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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT
OCTOBER, 1957

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Compiled By
Operation Managers

November 15, 1957

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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TABLE I. HLO-FORCE REPORT AND PERSONNEL STATUS CHANGES

Date October 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		
Chemical Research and Development	127	97	224	125	94	219	3	4	1	1
Reactor & Fuels Research & Development	150	97	247	149	96	245	4	3	3	2
Physics & Instrument Research & Development	56	24	80	54	25	79	2	0	0	1
Biology Operation	34	42	76	34	42	76	0	0	0	0
Operations Res. & Syn.	13	3	16	13	3	16	0	1	0	1
Radiation Protection	44	177	221	44	179	223	0	1	0	3
Laboratory Auxiliaries	44*	184*	228	44	182	226	1	3*	1*	1
Financial	16	34	50	16	35	51	0	0	0	1
Employee Relations	13	11	24	14	11	25	0	0	1	0
General	1	2	3	1	1	2	0	1	0	0
TOTALS	498	671	1169	494	668	1162	10	13	6	10
Totals excluding Internal Transfers	498	671	1169	494	668	1162	8	9	4	6

* 1 Reassignment to Non-Exempt payroll

Composite Separation Rate - - - - - 769
 Separation Rate (based on separations leaving G. E.) - - - - - 598
 Controllable Separation Rate - - - - - 085

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

Date October 31, 1957

Component	PROMOTIONS		EXEMPT TRANSFERS (2)						NON-EXEMPT TRANSFERS	
	Non-Exempt	Exempt	To HLO		From HLO		To Other G.E.		To HLO	From HLO
			Non-Exempt	Exempt	Other HAP	Other G.E.	Other HAP	Other G.E.		
Chemical	1	0	1	0	1(3)	0	1	0	1	0
Reactor & Fuels	3	0	4	3	0	1	1	0	2	0
Physics & Instrument	2	0	1	1	0	0	0	0	0	0
Biology	1	0	0	0	0	0	0	0	0	0
Operations Res. & Syn.	0	0	0	0	0	0	0	0	0	0
Radiation Protection	0	0	0	0	0	0	0	0	0	0
Laboratory Auxiliaries	1	0	3	1	0	0	0	0	0	0
Financial	0	0	0	0	0	0	0	0	0	0
Employee Relations	0	0	1	0	0	0	0	0	0	0
TOTALS	8	0	10	5	1	2	0	0	3	0

- (1) Data through 10/31/57
(2) Transfers within HLO not included
(3) G. B. Barton from APED

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SUMMARYBUDGETS AND COSTS

Fiscal year to-date costs are \$5,316,000 at the end of October or 30% of the \$17,605,000 FY 1958 Revised Budget which has been adjusted to reflect current authorizations from (1) product departments for Research and Development and Process Technology and (2) HOO-AEC for Washington Designated Programs. Controls are still being exercised on the basis of the preliminary financial plan.

Areas reflecting the most critical shortage of funds continue to be weapons research and development for CPD and process technology for IPD and FPD. While the financial plan when issued is expected to provide some relief in weapons research and development, process technology funds are indicated to continue in short supply.

Forecasts of Biology Research Program expenditures for FY 1958 exceed the amount authorized in the preliminary financial plan and a request for additional funds to cover increased expenditures on Radioecology studies will be made in the mid-year budget review.

October costs increased about \$44,000 over September.

RESEARCH AND DEVELOPMENT1. Reactor and Fuels

Additional steady state boiling curves were determined for conditions simulating I and E fuel elements in a "C" tube. The thirteen runs included one run where the tube power was increased up to 1067 kw while the hole was completely plugged. Excessive temperatures were prevented by the normal heat load being shifted entirely to the annulus.

Irradiation of two short sections of natural uranium metal, seven-rod cluster fuel assemblies to an exposure of about 1075 MWD/T in a KE Reactor through-hole resulted in no visible warp or distortion. However, considerable damage to spiders and rings occurred in handling after discharge. A four-rod cluster assembly irradiated in the MTR to about 550 MWD/T showed no signs of damage.

An irradiation of graphite samples at 975 C has just been completed in the MTR L-42 hole. This is the highest temperature yet employed in controlled exposure tests of graphite and was notable in regard to accuracy and precision of temperature control.

The Superior Tube Company and Chase Brass and Copper Company appear to have fabrication processes well in hand for the production of high quality B-D-F Reactor ribbed zircaloy process tubes.

