparation of a report on the proposed testing program has begun.

The installation of the control rod test facility continued during the month. The test chamber providing a hot humid atmosphere for the testing of motors will be in operation first. The estimated completion date for the facility is October 1.

Shielding Calculations

Incident fluxes on the PRPR shield became available from an IBM calculation, so the resulting radiation leakage was calculated. The top shield leakage was found to be 0.7 mrem/hr from primary neutrons, which is much less than the 5 mr/hr

expected from activated coolant. Activation of steel in the coolant circuit is calculated to be 7 mr/hr above the primary shield just over the reactor. The radial shield neutron leakage is negligible, but the dose from secondary gammas from neutron capture in the thermal shield is calculated to be 0.7 mr/hr with a D_2O reflector. Secondary gammas will be negligible with an H_2O reflector.

A rough calculation of heat generation in the shields shows 0.66 megawatt to be dissipated in the shields. This calculation will be refined when primary gamma and photoneutron fluxes are specified.

Irradiation Testing

A test proposal, HW-52006, was issued for the irradiation of plutonium-graphite fuel material.

Coolant Systems Development

The 19-rod cluster fuel element was removed after running for 680 hours at 300 C, 1600 psi. One of the rods was found to be ruptured in the form of an irregular tear. The rupture was apparently caused by failure of a weak spot in the tubing. Water analysis disclosed this incident occurred after about 500 hours of operation. It should be definitely pointed out that this rupture does not indicate any defect whatever in the actual 19-rod cluster design since no material in the element tested is specified for use in the actual element. All carbon steel spiral wire windings on the elements were found to be elongated about a half inch. Checks are presently being made to determine whether this resulted from a difference in thermal expansion between the carbon and stainless steels. A document on the complete results of the testing will be issued when this checking is completed.

A study of the PRPR secondary cooling (light) water system by representatives of the Betz Laboratories, Inc., indicates that standard Zeolite softening of the 300 Area plant supply water, with no steam recirculation beyond that required for deaeration, is the most economical treatment for the preparation of secondary cooling water. This treatment will require boiler blowdown rates greater than 65 gpm. This Zeolite softening is the treatment presently specified in the design criteria for PRPR secondary cooling system. Corrosion, scale formation, or other problems, caused by high CO_2 or SiO_2 concentrations in the boiler feed water should be adequately controlled by the high rate of blowdown. However, the effect of high chloride concentrations in the boiler feed water on stress corrosion cracking of the stainless steel steam generating equipment is not known. Tests are being designed by Coolant Systems Development Operation to measure the effects of this chloride concentration on stainless steel corrosion in 300 Area water.

The effect of local boiling of the PRPR moderator in contact with the aluminum shroud tubes on the corrosion of these tubes at the surface of the moderator liquid has been studied by Coolant Systems Development Operation. Review of work performed at Columbia University in which demineralized light water was subjected to local boiling on the surface of aluminum tubes indicates that these conditions will not cause significant corrosion of aluminum shroud tubes in the PRPR. Corrosion pit depths of two mils were the most severe effects found during exposures as long as six months in the Columbia University tests.

Thermal Hydraulics Studies

Preliminary tests of candidate flow nozzles which will be used to feed the moderator to the calandria were performed. These nozzles must demonstrate ability to provide complete mixing of the D_2O in the calandria to prevent hot spots from forming with a resulting change in density of the moderator.

The tests were run in a large water filled tank by using one nozzle placed in the center of a five-tube array conforming to the shroud tube geometry. Results indicate that there will be considerable mixing of the moderator even though the pressure differential across the nozzles is only four psi. The mixing was especially good in the upper half of the tank.

A study was made of the transient occurring after the failure of either an inlet or outlet header on the primary cooling system of the PRPR. The worst condition was the failure of the outlet header. It was determined that after 0.05 second the amount of water present in the active section of the process tube would be decreased to about 50 percent of its normal value.

Fabrication of Zircaloy Process Tubing

Two process tubes fabricated by the Chase Brass and Copper Company were shipped to HAPO. Difficulties were encountered during sizing and straightening of these tubes with the result that the ID of the tubes varies from 3.210" to 3.245" instead of the specified 3.250" plus or minus 0.010". These tubes will be satisfactory for initial development of techniques to fabricate the flange and end taper required on the completed tubing. Chase will utilize the two remaining extrusions to test other finishing techniques.

Allegheny Ludlum successfully pierced three billets for extrusion of PRPR process tubes early in September. Tube reducing of these tubes should be accomplished during September and October.

Fuel Element Sheathing - Nested Tubular Element

The Damascus Tube Company was unable to roll-form satisfactory 1.804" ID tubing because of excessive camber and edge waviness of the Zircaloy strip. The balance of the strip was shipped to HAPO where preparations are being made to stretch straighten and roller level the strip. If successful, the strip will be suitable for brake forming and welding. Damascus will attempt to fabricate the 2.154" ID tubing on September 5. NTH has welded some 3.000" ID tubes; however, difficulties were encountered during sizing. The tubes are being straightened prior to sizing to minimize scoring.

A program to assist the vendors with the problem of sizing Zircaloy tubing was initiated. Encouraging results were obtained using a nylon die. The program will emphasize new die materials and lubricants.

Plutonium Fuel Cycle Analyses

Plutonium fuel cycle analysis studies have pointed out that different reactor designs may be required to optimize for burning plutonium instead of U-235. Since Pu-240 is a fertile material analogous to uranium-238 except that it has

a 100-fold greater cross section, a reactor designed to operate efficiently with plutonium elements containing Pu-240 should have a higher resonance escape probability than one designed for U-235 elements. Further studies will point up the magnitude of design differences required to optimize various reactor types for burning these two alternative fissionable fuels.

Experimental Reactor Design

General. All design criteria for the PRPR have been issued. The detailed design for Phase I is 79% complete; overall detailed design for the PRPR is 10% complete. Phase I includes the containment vessel with inside structural concrete, storage basin, and a portion of the basement area of the service building.

The scale model of the PRPR is 75% complete.

A study was started during the month of changes required in the reactor design if the reactor were converted to use organic coolant.

Core Components. An analysis of the pressure drop around the calandria top drain header has shown that it is possible to maintain a uniform outflow circumferentially around the vessel. This is accomplished by using one orifice size but changing orifice spacing around the vessel.

Analysis of the pressure drop around the moderator inlet header shows that satisfactory moderator distribution to the inlet plenum may be achieved with one orifice size and uniform spacing between. The pressure drop around the header is small compared to the pressure drop through the orifices.

Reactor Piping. A new outlet jumper piping arrangement was laid out, incorporating an expansion loop to reduce stresses in the piping caused by thermal expansion. A 1/4-size model of this layout is being planned by Mechanical Equipment Development Operation.

A program was developed with Mechanical Equipment Development Operation to test the structural integrity of the jumper piping. An outline of the tests required and equipment and material needed was formulated.

Process Tubes. In order to expedite Zircaloy-2 tube fabrication for the experimental reactor, it is planned to order five finished tubes from each of two vendors for delivery in March 1958, and (pending the availability of project funds) to order the PRPR tubes in June 1958, based on quality and price of the five-tube lots. Delivery of tubes to be installed in the reactor will be required in April-July 1959.

An aluminum tube design for temporary use is being prepared as a back-up alternative in place of Zircaloy tubes. With aluminum tubes, the PRPR could be operated at full power (70 MW) at a bulk D_2O outlet temperature of 347 F (175 C) or somewhat higher, using a primary coolant pH of 4.5 to 5. Aluminum alloy X2219 was chosen for this application since it should require the least development in order to procure satisfactory tubes. Ten tubes will be ordered and tested concurrent with the 5-tube-lot Zircaloy tube orders, so that a full set of these aluminum alloy tubes could be procured in time for reactor startup if necessary.

Process Piping and Equipment. Revision Request No. 114-1, revising blowdown and feedwater flows in accordance with the recommendations of Betz Laboratories, Inc., was submitted for approval.

Preliminary calculations were made for an economic balance of primary loop parameters.

Control and Safety Systems. Design criteria for the control and safety systems were approved and issued.

Descriptions of the PRPR primary control system and the automatic controller proposed for the reactor were sent to interested instrument vendors.

Instrumentation. The design criteria for instrumentation were issued in approved form.

Shielding. The shielding design criteria were approved and issued.

Helium System. The helium system criteria were approved and issued. Inquiries were sent to prospective vendors concerning design of the helium compressors. Another inquiry has been sent to L'Aire Liquide of France concerning the applicability of their diaphragm compressors for this service.

Thermal Stress Analysis. Temperature distributions in selected components of the primary cooling circuit have been determined for specified conditions of cool-down. Work is proceeding on the determination of thermal stresses in these components.

Building and Site. The design criteria for outside facilities were issued. Scope revisions 99-1, 99-2, and 99-3, were issued revising portions of HW-48099, "PRP Reactor Building and Services Criteria."

Alternate Reactor Site. Work was started on scope criteria for the alternate PRP Reactor area approximately 2-1/2 miles north of the 300 Area. The new area would be identified as the 500 Area. Work was begun on criteria for the boiler plant and auxiliaries for this area.

Reactor Physics

Fuel Cycles. Formulation of the characteristics of a two region plutonium recycle reactor for programming on the IBM 650 computer is essentially complete. This program has as its goal the extension of the uniform analysis to a more general system which allows the following:

1. Uniform or spike enrichment.
2. Inert or depleted uranium carrier for spike Pu.
3. Non-uniform flux.
4. Removal of Pu from the system (for example, process losses).

Use of this program is anticipated in the evaluation of a wide variety of plutonium recycle systems.

A preliminary draft of the report on the uniform analysis was distributed as HW-51957-RD, "The Effect of Moderator Temperature on Maximum Attainable Exposure in Plutonium Recycle Operation," by J. L. Carter.

Lattice Physics. P-3 flux distributions were calculated for the PRPR lattices previously tested in the PCTR, with the object of determining the magnitude of the flux depression in the aluminum surrounding the central cell. It was found that in the eight-inch lattice this aluminum produces a 6% flux depression. Thermal utilization values were also obtained for PCTR lattices containing concentric-ring UO_2 fuel. The results are:

$f = 0.931$ (dry)

$f = 0.929$ (D_2O coolant)

$f = 0.863$ (H_2O coolant)

Additional cases have been set up but not yet processed through the IBM 650 computer.

Reactor Calculations. A description of the techniques used in carrying out 3-group reactor calculations has been prepared for distribution. This report, "Use of VALPROD-I Code in 3-Group Reactor Calculations," HW-52349, J. J. Regimbal, is designed as a supplementary instruction manual for the benefit of subsequent users of this and similar codes.

A report, "PRPR Gamma-Ray and Neutron Heat Generation Calculations," HW-52347, J. R. Triplett, has been prepared. This report presents work during the month in support of the reactor design studies. The following results are derived in the report:

1. Gamma intensity and current incident on top and bottom shields with and without reflector.
2. Gamma intensity and current incident on the radial thermal shield.
3. Gamma intensity and current incident on the radial biological shield.
4. Heat generation in the top and bottom shields.
5. Heat generation in the calandria tube sheets and tubes.
6. Heat transferred to the coolant loop, moderator loop, reflector, and shield cooling loops.

Safeguards Analysis

The Preliminary Safeguards Analysis, document HW-48800, was published and transmitted to the Atomic Energy Commission.

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATION

MONTHLY REPORT

AUGUST 1957

FISSIONABLE MATERIALS - 2000 PROGRAM

METALLURGY

Nuclear Safety, Critical Mass Consultation

Fuel Preparation Department

Specifications were determined to simplify plant handling procedures for 0.96 percent enriched U-235 fuel together with natural uranium. Since these simplified specifications were within the existing process specifications, no new formal specifications were required.

REACTOR

STUDIES RELATED TO PRESENT PRODUCTION PILES

Dry 7-1/2" Graphite Lattice Temperature Coefficient

Preparations are being made to begin these temperature coefficient measurements in the PCTR the middle of September. Work this month included fabrication of central cell-graphite pieces, minor modifications of the vacuum oven, and the irradiation of nickel-coated Pu-Al alloy foils to determine the extent of the corrections in the gamma counting of these foils due to the nickel coating. It was found that a 0.0015" coating gave corrections of from 1 to 6 percent in the Pu counting rates. It is expected that we will receive information on the stability of these coatings at oven temperatures soon from Plutonium Metallurgy Operation. At that time, specifications on the foils will be drawn up and submitted to Plutonium Metallurgy Operation.

A letter of specifications has been sent covering work to be done by the same group in preparing experimental, sectioned slugs of the 1000, 2000, and 4000 MWD/T synthetic exposure type.

Neutron Cross Sections

Cold Neutron Cross Sections

The liquid nitrogen cooled beryllium filter is now operating satisfactorily as a filter to allow cross-section measurements in the energy region below 0.005 ev. A mica crystal is being used as a monochromator. Fission cross section measurements have begun on U-235. Preliminary data have been obtained which show the expected 1/v variation over the energy interval 0.003 to 0.005 ev with a statistical precision of 1.5 to 5 percent.

A multiple plate boron chamber with 12 thin boron foils has been assembled and put into operation as a total cross section detector for the cold neutron energy region. This chamber has a much better ratio of counts to background than a BF_3 detector for these measurements. Preliminary measurements made on the total cross sections of U-235 and gold with the BF_3 detector were unsatisfactory and will be repeated with the new boron chamber.

Time-of-Flight Equipment

The channel address scaler of the 256 channel analyzer has been modified to operate at an input of 4 megacycles per second rather than the design frequency of 2 megacycles per second. This change was necessary for the analyzer to accept the output of the vernier chronotron. The analyzer has also been modified to accept the digital output of the chronotron and has been operated routinely as a data storage unit for the chronotron. The analyzer modifications were made in such a manner that it can also be easily used as a pulse height analyzer when desired.

Studies are underway to determine the timing errors involved in the detector photomultiplier tube used as an input to the chronotron. The RCA type 6810 phototube is the only tube known capable of producing pulses of the size required to drive the chronotron. The time response of the phototube was studied using a spark gap light source as a precision timed, variable strength source. Timing errors as large as 6 m μsec were found to result from a large variation in the size of the light pulse. Delay line pulse clipping was found to reduce this time spread error to less than 0.5 m μsec for a particular phototube over the range of pulse sizes 0.1 to 3 mev equivalent electron energy. This resolution is comparable to that obtained with other phototube types.

Neutron Thermalization Problem

J. L. Powell, physics consultant from the University of Oregon, has provided an integral equation technique, adaptable to arbitrary moderator temperature distribution, for the examination of the problem of determining the neutron energy spectrum and spatial distribution in a medium composed of two regions, each at a different temperature.

Resonance Escape Probability

Calculations are being made on the IBM-702 of effective resonance integrals for several rod sizes, for the important known resonances in U-238, under the "narrow resonance" approximation, in which U-238 is assumed to be a good moderator. This work, when combined with previous infinite-mass U-238 calculations, is expected to provide U-238 effective resonance integrals in fairly satisfactory agreement with experimental determinations.

2000

REACTOR

STUDIES RELATED TO FUTURE PRODUCTION PILES

Improved Production Reactor Studies

Material buckling measurements have been continued for the 1.66" natural uranium

fuel elements in the small exponential pile facilities. The fuel elements were enclosed in 1.735" O.D. - 0.028" thick aluminum cans. These fuel assemblies were centered in 2.125" O.D. - 0.065" thick process tubes resulting in a coolant annulus volume of 5.06 cc/cm. The results of the measurements completed this month are given below:

	Buckling x 10^6 (cm^{-2})		
Lattice Spacing	MTPB	H_2O	Air
9-3/8"		96 ± 10	143 ± 10
7-3/16"		65 ± 10	33 ± 10
6-3/16"	60 ± 10	25 ± 10	-157 ± 10

These results, together with data already reported, are sufficient to define the maximum and cross-over buckling for the H_2O and air-cooled lattices. It is also shown that there is a considerable difference at the tight lattice spacings in the air, H_2O, and MTPB cooled lattice bucklings.

Theoretical Evaluation of Lattice Data

A consistent set of parameters have been found that will allow one to calculate the material bucklings of dry lattices measured with the 1.66" solid and cored fuel elements. The measurements with these fuel elements were carried out in the dry eight-foot piles. Using a 2200 m/sec. value of 3.98 barns for the graphite absorption cross section, the experimental results were calculated with a fair degree of accuracy with a value for η of 1.285. The effective resonance integrals were obtained from the expression

$$\left(\sigma \frac{dE}{E}\right)_{eff} = 6.32 \left[1 + 4.6\ S/M\right] \times 10^{-24}\ cm^2$$

The calculated buckling values along with the experimental results are given in the table below:

	Buckling x 10^6 cm^2		
Lattice Spacing	Calc. Value	Exp. Value	Difference
	1.66" Solid Fuel Element		
6-3/16"	- 155.1	- 153.7	- 1.4
7-1/2"	39.0	73.3*	- 33.3
10-3/8"	110.4	119.6	- 9.2
12-3/8"	69.8	76.0	- 6.2
15"	1.6	- 4.3	+ 5.9

	1.66" O.D. x 0.81" I.D.		
6-3/16"	- 57.8	- 66.5	+ 8.7
7-1/2"	84.4	98.1	- 13.7
10-3/8"	102.8	109.3	- 6.5
12-3/8"	51.3	51.1	+ 0.2
15"	- 20.8	- 29.7	+ 8.9
	1.66" O.D. x 1.10" I.D.		
6-3/16"	1.7	2.9	- 1.2
7-1/2"	93.5	103.3	- 9.8
10-3/8"	67.4	73.0	- 5.6
12-3/8"	9.9	14.4	- 4.4
15"	- 60.6	- 61.4	+ 0.8

* The value measured in the small exponential pile facility for the 7-3/16" lattice spacing was 33 μ bucks. The 7-1/2" lattice data are now being investigated.

Au Cadmium Ratios

The multiple collision analysis of experimental gold foil cadmium ratios is at the advanced point of final integrations over the neutron energy spectrum. Preliminary cadmium ratios results for a 1-mil Au foil shielded by 40 mil of cadmium are within about five percent of the experimental value.

Fast Effect

The multigroup calculations of the ratio of U-238 to U-235 fissions for a wide range of rod sizes are consistently about ten percent higher than the experimental determinations of this quantity. The multigroup cross sections and analytical techniques are identical to those which have been used to compute to about one percent the critical masses of bare uranium assemblies ranging in enrichment from 5.5 percent to greater than 90 percent. It has been suggested that the discrepancy between calculated and experimental fission ratios may be, in part, due to the experimental assumption usually made that the gross gamma activity per fission is the same for U-238 and U-235. This suggestion is being explored.

Thermal Utilization, Thermal Flux, and Lattice Cell Shape

A formal report under this title (HW-52048) has been submitted to Technical Publications for processing. The abstract follows:

"Quantitative criteria are established to show that the propagated effect of a fuel rod in a lattice will be cylindrically symmetric if the lattice symmetry is high, if the lattice spacing is small compared with the moderator diffusion length, or if the fuel rod diameter is small compared with the lattice spacing. One or more of these conditions are ordinarily well met for heavy water and graphite lattices and for filled hexagonal (sixty-degree rhombic) light water lattices.

"Provided the propagated effect of a fuel rod is cylindrically symmetric, it is shown that the thermal utilization of a lattice array can be calculated exactly. Such a calculation involves the sum of a lattice array of zero order, modified Bessel functions of the second kind (i. e., K_0), and exact formulas for such sums valid for arbitrary diffusion length and lattice spacing are given for rectangular, open hexagonal, square, and filled hexagonal lattices and for the linear chain, by a refinement of the method of Galanin. For square and filled hexagonal heavy water and graphite lattices and for filled hexagonal light water lattices thermal utilizations so calculated differ only slightly from those provided by the usual equivalent cylindrical model.

"The Bessel function lattice sum technique is shown to provide accurate moderator flux traverses appreciably more easily than does a direct trigonometric series solution, since even the lowest order terms meet the cell boundary conditions exactly.

"The normalization of the Green's function for an infinite array of sink rods is shown to depend upon the radius of the rods and upon their proximity. If the rod radius vanishes, the Green's function reduces to the usual line sink approximation."

Analog Computing

A failure of the reference battery caused the computer to be inoperative for several days. Replacement has been made and operation resumed. While awaiting the arrival of a replacement battery, the computer was modified by the addition of ten, 10 UF condensers. This expands the time scale capacity of the machine and its ability to handle long-time constants.

A list of operating problems was presented to Goodyear Aircraft with the request for immediate corrective action. As a result extensive service will be performed by Goodyear in September on the Hanford machine.

Because many of the problems being considered for solution involve partial differential equations, solution by finite differences is being tried on the computer. This type of solution will be used on the one dimensional flux calculations with variations in buckling requested by IPD.

The introductory talk on analog computers was given to the following groups: Fuel Development Operation; Area Physicists, IPD.

To build up the log simulator it was first necessary to manipulate the kinetic equations in such a way that the neutron density and the fuel temperature appear on the computer in the form of logarithms and their derivatives. By so doing, reactor operation can be simulated through many decades of power.

Individual circuits for the delayed neutrons and the fuel temperature have been tested and are stable; however, the circuits have not, as yet, been successfully tied together.

STUDIES RELATED TO SEPARATIONS PLANTS

Dissolver Problem

Exponential experiments were continued with 1.007 percent enriched uranium in order to obtain additional data from which to base nuclear safety specifications for new dissolvers which are being designed for processing enriched uranium. The lattices used in the experiments were composed of 0.925" diameter rods positioned in a hexagonal pattern. The experimental work was continued along the following lines:

1. Further data was obtained on the reflector savings for enriched uranyl nitrate solutions as a function of U concentration and reflector thickness.

2. Measurements were taken to determine the effectiveness of a reflector when the lattice region is separated from that of the reflector with a thin stainless steel container.

3. The buckling was determined with 0.925" rods for the case in which the water moderator was replaced with an enriched uranyl nitrate solution containing 400 gm. of U/liter.

4. The buckling was measured for an enriched uranyl nitrate solution (homogeneous system) containing about 400 gm. of U/liter. Both Au foils and a BF_3 counter were used for neutron detection; the analyses of the data have not been completed.

The most significant information derived from the measurements this month are given below.

The experimental results indicate that for the case of the 1.6" lattice with the 0.925" rods (H_2O/U volume ratio of 2.15) a 1/16" thick stainless steel container between the lattice and reflector reduces the reflector savings of water by about 0.7 cm.; whereas a 3/16" thick container wall reduces the reflector savings by about 1 cm.

A large decrease in buckling was observed to occur when the water moderator was replaced with enriched uranyl nitrate solution. For the 1.5" lattice with the 0.925" rods, the buckling was reduced by about 2100 x 10^{-6} cm^{-2}. This result indicates that from the criticality viewpoint a much safer condition exists in plant dissolvers when the fuel elements are moderated with the uranyl nitrate solution; i. e., when the fuel elements are in partial states of dissolution and not moderated with pure water.

In order to reach firm conclusions regarding the latter point, further experiments are required with other enrichment levels to determine the dependency of the buckling on the enrichment of the uranyl nitrate solution.

Criticality Experiment

The experimental work in connection with the measurement of k_∞ for homogeneous slightly enriched UO_3-H_2O mixtures (criticality experiment) has been

completed; data analysis is in progress. A paper is being prepared for presentation at the Oct. 28-31 meeting of the American Nuclear Society covering this work.

Ra-Be Neutron Sources

Five Ra-Be neutron sources have been received from Atomic Energy of Canada Limited. Each source contains about 250 mg. of Ra with a Ra to Be ratio of 1 to 5; the neutron emission of each source is about 3.6×10^6 n/sec. These neutron sources will be used in Critical Mass Physics experiments. A sixth source is expected to be received in the near future which will complete the original order for six sources.

Pu Critical Mass Facility

Additional studies were made of the radiation hazards of possible bursts in critical assemblies in the proposed critical mass facility. Levels due to scattered radiation in the area surrounding the reactor site were determined for bursts of a given magnitude by making extrapolations of radiation intensities observed in the P-11 and two Oak Ridge bursts. This procedure required extrapolations in distance and solid angle of the radiation which escaped to the atmosphere. Only single scattering was considered. A graphical integration was performed applying appropriate scattering laws conservatively and assuming exponential and inverse square law attenuation of radiation.

The conclusion was reached that it was feasible to protect personnel in the vicinity of the reactor site from radiation bursts by excluding them from the area around the reactor site with a fence.

A document, HW-51828, was issued which gives the results of these calculations. This document also gives a brief summary of the bursts that have taken place in critical assemblies to date together with recommendations for burst magnitudes to be used as design criteria in the critical mass facility.

Nuclear Safety, Critical Mass Consultations

Organic-Aqueous Systems of Plutonium Solutions

A study was made of the nuclear safety of a layer of organic solution containing plutonium on top of a layer of aqueous solution containing plutonium for different concentrations of Pu in the two layers.

Continuous Task I and II Addition

At the request of the Research and Engineering Operation (CPD), a study was made to determine the nuclear safety of the addition of an extra vessel to hoods 9A and 9B in the 234-5 Building. Criteria for a safe vessel and its positioning in the hood were determined.

Enriched Dissolver Design

A study has been made of the preliminary annular dissolver design for Redox (for 0.96 percent U-235 fuel elements). Approval of the nuclear safety of

this design has been given (CPD).

Neutron Age Measurements

Foil and source handling techniques have been improved as a result of measurements made with a Ra-Be neutron source. The experimental equipment is now complete and measurements will begin as soon as reactor irradiations of the Na-Be neutron sources can be obtained.