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Programs on nickel plating of I and E wafer fuel element components and hot pressing and lead dip canning of I and E wafer elements were accelerated during the month in keeping with objectives of the New Production Reactor development program.

A three-year exposure of zirconium specimens to H-Reactor gas environment indicates no problem areas. The oxide scale was tenacious, and the metal was still ductile. Hardness and bend tests indicate that much of the strength obtained by cold working zirconium was retained under these exposure conditions.

Design for the PRPR Phase I bid package was completed during the month and the bid package transmitted to the AEC. Design for the entire PRPR project is estimated to be 18% complete. Detail design of the reactor core (Phase III) is in progress.

With firming up of the PRPR design, the design verification testing program is changing from an analytical and planning phase to an active experimental phase with a number of prototypical installations or components under test.

Development work is proceeding on a vacuum injection casting process for fabrication of clad Pu-Al fuel elements and equipment is being assembled for study of pressure injection casting. Feasibility of vacuum injection casting is indicated by a number of successful castings of aluminum into long stainless steel tubes. Extrusion of cast aluminum and of aluminum powder compacts has also been studied with satisfactory first results.

An investigation has been started on fabrication of high density UO_2 cores by combined pressing and sintering, with the hope the present steps of pressing, sintering, and grinding to uniform dimensions can be replaced by a single operation.

The fabrication of large (1-3") diameter, thin walled, Zircaloy-3 fuel jacket tubing may now be commercially feasible. The NTH Company has overcome galling problems by the use of textolite as a die material and are confident that remaining difficulties can be solved.

2. Chemical Research and Development

Studies to support Purex Phase II modifications show backcycling of the plutonium anion exchange wastes should not adversely affect head-end operations; cartridge studies and other column developments have not indicated a clear-cut method of increasing throughput in the Purex 1C column. Flow sheet modifications may be necessary.

Virtually fission product free plutonium concentrates have been produced in a simple manner from simulated plutonium recycle program fuel solutions by a 2-cycle anion exchange process. Work also continues on the selective solvent extraction recovery of plutonium, using tri-octylamines such as tri-n-octylamine.

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Work continues on a method of separating fission product and transuranic elements such as cesium, cerium, strontium, krypton, and neptunium. Scouting studies on methods of isolating cesium-137 were concluded and pilot scale tests scheduled for recovery, isolation, and packaging.

More extensive monitoring of Zinc-65 in fruits and vegetables from irrigated areas where water is taken from the Columbia River below Hanford show radio-zinc concentrations less than those in milk and beef samples previously measured.

Aluminum coating waste silicate gels show poor retention of long-lived fission products and questionable stability. Addition of adsorptive surfaces to the gel improved matters only slightly. Enthusiasm for this approach to safe, economical waste disposal is now low.

3. Physics and Instruments

The nuclear safety requirements for the solution of E-metal slugs were reviewed and experiments on random arrays of such slugs were begun to obtain more information on this complex problem.

Exponential experiments on 1.66-inch solid uranium slugs were completed for the LPR program and work on 7-rod clusters was started.

Detailed analysis of data on the nuclear safety of homogeneous uranium-water mixtures confirmed previous conclusions that the maximum always-safe enrichment is slightly over 1%.

Reactivity temperature coefficient experiments in the PCSTR have run into trouble from the large coefficient of the heating equipment itself which masks the changes in the test cell.

A new test site for studies on the wind erosion of Hanford terrain was put into operation near the Meteorological Tower and the first of a series of experiments was performed.

A low cost shield for future body monitor cells may be achieved by use of talc or soapstone according to recent tests on these materials; the essential point is their low natural radioactivity.

The outsize plastic scintillator (100 lbs.) was used experimentally for river surveys and its use in aerial survey is believed feasible.

Basic nuclear data measurements progressed by completion of a first run on the measurements of the slowing down of 1 Mev neutrons in water and by the excellent agreement observed between HLO and ANL data on the energy dependence of the neutron cross sections of U²³⁵.

The last of a group of printed circuits required for the interchangeable component, portable monitoring instrument program was designed and tested.

4. Biology

Whitefish exposed to fluctuating concentrations of reactor effluent were unaffected after five months' exposure. Water temperature increases of 2 and 3 C above normal for the Columbia River increased mortality of whitefish.

Confirming reports in the Russian literature, ground intestines of rats exposed to radiation and injected intraperitoneally into normal rats caused radiation-like deaths in the normal rats. This is contrary to most earlier experience in related tests.