REACTOR DEVELOPMENT - 4000 PROGRAM

STUDIES RELATED TO THE PLUTONIUM RECYCLE PROGRAM

PRPR Temperature Coefficients

An experiment has been undertaken in the PCTR to determine the "power" coefficient of the infinite multiplication factor for a 19-rod cluster of UO_2 fuel elements. Both possible cases, namely, with and without D_2O coolant, are being investigated using the D_2O calandria with an 8-inch lattice spacing inserted in the large cavity of the test reactor.

In the case with coolant, reactivity data have been taken over the process tube-temperature range from ~26° C to ~90° C. Preliminary results for this case indicate that the fractional change in k_∞ per degree centigrade change in temperature is $-(3.6 \pm 0.7) \times 10^{-5}$. The error is expected to be reduced by about 50 percent after the final data are analyzed. This coefficient refers to the case in which the effects of the expansion of the hot coolant is negated by keeping the total mass of coolant per unit length of rod constant. Except for small changes in the neutron temperature, the measured coefficient is $\frac{1}{p}\frac{dp}{dT}$, and is to be compared to an estimated value of -4.56×10^{-5}/°C quoted in HW-48800 RD, "Plutonium Recycle Program Scope of the Demonstration Reactor."

Fabrication of equipment to be used in the dry case (without coolant) is now in progress. Coverage of the temperature range from ~26° C to ~300° C is planned for this series of measurements. The dry coefficient should be less negative than the wet coefficient because the neutron temperature is constant.

D_2O - UO_2 - Pu Al Lattice Measurements

The nested cluster fuel elements were delivered to 305-B Building about the middle of the month. It was found that modifications in the moderator can for the test cell were necessary. The modifications should be completed shortly. The experimental fuel assemblies are being machined to hold copper foils for obtaining flux traverses.

Analysis of the PCTR data obtained for the 8" lattice with a fuel cluster containing 16 UO_2 rods and 3 Pu-Al rods has yielded preliminary values of k_∞ with air coolant of 1.115 and with D_2O coolant of 1.110. Since the wet-to-dry difference for this case has decreased from that found for the 7" lattice whereas the wet-to-dry difference increased for the 19 UO_2 rod case in going from a 7" to an 8" lattice, a second look at the data and interpretation for the cases reported here is in order.

Nuclear Safety, Critical Mass Consultations

At the request of the Plutonium Metallurgy Operation (Hanford Laboratories) nuclear safety criteria were provided for the design of an autoclave for plutonium-aluminum alloy fuel elements containing 1.6 percent Pu by weight.

Analog Computing

A report, HW-51398, "Simulation of the Kinetic Behavior of the PRPR," was issued. This completed the preliminary phase of the study of the reactor kinetics.

It was requested that we rerun the problem for normal operating power levels to aid in the design of the power generating equipment. The rescaling necessary to rerun the problem has been completed and, as soon as the erratic patch bay condition on the computer has been corrected, the problem will be run.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

Three field experiments designed to measure the vertical distribution of concentration of simulated stack gases at various distances up to 5000 feet from the source were completed; two of these experiments were successful. From the experimental data derived from these and previous experiments, it was possible to establish a functional relationship between the variance of the concentration distribution and the time after emission (or the distance from the source), which was accurate to within the uncertainty limits of the data.

Except for an anomaly in the slope of the variance versus time curve at the origin, the functional form fitted to these data permitted full utilization of Taylor's classical theory of diffusion and the resolution of the form of the Lagrangian correlation function appropriate to the vertical turbulent motions in stable atmospheres. This result, when coupled with the previous work of this Operation on the horizontal diffusion and meander of plumes in stable atmospheres, provided a much more rigorous and accurate solution of the problem of diffusion of stack gases in stable atmospheres than had been available heretofore.

The fundamental differences between the observed vertical diffusion rates and those predicted by widely used extensions of Taylor's theory, while strictly applicable for continuous elevated sources only, have also cast serious doubt upon the validity of estimates of atmospheric diffusion of materials emitted at ground level into stable atmospheres. Plans for modifications of present experimental techniques which will permit direct measurements of airborne and ground level concentrations at various distances downwind from a ground source were initiated.

The Portable Mast and its auxiliary equipment were prepared for further experimental work on the problem of wind erosion of small particulates. Alterations in the present experimental site due to an extensive range fire near the Benson

Ranch site have made that site unsuitable for erosion experiments and the Portable Mast is being returned to a site near the Meteorology Tower.

The first attempt to use wind tunnel facilities at the University of Washington for the calibration of wind instruments was made on August 31 and September 1. In general, the results were not satisfactory, due primarily to the inadequacies of the tunnel for this purpose. Further searches for a satisfactory calibration facility appeared to be required.

DOSIMETRY

Tests began on the feasibility of using the new pulse method of reading pencils with low charging voltages to decrease insulator leakage. At the low voltages, ion recombination might cause an error in measurement of dose delivered at a high rate. In an 8 mr/hr gamma-ray field pencils charged to 20 volts gave readings low by about 10%. This is probably acceptable for background work in any case, but background dose rates are two to three orders of magnitude smaller than 8 mr/hr and may result in still smaller error. Tests at lower dose rates require further improvements in the measuring techniques. Radiological Development Operation began to measure the leakage characteristics of pencils charged to low voltages. We are cooperating with them in a program to develop pencils as instruments for background measurements for Regional Monitoring and similar programs.

Phantom measurements with the Kadlec Hospital x-ray machine were completed.

Calibrations Operation feared that their radium sources might be leaking and requested our help in checking them. The body monitor scintillation counter detected radon and its decay products trapped in activated charcoal that had been stored with the source. About as much radium as normally found in the human body present as contamination on the outside of the source could account for the radon found. This much contamination would not be unlikely nor would it appear dangerous. If the radon is actually from a small leak, there is potential danger in further use of the source.

Annual maintenance of the Van de Graaff was completed. It is operating satisfactorily. The beam-deflection oscillator of the time-of-flight system was removed to be modified to work with the vernier chronotron system.

As another example of the use of the moderated neutron detectors, the average energy was measured by the double moderator technique for T(p,n) neutrons from a thick target. The results agreed with theory very well.

The measurements of w for protons are now under way. Calibration of the calorimeter for electron w measurements showed that further insulation was necessary.

The K source was recalibrated so that it could be used for routine calibration of film badges.

INSTRUMENTATION

The combination Alpha, Beta, and Gamma Hand and Shoe Counter is being modified to permit digital-type readout instead of the go or no-go indication of the green and red lights. The new system will employ glow-transfer decade scaling tubes

and register indication.

The prototype Portable Scintillation Beta-Gamma Dose-Rate Meter was modified to operate more reliably. The modification consisted of changing the multiplier phototube dyanode voltage and utilizing a different type of multiplier phototube.

An audio amplifier was modified for use in the routine calibration of poppy-type instruments. The audio pulses are amplified and applied to a scaler.

An investigation was started of proximity sensing devices for use with an experimental robot monitor. The robot monitor is visualized as an instrument which can scan automatically the floor of a room and provide information relative to radioactive contamination on the floor. A major problem in the development of such a device is that of sensing obstacles and holes.

The mechanical design was completed on the combination alpha, beta-gamma Air Filter Counter. The completed instrument is expected to replace the two instruments presently required for the same measurements and to result in higher reliability of readings. Two such instruments were requested by the Chemical Processing Department.

The detection of air alpha contaminants is complicated by the relatively high level of the naturally occurring alpha emitters. An investigation was started on a method of reducing the effects of the natural background by boiling the background off of a sample while retaining the contamination. A sample could then be counted for alpha contamination within several minutes after collection.

Development on the Zinc Sulfide Particle Detector for the Atmospheric Physics Operation is continuing. A system of shutters was fabricated to allow the exposure of the filter first to an incandescent lamp and then to a multiplier phototube. Another technique that appears promising involves the exposure of the filter to a radioactive source while the filter is being viewed by a multiplier phototube.

Acceptance tests were completed on 26 new HAPO GM's and started on 52 more. There are 19 more, out of a total order of 97, to be received. Evaluation tests were completed on three vendor-made prototype CP-TP high-range Dose Rate Meters of which 22 are on order. Evaluation of the Spear Transistor High Voltage Supply and of the Spear Fast Neutron Dose Rate Meter were continued.

Components for the experimental Radioisotope Analyzer were assembled and initial calibration was started. The instrument is being developed to demonstrate the application of computer techniques to practical detection and monitoring instruments.

Instrumentation was assembled to determine the feasibility of measuring the net ionic concentration of the atmosphere. This measurement is of interest to the Industrial Medical Operation for correlating the ionic concentration with hay fever symptoms in humans.

CUSTOMER WORK

Weather Forecasting and Meteorology Service

Type of Forecast	Number Made	% Reliability
8-Hour Production	93	86.5
24-Hour General	62	90.2
Special	124	88.7

The following number of telephone calls was handled by the automatic telephone recorder during each of the last three weeks of August:

Week Ending	Number of Calls Answered
August 19	1,362
August 25	1,259
September 1	1,127

The number of calls answered by the recorder was monitored on an hourly basis for the two-week period August 8-22. The total number of calls answered on each shift during this period is shown in the following table:

Shift	Total
00-08	567
08-16	1,605
16-24	699
Total	2,871

Summary of the Weather

Temperatures averaged slightly below normal. The weather was fair during practically the entire month with precipitation totalling only 0.02 inch.

Optical Service

Further studies were made on the types of optical equipment required in the fuel inspection cell in the PRP reactor building. The type of lighting required for the measuring equipment was determined. Some of the details of the equipment which affect the fuel element manipulator design were worked out to permit further study of manipulator design by others.

The Corning Glass Works quotation for fabricating a lead glass viewer for the rear faces of the 100-D and 100-F reactors was studied. A reply to the quotation was formulated indicating modifications in the design.

The possibilities of utilizing a periscope on the 200-East Area tank farm were studied and a tentative design was outlined.

The routine Optical Shop work included the fabrication of three quartz plugs and a lucite scintillation cell, and the aluminizing of the lucite scintilla-

tion cell. Two mirrors and twenty boron steel balls were prepared by vapor coating them with stainless steel; twenty more boron steel balls were vapor-plated with aluminum. A coolant pump was installed on the Optical Shop milling machine and the shop belt sander was serviced. Two lenses that had been darkened by radiation were reconditioned and a shutter and diaphragm were added to the head of a photovolt densitometer.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

PF Gast:mcs

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	H. W. Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
JL Powell	Aug. 4-17	University of Oregon Eugene, Oregon	Consultation.	JE Faulkner	No	300: 326
WB Harris	Aug. 6	Industrial Hygiene Branch, Health & Safety Lab., AEC New York	Discuss Instrumentation.	FE Adley RA Harvey	No	300: 329
DD Porter	Aug. 26	Goodyear Aircraft Corp., Akron, Ohio	Service Analog Computer	AE Tucker DD Marsh	No	300: 326

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
PF Gast RE Heineman	Aug. 14-15	E. I. DuPont de Nemours & Co. Savannah River, Ga.	Attend Information Meeting on Heavy Water Reactors.	CWJ Wende	Yes
PF Gast	Aug. 16-18	U. S. Atomic Energy Comm. Washington, D. C.	Discuss Plutonium Recycle Program	UM Staebler	Yes
	Aug. 19-20	Oak Ridge School of Reactor Technology, ORNL Oak Ridge, Tenn.	Attend Information Meeting	Lewis Nelson	Yes
RC McCall	Aug. 16-29	Northwestern University Chicago, Ill.	Attend Conference on Liquid Scintillation Counting.	--	No
		Argonne National Laboratory Lemont, Ill.	Discuss Body Monitoring	LD Marinelli	No

VISITS TO OTHER INSTALLATIONS (Continued)

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
RC McCall	Aug. 16-29	Armour Research Inst. Chicago, Ill.	Discuss Body Monitoring.	JW Baum	No
		Los Alamos Nat'l Lab. Los Alamos, New Mexico	" " "	EC Anderson	Yes
GE Driver	Aug. 17-23	IRE WESCON Conference San Francisco, Calif.	Discuss Instrumetation	--	No
AE Tucker	Aug. 21-22	Goodyear Aircraft Corp. San Francisco, Calif.	Discuss Operating Difficulties with Analog Computer.	R Lowry	No
EJ Seppi HW Lefevre	Aug. 28	A.I.E.E. Meeting Pasco, Wash.	Presented Papers.	--	No
JJ Fuquay MF Scoggins	Aug. 31 Sept. 1	University of Washington Seattle, Wash.	Calibration of Wind Instruments.	FI Badgley W Rae	No

Chemical Research and Development

ORGANIZATION AND PERSONNEL

Dr. John C. Sheppard, Chemist, terminated to accept employment as a professor at San Diego State College.

Dr. J. A. Offenbach, Chemist, terminated to accept employment in Oakland, California.

Dr. L. L. Ames, Chemist, was hired and assigned to Chemical Effluents Technology.

RELATIONS

The Summer Institute for Nuclear Energy (Chemical Processing) was completed. The nine professors completed a 'feed back' questionaire to furnish guidance in any future related activities.

V. R. Cooper and R. J. Sloat participated in a discussion of the Commission's review of chemical processing of power reactor fuels in Washington, D.C. on August 22.

M. T. Walling visited Savannah River Plant and Oak Ridge National Laboratory to discuss chemical processing technology.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Analytical Services

The 1706-KE gamma spectrometer was moved to the 183-KE Building. While considerably removed from the associated chemical laboratory, the new location (1) separates the spectrometer from corrosive fumes, (2) relieves crowded laboratory space, and (3) frees up floor loading required by an extended cave associated with a gamma coincidence counter (to measure Cu-64 and Sc-46).

Radiological Chemical Analysis is now measuring isotopes in KER loop water. Full use of gamma spectrometry awaits procedure modifications required by isotope spectra somewhat different from those of atmospheric pressure, production reactor effluent cooling water.

Hafnium oxide-boron carbide-graphite mixtures were made to specifications for use as experimental reactor control rod materials. Syntheses were checked by hafnium and boron assays.

Automatic Analyzing Monitor

Continued testing confirmed the reliability of the mechanical and programming features of the monitor. Gamma-counter components were extensively studied to determine sources of drift and instability. Of particular concern was the Cu^{64} gamma-gamma coincidence spectrometer portion of the system. Differences of several tenths of

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microseconds between two separately amplified pulses originating from two coincident gammas resulted in failure of the coincidence analyzer to register the event as a coincidence. To provide simultaneous pulses for the coincidence analyzer it appears necessary to match linear amplifiers and pulse height analyzers. Significantly improved performance was obtained using two DD2 amplifier-pulse height analyzers in the two gamma detector circuits. Further improvement in stability is expected when the amplifiers are adjusted.

The performance of the proportional counter for the measurement of P^{32} and Si^{31} was found to be markedly dependent on the source of counter gas used.

Trial operation with reactor effluent water will commence soon. The monitor was disassembled for setting up in the 100-F Area Aquatic Biology Laboratory where 107 water is available.

Evaluation of Slug Rupture Detectors

Rupture frequency, severity, and contribution to the radioisotope content of the Columbia River were summarized graphically for the period January 1952 through April 1957. The general trend since 1955, the year of most ruptures, has been downward in both total number and severity. Ruptures still contribute significantly to the radiologically important isotopes in the Columbia River and the need is emphasized for gaining information on actual release of fission products, basin cleanup, and retention in the river bottom.

Process Assistance

A single rear cross header at 105-H was successfully cleaned in an IPD test with Turco 4306-B; further testing is planned at H Area by injecting the reagent into all rear cross-headers during the scheduled September outage. The allowable working time per man in the rear face area is expected to be tripled by this treatment. Sampling specifications were prepared to best evaluate the radiological implications of the use of Turco and its safe disposal. An experiment was conducted to determine the relationship of pH and Turco concentrations in both process and river water. Turco concentration will be monitored during the test by performing pH analyses. Evaluation will be dependent on the anticipated correlation between effluent radioisotopes and Turco concentrations.

Reactor effluent radioisotopic composition over the past several years was plotted as a function of time. Independent variables which may be influencing the reactor effluent composition were also similarly plotted on an overlay which permits significant correlations to be visually observed. This graphical treatment of data is being undertaken to assist in identifying predominant relations between isotopes or between the isotopes and independent variables. Results to date have shown only casual relationships.

Uranium Oxidation - Melting Experiments

The literature search on fission product release mechanisms at high temperatures was summarized in rough draft form. The document will be issued in the near future. Plans were made to perform experiments designed to measure individual fission product release from heated irradiated uranium. The experimental work will begin when the necessary capital equipment is obtained.

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SEPARATIONS PROCESSES

Rate of Dissolution of Dingot Metal Spiked with Carbon

Wafers of Dingot metal which had been spiked to a nominal carbon content of 400 ppm by the metal fabricator were obtained from the Fuels Preparation Department. This material, which was in the as-rolled condition, had a finer grain size than any of the material heretofore studied (mean grain diameter of 0.04 mm), but dissolved at a very slow rate (0.30 g/hr., cm^2) in boiling eight molar nitric acid. After beta heat treatment the grain size was in the range 0.21 to 0.25 mm (mean diameter) and the dissolution rate in boiling eight molar nitric acid was 0.40 g/hr., cm^2. This latter value correlates very well with values reported last month, which were also obtained with materials which had been given a beta heat treatment.

A subject report is being prepared on this matter and will be issued as HW-52430.

Purex Phase II Flowsheet - Mini Runs

Three more runs were made with the same flowsheet used in Run 7-17 reported last month. In these runs the shielded twenty-one stage Mini unit was operated as a dual-purpose HA unit, a sixteen-stage unit was employed as a supplementary scrub section (HS unit) and the HC column was simulated by an exhaustive batch stripping operation. As before, both Mini units were operated at 35 C.

The flowsheet used in these runs was as follows:

HAF: 1.8 M UNH, 1.0 M HNO_3 (20 per cent full-level fission product activity), Relative flow 75, Introduced at stage 12.

HAX: 30 per cent TBP in Soltrol, Relative flow 345, Introduced at stage 1.

HSS: 4.0 M HNO_3, Relative flow 67, Introduced at stage 37.

HSR: As received, Recycled to stage 20.

1BSU (synthetic): 30 per cent TBP in Soltrol, 0.35 M HNO_3, Relative flow 67, Introduced at stage 18.

3WB (synthetic): 8.0 M HNO_3, Relative flow 25, Introduced at stage 6.

These runs were made to compare fission product scrubbing behavior with solvents of different "quality." Diluents used in these runs were prepared as follows.

Run 7-26. Soltrol which had been passed through a silica gel column.

Run 7-30. Soltrol treated with fuming sulfuric acid, then washed with five per cent sodium carbonate.

In both these runs the solvent was made up from vacuum-distilled TBP.

Run 8-7. Employed Purex plant I00 as the solvent.

Decontamination factors obtained in these runs are summarized in Table I. Results of an earlier run (7-17) which employed vacuum-distilled TBP in "as received" Soltrol are included for comparison.

TABLE I

DECONTAMINATION PERFORMANCE WITH VARIOUS SOLVENTS IN MINI RUNS ON PUREX PHASE II FLOWSHEET

Run	Solvent Treatment	Decontamination Factors					
		Zr-Nb			Ru-Rh		
		HAF/HAO	HAF/HAP	HAF/HCP[a]	HAF/HAO	HAF/HAP	HAF/HCP[a]
7-17	As received Soltrol	1.0×10^4	2.3×10^4	8.7×10^4	3.8×10^3	1.5×10^4	5.4×10^4
7-26	Silica gel	2.0×10^3	1.2×10^4	1.5×10^4	6.4×10^3	1.4×10^4	$\geq 6 \times 10^4$[b]
7-30	Oleum + 5% Na_2CO_3	3.8×10^3	2.0×10^4	2.5×10^4	1.1×10^4	2.8×10^4	$\geq 6 \times 10^4$[b]
8-7	Purex plant I00	380	940	3.4×10^3	1.0×10^3	1.2×10^3	$\geq 6 \times 10^4$[b]

(a) HC column simulated by exhaustive batch stripping.

(b) Ru not detected on gamma spectrometer. Value cited based on detection limit of five per cent of total gamma.

The treatments given the diluents resulted in little change in decontamination through the HAP. A smaller Zr-Nb decontamination factor was noted in the batch operation simulating the HC column with the treated diluents than was observed with either the "as received" Soltrol or with the plant I00. The high "C" column decontamination factor observed for ruthenium with the plant solvent arises from the ruthenium activity fixed in the solvent, or at least not removable by exhaustive carbonate scrubbing.

The treated solvents showed improved scrubbing behavior for Zr-Nb as compared with the other solvents. The Zr-Nb continued to scrub throughout the supplementary scrub section (HS unit). However, more Zr-Nb activity was extracted by the treated solvents in the extraction section so overall decontamination performance was no better with the treated solvents.

In run 8-7 the extended HA scrub section sufficed to reduce the ruthenium activity in the organic product to about the same level as had been present in the original HAX (Plant I00). This was not the case for zirconium-niobium, however.

The ruthenium decontamination obtained in the run with plant solvent is encouraging. It is planned to prepare a composite feed from the products of these runs and evaluate the additional decontamination which can be obtained on a low acid 2D-2E cycle as is in current use in the Purex plant. Such a flowsheet should be much more favorable for achieving zirconium-niobium decontamination than was the flowsheet used in these runs.

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

Six cartridges were tested in a 9-foot-high, 3-inch-diameter glass pulse column. Both organic and aqueous phase continuous operations were investigated at volume velocities from 335 to 1700 gal./hr.-sq.ft. and a pulse amplitude of 0.5 inch. All runs were made using the conditions of Purex Phase II Flowsheet.

Cartridge configurations tested were:

1. Stainless steel nozzle plates, 10 per cent free area, 4-inch spacing (present plant cartridge).

2. Stainless steel nozzle plates, 23 per cent free area, 4-inch spacing.

3. Stainless steel sieve plates, 23 per cent free area, 2-inch spacing.

4 and 5. Random arrangements of plastic sieve plates and 33 per cent free area stainless steel sieve plates.

6. One-linear polyethylene sieve plate (23 per cent free area) alternated with 4 stainless steel sieve plates (33 per cent free area), all on 2-inch spacing.

Capacity findings are summarized in Table II.

TABLE II

Cartridge	Continuous Phase	Flooding VV(1) at 60 cyc./min.
1	Aqueous	1500
1	Organic	1300
2	Aqueous	1100
2	Organic	1400
3	Aqueous	1300
6	Aqueous	1600

Note: (1) VV = Volume velocity, gal./hr.-sq.ft., sum of phases. A volume velocity of 335 is equivalent to a Purex plant capacity factor of 1.

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It is apparent that no significant capacity breakthrough has been made to date.

Other observations include:

1. Although no efficiency runs have been made, cartridge No. 6 appeared superior to the others in dispersion characteristics and rangeability.

2. Cartridge No. 2 exhibited the poorest rangeability and dispersion characteristics.

3. Runs made at ambient temperature (vice flowsheet requirement of ICX at 50 C) indicate that at a volume velocity of 1,000 gal./hr.-sq.ft. the flooding frequency is 10 ± 5 cycles/min. lower than with heated streams.

Organic Treatment - Step-Tray Contactor. The testing of a 16-inch-diameter step tray solvent treating contactor was initiated during the past month. The unit contains three plates spaced 30 inches apart. Each plate has a 26-inch-long, 4-inch-diameter aqueous downcomer which is capped with an aqueous distributor plate containing five 1/2-inch diameter holes. The organic distributor, located four inches immediately below the downcomer, contains seven 1/2-inch diameter holes. For use with 30 volume per cent TBP in Shell E-2342 diluent as the organic phase and 2-1/2 per cent sodium carbonate as the aqueous phase, the distributors were expected to holdup a 20-inch layer of organic under each tray when operating at a volume velocity of 700 gallons/hr.-sq.ft. and an aqueous-to-organic flow ratio of 0.26. The controlled interface was maintained at the top.

At ambient temperature (25 C), the column flooded at 420 ± 90 gal./hr.-sq.ft. When operating below flooding 80 to 100 per cent of the organic held up under the trays was contained in a shad-roe type emulsion. Increasing the temperature to 45 C raised the flooding volume velocity to 610 ± 90 gal./hr.-sq.ft. and gave a sharp aqueous-organic interface between trays. At both temperatures, the organic distributors dispersed the organic as approximately 1/8-inch globules.

Efficiency studies and capacity studies with larger free area organic distributors are planned.

WASTE TREATMENT, FISSION PRODUCT RECOVERY

Cesium Recovery

The more promising "acid side" flowsheets previously reported in HW-48829 REV have now been tested on full level Purex plant 1WW with good results. The object of the acid side approach is to recover cesium without the necessity of first precipitating the iron, aluminum, and uranium which are present at high concentrations in the waste solution, thus eliminating the necessity for handling and washing this precipitate.

Five milliliter samples of full level 1WW were neutralized to about p HO with sodium hydroxide and then scavenged with either co-formed zinc ferricyanide or zinc cobalticyanide, as shown in Table III. Initial samples were taken after digesting for one hour and centrifuging for fifteen minutes. Additional samples were taken after standing for two, four and eight days.

TABLE III

ACID SIDE CESIUM RECOVERY FROM PLANT 1WW

Conditions: Full level 1WW used for the first two experiments, 1WW diluted with an equal volume of water for the last two (each neutralized to pH 0).

Anion	Zn^{++} (M)	Cesium Recovery, Per cent			
		1 Hour	2 Days	4 Days	8 Days
0.01 M Ferricyanide	0.02	89	86	89	91
0.01 M Cobalticyanide	0.02	72	75	80	83
0.005 M Ferricyanide	0.01	98	97	96	--
0.005 M Cobalticyanide	0.01	94	94	94	--

Ferricyanide appears to be somewhat better than cobalticyanide in both sets of experiments, and dilute 1WW is better than full level 1WW. In neither case does there appear to be any significant radiation decomposition of the precipitate, at least for periods of time of up to eight days. Cesium recovery is adequate for further flowsheet development with either reagent and diluted 1WW. Since these results agree well with previously reported tracer level experiments, further full level testing of ferri- and cobalticyanides will be deferred until proper facilities for liter scale experiments are available.

Since the composition of plant 1WW has been found to differ considerably from flowsheet, a sampling program has been set up in conjunction with the Chemical Processing Department to determine and monitor the composition.

Cesium Isolation and Packaging

Two samples (three grams) of dry cesium zinc ferrocyanide ($Cs_2ZnFe(CN)_6$) sealed in capsules equipped with pressure gauges were exposed to a 1.25 mev (average) gamma flux for about 500 hours. The material in the capsules received 5.6×10^8r exposure. No pressure rise was noted in either capsule.

Studies of the adsorption of $Cs_2ZnFe(CN)_6$ upon oxides of iron, lead and mercury indicate that the addition of these oxides increases the centrifugation and/or settling rates and efficiency of $Cs_2ZnFe(CN)_6$. The use of these reagents in subsequent calcination or hydrolysis steps has been shown to be desirable.

Neptunium Recovery

Very promising preliminary results on the use of tri-n-octylamine to extract neptunium (IV) from nitric acid solutions were reported last month. Further intensive work has been aimed at evaluating the effect of pertinent variables and possible interferences and at extending the investigations to include plutonium. The detailed results are being issued as an informal report, HW-51958.

Briefly, the extraction coefficients of neptunium (V) and (VI) into tri-n-octylamine were much smaller than those of neptunium (IV). Thus, the values for E_a^o from 4 M nitric acid into ten per cent tri-n-octylamine in xylene were 66, 5, and 0.015 for neptunium (IV), (VI), and (V), respectively. It should thus be easy to strip neptunium quantitatively from the organic phase by oxidation to (V) with nitrite. The extraction characteristics of plutonium were strikingly similar to those of neptunium. Thus, those of plutonium (IV), (VI), and (III) from 4 M nitric acid into tri-n-octylamine were 82, 4.1, and 0.15. Thorium (IV), on the otherhand, was relatively inextractable (E_a^o = 0.52 under the above conditions). All of the fission products gave quite low extraction coefficients, implying high decontamination of neptunium or plutonium from these elements in a tri-n-octylamine extraction process.

Radiation damage studies showed no deleterious effects on neptunium or plutonium extractability or on fission product decontamination when samples of tri-n-octylamine were exposed to about 40 watt hours/liter of cobalt-60 gamma energy. Exposure of tributyl phosphate to a similar dosage forms degradation products which cause high plutonium losses and very poor decontamination.

Applications for which tri-n-octylamine appears to be uniquely well suited include:

1. Isolation of neptunium from 1WW, 2DW, or 2AW type Purex waste streams.

2. Recovery of plutonium from 1WW.

3. Recovery of plutonium from PRP type fuel elements where the uranium is considered to have no value.

4. As a replacement solvent for TBP in the Recuplex process.

These applications will be the subject of further, more detailed, development.

Removal of Iodine from Off-Gases

The chemistry and behavior of iodine in the Hanford separations processes was reviewed, and scouting experiments were made on a novel method for the removal of iodine-131 from dissolver off-gases. This involved scrubbing with an organic solvent to remove co-valent iodine species from the gas stream. In a demonstration experiment, an air-NO_2 mixture containing 0.5 grams of iodine was passed through 25 ml of 30 per cent TBP-Shell E-2342 without any appearance of iodine in a second trap containing starch indicator. The iodine decontamination factor was estimated to be of the order of 10^4 to 10^5. Most of the iodine was removed from the organic solution by scrubbing with 1.0 M sodium hydroxide solution. It is thought that certain unsaturated hydrocarbons might be even more effective than the TBP-Shell E mixture. Complete details are contained in an informal report, HW-51925.

Special Geological Studies

Overall progress on the CA-700 drilling project was satisfactory although the Hatch Drilling Company continued to fall slightly behind schedule. The Geological Survey portion of that project will be completed during September, following which it is

anticipated that no further use of their crews will be necessary. Completion of the entire project in December will mark the first break in continuous drilling at Hanford since March 1947 and reflects the more orderly and systematic approach to waste disposal that has now been achieved.

Observation Wells

Analyses of ground water samples from wells south and east of the Redox plant tended to substantiate the southeastward movement of contamination from the Redox cribs and the 216-WR crib. A new well drilled 100 feet east of the 216-WR crib disclosed that the low-level waste evaporator overheads discharged at this site had reached ground water some time previously and were contributing to the ground water contamination east of the 200 West Area. During the drilling operation zones of high sediment temperature were encountered, resulting from the disposal of high-temperature wastes in the nearby crib. Temperatures up to 140 F were measured in the sediments above the water table and as high as 120 F in the water table itself. These temperatures reflect the rather poor heat conductivity of soils and suggest a possible technique for tracing the movement of thermally warm wastes.

A monitoring well adjacent to the abandoned 216-S 1 and 2 cribs contained detectable Sr^{90} for the fourth consecutive month. No other well samples contained detectable concentrations of either radiostrontium or radiocesium.

The ground water contamination pattern in the 200 East Area was of nearly the same extent as previously. However, a number of wells some distance downstream from the 216-A-8 crib displayed an increase in radioactive contamination of up to ten times the previous month's average. This reflects the continued spread of ground water contaminants originating in the Purex boiling tank condensates discharged to the 216-A-8 crib.

For several months trace radioactive contamination appeared in some of the samples taken from a well in the Hanford townsite. Since no other monitoring wells along the north face of Gable mountain are contaminated it is not probable that the observed material in the Hanford well originates in the 200 Area disposal cribs. The material contaminating the ground water beneath the Hanford townsite was tentatively traced to the 100-F Area. A significant ground water mound exists beneath the 100-F Area resulting from leaks in the effluent discharge system. The effluent comprising this mound contains low concentrations of radioisotopes and the flow of this material southward from the area is believed to be responsible for the contamination appearing in Hanford wells.

Disposal to Ground

Samples of two batches of in-farm scavenged waste were tested for ground disposal, using standard laboratory soil column techniques. Tank 16-109C-101-BY was found acceptable for disposal of up to four column volumes and tank 15-112-C-101-BY was acceptable for disposal of up to two column volumes. The sample of this latter tank exhibited a breakthrough of both Sr^{90} and Cs^{137} after the passage of two column volumes of waste. The Co^{60} content of both batches of waste was below disposal limits. If the present production rate of scavenged waste continues, the CG-764 test well drilling project should be started immediately to assure that meaningful information will be obtained from the "use test"; such information was to have been

a very important part of the test which allows full-MPC level Co^{60} solutions to enter the ground water.

Four samples of aluminum coating waste were tested in laboratory soil columns to evaluate the possibility of direct crib disposal. The results of these tests reflect the wide variation in chemical composition encountered in coating waste, as a result of which, it is difficult to generalize conclusions regarding ground disposal. In all cases the wastes contained Co^{60} in concentrations exceeding 10^{-4} μc/cc and in a form which generally exhibited poor retention on the soil. The samples all contained a relatively large amount of Cs^{137}, possibly resulting from the selective removal of other radioactive fission products, such as Sr^{90}, by precipitated sludge. Most coating waste samples tested thus far could be disposed of to the ground in volumes up to one column volume per crib if the Co^{60} content is not accepted as a disposal limitation. In any case it would apparently be necessary to test each individual batch before disposal to the ground.

Four soil column tests were initiated to further evaluate the behavior of 241-A tank condensates in the ground. Two of the tests are designed to evaluate the possibility of increasing crib capacity by the addition of a layer of limestone to the bottom of the crib.

Soil column tests were conducted, using samples of waste from the Z plant, to evaluate the retention of fluoride ion on soils. The wastes tested are normally discharged to the 216-Z-1 and 2 cribs. The wastes were found to have a fluoride-ion content of 198 ppm. Upon passage through a soil column the first one-half column volume was found to have a fluoride-ion concentration of 89 ppm, indicating some retention by soils. Before two column volumes of effluent had been discharged, the effluent concentration was equal to the fluoride-ion concentration in the original waste. These data will assist with the evaluation of chemical toxicity problems associated with ground disposal of wastes.

Preliminary data concerning the adaptation to Hanford crib studies of the Hiester-Vermeulen technique for evaluating ion-exchange systems indicate a great deal of promise. An extensive study to systematically evaluate the variables involved in this adaptation was designed. The research is expected to require more than a year to complete but application of the system may be possible earlier. Evaluation experiments will include predictions of breakthrough data for seven-foot soil columns on the basis of data obtained from 40-cm soil columns. The development of this technique will provide a much firmer basis for determining crib life and disposability of wastes than has been available heretofore.

Uranium concentrations in the Columbia River in the vicinity of the 300 Area were found to be only 0.05 per cent of the maximum permissible concentration for drinking water. Analyses of data obtained by sampling traverses of the river, the 300 Area Pond, and the associated monitoring wells revealed that soil removal of uranium and dilution of the waste by ground water are ineffectual at this particular site, but that river dilution reduces the concentration to less than 1/500 of that in the riverbank monitoring wells. The data obtained confirm the safety of present uranium waste disposal in 300 Area and are useful in estimating shoreline discharge dilution factors. A report of these measurements is in preparation.

Gelling of Wastes - Field Work

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and the test will be run in early September. Approximately 200 gallons of gel will be discharged to a pit to evaluate mixing and pumping characteristics. Loss of moisture from the gel will be closely observed during the following weeks.

ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Nitrogen Dioxide Monitor. At the request of Chemical Processing Department - Research & Engineering, Process Control Development is designing and will fabricate a semi-portable NO_2 analyzer. The monitor will be similar to the one developed by C. P. Skillern, Relations and Utilities (HW-47559). The method is based on the color produced when NO_2 effects the diazotization of N-1 naphthylethylenediamine dihydrochloride. The monitor is being designed to measure NO_2 concentrations ranging from 1 to 3000 ppm. The color produced in the aqueous reagent by reaction with the NO_2 is measured with a filter photometer at 540 millimicrons. The design, under development and test, employs one of the flow cells recently developed for measuring uranium concentration. The optics and electronics are from the Beckman Flow Colorimeter.

Probe Type pH Unit. A gland seal pH probe for in-vessel immersion has been installed in the 321 Tank Farm. The gland seals employing Poly-FBA packing have performed satisfactorily when immersed to a depth 10 feet at ambient temperatures. Tests are continuing to determine the reliability of the gland seals and calomel electrode up to 90 C.

Gamma Absorptometer. The newly encapsulated americium-241 gamma source is being calibrated for use on the absorptometer to be used to determine plutonium concentration in the Purex plant ion exchange product. Uranium solutions at concentrations ranging from 0.14 to 331 grams per liter were used to establish the current vs. concentration relationship. Reproducibility over this range was better than ± 0.5 per cent of chart and was of the order of ± 0.5 gm. in the region of 50 gm per liter. Solutions containing lead salts ranging from 6 to 200 gm lead per liter were also analyzed in order to establish a valid relationship between lead, uranium and plutonium. Tests with plutonium solutions (two or possibly three concentrations) will be run to establish the working curve for plutonium.

Minor modifications to the source holder and ion chamber have improved the geometry of the unit so that the current amplifier is now operated in a range of greater

ANALYTICAL DEVELOPMENT AND INSTRUMENTATION

Mass Spectrometry

Several uranium isotopic standards and "analyzed" samples representing both highly enriched and slightly enriched materials were analyzed by thermal emission mass spectrometry for instrument checking purposes. The results agreed with the accepted values to within ± 0.3 per cent in all cases and the reproducibility (estimated standard deviation) within a series of 8 to 12 scans was ± 0.2 per cent for low U-235 values and within ± 0.02 per cent for high U-235 values. Sample sizes ranged from 10 to 15 micrograms.

Polarography

Square wave polarographic calibration curves were prepared for uranium, iron, lead, cadmium, and indium, and linearity was demonstrated for the range of 1.0×10^{-5} to 5.0×10^{-4} M for the first two elements and for the range of 1.0×10^{-6} to 1.0×10^{-4} M for the other three. Sparging for complete oxygen removal is necessary at the lower concentrations. It was also found that TBP interferes with uranium square wave polarography. The peak height of a square wave polarogram was found to be independent of the mercury drop rate for a given capillary.

EQUIPMENT AND MATERIALS

Continuous Calciner Off-Gas Scrubber

A scrubber was fabricated and tested to define design criteria for the installation of a similar unit in the 224-UA Building off-gas system as a replacement for the wire cloth filters currently in use. The scrubber consisted of a 6-inch-diameter glass pipe containing three sets of "disk and donut" type baffles. Each baffle had a two inch high weir to retain the liquid and force it through 1/8-inch-diameter holes drilled near the outer periphery of the disks (4-inch-diameter) and the inner periphery of the donuts (4-inch-diameter). The scrub solution, about 3 M nitric acid, was introduced into the top disk and flowed down the unit countercurrent to the gas stream.

Four UO_3 removal efficiency runs were made. Efficiency was found to be 90 to 95 per cent when the flows were such that a completely wet column wall was obtained. Between 75 and 85 per cent efficiency was obtained when the gas flow was insufficient to maintain completely wet walls.

The results of flooding runs are summarized in the following table:

Plate Spacing In.	Liquid Flow, Gal./Min.	Gas Flow, Cu.Ft./Min.(2) Range(1)	Optimum(3)
1	1.5	--	74
1/2	0.5 to 3.0	45 to 70	55
1/4	0.5	28 to 55	35
1/4	1.0	28 to 50	35
1/4	1.5	28 to 47.5	35
1/4	3.0	30 to 45	35

Notes:
(1) From the beginning of completely wet wall operation to incipient flooding.
(2) 28 CFM in the test unit is approximately equivalent to the gas flow from one calciner operating of 6 tons U/day.
(3) Maximum wetting of the column wall with a minimum of liquid entrainment.

Although the 1/4-inch spacing gave a lower range of gas flow for wet wall operation, it did not increase the rangeability of the scrubber. Liquid rate appears to exert only a minor effect on the flooding gas flow rate for any given plate spacing. Flooding, characterized by a buildup of foam above the top disk, occurred when a pressure drop of 3 inches of water across the scrubber was exceeded.

Pumps

Johnston Splined-Shaft No. 2. A deepwell turbine pump was inspected after 620 hours operation pumping 65 per cent nitric acid at 55 gpm against a 140-foot head. No measurable wear was found on the hardened 17-4 PH journals. Maximum diametral wear of the graphite bearings was 1.9 mil in the liquid throttle bushing. The graphite bowl bearings had worn up to one mil.

Redox Spare (Bingham Deepwell Turbine). A deepwell turbine pump equipped with the HAPO designed discharge head and Pyrex glass bearings has been checked for alignment of bore and mounting faces. Maximum run-out of the five bored sections of the head was less than one mil and the out-of-parallelism of the head was two mils. No mechanical cause has been detected to explain the trouble (reported last month) encountered during testing of this unit.

Pogo Stick Pump No. 3. A scaled-up version of the sampling pump has been modified as follows:

(a) Inlet seat diameter increased from 1/2 to 1-1/2 inches.

(b) Internal bleed port increased from 1/8 to 1/4 inch.

The pump now delivers 6.2 gpm against an 8-foot head when operated with 15 psig air and the pump submerged to four inches above the top of the casing. Life testing is in progress using a 25-second fill and nine-second discharge cycle.

Bearings

Bearing Test Machine. A new dead weight bearing test machine (SK-3-7270) has been fabricated and placed in operation. Preliminary data obtained from test runs indicate that this unit will provide reliable data for selecting bearing-journal combinations for testing in pumps and other process solution lubricated rotating equipment.

Glass Bearing Retention. The recent success of glass bearings in the Redox F-1 tank (1AFS solution-feed to extraction column partition cycle) has stimulated interest in developing simpler methods for installing and retaining glass bearings. The present method involves cutting a slot in the bearing and the housing. The slots are filled with asbestos. A ring retainer is used to prevent axial movement of the bearing.

Preliminary results from shrink fitting glass bearings into a stainless steel housing appear promising. A 1.5 mil interference fit was adequate to retain the bearing securely when bearing and housing were immersed in boiling water.

Materials of Construction

Marlex-50 Polyethylene, a product of the Phillips Chemical Company, was tested to determine the effect of gamma radiation on flex life and modulus of elasticity. The modulus of elasticity of Marlex-50 is approximately 20 per cent higher than that for Super Dylan tested, but the changes caused by irradiation are almost identical.

The effect of exposure to gamma radiation on the flex life of Marlex-50 was also quite close to that found for Super Dylan, with the exception that the greatest decrease in flex life may occur at a slightly higher dose. There was no improvement noted at 10^8 r, but the improvement at 1.5×10^9 was as marked as was noted with Super Dylan.

Corrosion Studies

Instrument Corrosion, 234-5 Building. A differential pressure transmitter from the 234-5 Building was submitted to the corrosion laboratory for inspection. The instrument had been in service on a line carrying 8.7 per cent oxalic acid. Operation of the instrument indicated relatively severe gas evolution as the diaphragm chamber was filled with oxalic acid. Spectrographic analysis showed the diaphragm chamber to be an 18 Cr--8 Ni stainless steel as marked. All surfaces of the chamber exposed to oxalic acid were coated with a film of iron, chromium, and nickel oxalates. Samples cut from the chamber were exposed to 10 per cent oxalic acid at room temperature. Initially high corrosion rates (0.11 ipm for the first hour) decreased rapidly with time to 0.005 ipm at six hours and to an equilibrium value of about 0.001 ipm after 16 hours exposure. These rates are higher, by a factor of 1,000, than previously observed for 304-L stainless steel under similar conditions. Piping changes were made in the plant to eliminate difficulty from gas evolution during the initial period of operation.

Redox Flange Studs. Three Redox flange studs were submitted for inspection following a series of failures when such studs were tightened. Two were intact, and the third had failed. Specifications called for the material in these studs to be hardened to Rockwell C-35. Spectrographic analysis showed that the studs are unalloyed carbon steel. Hardness of the two intact studs is R_C 33 and 35 and of the failed stud is R_B 85. It appears that some of the studs in use have not been heat treated to proper hardness.

Materials of Construction for Darex Feed Preparation. Corrosion data continue to indicate that titanium is a satisfactory material for construction of Darex feed preparation equipment. Data reported by BMI indicate that the cobalt-base alloys, S-816 and Haynes 21, are also satisfactory (negligible attack on Ti and < 1 mil/mo. on the cobalt-base alloys under Darex dissolver conditions). In HLO tests, vapor phase, interface, and liquid phase corrosion rates for titanium were all less than 1 mil/mo for solutions simulating the beginning, midpoint, and endpoint of Darex dissolution (absence of stainless steel components). Rates observed for S-816, although higher than those for Ti, would average less than 3 mils/mo for the entire dissolving cycle.

Samples of A-55 titanium were exposed to 5 M HNO_3 - 2 M HCl (beginning conditions, Darex dissolution) for times ranging from 24 to 240 hours and temperatures from 115 to 145 C (sealed capsules). Equilibrium corrosion rate at 145 C was 0.003 in/mo indicating satisfactory performance of titanium under heat transfer conditions in Darex dissolver solution.

Titanium is attacked by HCl in the absence of HNO_3 or other oxidant. Since a rectifier unit used to remove chloride from Darex dissolver solution will be exposed to HCl solutions and vapors containing variable amounts of HNO_3, an attempt was made to determine the minimum concentration of HNO_3 necessary to maintain titanium passive to attack by HCl. The corrosion of titanium by boiling 1 M HCl (both liquid and vapor phases) containing as little as 0.01 M HNO_3 was negligible (1 mil/mo.). At 0 M HNO_3 the corrosion rate (liquid phase) was 37 mils/mo.

Corrosometer and weight loss tests are in progress to evaluate the effects corrosionwise of processing Darex-prepared feed solutions in Redox plant equipment.

Corrosion of Titanium in HNO_3. When titanium was exposed to boiling 60 per cent HNO_3 at a metal temperature of 140 C (non-pressurized heat transfer equipment) an amorphous, tightly adherent coating formed on the metal surface. It was not pyrophoric. In 30 per cent HNO_3 at the same conditions the coating was not formed, and the metal surface was removed uniformly.

Conversion Process

Addition of Ammonia to UNH

The addition of ammonia to uranyl nitrate prior to calcination is reported to improve the reactivity of UO_3 produced in pot-type calciners at Port Hope. In preparation for pilot plant tests of the procedure in a continuous calciner, the addition of 10 weight per cent NH_3 solution and of gaseous NH_3 to 100 per cent UNH was investigated. Permanent precipitation occurred when about 2.8 gallons of 10 per cent NH_3 solution per 100 pounds of UO_3 was added to 100 per cent UNH maintained at 75-80 C.

Although the ammonia solution was added beneath the surface of vigorously agitated UNH, some NH_3 escaped. Analysis for NH_3 in the final UNH solution showed that the loss was about 10 per cent. The pH of the final solution was 1.45. When gaseous NH_3 was added to the molten 100 per cent UNH, permanent precipitation occurred at pH 1.70. The ammonia content of the final solution was 1.26 M compared to 1.17 M when 10 per cent NH_3 solution was used. Loss of NH_3 when adding gaseous NH_3 was not determined.

NEW PROCESSES

Separation of Plutonium from Uranium by Anion Exchange.

Six runs were made to determine the effectiveness of the anion exchange process for the separation of small quantities of plutonium from much larger quantities of uranium as a uranyl nitrate solution. Both a room temperature and an elevated temperature run were made at each of three different uranium to plutonium feed concentration ratios. The resin used in the six runs was Dowex-1, X-4 (50-100 mesh).

The conditions of these runs and the results obtained are summarized in Table IV.

The uranium decontamination obtained in Run 7-I is quite apparently not consistent with the high decontamination factors observed in Runs 7-III and 7-IV, and it is suspected that cross-contamination may have occurred in this run. The conditions of Run 7-I are thought to represent the most favorable condition for separating plutonium and uranium of those studied, as indicated by the fact that the resin capacity in this case was about the same as is normally found in the absence of uranium (i.e., 126 to 129 grams plutonium per liter of resin). Further work is planned to resolve this anomaly.

In any event it is apparent from the results of Runs 7-III and 7-V that excellent separation of plutonium and uranium can be effected by anion exchange in nitrate solutions containing a large excess of uranium, but the capacity of the resin for plutonium is considerably lower under these conditions.

It is believed that the anion exchange process has potential for effecting separation of plutonium from uranium in the Purex 1BXP stream (ca. 0.08 M U, 1 g/l Pu) or from feed solutions prepared from Plutonium Recycle Reactor fuels.

TABLE IV

SEPARATION OF PLUTONIUM FROM URANIUM BY ANION EXCHANGE

Run Conditions: Feed: 7.2 M HNO_3, U and Pu as indicated
Wash: 20 column volumes 7.2 M HNO_3
Resin: Dowex-1, X-4 (50 - 100 mesh)

Run No.	7-I	7-II	7-III	7-IV	7-V	7-VI
Loading Temp., °C	58	Ambient	57	Ambient	57	Ambient
Flow Rate, ml/m,cm^2	12.7	11.8	11.4	9.7	10.5	10.5
g/l U in Feed	44.0	44.0	118	118	153	153
g/l Pu in Feed	0.735	0.735	0.237	0.237	0.107	0.107
M NO_3^- in Feed	7.4	7.4	8.2	8.2	8.5	8.5
Wt. ratio U/Pu in Feed	60	60	500	500	1400	1400
Wt. ratio U/Pu in Product	2.6×10^{-2} (?)	8.9×10^{-2}	4.7×10^{-4}	4.3×10^{-2}	2.5×10^{-3}	3.9×10^{-2}
U Decontamination Factor	2.3×10^{3} (?)	6.8×10^{2}	1.1×10^{6}	1.2×10^{4}	5.6×10^{5}	3.7×10^{4}
Resin Capacity at 50% Breakthrough (g Pu/l resin)	128	47	29	19	10	11
Percent of Pu in Feed Retained by Resin at 50% Breakthrough	95	72	87	81	86	80

Plutonium Recovery from Purex 1WW - Radiation Stability of Amberlite IRA-401

Four samples of Amberlite IRA-401 were equilibrated with a synthetic Purex 1WW solution and were then irradiated in a Cobalt-60 source. The irradiated resins were then washed into a column with 7.0 molar nitric acid and the capacity of the resin for plutonium determined at fifty per cent breakthrough. The results obtained are summarized in Table V.

TABLE V

EFFECT OF GAMMA IRRADIATION ON CAPACITY OF AMBERLITE IRA-401 FOR SORPTION OF PLUTONIUM

Loading Conditions: 7.0 M HNO_3, 0.57 to 0.63 g/l Pu, Flow 19 to 21 ml/m,cm^2.
(Capacity of resin before irradiation ca. 66 g. Pu/l resin at 50 per cent breakthrough.)

Run No.	8-I	5-III	8-II	8-III
Radiation Level, R	1.69×10^8	2.03×10^8	3.5×10^8	4.5×10^8
Resin Capacity at 50% Breakthrough (g. Pu/l resin)	53	46	44	23
Resin Capacity (Per cent of Initial Capacity)	80	70	67	35
Per cent of Pu in Feed Retained by Resin at 50% Breakthrough	92	92	92	87

From these results it appears that Amberlite IRA-401 should give satisfactory performance up to radiation levels of at least 3.5×10^8 R, and thus might be expected to have a usable lifetime of the order of 14 days in Purex 1WW. The only resin sample which showed visible evidence of physical damage was that sample irradiated to 4.5×10^8 R. The volume of this resin was decreased by about 12 per cent, there was a large proportion of fines and the resin particles tended to agglomerate.

Flurex Development

Further studies of Flurex cell operation were made to verify or deny >90 per cent current efficiencies obtained in experiments reported last month in which NH_4NO_3 or $NaNO_3$ served as catholyte. Analyses of feed compartment solutions from these runs showed that Na^+ and NH_4^+ concentrations were still increasing at shutdown and that longer runs are necessary to reach equilibrium conditions in the cell. Tentative conclusions drawn from runs made this month are that, when operating with approximately 0.1 M NH_4NO_3 as anolyte and 1.5 M UNH as feed, overall current efficiency

[redacted]

for uranium transfer at equilibrium is about 80 per cent. About 10 per cent of the current is carried by NH_4^+ back-transferred from the anode compartment, 10 per cent by H^+ entering with the UNH feed and 0.02 per cent by back-transfer of fluoride from the cathode compartment.

A noteworthy observation made during the longer (10 hour) runs was that the nitrate concentration in the catholyte increased with time and did not appear to approach an equilibrium value. The cation membrane used was Permutit 3142 which has been shown to increase markedly in hydraulic permeability on exposure to process solutions at 60 C. It appears probable that the observed increase in nitrate ion in the catholyte is associated with an increase in permeability of the membrane. If so, the tendency of Permutit to become porous with use may preclude its application in a Flurex cell since appreciable concentrations of nitrate can not be tolerated in the cathode compartment. The porosity of Nalfilm 1 cation exchange membrane does not increase so markedly on exposure to Flurex process solutions. However, it does have some objectionable resistance characteristics when in contact with UNH solutions more concentrated than 0.5 M which would limit the usable concentration of UNH in the feed.

Results of experiments regarding the effect of process variables on hydrogen ion back-transference from the anode compartment may be summarized as follows:

(a) Hydrogen ion back-transference rate is independent of anion membrane type. (Nalfilm 2, Permutit 3148, and Amberplex A-1 were studied.)

(b) Hydrogen ion back-transference increases with anolyte acidity.

(c) Increasing membrane current density increases hydrogen ion back-transference rate.

(d) Increasing temperature of the anolyte and catholyte (solution on cathode side of membrane) decreases hydrogen ion back-transference rate.

Anodic corrosion rates for a platinum anode in 0.1 M NH_4NO_3 were determined as a function of pH (5.3 - 8), fluoride concentration (0.0001 - 0.0005 M), current density (2 - 5 amps/in.^{2}) and applied potential (25 - 50 volts). Rates obtained ranged from 0.03 to 0.09 mg/amp.hr.

Preparation of UF_4 from Uranyl Nitrate

In the course of studies on destruction of nitrate by formic acid, it was observed that some uranium was reduced to the + 4 oxidation state. The reaction is catalyzed by ultraviolet light. If HF is present during the reduction, $UF_4.XH_2O$ is formed, while if NH_4F and HF are present the NH_4UF_5 double salt is formed. In typical experiments, HF and HCOOH were added to UNH solutions to destroy nitrate and produce a UO_2F_2 solution. Excess HF and HCOOH were added and the solution irradiated (sunlight or ultraviolet lamp). The resulting UF_4 slurry was heated to boiling, centrifuged, washed, and dried. So far, UF_4 hydrates containing about one mole of water per mole of UF_4 have been prepared. When ammonium ion was present during the reduction, anhydrous NH_4UF_5 was obtained.

Preparation of UF_4 from UNH

Two study flowsheets for the electrolytic production of UF_4 from UNH have been developed. The proposed flowsheets include destruction of nitrate ion with formaldehyde, electrolytic reduction of UO_2SO_4 or UO_2Cl_2, external precipitation of $UF_4 \cdot 3/4H_2O$, filtration, drying and dehydration of the precipitate, and recycle of the filtrate through a concentrator. Advantages of the processes are simple recovery of the nitrate as nitric acid, simplicity of electrolytic cell construction, and low chemical costs. The principal disadvantage in comparison with a process utilizing the UO_3 to UO_2 to UF_4 route is possibly higher capital cost.

REACTOR DEVELOPMENT - 4000 PROGRAM

Anion Exchange Process for Recovery of Plutonium from Plutonium Recycle Reactor Fuels

Three preliminary runs were made to examine the feasibility of employing anion exchange to accomplish recovery and decontamination of plutonium from Plutonium Recycle Program reactor fuels.

In order to reduce the volume of feed to be handled, a very small column (4.0 mm diameter x 1.0 cm bed depth) was employed. The three runs investigated the recovery of plutonium from the following feeds:

1. The product resulting from a batch extraction step with TTA. This feed contained 7.4 M HNO_3, 2.7 g/l Pu (IV), 3.5×10^8 γ/m, ml Zr-Nb. The fission product spike was prepared by extracting zirconium from Purex dissolver solution with TTA. Approximately 90 per cent of the gamma activity was due to zirconium-95, the remainder to the daughter niobium-95.

2. A feed simulating a dissolver solution prepared from a plutonium-aluminum alloy fuel element. This solution contained 0.94 M HNO_3, 1.5 M $Al(NO_3)_3$, 2.35 g/l Pu (IV), 8.1×10^9 γ/m, ml Zr-Nb, 5.7×10^8 γ/m, ml Ru-Rh. The source of the fission product activity in this instance was the aqueous waste remaining after extraction of uranium and plutonium from Purex dissolver solution with TBP.

3. A feed simulating a dissolver solution prepared from an irradiated UO_2 fuel. This solution contained 7.0 M HNO_3, 200 g/l U, 2.7 g/l Pu (IV), 1×10^{10} γ/m, ml Zr-Nb, 6.6×10^8 γ/m, ml Ru-Rh. The source of fission product activity in this case was Purex dissolver solution.

The conditions of these runs and the results obtained are shown in Table VI.

TABLE VI

DECONTAMINATION IN ANION EXCHANGE PROCESSING OF SYNTHETIC PRP FEEDS

Conditions: Feed: As indicated
Wash: 7.5 M HNO_3, rate as indicated
Elutriant: 0.25 M HNO_3
Resin: Dowex-1, X-4 (100 - 200 mesh)
Temperature: Ambient

Run No.	1(a)	2(a)	3(b)
Feed(c)	(1)	(2)	(3)
Feed Flow Rate, ml/m, cm^2	1.9	0.8	0.9
Wash Flow Rate, ml/m, cm^2	1.7	1.3	1.5
Wash Volume, No. of Column Volumes	22	40	28
Pu Concentration Factor Product/Feed	9.5	7	3
Arithmetic Decontamination Factors			
Zr-Nb	920	---	680
Ru-Rh	900	1300	600
Gross γ	1500	>2000	900

(a) The column was loaded only to about 80 per cent capacity in these runs. this operation would thus correspond to a recovery system in which a single column would be employed to recover plutonium.

(b) The column was loaded to capacity in this run. This operation thus simulates operation with two columns in series.

(c) See text.

The fission product decontamination obtained in these preliminary runs was significantly poorer than the results (decontamination factors of 4100 for zirconium-niobium and greater than 5000 for ruthenium) which were obtained in an earlier run which employed a larger column and used Purex 1BP as the feed. It is believed that the decontamination in the present runs may have suffered from incomplete purging of fission product activity from solution pockets which existed at the product withdrawal point in the small column wich was used in these runs. A new column has been constructed to alleviate this problem and to permit operation at elevated temperature.

The objective in work planned for the immediate future is to evaluate the technical feasibility of a two-cycle anion exchange process for recovering and purifying plutonium from irradiated PRP fuels. It is believed that the simplicity of operation inherent in a fixed-bed ion exchange process offers advantages for anion exchange over other aqueous processing techniques for incorporation into a close-coupled PRP processing facility or perhaps into the U-plant head-end facility projected for the processing of propulsion and power reactor fuels at HAPO.

Plutonium Oxide Fuel Material Studies

Approximately 90 grams of 20 per cent PuO_2-UO_2 mixed crystal material was prepared for the prototype fuel element being fabricated by Ceramic Fuel Development. This material will be blended with additional UO_2 in a ball mill to give the two weight per cent plutonium content desired for PRP application. It will be necessary to reduce the blended mixture to a free flowing powder prior to loading into the cans. This is to be accomplished by a second hydrogen reduction.

The extremely slow dissolution rate plus the silicon residue pose special problems in the chemical processing of this material. Serious consideration of this fuel for PRPR may require an expansion of effort to attack the associated problems.

TABLE VII

DISSOLUTION OF PLUTONIUM FROM 1.65 PER CENT Pu-Al-Si CAST ALLOY

IN 8.5 M HNO_3 - 0.003 M Hg^{++}

Sample No.	Time (Hours)	Dissolved-Pu (mg./l.)	Percent Dissolved
1	1	16.3	12.7
2	2.5	20.1	15.6
3	5.25	34.9	27.1
4	22	76.0	59.0
5 (a)	46	105	80.7
6	48	109	84.0
7	53.5	119	91.0
8	71	133	98.0
9	78 (b)	136	100 (c)

(a) The sample was crushed to remove the silicon layer after taking sample No. 5.

(b) Solid lumps of silicon residue remain after 78 hours.

(c) Residue was not analyzed for plutonium.

Dissolution of Zircaloy-2 in Ammonium Fluoride Solutions

Recent work has emphasized the difficulty, as well as the importance, of obtaining reproducible surfaces to study the protective action of oxide films against attack by ammonium fluoride. Additional experiments were performed employing rectangular coupons of Zircaloy-2 which had been oxidized for 110 hours in oxygen at 440 C. These coupons were exposed to attack by boiling six molar ammonium fluoride after (1) exposure to boiling ten molar nitric acid for one hour, (2) exposure to boiling 10 M HNO_3, 0.005 M F^- for one hour, and (3) no treatment after oxidation. In contrast to earlier work which indicated that attack of oxidized samples by boiling six molar ammonium fluoride was somewhat enhanced by prior exposure to nitric acid, the coupon which had not been exposed to nitric acid dissolved at a slightly greater rate in ammonium fluoride than did either of the other coupons.

In an attempt to establish reproducible surface layers, eight solid cylinders of Zircaloy-2 with polished surfaces and hemispherical ends were procured. Some roughness, however, was visible on the surfaces of some of these specimens. The two cylinders which appeared to have the smoothest surface were reserved for autoclaving and the remaining six were exposed to oxygen at 440 C.

One purpose of the experiments was (hopefully) to obtain a correlation between the thickness of the oxide film and the rate of attack by ammonium fluoride solutions.

Accordingly, samples were withdrawn from the furnace after 18, 88, and 236 hours exposure to oxygen at 440 C. The surfaces of the samples which were oxidized for 88 hours or more all contained white lines running lengthwise on the cylinders and indicating presumably increased oxidation along surface imperfections. The 236 hour sample containing the most white lines was exposed to boiling six molar ammonium fluoride, as were the 18 and 88 hour samples. Extensive attack was observed along the white lines on the surface of the 88 hour sample but not of the 236 hour sample. The data presented in Table VIII shows the weight losses observed as a function of time for these samples along with the weight gains observed on oxidation and those to be expected from the data presented in WAPD-98 for the oxidation of zirconium. Results of earlier experiments of interest are included for comparison.

TABLE VIII

EFFECT OF OXIDIZING TREATMENTS ON RATE OF ATTACK OF ZIRCALOY-2 BY BOILING 6 M NH_4F

Sample	Oxidizing Treatment	Weight Gain on Oxidation (mg/dm^2)		Weight Loss on Exposure to Boiling 6 M NH_4F for Indicated Time (mg/cm^2)		
		Obs.	Calc'd.	10 min.	20 min.	30 min.
Solid Cylinder Zircaloy-2	18 hrs. in O_2 at 440 C	16	10	8.5	100	160
	88 hrs. in O_2 at 440 C	28	21	5.8	50	140
	236 hrs. in O_2 at 440 C	42	35	0.35	7.7	26
UO_2 Clad in Zircaloy-2	91 hrs. in O_2 at 440 C	--	22	0.048	0.48	4.7
Hollow Cylinder Zircaloy-2	One month in H_2O at 300 C	--	9	20	120	--

Assuming the surfaces of the 18 hour and 236 hour samples to have been uniform, the rate of attack by ammonium fluoride can be said to decrease a factor of about six for a two-fold increase in thickness of the oxide layer. A comparison of the results obtained with the 88 hour sample and the 91 hour oxidized clad UO_2 cylinder shows very clearly the importance of surface condition - comparable conditions of oxidation gave material varying a factor of 100 in rate of attack.

In an effort to determine the effectiveness of a nitric acid treatment on the rate of attack of oxidized Zircaloy-2, the smoothest of the 236 hour oxidized solid cylinders was exposed to ten molar nitric acid for three hours before being exposed to boiling six molar ammonium fluoride. On exposure to the ammonium fluoride, extensive attack was observed along the white lines and the weight loss was 0.23, 10, and 62 mg/cm^2 after 10, 20, and 30 minutes.

SECRET

Extrapolation of the data presented in WAPD-98 for the reaction of zirconium with high temperature water yields a value of about 20 mg/dm^2 for the amount of oxide formed in a year in 300 C water. Thus it appears that the experiments were done in the range of oxide thickness of interest. It is hoped that the solid cylinders presently being autoclaved will serve as a check on this value as well as give some indication of the relative protective properties (as regards dissolution) of oxide films formed by reaction with water and with oxygen.

Experiments were also performed to determine the optimum conditions for the metathesis of uranium (IV) - fluoride salts to uranium dioxide. These experiments were done using a green salt which, on the basis of uranium, ammonia, and fluoride analyses, is a mixture of UF_4 and NH_4UF_5 (about 70 weight per cent UF_4). Each experiment employed one gram (3.1 millimoles) of salt and 10 ml. of metathesis solution. The metathesis steps were carried out in a boiling water bath, and the salt and solution were mixed by stirring throughout the course of the reaction. The washing steps were carried out at room temperature, each one involving stirring the solid (ca. 0.4 ml) with 10 ml 0.5 M KOH for 15 minutes. The fluoride removal obtained in the various experiments is shown in Table IX. In the experiment giving the best fluoride separation, the weight ratio of fluoride to uranium was ca. 0.0001 (mole ratio ca. 0.0012). Uranium analyses gave values ranging from 0.0006 to 0.005 g/l in the metathesis solutions and from 0.002 to 0.004 g/l in the wash solutions. These concentrations correspond to uranium losses of the order of 0.01 per cent under the conditions of these experiments.

TABLE IX

REMOVAL OF FLUORIDE BY METATHESIS WITH KOH

Metathesis Conditions			Cumulative Decontamination Factor for F^-			
M KOH	Moles KOH/ Moles U	Time	Metathesis	1st Wash	2nd Wash	3rd Wash
2 M	6.5	0.5 hr.	16	74	96	138
5	16	0.5	26	550		
5	16	3.0	28	350	600	
15	49	0.5	20	410	3,000	
15	49	2.2	33	450	3,700	

Non-Rigid Fuel Core Studies

A sample of uranium oxide-bismuth prepared by reaction of uranium metal and bismuth sesquioxide was sectioned and analyzed. Results of five sections of the ingot were: 46.2, 13, 7.8, 9, and 4.7 weight per cent uranium (from top to bottom of the slug which was one inch in diameter by four inches long). Although the material balance was poor (140 per cent recovery of the uranium), the results indicate a higher concentration of uranium near the top of the sample.

Another uniform appearing sample prepared by the above method and corresponding to Bi-15 w/o UO was used to study mobility and filtering characteristics. A 205 gram piece was induction heated in helium to 450 C and held for ten minutes on a Pyrex frit. Application of vacuum caused the bismuth to readily filter. After three such cycles no further bismuth was removed though the residue was at red heat. The U/Bi weight ratio in the filtrate was 0.018 and in the precipitate 0.40. Over 92 per cent of the uranium was retained on the filter. The nature of the retained uranium is not known. The stoichiometry of the reaction would predict half of the uranium to be as the oxide if UO_2 is the product; the remainder would exist as the intermetallic compound, UBi_2. It is therefore possible that the retained material is a mixture of UO_2, UBi_2 and perhaps some UO, although there is no direct evidence for the latter. It is, however, probable that UO_2 suspended in metallic bismuth can be removed by filtration.

Reprocessing Method for Rejected UO_2 Sintered Fuel Material

A sample of high density sintered UO_2 was heated to 500 C in air. Oxidation of the piece occurred rapidly resulting in formation of a fine powder of low density and, undoubtedly, high surface area. Reduction of this material should result in an excellent quality UO_2 for refabrication into ceramic fuel material. This oxidation may be the basis for a simple, non-contaminating rework process for sintered UO_2 fuel material.

Flowsheets for PRP Fuel Processing in the Hot Semiworks

Preparation of a flowsheet for the processing of PRP Pu-Al fuel elements in the Hot Semiworks was continued. Three study flowsheets were developed for comparison. They included: (1) use of 30 per cent TBP as the solvent, with uranium as a diluent to aid in decontamination and critical mass control; (2) use of 30 per cent TBP without addition of uranium; and (3) use of 5 per cent TBP without addition of uranium. Flowsheet (1) appears most feasible due to better decontamination potential and minimum problems with criticality. Further comparisons and study of required HSW equipment alterations were underway.

PRP Plutonium Fuel Reactivity and Isotopic Composition

A detailed mathematical study of PRP plutonium reactivity and isotopic composition of recycled fuel was made. As a result of this study, when moderate yield losses of one per cent or more are considered it was shown that fuel reactivity after a few cycles stays nearly constant and never falls to levels which would indicate desirability of fuel discard. These data support optimism for the recycle concept and simplify consideration of the fuel processing problem.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Environmental and Radiation Chemistry

Tests were completed of the application of a multichannel gamma spectrometric procedure to the determination of Zr^{95}-Nb^{95}, Ru^{103}-Ru^{106}, I^{131}, Ba^{140}-La^{140}, and Ce^{141}-Ce^{143} in 150 gram vegetation samples without the necessity of chemical separation.

Environmental Analytical Services

A 100-channel gamma energy analyzer is being used routinely to measure the following fission products on vegetation: Ba-La-140, Cr-141, Ce-144, I-131, Ru-103 + Ru-106, and Zr-Nb-95. Samples are 150 gram weekly composites from each of 17 zones comprising plant and surrounding areas. Comparative measurement of both I-131 by leaching-beta counting and Non-Volatile Beta Activity (NVBA) were made in the four zones having the probability of highest I-131 deposition.

I-131 results by the two methods agreed. Routine measurement will henceforth be exclusively by gamma spectrometry. Spectrometry results indicate an I-131 detection limit of 5×10^{-7} μc/gram of vegetation in the absence of higher energy isotopes. Large quantities could increase the detection limit 25-fold. With the present isotope spectrum the I-131 detection limit is 2×10^{-6} μc/gram. Additional experience will give a better definition of the detection limit range.

With the present isotopic spectrum NVBA measurements were only 8 per cent higher than the sum of the isotopes measured by spectrometry less I-131. That observation fully supports Regional Monitoring's abandoning its request for NVBA measurements now that multi-channel gamma energy spectrometry is available for making individual measurements of all important gamma-emitting isotopes on vegetation. High fall-out of pure beta activities like Sr-90 will escape measurement. However, other warning signs are available for instituting special analyses of those isotopes when needed. In addition sporadic Sr-90 measurements are planned.

A coincidence spectrometer was set up which utilizes two 5-inch-diameter 3-inch-high sodium iodide crystals as detectors. It was found to have a counting efficiency for point sources of two to three times that of a spectrometer using two 3-inch-diameter by 3-inch-high crystals. On samples contained in nine ounce bottles, the larger crystal spectrometer had an efficiency about six times greater than the smaller crystal spectrometer for Ru^{106}. This instrument makes possible the determination of Ru^{106} in vegetation samples without chemical separation. Comparison of these data with the multichannel spectrometric determination of Ru^{103}-Ru^{106} allows the calculation of the Ru^{103} and Ru^{106} separately. If present in large amounts Ba^{140}-La^{140} interferes with this determination, but correction can be made using the value for Ba^{140}-La^{140} obtained by the multichannel spectrometer.

The study of the radioisotope content of aquatic life in the Columbia River was resumed as a joint effort with the Radioecology Operation in order to determine the ecological distribution of radioisotopes during a period of relatively high metabolic activity. These studies will be compared with the values obtained in the previous study made during a period of low metabolic activity and will also include samples of aquatic life from the Columbia River taken from the plant to the Pacific Ocean. In order to facilitate the counting of small organ samples the three inch well crystal detector on the 20 channel spectrometer was calibrated for samples contained in a small vial and for the isotopes found in reactor effluent water. This instrument, the 100 channel spectrometer and the coincidence spectrometer will be used in the study.

Investigations were begun on the measurement of bremsstrahlung radiation from beta emitters as a quantiative method of analysis using a sodium iodide crystal detector

and a multi-channel analyzer. Practical application of this counting method was made for the Metabolism Operation in a rat feeding experiment. Sr^{90}-Y^{90} was measured in rat food and feces by bremsstrahlung counting in the presence of Ca^{45} and Cr^{51} also present in the feed. The Cr^{51} was measured by gamma counting. These studies showed that hard beta emitters can be measured by bremsstrahlung counting without chemical separation. This greatly simplifies analysis of certain types of biological samples.

The sensitivity of the direct spectrophotometric determination of nitrate ion at 204 mμ was increased to allow a detection limit of 0.002 ppm in the absence of interfering ions by using 10 cm quartz window cells and a photo-multiplier attachment on the Beckman DU spectrophotometer. This procedure requires removal of interfering ions. This appears to be possible using exchange or precipitation on a cation exchange column loaded with silver ion. Successful development of this procedure will simplify and improve the detection of movement of underground wastes.

Geology and Hydrology

Geologic mapping adjacent to the Yakima Ridge on the west side of the Hanford Works disclosed Touchet beds dipping radially outward from that uplifted mountain mass. A bed of volcanic ash high in those beds was tentatively correlated with an ash bed farther north definitely related (University of Washington) to an eruption of Glacier Peak and dated by radiocarbon analyses on adjacent peat beds as 6800 years old. The Touchet beds thus suggest uplift of the range probably to historic time. This discovery is a corollary to the previously unrecognized but now proved tectonic deformation of the type Ringold sediments. The youthfulness of the mountain ridges is emphasized and accordingly the possibility that Hanford may be in a still more earthquake-prone area than previously believed.

The Touchet sediments change appreciably in content and appearance from north to south across the Yakima Ridge anticlinal axis, particularly across the southeastward buried extension of that ridge and indicate the presence of the ridge prior to Touchet time. Tracing of the ridge by all possible means, including the change in composition, assists in the determination of the possible effect on natural ground waters on the project and on the possible direction of movement of radioisotopes in those waters.

Ground water pumping tests were conducted in two wells to determine the transmissibility of the glaciofluviatile aquifer extending southeastward of 200 East Area. Very high permeabilities were previously indicated in this area by the rapid movement of tracer materials in the ground water and by the elongation of the 200 East ground water mound. This high permeability is borne out by the coefficient of transmissibility values of 2.0×10^6 and 2.9×10^6 gal/day/ft resulting from these tests. The field coefficient of permeability estimated from these data is from 50,000-65,000 gal/ft^2/day.

The volume of sediments artifically saturated by the rising water table in the period from 1944 to 1957 was determined from the changes in ground water contours during that period. The rising water table is ascribed entirely to the effect of plant operation. The total volume saturated during the period was determined to be 6.2×10^{10} cu. ft. The total volume of water discharged to the ground was 3×10^{10} gallons. On the assumption that none of the water was lost by evaporation

or discharge to the river, the "wetted porosity" of these sediments was calculated to be about 6.4 per cent. An estimate of the influence of the 200 East and 200 West Area operations individually resulted in wetted porosity values of 7.2 per cent and 6.0 per cent, respectively, indicating the degree of variation that may be anticipated in this aquifer characteristic. The wetted porosity represents the volume fraction of the sediments comprising pore space that would fill with water when the sediments are saturated. The specific retention capacity of the sediments represents the volume fraction of the sediments occupied by water that would not drain from the sediments for a specified period of time. The specific retention capacity is therefore always less than the wetted porosity and generally would be less than one-half of the wetted porosity. Thus the specific retention capacity of the sediments examined is probably less than 3 per cent. This contrasts with the 10 per cent value presently used in specifications for "specific retention" disposal and indicates the degree of further restriction which may be required.

Unsaturated flow experiments utilizing refined techniques permitted the determination of the moisture content exponent in the modified Darcy equation (c-values) with considerably improved assurance and precision. Fifteen determinations of c resulted in an average value of 3.93 ± 0.05 on the 95 per cent confidence level. The improved precision evident with these new techniques will permit additional unsaturated flow studies to promote understanding of the movement of wastes downward through the soil from a disposal crib.

Soil Chemistry and Geochemistry

Further laboratory research substantiated the effectiveness of calcite for removing radiostrontium from wastes containing phosphate ion. It was found that limestone exhibited the same reaction for removing strontium as other forms of calcite but some tests pointed to a somewhat lower effectiveness of limestone, probably as a result of significant impurities in the sample tested. The reaction proceeds equally well in distilled water solutions of radiostrontium and in 40 per cent $NaNO_3$ solutions. The apparent lack of competition with other cations in the solution marks the reaction as being other than ion exchange. There is evidence that the capacity of calcite for removing strontium is increased as the particle size of the mineral decreases, indicating that the reaction probably occurs on crystal faces. The reaction appears to tend toward complete removal of strontium, being limited only by the availability of phosphate ions. Factors affecting reaction rate remain to be studied.

Study was initiated to determine the reaction mechanism by which radiostrontium is selectively adsorbed by calcite crystals in the soil. The reaction appears to differ from a normal ion exchange reaction by its dependence on the presence of phosphate anion in the system and by its non-conformance with equilibrium requirements. The mechanism postulated involves the incorporation of phosphate ions into suitable positions on the calcite crystal vacated by carbonate ions, followed by a growth of strontium phosphate on these activated sites. This mechanism will be tested by use of P^{32}-traced phosphate solution.

Field Apparatus Development

The ground water direction-velocity instrument was returned to the field and tested in a screened well. Mechanical performance was satisfactory but the conductance probe system did not indicate the flow through the well expected from other work. Improvement in electrolyte composition or method of release is indicated.

Instrument tubing for use with the in-well permeability testing packer was received. Solenoid valves and a vacuum gage were received for use with the water deaeration system. Two F & P variable area tube flow meters and a Kates 0.1 - 1 g/m flow regulator were installed in 292-U Building. This system provides accurate water measurement and control for various model studies.

Designs were made for a cable or wire line measuring device. Such an instrument has long been needed to measure cable payout and takeup for accurate placement of in-well equipment and samplers. With the advent of shaped charge perforating, it is very important that the charge carriers be precisely positioned in the well. The measuring device consists of a calibrated pulley, pulley housing, flexible drive shaft and a mechanical revolution counter. Measurement of payout or takeup to 0.1 foot should be possible.

The scintillation well probe was converted from a spectrometer instrument to an integral count instrument. The CRM acceptance range of counting rates may limit the use to relatively low levels of active material in wells.

Radioisotopes in Reactor Effluent

Research to study the formation of As^{76} in reactor effluent by the addition of 10^{-4} ppm stable arsenic to the cooling water through a reactor tube was delayed because of reactor operating conditions unfavorable to the experiment.

The adsorption of radioisotopes in reactor effluent on suspended solid material in the river was investigated in a preliminary way. A sample of silt deposited by the river was shaken in a sample of reactor effluent for one hour. The silt adsorbed 64 per cent of the radioactive material; Np^{239}, Cr^{51}, Cu^{64}, and Mn^{56} were among the isotopes most readily adsorbed. Quantitative evaluation of this adsorption will assist with evaluation of the hazards of reactor effluent discharged to the river and the interpretation of river monitoring data.

V. R. Cooper

Manager
Chemical Research & Development

VR Cooper:bp

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
W. B. Harris	8/6/	AEC, New York Operations Office	Discuss waste disposal research	JF Honstead	No
J. Crawford	8/7/	Bureau of Mines Washington, D.C.	General discussion of Hanford waste disposal practice.	DW Pearce	No
A. S. Cary T. Ward	8/20/	Corps of Engineers Seattle, Washington	Discuss results of Sonoprobe work and geological conditions beneath river, particularly at proposed dam site.	RE Brown	No
E. H. Peabody	8/27/	General Electric San Jose, California	Discuss stack gas sampling.	LC Schwendiman	No
G. R. Wensch	8/29/	AEC Division of Reactor Development Washington, D.C.	Inspect facilities and discuss PRP activities	WH Reas EE Voiland	Yes

VISITS TO OTHER INSTALLATIONS

L. J. Kirby	8/5-9/	Gordon Research Conference Meriden, N.H.	Attend Meeting		
M. C. Lambert	8/6/	Dow Chemical Company Boulder, Colorado	Discuss anion exchange on purity of Pu.	IB Venable JF Willging	Yes
	8/7-9/	X-Ray Symposium Meeting Denver, Colorado	Attend Meeting		No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
L. J. Kirby	8/12-13/	Argonne National Laboratory Lemont, Illinois	Discuss separation methods for Pu and examine alpha energy analysis.	MH Studier	Yes
R. J. Brouns	8/13-16/	Argonne National Lab. Lemont, Illinois	Confer on Washington Designated Programs and discussion of analytical methods.	C Stevens M Studier S Flikema P Hageman	Yes
A. E. Smith	8/13/	A&P Office Idaho Falls, Idaho	Observe remote maintenance hot shop.	JL Schwennesen	Yes
		Phillips Petroleum Office Idaho Falls, Idaho	Discussions on mechanical fuel processing and equipment development.	JL Schwennesen	Yes
R. J. Sloat V. R. Cooper	8/20/	Westinghouse Atomic Products Department Forest Hills, Penn.	To discuss reprocessing of fuels from propulsion and power reactors.	Mr. Boysey	Yes
	8/21-23/	AEC Office Washington, D.C.	" " " "	EJ Bloch RC Dalzell	Yes
R. E. Connally	8/19-21/	Radiation Laboratory Berkeley, California	Confer on alpha detection & analysis equipment and methods.	A Ghiorso	Yes
	8/22-23/	I.R.E. Conference San Francisco, California	To Attend Meeting		No
R. H. Moore	8/19-23/	Gordon Research Conference Meriden, N.H.	To Attend Meeting		No
	8/26/	Brookhaven National Lab. Upton, L.I., New York	Technical discussion on pyrochemistry.	R Wiswall	Yes
M. T. Walling	8/19-21/	Oak Ridge National Lab. Oak Ridge, Tennessee	Technical consultation on chemical processing problems.	FR Bruce	Yes
	8/21-23/	Savannah River Project Aiken, South Carolina	" " " "	TH Siddall DG Karraker	Yes

A. Organization and Personnel

On August 1, 1957, the new L-4 Operation, Radioecology, was formed from personnel previously in Aquatic Biology and Biological Analyses Operations. J. J. Davis was appointed Manager of this new component.

B. TECHNICAL ACTIVITIES

FISSIONABLE MATERIALS - 2000 PROGRAM

BIOLOGICAL MONITORING

Samples of terrestrial and aquatic organisms are routinely collected and assayed for radioactive contamination released to the atmosphere, impoundments, and the Columbia River.

Atmospheric Contamination

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

Collection Site	μc I^{131}/g thyroid Average	Maximum	Trend Factor
East of 200 East Area	2×10^{-2}	2×10^{-2}	- 3
West of 200 West Area	2×10^{-3}	2×10^{-3}	-
100-B Area	1×10^{-3}	3×10^{-3}	- 3
One mile SE of Redox	8×10^{-4}	1×10^{-3}	- 3
Meteorology Tower	7×10^{-4}	9×10^{-4}	- 3
Prosser Barricade	7×10^{-4}	8×10^{-4}	-11
Four miles SW of Redox	3×10^{-4}	3×10^{-4}	- 3
Five miles SE of Redox	8×10^{-4}	9×10^{-4}	- 8*
Route 2S, mile 3	9×10^{-4}	9×10^{-4}	-11*
Wahluke Slope, ENE	4×10^{-4}	4×10^{-4}	-15*
Wahluke Slope, N	3×10^{-4}	4×10^{-4}	-13*

*The last four trend factors compare values with samples obtained in June rather than July because collections at these stations were made bi-monthly.

These values are substantially below those of last year, by factors of 2 to 30 in most instances.

Concentrations of mixed fission products were present in rabbits as follow:

Sample Type	μc FP's/g sample Average	Trend Factor
Bone	5×10^{-5}	-
Feces	4×10^{-5}	-
Liver	4×10^{-6}	-

[redacted]

Swamp Contamination

No samples were collected.

Columbia River Contamination

The contamination levels during August for beta emitters in small fish which serve as an index for other aquatic forms, whitefish which are an important sport fish, and in birds which inhabit the Columbia were as follows:

Sample Type	Collection Site	μc beta emitters/g wet wt. tissue Average	Maximum	Trend Factor
Minnows (entire)	Hanford	2×10^{-2}	2×10^{-2}	- 23
Whitefish flesh	Priest Rapids	3×10^{-5}	7×10^{-5}	- 2
Whitefish flesh	McNary	2×10^{-5}	2×10^{-4}	
Swallows	Hanford Res.	3×10^{-3}	7×10^{-3}	- 5
Shorebirds	"	2×10^{-3}	6×10^{-3}	- 3
Terns	"	2×10^{-3}	4×10^{-3}	- 7
River ducks	"	2×10^{-3}	3×10^{-3}	- 5
Mergansers	"	5×10^{-4}	1×10^{-3}	- 2
Gulls	"	4×10^{-4}	2×10^{-3}	- 2
Herons	"	5×10^{-5}	7×10^{-5}	-

The activities for minnows were between two and three times values for the same period last year, whitefish from Priest Rapids were four and one-half times greater, and most birds were from two to six times greater.

Effect of Reactor Effluent on Aquatic Organisms

Young whitefish continue to be subjected to four per cent strength reactor effluent and to an equal quantity of the effluent which is varied in concentration to simulate conditions which may exist when the flow of the Columbia River fluctuates widely during each 24-hour period as a result of power production at Priest Rapids Dam. At the end of three months, there is yet no indication of any adverse effect due to effluent levels being tested or to a difference in effect in either of the two effluent conditions.

Further results on the temperature sensitivity of young whitefish show no new trend. At this season, water temperatures 2 C and 3 C above normal for the Columbia have not significantly increased mortality although a considerable effect was noted last winter for the incubating eggs.

BIOLOGY AND MEDICINE - 6000 PROGRAM

METABOLISM AND TOXICITY OF RADIOACTIVE MATERIALS

Biological Chains

Water in a pond which was spiked with Cs^{137} to a concentration of 6×10^{-3} μc/ml was decontaminated by a factor of 9,500 within 56 hours due to biological means.

[redacted]

All forms of biological organisms in pond concentrated the Cs^{137} and a large amount of the original activity has become accumulated in the mud.

Research on the accumulation of Ru^{106} by aquatic organisms was initiated August 5. At that time, 10.3 mc of Ru^{106}-Rh^{106} were introduced into a pond containing water, algae, and fish.

The data indicate a gradual decrease of activity by the water. Contamination of algae rapidly increased and then decreased. Recent samples have shown increasing amounts of activity, however. The contamination of fish have been increasing since the study began.

Zinc

Zn^{65} is retained in bone and pelt of rats with a half-life of about 150 days over a period of 10 to 100 days post-injection. Over this same period the half-life in the visceral organs and muscle is 20 to 25 days. Total retention after 100 days amounts to about 10 per cent of the injected dose with nearly all of this present in the bone and pelt. The 150 day half-life in bone is about six times longer than the value currently employed in establishing MPC's. In studies of Zn^{65} absorption from the G.I. tract, the addition of inert zinc carrier was shown to decrease absorption by a factor of approximately four when zinc concentration was increased by a factor of 1,000.

Strontium

An experiment was completed measuring the effects of time and dietary calcium on the deposition and retention of chronically fed Ca^{45} and Sr^{90} in mature rats. The rats were pre-conditioned for 4 weeks on 0.1%, 0.5%, and 2.0% calcium diets. Sr^{90} and Ca^{45} were added to the diets and animals sacrificed after 3, 6, 13, and 24 days. The ratio of Sr/Ca deposition in bone was shown to be a function of both time and dietary calcium level, decreasing between the 3rd day and 24th day sacrifice groups by about 1/3, and increasing by a factor of 3 from the low to the high calcium groups. While percentage deposition of both Sr^{90} and Ca^{45} was decreased by increasing the total calcium level in the diets, this effect was not stoichiometric and was much greater in the case of Ca^{45} than Sr^{90}. These results bring into question the legitimacy of interpreting Sr^{90} hazards in terms of Sunshine Units and discrimination factors, without consideration of actual Sr^{90} or inert calcium levels.

The statistical analysis was completed on the data from an experiment designed to test the applicability of calcium gluconate as an isotopic diluent of strontium in lambs. The addition of calcium gluconate to three times the normal concentration of milk reduced the Sr^{89} deposition in bone by about 50 per cent, confirming our previous report.

(The addition of Na gluconate to the milk more than doubled the liver deposition of Sr^{89} compared with the control group or the groups fed Ca gluconate. This interesting but probably insignificant observation remains unexplained.)

[redacted]

Iodine

In order to determine if the lowest radioiodine regimen of 0.15 µc a day may be responsible for the gradual reduction in thyroid uptake, the 6½-year-old control ewes were fed 0.15 µc/day until apparent thyroid equilibrium was reached. The thyroid burden exhibited at equilibrium in these controls is precisely the same as that manifested in the group of the same age exposed to 0.15 µc/day for their entire lifetime. This serves to confirm the observation that 0.15 µc/day is non-damaging under the conditions of our experiment.

Cesium

Results of the 400-day sacrifice in the chronic oral Cs^{137} experiment showed no significant changes since the 300-day sacrifice.

Cerium

Experiments were initiated to study the distribution in the gonad and other tissues of Ce^{144} - Pr^{144}. Ce^{144} has recently been reported in Wisconsin milk samples.

Plutonium

An experiment was completed comparing the effectiveness of zirconium citrate and EDTA separately and in various combinations for removal of plutonium deposited in rats 30 days prior to initiation of treatment. Treatments were given for two two-week periods with a week of no treatment in between. EDTA alone was as effective as any of the combinations tested and considerably better than zirconium citrate alone. The most effective treatment reduced the plutonium content of the animals from 59% in the controls to 47% in the treated animals. These results demonstrate the ability of EDTA to remove firmly deposited plutonium. However, the rate of removal was considerably less during the second two-week treatment period, suggesting that further continued treatment would have been relatively ineffective.

In short-term experiments, the chelating agents Chel DM41 and potassium acid saccharate were found to be less effective than EDTA in the removal of plutonium. Further tests with Chel 330 showed that it left about 1/3 as much plutonium in the bone as was left after treatment with equimolar quantities of EDTA. Further studies with Chel 330 are planned. It has the disadvantage of being somewhat more toxic than EDTA.

Radioactive Particles

Five hundred days after intratracheal injection of $Ru^{106}O_2$ into mice only one per cent of the Ru^{106} remained. Two-thirds of this was in the lung.

Short-term retention and distribution studies following inhalation of $Ru^{106}O_2$ particles (0.01 to 4 microns in diameter) by mice are complete. It was observed that the amount present in the gastrointestinal tract immediately after exposure increased with the duration of exposure up to at least two hours. Immediately after a one-hour exposure, approximately 20 per cent of the amount inhaled was present in the lung, one per cent in the trachea, and 30 to 40 per cent in the G.I. tract. About 30 per cent is present in the upper respiratory tract

and the remainder is assumed to have been exhaled. Twenty-four hours after exposure only 10 to 14 per cent of the inhaled amount was present in the lung and about 5 per cent in the G.I. tract.

The training of dogs to breathe from an exposure chamber is continuing in preparation for inhalation experiments with $Pu^{239}O_2$ aerosols.

Dialysis of strontium^{90} sulfate particles in isotonic saline solution indicate there is no marked migration of Y^{90} from the particles upon decay of Sr^{90}.

Gastrointestinal Radiation Injury

One day after x-ray exposure of the abdominal region of rats to 1900 r the desoxyribonucleic acid content in all sections of the G.I. tract was reduced by approximately 50 per cent. The reduction was 35 per cent after 3 days. Oxygen consumption of the ileum was markedly depressed, while that of the colon was relatively unaffected, and the jejunum was stimulated approximately 25 per cent. Further studies on these findings are planned. In all previous irradiations of the exteriorized intestine, the intestine has been exposed only from a point several inches below the stomach. Animals have now been exposed with the stomach and the entire small intestine exteriorized. At the same x-ray dose the survival time of this more thoroughly exteriorized group is not less than that previously noted when the amount of intestine exposed was not so extensive.

Relative Biological Effectiveness

Preliminary studies of non-irradiated yeast cells indicate that the concentration of RNA in the suspending medium is large enough to be satisfactorily measured with the Beckman Spectrophotometer. No evidence of DNA could be found although there was a suggestion of the presence of ATP. The concentration of RNA in the suspending medium will be utilized in evaluating the effects of x-ray on permeability of the yeast cells.

Populations of the haploid strain of yeast were found to contain 16 per cent of the cells deficient in cytochrome. X-rays appear to have a greater effect upon the cytochrome deficient cells than on those which have the "normal" cytochrome. Differential sensitivity of cell populations to radiation will be studied further using additional techniques for dividing these cells into groups for testing.

Genetic Effects of Metabolized Isotopes

No report.

Uptake of Radioactive Substances by Growing Plants

Beans, grown in pots to which Sr^{90} and "carrier" $CaCl_2$ were added in the same concentrations as previously tested by the Neubauer method, show no depression of Sr^{90} uptake by the addition of $CaCl_2$. The concentration of Sr^{90} in the plant material was appreciably greater than previously reported for barley seedlings grown by the Neubauer method.

1237539

HA Kornberg

HA Kornberg
Manager, Biology

[redacted]

C. Offsite Visits and HLO Visitors

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
VISITORS TO HAPO						
Roy L. Bouque	8/29	Booze, Allen and Hamilton Mgmt. Consultants, Seattle	Discuss mgmt.	H.A. Kornberg	No	100-F, 108-F, 1705-F, 146-FR, 141-M
VISITS TO OTHER INSTALLATIONS						
W. J. Clarke	8/13-24/57	AMVA Convention, Cleveland Allied Labs, P-M Company, Indianapolis ORNL, Oak Ridge, Tenn.	Attend conv. Discuss new strain of pigs. Correlate work on bone marrow transplants.	- Dr. C.J. York Lt. Col. Kuhn	- - Yes	
R. C. Thompson	8/19-20/57	Argonne National Lab., Lemont, Illinois	Attend Sub-Committee meeting on Internal Emitters, NAS	Dr. A.M. Brues	Yes	
J. J. Davis and W. C. Hanson	8/25-30/57	Stanford University, Palo Alto, Calif. and USNRDL, San Francisco	Present papers at AIBS meetings and discuss ecology.	Curtis L. Newcombe	Yes	

D. Lectures

a. Papers presented at meetings

J. J. Davis, "The Dispersion of Radioactive Materials by Streams: with special reference to the Columbia River," American Institute of Biological Society Meetings, Stanford University, Palo Alto, California (August 28, 1957).

W. C. Hanson, "Accumulation of Radioisotopes from Fallout by Terrestrial Animals at Hanford, Washington," American Institute of Biological Society Meetings, Stanford University, Palo Alto, California (August 28, 1957).

E. Publications

George, L.A. Jr., Patricia L. Hackett, L.K. Bustad, "Leukocytic Response in Lambs Exposed to Whole-Body X Irradiation," Am. J. Vet. Res. XVIII(68), 631-633, July 1957.

Marks, S., L. A. George, Jr., and L. K. Bustad, "Fibrosarcoma Involving Thyroid Gland of Sheep Administered I^{131} Daily," Cancer 10, May-June 1957.

[redacted]

OPERATIONS RESEARCH AND SYNTHESIS OPERATION MONTHLY REPORT

August, 1957

ORGANIZATION AND PERSONNEL

Dr. R. L. Basmann reported for work on August 28 as an Operations Research Analyst in the Operations Research function.

OPERATIONS RESEARCH ACTIVITIES

Economic Studies

Studies of methods of economic evaluation of capital expenditures were continued.

Matrix Methods of Cost Allocation

Using cost data for the Hanford Laboratories for the month of March as an example, the inverse of a 88 row allocation matrix was obtained. Arrangements have been made to discuss this example with cost accounting personnel. A report describing the method and its advantages is being prepared.

Attitude Survey

Coordination of the forthcoming plant-wide attitude survey continued. All aspects of the survey up to the distribution of the questionnaires to employees have been completed.

Paperwork

A member of the Operations Research function participated in the IPD paperwork clinics conducted by W. Engesser of Oregon State College. Close liaison has been maintained with Office Procedures to provide assistance in the development of an initial attack on the HLO paperwork problem.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Fissionable Materials

Coating and Corrosion Operation plans a long term experimental program to determine which Al-Ni-Fe-Ti-Be-Zr alloy, among those which are within certain alloy limits necessary for reactor use, minimizes corrosion. Experimental designs were suggested for the project which make possible rigorous statistical analysis at various stages of experimentation. After all experimental alloys are assayed, estimation of the minimum corrosion alloy is also possible.

Further analysis was done on recent corrosion data to determine whether or not the range of applicability of the present uniform corrosion model can be extended.

4000 Program - Reactor Development

A member of Non-metallic Materials Development, Fuels Development Operation, was given mathematical assistance on a procedure for finding the corrected distribution of intensity across an x-ray diffraction line. Mathematically, the problem was one of solving the convolution integral equation

$$h(x) = \int_{-\infty}^{+\infty} f(y)\, g(x - y)\, dy$$

for the unknown function f(x), if the functions h(x) and g(x) have been numerically determined at equally spaced intervals by instrumental observations.

6000 Program - Biology and Medicine

Discussions were held with interested personnel concerning various statistical problems associated with the use by the Biological Analysis Operation of the electron microscope to estimate the size distribution of specific particle populations. A statement of the variability associated with the more common methods of estimation was supplied.

Further discussions were held with Biology Operation personnel concerning the use of statistics in continued investigation of the isotopic dilution hypothesis as an explanation of strontium-calcium deposition in bone. One possibility currently being investigated is the simulation of the isotopic dilution phenomenon with an appropriate probability model. The average value properties of several probability models, all extensions of the red-black ball model mentioned in the July report, have been compared with empirical evidence.

The Experimental Animal Farm Operation recently concluded an investigation of the effectiveness of Ca as a preventor of Sr^{90} deposition in sheep. Bone and liver data are currently being analyzed for significant factors.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PROJECT DEPARTMENTS

FUELS PREPARATION DEPARTMENT

Process Control

Quality Control personnel have issued a report presenting a revised method of reporting destructive test results in their monthly Quality Report. This report incorporated recommendations of Industrial Statistics personnel, and was based on the use of control charts.

The penetration tester is an instrument which is designed to reject I and E slugs when the minimum tube wall thickness is below a specified level. In practice, this tester also rejects a large number of acceptable slugs, as has been determined by stripping some of the slugs rejected by the penetration tester. Consideration is being given the problem of salvaging the excessive number of acceptable slugs that are erroneously being classified as rejects.

A significantly large number of ruptures of slugs from one canning line prompted a request by Quality Control personnel for analysis of operational data to determine whether or not this line differed from the others with respect to canning conditions (temperature, silicon content, etc.). Data for this analysis are presently being collected.

Process Experimentation

In view of preliminary rupture experience of slugs with Hunter Douglas cans, an analysis was made of reject rates for the period during which Hunter Douglas components were used to determine whether or not such reject rates were significantly different.

Work is proceeding on conducting a process capability study of all quality characteristics.

IRRADIATION PROCESSING DEPARTMENT

Rupture Analyses

An analysis of rupture experience data was performed in order to compare slugs canned with aluminum components from different vendors.

Considerable data are being reviewed in order to investigate the relationship that may exist between slug reject rates and subsequent slug rupture rates.

Production Test Design and Analysis

Production test PT-613 was concerned with the evaluation of the effects of delay time before quenching on the dimensional distortion of irradiated fuel elements. Two charging patterns were utilized, one involving mixed charges of slugs canned using four different delay times, and the other consisting of full charges of each type slug. Results of the analysis of data from this production test were reported. (Document HW-51919 RD to W. K. Kratzer, 8-13-57, "Effects of Delay Time Before Quenching on Dimensional Changes of Irradiated Fuel Elements.")

Production test IP-2-A involved partial E-N loadings of solid and cored metal. In addition, 8 tubes of normal solid metal were subjected to post irradiated measurements to serve as controls. The primary purpose of the test was to compare the behavior of the solid E-N slugs with the cored. (Confidential-Undocumented letter to W. K. Kratzer, 8-9-57, "Dimensional Changes of E-N Loadings - Solid and Cored Metal.")

A graph useful in interpreting the results of run-to-tupture tests was prepared. This covered the situations where the null hypothesis is not that the two metals are comparable with respect to rupture rates, but rather that one metal is better than the other by a factor of k.

A further study was made of the accuracy and precision of the B-Basin profilometer with respect to warp, ellipticity and diameter readings. Sixteen brass standards were first calibrated by instruments in the 300 area and were subsequently measured on the B-Basin profilometer. The results indicated the

presence of appreciable biases. Recommendations for utilizing the results were made. (Unclassified letter to K. E. Fields, 8-19-57, "Present Biases and Precisions in the B-Basin Profilometer.")

Other

In an effort to simplify the procedure for obtaining some of the results related to determining optimum tube powers, work is being done on developing suitable nomographs and other aids.

Several analyses were performed to investigate the difference observed between the proportion of defective tubes from different lots.

CHEMICAL PROCESSING DEPARTMENT

Final Product Specifications

The analytical error components (dilution and titration) required for demonstration of minimum plutonium content of refabricated War Reserve weapon parts were re-estimated using all data obtained since April, 1957. The revised acceptance limits for fabricated parts were reported to CPD personnel.

The feasibility of using alternate methods of meeting customer specifications is being investigated, since dissatisfaction with the present working specifications on refabricated parts still exists.

To aid in the detection and control of possible biases in the weighing and titration steps of plutonium content measurements by the 234-5 Laboratory, the introduction of suitable standards by Process Chemistry personnel is being attempted. The lack of such standards has made it very difficult to isolate certain bias sources in the past.

Data on security violations and radiation incidents are being evaluated for the Employee Relations Operation in hopes of determining key factors that are positively correlated with frequency of incidents.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

Activities for Other Operations

Mathematical consultation was provided to a member of the Data Processing Operation on methods to be used in solving an inhomogeneous partial differential equation. Further advice was given on the numerical interpretation of the special functions which were encountered in obtaining the solution.

Revised conversion equations for Pu formation and U-235 consumption are being developed for SS Measurements personnel. Once adopted, new bias equations will be necessary in order to remove the bias introduced by the use of average exposures. Since it appears that these equations can be very closely approximated by nth degree polynomials, the general method for estimating the bias correction term was developed on that basis. (Unclassified letter to D. W. Hoba, 7-31-57, "General Method for Computing Bias in Conversion Equations.")

Assistance was provided the Industrial Medical Operation in designing a sample survey to determine what percentage of the total work force would be expected to participate in the Asiatic Flu vaccination program.

Activities Within HLO

Integral calculus type computations were done for personnel of Coating and Corrosion Operation in connection with instrument design for future experiments.

Statistical evaluation of Pu deposition data for HAPO personnel was completed in August. Agreement of the data with a random accident type probability model makes possible confidence interval estimates of the number and severity of future Pu incidents. Information is also available at the individual level on the probability of surpassing 100% MPC within a period of fixed length given a certain percent of MPC initially. Results of the study were sent to interested personnel of the Radiation Protection Operation. (Unclassified letter, 8-23-57, "HAPO Personnel Pu Deposition.")

Radiation Protection Operation requested assistance in determining a statistically rigorous method of utilizing positive Bioassay data to estimate deposition. The problem can be phrased as a joint confidence region estimation of the parameters of a Fredholm type integral equation. Proper choice of the dates to collect the Bioassay samples reduces this formulation to an easily solvable quadratic programming problem. Work continues in this area.

A differential equation, expressing the rate of change of the molarity of a dynamic solution as a function of intake and outlet solution molarities was solved for Chemical Development Operation (Unclassified letter to J. L. Carroll, 8-26-57, "Derivation of Molarity Function.")

Chemical Effluent Technology Operation requested assistance in evaluating a definite integral of a damped Bessel function in connection with waste behavior in a soil column. The problem was transformed into an equivalent one involving the non-central Chi-Square distribution. A table of values as a function of two parameters is being prepared from existing information on the non-central Chi-Square distribution.

Statistical and Mathematical Research and Development

A mathematical investigation of the efficiency of iterative median estimation schemes was initiated. Calculation of efficiencies has been reduced to a routine computer calculation.

The distribution of the statistic max ($|x|$, $|y|$, $|z|$) where x, y, z are the ordered sum of n random permutations of the integers -1, 0 and 1 was investigated as a possible tool for effecting distribution free quality control on a group of three machines. The problem was reduced to finding the distribution of the length of a two dimensional random walk confined in an equilateral triangle with one absorbing and two reflecting barriers.

Computation of occupancy probabilities was concluded in July. The first draft of a formal HW report of the probabilities in tabular form and an explanation of their use is being prepared.

Closed expressions for the evaluation of two determinants which arose in a statistical problem were obtained. Although the determinants were of arbitrary order, their particular structure permitted their evaluation as solutions of linear difference equations.

The necessary and sufficient conditions on the coefficients of a particular quadratic form so that the form would be positive-definite were obtained.

OFFSITE PROJECTS

Preparation of the final report on Operation Pool is essentially complete, and the report will be issued during the first week of September.

OFFSITE VISITS AND VISITORS

A. de la Garza, S. A. Levin and M. Schwinn of Union Carbide Nuclear Company, Oak Ridge, visited with J. B. Work on August 7, 1957 for a discussion of Operation Pool and certain aspects of cascade operation.

Allen Butterworth, Tom Whitten and Kirk Fox of the AEC Office of Operations Analysis spent August 8 discussing combined operations economic analysis with C. A. Bennett and J. B. Work.

Carl A. Bennett

C. A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

[redacted]

RADIATION PROTECTION OPERATION MONTHLY REPORT - AUGUST, 1957

A. ORGANIZATION AND PERSONNEL

Organization

No significant changes in organization occurred.

Force Summary	7-31-57	8-31-57
Exempt	42	42
Nonexempt	188	185
Total	230	227

B. ACTIVITIES

Radiation Monitoring

Monitoring coverage was provided for Construction, Hanford Laboratories and Relations and Utilities without incident. Minor difficulties with stack contamination on subcontractor equipment was encountered at Purex. Routine air samples in the 231 Building led to the discovery of several sources of plutonium causing abnormal air contamination. Gross amounts of plutonium were handled with good control in the 325 and 3706 buildings. A 0.5 curie Cs^{137} source was used in tests in the 321 tank farm without difficulty.

High-level (10 r) pencil dosimeters and crystal dosimsters were placed into service as part of the emergency and civil defense monitoring programs. The crystal dosimeters which have a maximum range of 600 r are installed in 614 buildings on and off the project.

A detailed report of Radiation Monitoring is contained in HW-52312.

Regional Monitoring

The average daily emission of I^{131} was 1.0 curie as compared to 1.7 curies in July. The daily average emission rate for the last year is 1.2 curies. I^{131} deposition on vegetation ranged from < 2 to 5 x 10^{-6} μc/gm. A composite sample from ten locations between Coeur d'Alene, Idaho and Great Falls, Montana was higher than local samples by a factor of 20 and was attributed to bomb debris fallout. A small emission of radioactive particulates occurred during a Redox stack flush. The emission extended for about one-half mile in a southeast direction and primarily consisted of Ru^{106}.

Gross beta activities in the Columbia River were generally higher than in July and reflected the reduced river flow rate. Isotopic analysis of raw water at 100-F showed an average of < 4.0% of the continuous occupational MPC. Raw water at the Pasco filter plant was essentially unchanged and showed an average of < 0.7% of the continuous occupational MPC_{GI}. Water taken from the recently completed Ranney caissons which now supply Kennewick water indicated a filtering action resulting in about 10% of the beta emitter activity normally found (5 x 10^{-6} μc/cc) in Kennewick raw water supplies.

A detailed report of waste disposal monitoring is contained in HW-52411.

Exposure Evaluation and Records

Four cases of suspected tampering with personnel meters have occurred in the last four months. These cases have resulted in doses up to 9.2 rads being assigned to four individuals since the doses to the film badges appear valid. One such suspected case occurred in August. An IPD employee's badge indicated a dose of 9.2 rads for a one-day period.

Badge films for 234-5 Building employees whose total 1957 dose (January to August) exceeded 1 roentgen were re-evaluated taking into account recent modifications in low energy X-ray calibrations and dose to critical organs.

One case of minor (< 1% MPL) plutonium deposition was confirmed in August. The total number of cases of plutonium deposition on record is 206.

Exposure histories for eighteen former employees were prepared for off-site transmittal.

The informal request for self-service badge racks and badge house modifications was submitted to the AEC. A detailed study was initiated on the several proposals for expediting movement of employees through the main badge houses. This study was in response to the task force reviewing the security practices on the plant.

During July and August, approximately 2,100 roving or central badges were established. The progressive adoption of this system has resulted in the reduction of badge films processed since January, 1957, from 54,000 to 33,000 per month.

Radiological Development

Arrangements were made to incorporate the newly adopted mixed energy dosimetry method used on 234-5 exposures into the electronic data processing routine. Progress was made on the scope design of the badge processing machine. Adoption of the exchange badge system which is in progress will greatly facilitate development of an appropriate device since mobility will not be necessary.

Prototype bioassay flask containers were modified and tested for acid resistance, durability, strength, washing and sterilization. Results of all tests were satisfactory. Design modifications and specifications were completed, and invitations to bid were prepared. An order will be placed for 1,000 of these boxes during September, bids permitting.

A Protective Clothing Standards Study Group was established to assist in preparation of HAPO protective clothing standards in conjunction with the HAPO Standards Council.

A small-scale trial run of reactor rear face piping decontamination was completed. The decontaminant (Turco 4306-B) was introduced through the rear face header on the extreme fringe zone of the H reactor. The decontamination obtained was highly effective. A careful balance of water pressures allowed the decontamination solution to pass through the header, pigtail and nozzle without entering the process tubes. The decontamination observed indicated a reduction in dose rate by a factor of two as a minimum, and, in the case of some components, virtually complete elimination of the source of radiation. A large-scale test was planned for September.

Calibrations

A requisition for 100 GM meters was processed as part of the long-range procurement and replacement schedule for portable instruments. Four radium sources, which were in excess of needs, were prepared for shipment to the University of California Radiation Laboratory. One new 0.5 curie radium source (E-615) was received for use in the second calibration well.

Gamma calibration of film was extended this month to accomodate the 16 and 58 kev energy components encountered in 234-5 Building.

Radiological Consultation

Several documents, papers and bulletins were reviewed and comments returned to the interested parties. Of particular interest was a draft of a proposed modification of Handbook 59 which amplifies with more specific details the preliminary statement on external dose limits which was issued earlier this year by the NCRP.

The depth dose curve for 17 kev gamma rays was obtained and exposure limitations to plutonium workers reviewed. Since the bone dose from this energy is negligible, the dose in the gonads becomes limiting as long as the eyes are protected. Equations for limiting the gonads to 3 r in a field of mixed 17 kev and harder radiations were devised and applied to the case of external dose from plutonium.

Radiological Standards

The first report of the American Standards Association Z-54 Section Subcommittee on Permissible Contamination Levels of Industrial Materials was received and comments on the influence of this report were returned to the subcommittee.

A modified permissible limit for exposure to the gamma radiation emitted from metallic plutonium was issued. The modified limit separately considers the known 17 kev gamma component and relates the effects of this component to the HAPO film badge and to the critical organs involved. The modified limit continues as 3 r per year at the critical organs, but provides administrative flexibility by allowing an individual's permissible limit to be based on his exposure to the separately determined gamma radiation components present at a particular work location. Practical application is found in 234-5 and 231 buildings.

Internal Exposure Studies

A program for routine isotopic analysis of contamination on environs vegetation was initiated. This coupled with examination of the dietary habits of residents of the West should eventually permit evaluation of environs dose from consumption of foodstuffs.

Columbia River Studies

Several actual or potential activities on the Columbia River are receiving appropriate attention. These include the dam under consideration by the Benton and Franklin Counties Public Utility Districts about four miles upstream from the 300 Area; the pulp and paper plant planned for location at Attalia, 11 miles downstream from Pasco; and the uranium ore refinery operated by the Dawn Mining Company at Ford, Washington. The refinery has announced its readiness to buy ore. Its wastes are discharged to the Columbia River.

C. EMPLOYEE RELATIONS

Safety

There were two medical treatment injuries for a frequency of 0.55.

Security

No security violations occurred.

Suggestions

Radiation Protection personnel submitted nine suggestions, none of which were adopted.

Beneficial Moves

Three beneficial moves occurred including the transfer of R. G. Clark to Reactor Engineering Development Operation.

Relations

One grievance, outside of HLO, concerned the administration of radiation exposure within the weekly permissible limit. The need for close working relationships between components was clear in order that inconsistent practices could be avoided. A monthly functional meeting was instituted for all Radiation Monitoring managers on the plant to promote better communications.

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
W. B. Harris	8/5-6/57	Health & Safety Lab. New York Operations Office, AEC New York 23, New York	Discuss radiation protection policies and methods.	AR Keene & Staff	Yes	300
Bryce L. Rich	8/19-21/57	Phillips Petroleum Co. Idaho Falls, Idaho	Discuss I^{131} detection in the body and stack monitoring.	AR Keene & Staff	Yes	303:300
W. F. Patton	8/13-14/57	Pratt & Whitney Aircraft Corporation Livermore, California	To observe all phases of exposure evaluation and records work.	FL Rising LF Kocher	No	300

VISITS TO OTHER INSTALLATIONS

C. M. Unruh	8/1-5/57	AEC Mercury, Nevada	Participate in weapons testing per request of AEC.	J Deal	Yes	

REGIONAL MONITORING

The general findings are summarized in the following:

Sample Type and Location	Activity Type	Average Activity Density μc/cc	Trend* Factor
Drinking Water and Related Materials			
Benton City Water Co. Well	alpha	1.2×10^{-8}	--
100 Areas	beta	$(0.06 \text{ to } 5.9) \times 10^{-6}$	+2
200 Areas	beta	$(0.4 \text{ to } 1.2) \times 10^{-7}$	--
Pasco, Kennewick, McNary Dam	beta	$(< 0.0^{?} \text{ to } 2.8) \times 10^{-6}$	--
Backwash Solids - Pasco Filter Plant	beta	2.7×10^{-1} μc/gm	+2
Backwash Liquids - Pasco Filter Plant	beta	2.5×10^{-6}	--
Anthracite, Sand Filter - Pasco Filter Plant	beta	6.4×10^{-4} μc/gm	+3
Other Waters and Related Materials			
200 West Wells	beta	$< 2 \times 10^{-7}$ to 3.6×10^{-3}	-2
200 East Wells	beta	$< 2 \times 10^{-7}$ to 6.9×10^{-2}	--
Wells Near 200 Areas	beta	$< 2 \times 10^{-7}$ to 1.2×10^{-6}	--
Outlying Wells	beta	2.1×10^{-7}	--
Columbia River - Hanford Ferry	beta	2.2×10^{-5}	--
Columbia River - Below Reactors	beta	1.9×10^{-5}	--
Columbia River - Paterson to McNary	beta	4.5×10^{-7}	--
Columbia River - Mud	beta	$(0.1 \text{ to } 5.0) \times 10^{-4}$	+2
Raw Water - Operating Areas	beta	$(< 0.003 \text{ to } 1.6) \times 10^{-5}$	+3
Reactor Effluent Retention Basins to River	beta	13,000 to 38,000 μc/sec/reactor	--
		$(2.2 \text{ to } 8.8) \times 10^{-3}$	--
Reactor Effluent Retention Basins to River	alpha	< 0.04 μc/sec/reactor	--
		$< 5 \times 10^{-9}$	--
I-131 in Farm Wastes to River	I-131	1.2×10^{-6}	--
I-131 in Columbia River - Hanford	I-131	3.9×10^{-8}	--

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

Sample Type and Location	Activity Type	Average Activity Density μc/cc	Trend* Factor
Atmospheric Pollution			
Gross Alpha Emitters	alpha	$(< 2 \text{ to } 5) \times 10^{-15}$	--
Gross Dose Rate - Separations Areas	beta-gamma	0.5 to 2.6 mrad/day	-2
Gross Dose Rate - Residential Areas	beta-gamma	0.7 mrad/day	--
Active Particles - Separations Areas	beta	$(3.1 \text{ to } 7.1) \times 10^{-13}$	--
I-131 Separations Areas	I-131	$(0.2 \text{ to } 1.0) \times 10^{-12}$	--
I-131 Separations Stacks	I-131	1.0 curie/day	--
Ruthenium - Separations Stacks	Ru-103-106	< 0.02 curie/day	--
Active Particles - Wash., Idaho, Ore., Mont.	--	0.004 to 1.8 ptle/m^3	+50
Active Particles - Project	--	0.001 to 0.098 ptle/m^3	--
Vegetation			
Environs of Separations Areas	I-131	$(< 2 \text{ to } 4.1) \times 10^{-6}$ μc/gm	-3
Residential Areas	I-131	$< 2 \times 10^{-6}$ μc/gm	--
Eastern Washington and Oregon	I-131	$< 2 \times 10^{-6}$ μc/gm	-6
Fission Products Less I-131 Wash. and Ore.	beta	$(0.6 \text{ to } 7.0) \times 10^{-2}$ μc/gm	-7
Alpha Emitters - Separations Areas	alpha	$(< 0.3 \text{ to } 8.2) \times 10^{-7}$ μc/gm	--

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

RADIATION MONITORING	Hanford Laboratories	Minor & Major Construction	Others	August	Year to Date
Special Work Permits	1881	312	238	2431	21,605
Routine and Special Surveys	1244	509	269	2022	19,895
Air Samples	2062	109	143	2314	18,325
Skin Contamination	3	6	0	9	156
*Class II Radiation Incidents	0	0	0	0	1
**Class II Radiation Incidents	0	0	1	1	5

EXPOSURE EVALUATION AND RECORDS

Gamma Pencils	Pencils Processed	Paired Readings 100-280 mr	Paired Readings Over 280 mr	Lost Readings
August	141,400	9	10	7
1957 to Date	1,801,826	99	99	72
300-L Area				
August	19,462	7	4	0
1957 to Date	61,010	17	8	3

Beta-Gamma Film Badges

	Badges Processed	Readings 100-300 mrads	Readings 300-500 mrads	Readings Over 500 mrads	Lost Readings	Average Dose Per Film Packet mrad(ow)	mr(s)
August	33,174	768	28	6	96	1.50	5.35
1957 to Date	370,522	5,315	219	56	603	1.66	3.62

Slow Neutron Pencils

	Pencils Processed	Paired Readings 4-12 mrem	Paired Readings Over 12 mrem	Lost Readings
August	3,050	46	16	1
1957 to Date	20,216	270	92	14

Fast Neutron Film Badges	Badges Processed	Readings Above 50 mrem	Lost Readings
August	820	1	0
1957 to Date	7,564	4	10

Bioassay	August	1957 to Date
Plutonium: Samples Assayed	1126	9422
Results above 2.2 x 10^{-8} µc/sample	30	245
Fission Product: Samples Assayed	1212	10391
Results above 3.1 x 10^{-5} µc FP/sample	3	13
Uranium: Samples Assayed	419	3232

*Radiation Monitoring Operation Customers
Total Plant

1237555

Uranium Analyses	Following Exposure Units of 10^{-9} µc U/cc			Following Period of No Exposure Units of 10^{-9} µc U/cc		
Sample Description	Maximum	Average	Number Samples	Maximum	Average	Number Samples
Fuels Preparation	17.02	2.68	104	7.10	2.08	43
Hanford Laboratories	7.84	3.62	13	5.09	2.48	11
Chemical Processing	26.87	5.43	111	25.26	3.75	92
Chemical Processing*	124.0	14.14	30	86.03	21.24	10
Special Incidents	4.36	1.68	4	--	--	--
Random	0.34	0.34	1	--	--	--

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

Tritium Analyses	August	1957 to Date
Samples Assayed	0	59
Thyroid Checks		
Checks Taken	27	280
Checks Indicating .01 µc	0	1
Hand Checks		
Checks Taken - alpha	49,076	434,479
- beta-gamma	46,134	403,450

CALIBRATIONS

Portable Instrument Calibration	Number of Units Calibrated August	1957 to Date
CP Meter	1,017	8,382
Juno	346	2,884
GM	1,308	11,105
Others	161	1,399
Total	2,832	23,770
Personnel Meters		
Badge Film	1,824	17,658
Pencils	7,230	39,535
Others	143	1,452
Total	9,197	58,645
Miscellaneous Special Services	459	3,265
Total Number of Calibrations	12,488	85,680

A. R. Keene, Manager
RADIATION PROTECTION

ARK:bh

1237556

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LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - AUGUST, 1957

General

Safety performance of the Operation was considered satisfactory as indicated by the Minor Injury Frequency Rate. The rate continues to fall within the established control limits and is 3.12 for the month, down from 3.92.

The absenteeism rate remained at 3.6 per cent, the same as the previous month. This rate is slightly above the expected rate but not significantly so.

There were no security violations charged to the Operation. This represents considerable improvement over July when there were three.

One unit jurisdictional grievance was filed in the Technical Shops. The Step I answer was not satisfactory to the aggrieved. A unit grievance was filed by an FPD sign painter protesting the assignment of certain work in the Drafting Operation. Several grievances were filed by FPD maintenance personnel involving assignment of work to Construction Operation. Step II discussions of these grievances are pending.

Facilities Engineering Operation

There currently are 35 active HLO "Equipment" and "Plant Acquisition and Construction" projects. Of these 12 are under construction, 10 are in the design stage, and 13 are being prepared for, or are awaiting, AEC approval.

Project activity has been initiated on all budget items for FY 1958. Budgeted "Equipment" and "General Plant" projects are being reviewed and integrated with those of other HAPO components. These efforts will result in equitable allocation of funds and will allow proper planning of project activity.

The first meeting with managers of other HAPO departments and operations working in project activities was held on July 12, 1957. It was decided meetings would be continued at monthly intervals. The purpose of these meetings is to discuss mutual problems and subjects common to project activities at HAPO. Subjects discussed at the first meeting were personnel plans, integration of projects, practices of estimating and financing, project materials handling, procedures and relations.

A time study of drafting work has been made and tested on a "dry run" basis. This study is a result of requests by customers for drafting services by only the faster and more experienced draftsmen and designers. This condition became acute during May and June when economy measures were being exercised in HLO. It is believed a fixed time (or price) per drawing will allow a more equitable assignment of work in the drafting room with the quality of product maintained and at a rate that is uniform. This method is now being used in our drafting operation.

Project activities are summarized on the attached report. Charts have been printed showing the planned schedules for scope, design, procurement and construction for Plant Acquisition and Improvement activities.

The AEC was apprised of the scope of work on Project CG-747, Plutonium Fabrication Pilot Plant. The Commission made suggestions on the scope and due consideration has been made by CEO. It is planned to submit the scope of work to the Commission for this project during the early part of September.

A design review meeting was held to review the scope of work on CA-749, High Level Radiochemistry Facility, with representatives of CEO and HLO present. Cost estimates indicated certain economies would need to be made. These may be possible by better utilization of adjacent space and utilities and possibly by reducing the cells from three to two.

A meeting was arranged by Contract Administration for HAPO departments and operations project and financial personnel to review the General Plant Project activities for FY 1958 and to recommend a method of equitably allocating anticipated available funds. No definite conclusions were reached, except it appears HLO's portion of this budget item will be about $700,000. A firm list of work indicates HLO needs about $1,000,000 of General Plant funds; therefore, steps are being taken to establish an order of preference for HLO projects.

A revised estimated expenditure pattern by quarters was developed for HLO's Plant Acquisition and Construction Projects and was transmitted to Contract Administration.

The status of jobs under $5,000 indicates these are being completed at a more rapid rate. This is primarily due to an increase of personnel in the engineering group. A brief of these jobs is as follows for the year since FEO has been active: 29 jobs have been acted upon and closed out;3 jobs after study resulted in Informal Requests; and 13 jobs after study resulted in Project Proposals.

The status of 21 jobs remaining active is as follows:

Job No.	Title	Status
90004	Contaminated Waste Chute,327 Bldg.	Hold pending customer's decision.
90013	Thermal Expansion Layout	Requires scoping by customer; no work can be started at present.
90015	Portable Vacuum System	Apparatus to be purchased.
90017	X-Ray Diffraction Sample	Requires scoping by customer; inactive at present.
90020	Impact Tester	Requires scoping by customer; inactive at present.
90028	Modification of Elevator,327 Bldg.	Inactive at present.
90048	Fabrication and Installation of Pig Feeder Stalls, 141-F Bldg.	Work Order to be written to C.O.
90050	Modifications to Master Slave Manipulator	Held up; individuals concerned on vacation.
90051	Repair and Relocation of Hoods, 329 Bldg.	Plant Forces Work Review submitted; awaiting decision.
90052	100-F Area Pasture	Work Order issued to C.O.
90053	Winterize 108-F Train Shed Air Conditioner	Work Order issued to C.O.
90054	Installation of Heating Cable and Insulation - Manure Auger, 141-N	Plant Forces Work Review submitted; awaiting decision.
90055	Whole Body Animal Counting Room, 141-F Bldg.	Plant Forces Work Review submitted; awaiting decision.
90059	Breathing Air System, 141-FS	Plant Forces Work Review approved; proceeding with work; FEO job folder closed out.

The Shielded Cave in 325 Bldg. (AR-57-HLO-47) is 75 per cent complete. Total expenditures to July 31 were $16,894. Remaining balance of funds is $4,436.

The landlord and building engineering group performed work on the following:

a) Repairs to 306 Bldg. heating and ventilation systems.
b) Study of surface water drainage on south side of 314 Bldg.
c) Review of over 2000 drawings of facilities and voiding of over 500 as obsolete.
d) Assistance in compilation of Research and Development facilities at HAPO (Secret Document HW-51999).
e) Reply to a space survey questionnaire presented by University of California Radiation Laboratory.

Other landlord activities are as follows:

a) The 207-S Retention Basin Instrument Bldg., which was inadvertently included in the HLO Plant Accounts at the time of reorganization, was transferred to CPD, 200-W Area, thus relieving the HLO landlord of accountability.
b) An order was issued to the Photography Operation to photograph each HLO building at HAPO. Prints of these photos will be included in a landlord brochure of each building. The Classified Documents Review Office has ruled such photographs as "Unclassified" but will not permit aerial photographs in this category.
c) An unfinished boat dock, located in the desert north of the 300 Area was removed from HLO Plant Account records by means of a Property Disposal Request. Work on the dock and dredging of the Columbia River bank for moorage was done in 1955. The HLO landlord is relieved of further accountability.
d) Negotiations have been opened with AEC Property Management Branch to obtain custody of the buildings and facilities now used by U. S. Geological Survey, located near the main entrance to 200-E Area. The facilities will be used as a headquarters for well drilling operations. USGS is expected to vacate the facilities within 90 days.

Twelve purchase requisitions were processed in an estimated amount totaling $6,600. Three bid reviews were made.

Code water tanks and air receivers in 306, 314 and 326 Bldgs. were inspected by the third party inspector.

The drafting operation produced and revised about 215 drawings. The backlog of work is moderate to heavy. Work in the 231-Z Building is very heavy and is being farmed out to CEO. The backlog in 1707-D approximates 1 man year's work. The graphics work by FEO was questioned during the month. Presently the majority of graphics is being farmed out to R & U. Approximately 6500 square feet of drawings were reproduced on the ozalid print machine during the month. Some of the major designs in progress are as follows:

a) "Re-design of Hanford Slave Manipulator" - JE Jelacic, Engineering Designer - CL Boyd, Engineer. The reason for the re-design, to increase the handling capacity from 3 lb. to 20 lb.

b) "Annular Dissolver, 321 Bldg." - KM Kammeyer, Draftsman - JJ Shefcik, Engineer. The design drawings on the Annular Dissolver were drawn up prior to fabrication of a small scale model of a slug dissolver. This dissolver will be tested in 321 Bldg. If successful it will be a part of 800,000 production line installation in 200-E Area.
c) Poison Spline Disposal Piping "C" - WD Leahy, Design Draftsman - F. Mollerus, Engineer. This particular job is a part of Poison Spline piping arrangement on the front elevator of 105-C.
d) As-Builts on 321 Bldg.- Piping, Architectural and Electrical - LG Sagerser, Design Draftsman - G. Fitzpatrick, Engineer. This job is being pushed by the 321 Bldg. manager prior to extensive project changes.
e) ETR Basket Arrangement - RC Carlson, Engineering Designer - D. Kaulitz, Engineer. CEO designed the ETR process tube; HLO was required to supply the basket arrangement design.
f) 14-Ton Radiometallurgy Laboratory Cask - KM Kammeyer, Draftsman - WS Kelly, Engineer. Portographs were run on H-3-5894 sheets 1 - 4. Revisions were made in the portographs to make the cask feasible for use in the radiometallurgy building. New drawing numbers will be assigned.
g) Profile Column Sampler - Engineering Designer, RH Somerville - RT Alleman, Engineer. This drawing was made at the request of LJ Lucas to enable the shops to clarify the union dispute over jurisdiction between the millwrights and sheet metal workers. The delineation on the drawing presented to shop by Mr. Alleman was vague and incomplete; therefore, Mr. Kelly was unable to assign the work to the proper craft.
h) Comparison Fission Chamber - Engineering Designer, RH Somerville - Engineer, Friesen. Design and preparation of shop drawings to provide Fission Chamber which could be operated as a vacuum or gas filled for the purpose of exposing samples to metron beams; comparison readings from sampler with existing data.
i) RC Carlson has designed the following jobs and has been assigned the responsibility of following them through the 328 Bldg. shop: Cryostat, Quick Disconnects, MTR Baskets, "B" Block, Refrigerated Cask, Vac. Arc. Melting Furnace, Hot Storage - 326, Pipe Rack - 326, ETR 3" x 3" Critical, Proposed Basket ETR, Proposed Withdrawal Tool, ETR 9" x 9" Critical.

Technical Shops Operation

Total productive time for the month was 11,230 hours. The total shop work backlog is 20,601 hours of which 40 per cent is scheduled to be completed by October 1. Overtime worked during the month was 2.1 per cent (387 hours) of the total available hours.

Distribution of time was as follows:

	Man Hours	% or Total
Fuels Preparation Department	1820	16.2
Irradiation Processing Department	2208	19.6
Chemical Processing Department	1184	10.5
Hanford Laboratories Operation	5903	52.6
Construction Engineering Operation	4	.1
Miscellaneous	111	1.0

Customer demands for service remained firm in all components of the operation. A near optimum backlog exists in the Glass, Optical and Electronic Shops, with the Machine Shops carrying a backlog approximately 25 per cent above what is considered to be optimum.

Safety and security performance was considered satisfactory with no major violations.

Absenteeism decreased from 3.5 per cent in July to 2.5 per cent in August.

Technical Information Operation

Reorganization plans for the operation were completed and effected September 1, 1957. The following changes were made:

1) The Branch Files Operation was combined with the 300 Area Classified Files Operation. The new component is the Document Distribution and Files Operation.
2) The Technical Publications Operation was combined with the Abstracting and Bibliography Operation. The new component is the Reports, Reference and Publications Operation.
3) The Document Classification-Declassification Operation was eliminated. A Specialist, Classification-Declassification will report directly to the Manager, Technical Information.

The ratio of supervisors to direct contributors changed 11.2 to 7.5 per cent.

Work continued on programs to reduce marginal services provided by Technical Information. Coincident with the reorganization the 200 Area Branch Files is being discontinued on September 6 and the number of clerks in the 700 Area Files and the 100 Area Files will be reduced to two each. Further reductions in the periodical routing service are planned.

Considerable planning has been required in order to accomplish the personnel changes made necessary by the reduction of the Technical Information work force and the reorganization. It appears that ROF's will not be necessary but in some cases a reduction in job grade may be required since present job classifications will not always fit available openings.

Comments were supplied to HOO on AEC proposed revision of AEC Manual Chapter 3202 "Reporting and Dissemination of Information Resulting from AEC Research and Development Activities". The revised chapter requires the categorization and standard distribution of all informal research and development reports. It was pointed out that the Chapter was unsatisfactory in its present form because (1) it would flood the AEC with a large number of informal research and development reports of questionable usefulness, (2) put an undue publishing and editing burden on the contractors, and (3) hamper the free use of informal reports so necessary to scientific communication.

A proposed system for a simplified IBM system of document control is being studied. Basically, the system would (1) separate from the present EDPM system the on-plant circulation of documents and handle this function in the Classified Files with simpler EAM equipment and (2) set up in IBM a document control system for the total site accountability. This audit system would be based on primary records furnished by the Classified Files and would be used to prepare inventories to be certified by the Files.

A procedure for field routing of documents was prepared and tested. Eight secretaries, representative of five HAPO departments and operations, were asked to

review the procedure and prepare samples of the routing forms. The results of the test show that the system is workable and would probably be used in offices where there is genuine need for it. However, many secretaries said they would prefer returning the documents to a Files office unless the re-route was urgent.

A booklet "Facts are Tools" was published and distributed to all exempt employees. The booklet gives the reference resources and services available from the Technical Information Operation. Personnel Practices Operation, Relations and Utilities, are planning to use the booklet in their Ph.D. Recruitment program, and 150 copies have been supplied to them.

The Chief, AEC Patent Branch, has requested that procedures be instituted for sending all unclassified documents and papers to the Patent Branch for a patent review prior to unclassified release. There is some question as to the intent of the request, i.e., does it apply to all Unclassified documents and papers or only those which disclose the subject matter of an invention. Following clarification of intent, procedures for obtaining the necessary patent clearances will be defined. This request does not concern documents being processed for declassification. All such documents are automatically forwarded to the Patent Branch for review.

A memorandum, "Classification: Reactor Production Data" was distributed to the field. It contained revised AEC instructions on the classification or production data for the Hanford reactors. Although these instructions appear to be somewhat more restrictive than previous instructions, it is not expected that compliance will cause any unusual difficulties.

The AEC Division of Production has expressed its concern to HOO regarding certain HAPO reports released to the CAProgram. The point at issue, which directly affects the current program of selection of reports for the CAProgram, is the use of production information in the CAProgram. The present basis is that indirect production information is releasable to CAP if it appears in a research and development report and is incidental to the main discussion. Clarification of the use of production information in the CAProgram is badly needed.

A new form for renewing assigned periodical subscriptions was designed. The new form combines (1) an earlier "authorization to renew" form which notified the customer of the approaching expiration of his assigned periodical subscription, and (2) the present library procurement form which is used to re-order the subscription. It is estimated that the new form will save about $100 a year.

The inventory of Files documents in the Record Center was resumed, after a lapse of two months. A total of 287 boxes containing 10,913 documents were inventoried. The job is now 1/3 finished and will take about six more months.

A number of new forms and procedures received attention:

1. The last copy of the duplicating order form is being used as a transmittal for classified documents sent to Duplicating for reproduction. This avoids having to type up a separate transmittal list. The signed copy is brought back immediately by the messengers.
2. A new "Approval for Offsite Transmittal" form was developed and placed in Stores. This form has gone through many changes and it is hoped that it will now be fully satisfactory.

3. The slides which have been filed in 700 Branch File were transferred to the 300 Files.

Approximately 12,000 cards (10 drawers) were removed from the corporate author file. The cards pulled were for reports from those sites which maintain a consistent document numbering system so that duplication of the corporate author file occurred in the number file. The searcher in the corporate author file is now directed to the number file for those sites.

A heavy backlog of R & D reports which had accumulated in 300 Area Duplicating during July was being rapidly reduced at the end of the month. However, 11 of the 26 reports issued during August had been in Duplicating for more than a month. Average processing time is expected to be reduced to two weeks shortly.

A preliminary survey of the impact of the HAPO Classification Guide on HAPO operations and costs has been completed. As a result of the survey, it was recommended: (a) that the Classification Committee re-study the Guide to analyze the problems which strict conformity would cause, and (b) that the General Electric membership on the Classification Committee be revised to include representatives for the several HAPO Departments.

Work Load Statistics

	July	August
Documents routed and discharged	21,224	22,331
Documents issued	10,470	16,968
Documents destroyed	1,962	3,424
Reports abstracted	212	219
Formal R & D reports issued	2	26
Document classification changes	556	1,207
Books circulated	2,406	1,758
Periodicals circulated	8,091	4,645
Volumes added to the collection	325	339

Radiographic Testing Operation

The activity for the Radiographic Testing Operation continued to be a low level due to vacations and reduction in force because of illness. Total tests performed for the month, 648. Of the total, 474 tests were radiographic exposures (including x-ray and gamma ray exposures) and the remaining 174 tests were supplementary tests. Supplementary test work was done in only two fields, eddy current and ultrasonic testing. Work was done for 14 different organizational components including all of the operating departments. A total of 13 reports were issued detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on eight different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in Part II.

Part of the portable x-ray equipment (tube head and control console) was returned to the manufacturer for modifications to allow maximum kilovoltage of 275. Special scheduling was arranged to avoid an extended down-time with the equipment. The modified equipment was received and operated after correcting difficulties apparently caused during transportation.

Work done this month was in four main categories: new vessel fabrication, maintenance, construction and assistance in research and development programs.

In new vessel fabrication, work was continued on jobs started in previous months. The major effort was on the HA column being fabricated in the 200-West shops. By the end of the month major assembly had been started and checked with all of the sub-assemblies already examined. The L-cell package being fabricated in the 200-East shops still continued to occupy considerable time. This job has turned out to be one of the largest projects undertaken by the Radiographic Testing Operation in the total number of joints examined. Complete breakdown will be made upon completion of the work. All of the work consists of pipe welds in sizes ranging from 1/2 inch to 8 inches in diameter. A very minor amount of work was done on the Redox Dissolver being fabricated by Minor Construction forces at White Bluffs. Only miscellaneous piping work was done on this job.

A number of maintenance items required the attention of the Radiographic Testing Operation during the month. Selected boiler lines on all five of the boilers at D Area were examined for possible damage by erosion and corrosion. Results showed that the majority of the lines were in reasonably good condition with only two indicating need for immediate repair. It was interesting to note that pitting corrosion or attack was the only type of damage found. Ultrasonic thickness measurements were made on another elevated water tower to obtain an evaluation of corrosion attack. As in the other tanks examined, no serious conditions were discovered. Work was completed on the pressure vessel survey in the 100-KW Area on the helium and CO_2 storage tanks. It was necessary to extend this work since the one tank originally examined indicated serious defects in the shell and head welds. All four tanks were found to be in similar condition and remedial action is indicated. Work continued in the evaluation of corrosion attack of the buried stainless steel process lines in the Redox building. Laboratory induced stress corrosion of stainless steel piping is being done to provide standards for the evaluation of degree of attack.

Only one job involving construction work was done during the month. From the preliminary results obtained on the high temperature, high pressure piping in the KAPL-120 Loop, examinations were extended to additional joints to obtain a more complete survey. Radiation levels in and around the loop continued to offer considerable difficulty in satisfactorily completing this work.

In the area of process technology and research and development assistance increased emphasis was evident in the examination of PRPR fuel element component materials. Small diameter zirconium with and without fillers of aluminum were examined. Some samples of stainless steel with aluminum filler were also examined. Additional data was obtained on the special Al alloy process tubes. Improved eddy current results were obtained using new probes recently obtained for this work. With the increased sensitivity, numerous indications were obtained that will need further analysis for full evaluation. An interesting job was worked on in connection with graphite thermal conductivity studies. It was necessary to know the exact location of two thermocouples designed to be located a fixed distance apart in a graphite rod. By exposure of the assemblies from two different locations it was possible to demonstrate exactly the position of the thermocouples and to calculate the distance between them.

Miscellaneous work done during the month included welder qualification coupons, a large number of experimental thermocouple configurations obtained from various groups, and evaluation of the integrity of aluminum cans for fuel elements.

Testing Statistics

Component	No.of Tests	Ft.of Weld or Material	No.of Pieces	Description
A. Chemical Processing Dept.	286	251	108	Stainless steel process vessels and piping
B. Construction Engineering Op'n.	24	13	9	Stainless steel process vessel & welder coupons
C. Fuels Preparation Dept.	5	3-1/2	5	Aluminum cans
D. Hanford Laboratories Op'n.	103	618	51	Zirconium & aluminum & stainless steel tubing. Composite Zr, SS & Al elements. Thermocouples & graphite.
E. Irradiation Processing Dept.	230	170 6-1/2 sq.ft.	68	Carbon steel storage & process vessels & piping. High pressure SS piping. Corrosion evaluation.
	648	1055-1/2 6-1/2 sq.ft.	241	

Laboratories Administration and Technical Liaison

Four new Organizational and Policy Guides were issued. Timely revisions were issued on specific sections to six existing guides. The review of AEC Manual chapters which are the prime responsibility of Laboratory Auxiliaries Operation was completed. The pertinent information and procedures requiring conformance are being incorporated into the Organization and Policy Guides.

The following contract was processed for approval:

Special Agreement SA-32 - Union Carbide Corporation acting by its Division, Linde Company.

The following contract has been closed out:

Contract No. SO-11, Speer Carbon Company.

Negotiations were conducted with Chemical Processing Department to obtain services under Maintenance and Repair Contract No. MRO-8, Applied Research Laboratories, for the servicing of spectrochemical analytical instruments in Hanford Laboratories.

L. J. Lucas

Acting Manager,
LABORATORY AUXILIARIES

LJLucas:JLBoyd:sf

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MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
General Plant Projects - FY 1956 AEC-2-23X-56-L-2		Reactor & Fuels	$140,000	$140,000* / 4-4-57	100 / 100	2 / 2	5-23-56 / 12-7-56	As Completed	9-28-56 / 5-1-58
CG-664	350°C Flow Loop - 314 Bldg.	REMARKS: Fabrication of the test loop by Construction Operation is scheduled to begin in October 1957. Purchased items for fabrication are still being received. *Includes $350 transferred equipment.							
General Plant Projects - FY 1957 AEC-2-23-57-N-2		Radiation Protection	$150,000	$150,000 / 2-4-57	94 / 75*	N.S. / N.S.	2-18-57 / 11-1-57*	5-1-58*	10-1-57 / 6-1-58*
CA-658	Shielded Personnel Monitoring Station - 747 Bldg.	REMARKS: Carey and Kramer, the architect-engineers on this project submitted their detailed design of the facility for review. Design is currently being reviewed and comments are being prepared. *Estimated on basis of current status.							
CG-680	Corrosion Testing Facilities - 314 Bldg.	Reactor & Fuels	$135,000	$135,000* / 5-2-57	100 / 100	22 / 32	10-3-56 / 5-27-57	2-2-58	1-25-57 / 3-2-58
		REMARKS: FH Lohse, contractor, has installed the major portions of the pipe headers and has set most of the equipment in designated locations. Electrical work is slightly delayed due to delay in receipt of instrument panel boards. A construction schedule was approved by AEC in August. Final repairs to area of 306 Bldg., where equipment was removed, has been started. All equipment in 326 & 322 Bldgs. transferred. *Total project cost of $166,000 includes $31,000 in transferred equipment.							
CA-685	Alterations to Buildings 325 and 326	Laboratory Aux.	$23,000	$23,000 / 10-4-56	100 / 100	100 / 100	10-1-56 / 4-9-57	As Completed	11-14-57 / 8-15-57
		REMARKS: Installation of a wind screen on the 326 stairway and alteration of the door frame were completed. This project is complete except for final painting of the wind screen and door frame.							
CA-700	Geological and Hydrological Wells - FY 1957	Chemical Research	$122,000	$122,000 / 6-27-57	100 / 100	66* / 53*	11-8-56 / 10-24-56	As wells Completed	1-15-57 / 12-10-57
		REMARKS: *Fixed Price Contractor only. U.S.G.S. has completed 12 wells and a total of 4695 feet of hole. It appears U.S.G.S. will be able to drill about one more well on the project before running out of funds. The fixed price contractor has completed 11 wells and a total of 3246 feet of hole. The Commission is currently negotiating the addition of one 540 foot well to the fixed price contract.							

UNCLASSIFIED

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
CA-728	High Level Exposure Facility Addition - 141-H Bldg.	Biology Research	$26,000	$26,000 2-11-57	100 100	35 60	3-11-57 7-16-57	10-1-57	6-20-57 11-1-57*
		REMARKS: An overhead beam for supporting hogs, a floor drain, and a safety shower were added to the original scope of the project. Erection of the building addition is complete. The contractor is currently installing building services and furniture. *Directive completion date 1-11-58.							
CG-729	Ventilation System Improvements 222-U Bldg.	Chemical Research	$73,000	$73,000 3-12-57	100 100	10 13	4-23-57 7-15-57	3-15-58	5-28-57 6-15-58
		REMARKS: The ability to obtain early delivery on material and equipment for the project tends to indicate completion well ahead of the directive completion date of 9-15-58.							
CG-733	Plutonium Metallurgy Facility Expansion	Research and Fuels	$295,000	$295,000 5-10-57	90 97	2 11	5-14-57 6-10-57	As Completed	10-1-57 6-15-58
		REMARKS: The field release for the remainder of Construction Operation funds was issued on 8-16-57. Detail design is on schedule. Construction Operation resumed work the week of August 26th in Room 34 of 231-Z Bldg.							
IR-222	Aquatic Biology Raw Water System - 100-KE Area	Biology Research	$8,900	$8,900 4-8-57	100 100	95 100	1-2-57 4-20-57	8-12-57	4-11-57 8-12-57
		REMARKS: This project was completed on 8-12-57, within the authorized funds and approximately two months ahead of schedule. It will not be included in the Monthly Project Report hereafter.							
IR-224	Biology Controlled Activity Water System - 100-F Area	Biology Research	$19,900	$19,900 6-27-57	100 100	Not Schd. 2	1-2-57 7-22-57	As Completed	4-11-57 12-27-57
		REMARKS: Orders were placed for equipment and materials. Difficulty in obtaining coated and wrapped 1" steel pipe necessitated substituting black iron coated pipe for the two short runs at each end of the system.							

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

HW-52303 DEL
AUGUST 1957

TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION	PROJECT PROGRESS IN PER CENT		STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE
				DESIGN	CONST.			
			AMOUNT	SCHED	SCHED	DESIGN		DESIGN
			DATE	ACTUAL	ACTUAL	CONST.		CONST.
Projects - FY 1958	Chemical Research	$77,500	None to date None to date	To be est To be est	To be est To be est	1* 7*	12*	4* 13*
REMARKS: Project proposal was sent to AEC on 5-28-57. It is still awaiting authorization. AEC is waiting for another project proposal to be submitted from IPD in order to get the overall picture on project work in the 1706-KE Bldg. and to let one fixed-price contract. *After Authorization.								
ant Radio-Analysis ratory Addition - 1706 KE								
sion of the 3745-B Bldg.	Physics & Instr.	$225,000	None to date None to date	To be est 0	To be est 0	1 mo.* 9 mo.*	16 mo.*	6 mo.* 16 mo.*
REMARKS: A new Plant and Equipment Analysis Report and project proposal are being prepared with a reduced scope. *After authorization.								
ons to the 314 Building	Reactor & Fuels	$46,000	None to date None to date	To be est 0	To be est 0	1 mo.* 6½ mo.*	12 mo.*	5 mo.* 12 mo.*
REMARKS: The project proposal was approved by the AEC Board of Review on 7-25-57 and is awaiting availability of funds for issuance of a directive. *After authorization.								
ons to the 622 Building	Physics & Instr.	$80,000	None to date None to date	0 0	0 0	11-1-57* 6-1-58*	11-1-58*	5-15-58* 12-1-58*
REMARKS: Project proposal awaiting AEC approval. Presently deferred awaiting availability of funds and answers to questions the Commission is preparing. Fund will not be available until some time in October. *Based on estimated AEC approval on 10-1-57.								
tions to the 327 Building	Reactor & Fuels	$80,000	None to date None to date	0 0	0 0	11-1-57 3-1-58*	10-1-58*	1-15-58* 11-1-58*
REMARKS: Project proposal being revised. *Based on AEC approval by October 1, 1957.								

UNCLASSIFIED

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
	Additions to the 305-B Building	Physics & Instr.	$55,000	None to date / None to date	0 / 0	0 / 0	12-1-57* / 5-15-58*	9-1-58*	4-1-58* / 10-1-58*
		REMARKS: Cost estimates have been prepared. Project proposal is currently being reviewed for final routing. *Based on AEC Approval by 11-1-57.							
IR-232	Repair Damage and Addition to Heating System - 747 Bldg.	Laboratory Auxiliaries	$15,000	$15,000 / 8-29-57	90 / 90	0 / 0	7-1-57 / 10-1-57	As Completed	8-12-57 / 2-1-58*
		REMARKS: The Informal Request was approved by the Commission. Procurement of materials was initiated. *IR Date.							
	Alterations to the 321 Building	Chemical Research	*	* / *	* / *	* / *	* / *	*	* / *
		REMARKS: General scoping was completed. Project proposal preparation was initiated. *Not determined to date.							
	Supplemental Heating and Lighting-Bldgs. 326 and 328	HLO	*	* / *	* / *	* / *	* / *	*	* / *
		REMARKS: *Estimate of cost for supplemental Heating and Lighting has been made. Further work on Proposal has been held up pending results of Engineering Study now in progress.							
Equipment Not Included in Construction Projects - Program Class 2900		Reactor & Fuels	$120,000	$120,000 / 2-7-57	100 / 100	95 / 95	5-1-56 / 6-1-57	8-31-57	4-1-57 / 9-30-57
CG-620	Vacuum Furnace	REMARKS: Difficulties have been encountered with the high frequency power supply. The 50 KW MG set has shorted out and is being returned to the vendor for repair. It has been necessary to extend the fixed-price installation contract due to necessary removal and reinstallation of the MG set. Installation is complete, except for the MG set, capacitors and miscellaneous punch list items that were not in the original contract. A factory engineer was at the plant during start-up.							

UNCLASSIFIED

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
CG-660	Modifications and Additions to the Metallographic Cell - 327 Building	Reactor & Fuels	$147,000	$135,000 / 3-15-57	100 / 100	6 / 4.5	3-27-57 / 5-14-57	12-31-57	4-1-57 / 12-31-57
		REMARKS: Very little progress was made by GE Plant Forces during the month. Electrical work continued in the basement of 327 Bldg. and orders for minor cell materials were placed. The metallograph vendor has promised shipment by 9-15-57. The cell vendor began casting the cell structure on August 28, 1957.							
CG-661	Additional Heat Generation Facility - 189-D Bldg.	Reactor & Fuels	$664,000	$22,400* / 11-13-56	30 / 34	0 / 0	12-6-56 / 11- -58	As completed	9- -58 / 7- -59
		REMARKS: Design has ceased pending vendor information as per schedule. This is dependent upon full authorization. Rev. 1 of project proposal was approved by AEC Board of Review on 7-25-57 and transmitted to Washington D.C. AEC for approval. *Interim authorization for preliminary and detailed design in part.							
CG-672	Monochromatic Neutron Beam Facility - 105-KE Bldg.	Physics & Instr.	$195,000	$195,000 / 3-7-57	100 / 100	0 / 0	5-21-56 / 10-1-57	6-1-58	10-1-58 / 5-1-58
		REMARKS: The two large bearings were shipped from HAPO to the Bremerton Navy Yard for use in assembly and testing of the spectrometer castings. Due to a reduction in force the Navy Yard has notified AEC that delivery of the casting will be delayed from 10-1 to 12-13. The second crystal box has been received and vendor reports indicate that other equipment is on schedule. Construction will probably start next month.							
CA-681	Hanford Equipment in the ETR	Reactor & Fuels	$1,200,000	$1,200,000 / 9-12-57	100 / 100	0 / 0	9-17-56 / 9-9-57	10-1-58	5-29-57 / 8-15-58
		REMARKS: Work Authority CA-681(3) dated 8-12-57 authorized incurrence of costs to $900,000. Acceptance was made by HLO, but noted GE had requested funds in the amount of $980,000. Purchase Orders held up for lack of funds have been released. Phillips Petroleum Co. has not submitted necessary information to CEO to complete design revisions. CEO representatives will be at the ETR the week of 8-26 to establish start of installation and manpower scheduling.							
CG-682	High Level Cut-Off and Examination Cell - 327 Bldg.	Reactor & Fuels	$430,000	$430,000 / 8-20-57	100 / 100	0 / 0	7-18-56 / 8-29-57	10-1-58	6-26-57 / 10-1-58
		REMARKS: AEC Directive HW-390 Mod. 2 dated 8-20-57 authorized GE $430,000 total project funds. Procurement of critical cell equipment and materials was initiated immediately.							

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

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CA-695	Radio Telemetering Network	Physics & Instr.	$89,000	$89,000 1-10-57	100 100	Not Schd. 20*	2-22-57 7-25-57	4-15-58	5-27-57 5-15-58

REMARKS: F. H. Lohse, contractor, has completed installation of 5 wind charger stations on Waluke Slope and has moved across the river to install remainder. Revisions of specifications and bid assembly were performed. Bids will be requested on the basis that the vendor provide one station per HAPO design for testing with re negotiated contract for the remaining 19 stations. Responsibility for the design (by HLO) will be by HAPO. The vendor will only be held responsible for components and workmanship.

*Wind charger contract only.

IR-231	Badgehouse Alterations for Self Service 100-200 Areas	Radiation Protection	$18,500	$18,500 8-29-57	Not Schd. 95	0 0	7-1-57 10-1-57	As Completed	9-15-57 2-1-58*

REMARKS: The Informal Request was approved by the Commission. The project will be managed by HLO. Construction Operation of CEO will perform the work. At the Commissions request an off-site contractor will be employed to fabricate the badge-racks.

*IR date.

	In-Reactor Studies Equipment - 105-KW Bldg.	Reactor & Fuels	Not Determined	* *	* *	* *	* *	*	*

REMARKS:

A project proposal, requesting $15,000 for preliminary design, is being prepared. Funds available to this project in FY 1958 limit it to design only.

*Not yet established.

	Vacuum Air Sampling System - 108-F Building	Biology Research	$35,000	* *	* *	* *	* *	*	*

REMARKS:

*Lack of available equipment funds for FY 1958 necessitated withdrawal of the project proposal at this time. No immediate action is contemplated.

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

AUGUST 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
New Construction - FY 1958		Physics & Instr.	$2,000,000	None to date / None to date	To be est / 0	To be est / 0	None est / None est	None est	None est / None est
CG-731	Critical Mass Laboratory	REMARKS: A new project proposal is being prepared for submission. Preliminary drawings have been made and a technical report prepared on burst magnitudes.							
CG-744	Metallurgical Development Facility	Reactor & Fuels	$3,600,000	None to date / None to date	To be est / 0	To be est / 0	3 mo.** / *	*	10 mo.** / *
		REMARKS: Project proposal sent to Washington D. C. AEC for approval on 5-28-57. Proposal is for $60,000 for preliminary design and initiation of detailed design. *To be established after scoping is completed. **Detail design only.							
	Modernization of 306 Building	Reactor & Fuels	$200,000	None to date / None to date	To be est / 0	To be est / 0	To be est / To be est	As Completed	To be est / To be est
		REMARKS: Preparation of project proposal is underway. Scoping is proceeding.							
CG-747	Plutonium Fabrication Pilot Plant	Reactor & Fuels	$4,000,000	$100,000 / 4-12-57	100* / 98*	0 / 0	4-22-57 / 11-1-57	Partial 5-1-59	10-1-58 / 8-31-60
		REMARKS: Project Proposal Revision 1 requesting total project funds is in Washington, DC awaiting AEC approval. Status is currently in a state of flux. Several meetings were held with the Commission during the month to discuss building scope. *Preliminary Design Only.							
CA-749	High Level Radiochemistry Cell	Chemical Research	$800,000	$15,000 / 7-8-57*	80** / 70**	To be est / 0	7-11-57 / July '58	June '59	May '58 / June '59
		REMARKS: Design criteria was completed and an estimate made that reflected a total project cost of $1,175,000. A design review meeting was held on Aug. 26 and various means of reducing costs were proposed. After investigation of these propositions another design meeting will be held Sept. 6 to determine design action. *Interim authority. **Preliminary Design Only.							

UNCLASSIFIED

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED / ACTUAL	STARTING DATE DESIGN / CONST.	BENEFICIAL USE DATE	PROJECT COMP. DATE DESIGN / CONST.
CG-758	Ceramic Fuels Development Press and Furnace Additions	Reactor & Fuels	$200,000	$200,000 / 8-1-57	NS / 1	0 / 0	8-8-57 / 5-8-58*	As Completed	2-8-58* / 10-1-58

REMARKS: Purchase orders have been placed for purchase of the sintering furnace and hydraulic press. Design has been started on installation of the furnace. The work authority was received this month on August 1.

*Tentative dates.

REMARKS:

REMARKS:

REMARKS:

REMARKS:

UNCLASSIFIED

BM-7300-005 (11-56) AEC-GE RICHLAND, WASH.

LABORATORY AUXILIARIES MONTHLY REPORT (cont.)

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas & Buildings Visited
F. L. Parmelee	8-26-57	Pratt Whitney Co., San Francisco, Calif.	To discuss machine tools, cutters and gages.	L. J. Lucas	No	328 - 300
C. R. Gerner	8-12-57	Catalytic Const.Co., Philadelphia, Pa.	Inquiry on prospects of contract research for G.E.	R. W. Benoliel J. F. Honstead	No	703 - 700
R. E. Vener	8-12-57	"	"	"	"	"
T. H. Milliken	8-12-57	Houdry Process Corp., Philadelphia, Pa.	"	"	"	"

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
S. P. Gydesen	7-27 to 8-10-57	Western Reserve University, Cleveland, Ohio	Attend special summer seminar.	Dean J. C. Shera	No

R. J. Lucas

Acting Manager,
LABORATORY AUXILIARIES

General

On August 31, 1957 the staff of the Hanford Laboratories Operation totaled 1,159 including 498 exempt and 661 nonexempt employees. Of the total exempt employees there were 432 with college degrees including 416 technical degrees as follows:

BS	MS	PhD
214	106	96*

In addition, there are 36 nonexempt employees with college degrees.

*The reduction in this total this month is the result of the termination of four PhD summer professors.

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

Personnel Development and Communications

The Hanford portion of the AEC-ASEE Summer Institute of Nuclear Energy was terminated on August 16. A course-completion dinner and certificate-presentation ceremonies on August 15 highlighted the end of the Institute.

The AEC Radiological Physics Fellowship Training Program was concluded August 30.

Initial contacts were made during the month with A. F. Scott, AFSWP Program Coordinator at Reed College, on matters pertaining to the training of the new class of AFSWP personnel.

Arrangements were made to ship an assortment of radiation-detection instruments to Reed College in mid-September for training and demonstration purposes.

Twenty-six Technical Graduates and fourteen Technician Trainees were on assignments within the Laboratories at month's end. Twenty-one and ten were on assignments in the respective categories at the end of August.

Selection of course instructors for the three fall sessions of PBM-I was completed during the month and selection of 48 course participants was initiated. The fall session will begin in mid-September.

The fifth session of "Understanding People" was convened during the report period. Nine exempt-roll personnel and one nonexempt employee are participating.

Thirty-one HLO employees were enrolled in the Relations and Utilities course "Data Processing".

An HLO instructor for the course, "Principles and Methods of Supervision and Leadership" was trained and certified by a representative of the Sales Analysis Institute of New York.

The course "Written Communications" was presented for the first time to sixteen exempt employees in two, four-hour sessions during the month.

Eighteen women employees attended "Secretarial-Clerical Training".

Three Manager's luncheons were held for twenty-eight nonexempt employees and fifty-six exempt employees.

Twelve HLO employees participated in the August Area Tours for Women.

Twenty-three technical articles and papers were processed for publication during the report period.

Personnel Practices

Placement and Records:

All secretarial openings have been filled with the exception of one in Employee Relations and one in Laboratories Auxiliaries. Radiometallurgy Operation is anticipating four to five openings for Engineering Assistants. It is expected that these will be filled by employees available in other HAPO components. There is one design draftsman opening which will present some difficulty.

Two nonexempt employees were transferred to other components at Hanford. In addition, four new nonexempt transfer requests were received during the month.

During August there were seven 5-year and thirteen 10-year service recognition pins awarded. In addition, one 1-year, one 3-year, one 4-year and one 5-year attendance recognition awards were issued during the month.

Personnel status changes of exempt and nonexempt employees and transfer activities are summarized in Tables I, II and III.

Suggestions:

Seventeen suggestion awards were paid to sixteen Hanford Laboratories employees. Awards amounted to $150. For the year to date HLO has paid seventy suggestion awards, totalling $2,990 and representing a savings of $35,098.

During the month of August 30 suggestions were received representing a slightly higher figure than would be expected during the summer months.

Benefit Plans:

Hanford Laboratories participation in the Employee Benefit Plans as of the end of August is listed below:

	July	August
Insurance Plan	99.6%	99.7%
Pension Plan	97.9%	98.2%
Stock Bonus Plan	59.4%	60.2%

Selective Service:

The military status of HLO employees is shown in the following table:

STATUS		Non-Technical	Technical	Non-Technical 1-A	*Critical	TOTAL
Reservists	Standby	11	30	0	1	42
	Ready	20	20	6	2	48
	Total	31	50	6	3	90
Non-Veterans		30	37	23	41	131
TOTAL		61	87	29	44	221

Deferments requests pending	7
Deferments granted	2
Deferments denied, appealed and pending	0
Deferments pending at Presidential appeal level	0

*Critical refers to those employees for whom deferments are currently being requested.

Deaths:

Two Laboratories employees passed away during the month.

Union Relations

Regional Monitor negotiations are continuing with the primary problem currently being that of seniority as a result of the Company's latest proposal to the HAMTC.

There have been no further developments in the Wonacott arbitration case regarding Radiation Monitor jurisdiction.

Two straight swing shifts have been arranged, one in Laboratories Auxiliaires and one in Radiation Monitoring. The one in Radiation Monitoring was set up entirely for the advantage of employees desiring to attend college and in Laboratories Auxiliaries it was for the convenience of the entire group as well as for educational purposes.

There have been no further developments in connection with the Maki grievance.

Three grievances were received during August as follows:

1 - Misassignment of work - 231 Bldg. Step II answer was directed to HAMTC late in August.

1 - Misassignment of work - Facilities Engineering Operation. Step I answer unsatisfactory and grievance has now been scheduled for Step II discussion.

1237577

1 - Distribution of overtime - Technical Shops. Step I answer not satisfactory.

Technical Placement

PhD Recruiting:

During the month 4 candidates visited HAPO for interviews; 4 offers were extended by HLO, 5 offers rejected, and 3 candidates placed on the HLO rolls. There are 14 HLO open offers at the end of the month to carry over in the 1957-58 recruiting year.

A summary of PhD recruiting from September 1, 1956 to date:

Cases Considered	Visited	To Visit	Offers				On The Roll
			Extended	Accepted	Open	Rejected	
751	112	35	66	18	14	45	11

A statistical summary of HAPO PhD recruiting activity appears in Table III. Included are 11 carry-over offers of which 5 are acceptances and on the rolls (4-HLO, 1-IPD) and 6 rejections.

Health and Safety

During August, Laboratories personnel worked a total of 187,072 hours with no disabling injuries. Since September 1, 1956, a total of 2,258,801 hours have been completed with no disabling injuries. Council Safety Awards for the completion of 264 consecutive days without a disabling injury on May 22 were distributed this month.

There were 25 medical treatment injuries with a frequency of 1.34 as compared to 2.15 last month. For the year to date, the frequency is 1.77.

Fire runs were made to HLO buildings for the following incidents:

1. A fluorescent lamp ballast in a store room of 329 Bldg. burned out.
2. A gasket in a steam line ruptured, actuating a deluge system in the 321 Building tank farm.

No damage or loss was recorded.

Ten security violations in August made the 1957 HLO total 74.

HLO was represented on a physical security task force, which decided that currently the best approach to facilitating access to the various HAPO areas was to explore the feasibility of a system, wherein, both the health and security badges can be taken home by the employee or can be combined into one instrument.

A study was made of past security performance which established the need of forceful support from Level 3 management, the desirability of communicating to all document holders the most effective means of avoiding violations, and the advisability of establishing more formalized, mandatory procedures to assure better performance.

A study was made of acceptable methods of reconciling the reporting of retroactive injuries with administration of the Safety Award Program.

An HLO recommendation was prepared stating preference for carefully monitoring the record of all obscure injuries on the date an award is attained, then closing the records so that an award cannot be jeopardized by a past injury.

The Specialist, Health and Safety participated extensively in providing consulting and educational services to Laboratories personnel during the month.

In August only 78% of the monthly quota of medical exams was completed owing to the absence on vacation of a high percentage of scheduled employees.

Salary and Wage Administration

Salary reconciliation work was carried on at HAPO during August concurrent with visits by salary administrators from Atomic Products Equipment Department and Light Military Electronic Equipment Department.

A rough draft copy of the proposed performance appraisal has been prepared in conjunction with other HAPO salary and wage components and has been forwarded to level 2 and 3 HLO managers for their review. It is expected that the final approved appraisal form will be used during the year-end annual appraisal time.

Effective August 1, a new level 4 component, Radioecology, was added to the Biology Operation. The appropriate approvals and transfer of personnel were accomplished concurrent with the same date.

Due to vacation schedules, no auditing functions were performed for the month.

The following position changes were effective during the month:

Position Changes -- 2
Positions Added -- 2

The HLO attitude survey questionnaires were received during the latter part of the month and have been prepared for mailing to all HLO personnel during the first week of September.

The major efforts of the Specialist, Wage Administration were devoted to performing the union relations functions while the Manager, Union Relations was on vacation.

Manager
Employee Relations

TG Marshall:tr

VISITORS T

VISITORS TO HAPO

Name: E. F. Bradford
Date of Visit: August 1, 2, 1957
Company or Organization Represented: Atomic Products Equipment Department
Reason for Visit: Salary Reconciliation
HAPO Personnel Contacted: R. D. Tillson
Access to "Restricted Data": None
Areas and Buildings Visited: 703 Bldg., 700 Area

Name: J. C. Bartholomew
Date of Visit: August 5, 6, 1957
Company or Organization Represented: Light Military Electronics Equipment Dept.
Reason for Visit: Salary Reconciliation
HAPO Personnel Contacted: H. A. Paulsen, R. D. Tillson
Access to "Restricted Data": None
Areas and Buildings Visited: 703 Bldg.

TABLE III. EMPLOYMENT - TECHNICAL PERSONNEL STATUS

I. Employment

Non-Exempt Employment Status	July	Aug.	Non-Exempt Transfer Requests	July	Aug.
Requisitions			Transfer Cases		
At end of month	17	26	Active cases at end of month	47	46
Cancelled	3	1	Cancelled	3	1
Received during month	10	17	New during month	3	4
Filled during month	14	7	Transfers effected	3	4
Candidates Considered			Planned Transfers		
Total Applications	1	3	Effective during month	3	1
Total Transfer Request from other at HAPO	7	9			
Total interviewed	0	0			

II. Technical Personnel Placement

Ph.D. Recruiting - (Compiled by R&UO for all HAPO)

		VISITS TO RICHLAND				OFFERS			On The Roll
	Cases considered	Extended	Visited	To Visit	Open Invite.	* Extended	* Accepted	Open	
Engineering:									
Chemical	67	35	15	2	6	9	2	2	1
Electrical	23	9	2	2	-	2	-	2	-
Mechanical	27	17	8	3	-	8	2	3	1
Metallurgical	43	24	9	1	7	5	2	1	1
Civil	2	-	-	-	-	-	-	-	-
Science:									
Chemistry	243	85	36	6	5	26	3	4	2
Physics	246	112	31	21	15	22	4	4	3
Math-Stat.	49	14	4	-	1	1	1	-	-
Other	47	9	7	-	1	6	4	-	4
DVM	4	-	-	-	-	2	2	-	1
TOTAL	751	305	112	35	35	81	20	16	13

*Offer totals include 12 carry-overs from the 1955-56 season with 3 acceptances not on the roll as of 9/1/56 and 6 open offers at that time.

BS/MS Experienced Recruiting - HLO

		VISITS TO RICHLAND				OFFERS			On The Roll
	Cases considered	Extended	Visited	To Visit	Open Invite.	* Extended	* Accepted	Open	
Engineering:									
Chemical	16	7	3	-	-	1	-	-	-
Electrical	30	15	8	-	-	4	2	-	2
Mechanical	36	23	15	-	-	5	3	-	3
Industrial	7	4	3	-	-	3	2	-	2
Metallurgical	22	14	8	-	-	6	4	-	4
Ceramic	4	3	3	-	-	4	1	-	1
Other	16	5	2	-	-	-	-	-	-
Science:									
Chemistry	31	6	2	-	-	3	2	-	-
Physics	15	7	5	-	-	2	1	-	1
Math-Stat.	6	4	3	1	-	3	2	-	2
Other	51	2	2	-	-	-	-	-	-
TOTAL	234	90	54	1	-	31	17	-	15

*Offer totals include 2 carry-overs from 1955-56 season not on the roll as of 9/1/56.

TABLE IV. Exempt Transfer Cases

			August	July	Total
Active cases at beginning of month			17	16	
New cases:	Initiated by employee		3	2	
	Initiated by management*		2	1	
Cases reactivated					
			22	19	
Cases closed:	Transfers:	Within HLO			4
		Within HAPO			2
		Other G. E.			13
	Withdrawn			2	19
	Terminated		1		12
			21	17	50
Active cases at end of month			21		21
Total cases (Includes those initiated prior to and since 9/1/56)					71
Initiated by employee		50			
Initiated by management*		21			
		71			

* Includes ROF's, transfers proposed by employee's management, and requests from other G. E. departments.

TABLE V. Union Relations

Grievances Processed - September 1, 1956 to date

Total processed 30 (includes 2 non-unit grievances)

Step I

Answered satisfactorily*	17
Pending time limit	1

Step II

Pending Step II discussion	1
Pending Step II answer	0
Answered	
Pending time limit	2
Satisfactorily**	9

* 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 REPORT
August 1957

Compiled by Members of the
FINANCIAL OPERATION
HANFORD LABORATORIES OPERATION

Personnel

There were no personnel changes in the Financial Operation during August.

Activities

General Accounting Operation

Letters seeking AEC approval or agreement were prepared covering the participation of Dr. R. F. Foster in the Symposium in Naples, Italy and for the participation of Hanford Laboratories personnel in the National Academy of Sciences Study.

An inquiry was received from APED, San Jose, relative to the possibility of their billing HLO for consultation services, and a reply incorporating certain modifications to their proposal was prepared and forwarded to them.

Due to the limited funds available to Hanford Laboratories for attendance at off-site courses and seminars, Level 3 managers were requested to furnish their estimated FY 1958 requirements in order that a priority listing might be established.

An examination of a request for bid quotation received from APED covering the fabrication of uranium pellets by HLO indicated that this activity would require AEC approval under Article II, Section 8 (b) of the Prime Contract. A letter requesting approval is in process.

Equipment funds applicable to the 6000 Program were allocated to the level 3 operations. Funds requested, plus FY 1957 commitments, totaled $206,000. Funds available per AEC Financial Plan are $80,000.

A tentative allocation of $3,376,000 for equipment in support of the 2000 Program has been received from Contract Administration. Allocation of these funds to level 3 operations, based on priority requirements, will be accomplished early in September.

Funds available to Hanford Laboratories Operation for attendance at meetings of professional and trade societies during FY 1958 have been allocated to level 3 components. The allocation is based on the number of professional personnel in each component weighted by the supervisory levels within the components.

The method of reproducing pocket size cards is being revised to eliminate the photographic reduction process effective with cards to be issued for the month of August. This will reduce the cost significantly and expedite the issuance of the cards. The size of the card will be increased from 3" x 5" to approximately 4" x 7".

Reports of findings in connection with the physical inventory of uninstalled catalogued equipment in the custody of Laboratory Auxiliaries Operation and Biology Operation were issued during the month.

The Laboratory Auxiliaries Operation inventory which consisted of 379 pieces of equipment, valued at $863,000 had only one missing piece of equipment --- a refrigerator valued at $100. Fifty items valued at $32,000 were physically located during the inventory for which no records could be found.

The Biology Operation inventory covering equipment valued at $471,000 and consisting of 618 pieces, revealed 29 pieces valued at $15,000 to be missing. Forty-nine items valued at $29,000 were physically located during the inventory for which no records could be found.

Missing equipment in both inventories was transferred into a special code to be held until located or until the entire HLO inventory is completed. Upon completion of HLO inventory, missing equipment will be written off after processing of required documents.

The inventory of the Hot-Semi-Works is complete and reconciled with property records. No transfer will be made until the Commission is in agreement with transferring the Hot-Semi-Works from operational status to that of "Plant and Equipment Held for Future Use".

Cost Accounting Operation

Allocation of depreciation expense applicable to HLO property and that assessed from Relations and Utilities Operation has been reviewed and standard amounts have been established for monthly distribution effective with August business. The basis used for allocating depreciation expense is the dollar value of end functions included in the FY 1958 operating budget. This basis was deemed best due to the multi-purpose nature of HLO facilities.

The operating budget for Hanford Laboratories has been completed and was shown on operating reports issued for the month of July.

An attachment to the monthly operating cost report is planned, effective with August reports. The attachment will show, by organization, the percentage of occupancy in each Hanford Laboratories building and the rental charge for the current month.

A suggestion for the elimination of all time distribution reports, with cost distribution being handled by use of IBM salary runs, was submitted by two members of the Cost Accounting Operation and is currently being reviewed. Two other suggestions submitted by Cost Accounting employees, also utilizing IBM are being reviewed. One pertains to distributing costs of calibrating and maintaining portable health instruments and the second pertains to accumulating information on the purchase of hand tools by each HLO component.

The actual rate of HLO general overhead for the month of July was 27%, however, 25% was used for distributing overhead which was based on the FY 1958 budget. It is still anticipated that the actual rate will aggregate 25% over the entire fiscal year.

Personnel Accounting Operation

A report of the number of Chemists, Chemical Engineers and related scientific personnel was prepared and transmitted to Contract Administration. The number of employees reported will be used to determine the enrollment fee in the American Chemical Society.

Revision to Personnel Accounting Service Bulletin on the subject "Payments to Salaried Employees Absent from Work" was received as a result of General Announcement #168, dated July 26, 1957. This change will require changing Appendix "B" to the Prime Contract and other existing instructions on this subject. New delegations of authority will be recognized upon receipt of authority from the HAPO General Manager.

Financial Safety, Health and Security Meeting was held on August 30, with members of HLO Financial and R&U Security participating. There were thirty in attendance.

Payments for one patent award and one military encampment were made during the month.

Auditing

The audits for the year ended July 31, 1957 were completed and a schedule for the new audit year submitted to Contract Administration. Field work on the new year's first audit (Suggestion Plan) is nearly complete. The report will be issued in September.

Measurements

The Measurements report for Hanford Laboratories was submitted at the end of July summarizing activities during the first six months of 1957. Expected figures for HLO security performance were reviewed in detail in cooperation with the Specialist, Health and Safety. Efforts to establish revised unit cost measurements in Exposure Evaluation and Records neared completion.

Office Procedures

Extensive preliminary studies concerning the problem of paperwork flow in HLO were continued with Operations Research in August. A questionnaire survey form has been developed, with appropriate instructions for use, and it is to be test-checked on a trial run by a few level 5 components during early September. If acceptable it will be used throughout HLO about mid-September.

Payroll Statistics

Changes During Month	Total	Exempt	Non-Exempt
Employees on Payroll at Beginning of Month	1 170	499	671
Additions and Transfers In	11	5	6
Removals and Transfers Out	(22)	(7)	(15)
Transfers from Non-Exempt to Exempt	-	1	(1)
Employees on Payroll at End of Month	1 159	498	661

Overtime Payments During Month	August	July
Exempt	$2 880	$ 6 210
Non-Exempt (Five weekly periods in August)	6 548	7 585
	$9 428	$13 795

Gross Payroll Paid During Month		
Exempt	$369 918	$366 164
Non-Exempt (Five weekly periods in August)	332 421	261 658
	$702 339	$627 822

Participation in Employee Benefit Plans at Month End	Number Participating		Percent Participating	
	August	July	August	July
Pension Plan	1 072	1 073	98.2%	97.9%
Insurance Plan				
Personal Coverage	1 179	1 156	99.7%	99.6%
Dependent Coverage	716	707		
U.S. Savings Bonds				
Stock Bonus Plan	698	695	60.2%	59.4%
Savings Plan	96	101	8.3%	8.6%

Insurance Claims Paid	August		July	
	Number	Amount	Number	Amount
Employee				
Life Insurance	-	-	-	-
Weekly Sickness & Accident	12	$ 1 113	9	$ 806
Comprehensive Medical	26	2 836	29	3 635
Dependent				
Comprehensive Medical	56	6 442	54	5 336
Total	94	$10 391	92	$9 777

Good Neighbor Fund	August	July
Number participating	754	747
Percent Participating	65.0%	63.8%

Other Statistics

Cash Advances and Travel Expenses		August		July
Accounts Outstanding at Beginning		$10 721		$ 4 106
Charges:				
Cash issued - by checks	29	5 854	27	3 250
- by currency	44	4 521	27	2 884
Transportation		6 145		5 440
Other - (Billings from other GE Components, moving expenses, etc.)		3 064		2 044
		30 305		17 724
Less:				
Expense Vouchers Processed				
Travel expense accounts	37	7 777	13	1 895
Other (moving expense, conference expense, etc.)	14	2 726	7	130
Refund of advances	35	2 628	53	5 229
Billings to and from HAPO components - net		2 634		(251)
		15 765		7 003
Accounts Outstanding at Close	51	$14 540	33	$10 721

W. W. Sale
September 9, 1957

INVENTIONS OR DISCOVERIES

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

INVENTOR	TITLE OF INVENTION OR DISCOVERY
K. C. Knoll	Delayed-Action, Remote Sampler for Water.
A. S. Wilson	A Method of Promoting the Dissolution of Plutonium Dioxide in Nitric Acid.
J. C. Sheppard	The Isolation of Neptunium from Waste Nitric Acid Solutions Using Tri-n-octylamine.
J. C. Sheppard	The Isolation of Plutonium from Waste Nitric Acid Solutions Using Tri-n-octylamine.
J. C. Sheppard	The Separation of Plutonium from Uranium Using Tri-n-octylamine.
W. L. Lyon	Reconstitution of Pu-Al Alloy Fuel by Reaction with Zinc Chloride.
W. L. Lyon	The Concentration of Pu in Pu-Al Alloy Fuel Material by the Removal of Al as the Aluminum Sub Fluoride.

W. M. Parker /lt