Significant increases in lung cancer have been shown to occur in mice receiving plutonium or radioruthenium oxides about 200 days after the injections.

Technical and Other Services

Two cases of minor plutonium deposition were confirmed in October. The total number of cases of plutonium deposition on record is 209.

Iodine-131 emission was well controlled with an average weekly emission below 3 curies from chemical processing stacks.

Work on the plant-wide coordination of the attitude survey is essentially complete.

A preliminary investigation of the feasibility and desirability of the physical and financial input-output analysis of HAPC operations has been undertaken and will be completed in November.

Conversion to the new system of document accountability utilizing standard IBM equipment for internal control was started during the month.

Work is proceeding on the development of procedures compatible with HAPC operation and in compliance with AEC requirements in the areas of document classification and patent review of unclassified reports (including papers and speeches).

The lack of funds for Project CG-747, "Plutonium Fabrication Pilot Plant," continues to hamper progress. Although authorized funds are not completely exhausted, operation is almost a day to day basis, and it is not possible to increase design activity as required to meet schedule commitments.

Other project funds which are held up are principally "General Plant Projects" and the lack of funds in this category can result in a sizeable carryover into FY-1959 of funds which are not obligated in 1958.

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Supporting Functions

1. Financial

It has been determined that consulting service performed by APED for HAPO will be considered as "assistance to Hanford" work. APED and HLO management have been advised as to procedure.

The .59% cost of living salary adjustment which was effective 10/28/57 will increase HLO payrolls approximately \$15,500 per annum.

It has been determined that in HLO 12% of travel cost and 16% of total travel from September 1, 1956 through August 31, 1957 was for the purpose of attending meetings of professional societies.

A comprehensive plan to reduce paperwork through the integrated efforts of all individuals, rather than through arbitrary or mandatory procedures was issued.

2. Employee Relations

At month's end the staff of the Hanford Laboratories Operation totalled 1169, including 498 exempt and 671 nonexempt employees.

The proposal for Hanford participation in the 1958 AEC-ASEE Summer Institute was forwarded to HOO-AEC early in the month. We understand that the proposal has been accepted.

Approximately 128 HLO employees participated in training courses during the month.

Twenty-eight technical papers and articles were processed for publication during the month.

Oral ROF notices have been given to 22 Radiation Monitors and written notice to 2 Servicemen and 1 Calibrator. Eleven of the Radiation Monitors will bump to monitoring positions in other HAPO Departments as a result of their seniority.

Five PhD acceptances have been received since September 1.

Three grievances were received during October, all pertaining to misassignment of work. All are currently at Step II.

There have been no new developments in the negotiations with the Regional Monitors.

There were no disabling injuries during the month. There were 29 medical treatment injuries with a frequency of 1.39 as compared to 1.68 during September. For the year to date the frequency is 1.72.

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There were 2 security violations in October bringing the total to 81 for 1957.

At midnight, October 1, HLO completed 396 days or 2,445,878 hours without a disabling injury to qualify for the General Manager's Safety Award.

The attitude survey results were distributed. There was considerable activity in analyzing problem areas, both generally and in specific components. It is intended to effect changes in procedure or communication to be reasonably responsive to the needs expressed in the survey. Specific items already prepared include: salary plan information, general objectives and goals, paperwork, and attendance at professional society meetings.

HM Parker

Manager,
HANFORD LABORATORIES

HM Parker:kss

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REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATION

TECHNICAL ACTIVITIES

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. METALLURGY PROGRAM

Corrosion Studies

Corrosion Control in Fuel Elements. Recent in-reactor tests indicate that the uniform corrosion of fuel elements in the present Hanford production reactors can be reduced by a factor of two to three by chromic acid autoclaving. This was first indicated in a single tube experiment in PT-313-105-37M (HW-44953), and further confirmed in a four-tube experiment (PT-IP59A). In these tests aluminum clad (1245 alloy) fuel elements autoclaved in one percent chromic acid were charged alternately with standard fuel elements. The fuel elements were exposed to a nominal 400 MWD/T, discharged, and visually examined. The slugs were cleaned and weighed, and the weight losses of the chromic acid autoclaved fuel elements were only one-half to one-third of the losses of adjacent standard fuel elements. Portions of the original film were still intact on the special fuel elements.

Chromic acid autoclaving of the fuel elements is entirely practical, requiring little change from present processing techniques. However, it protects the fuel elements against corrosion only, and uniform corrosion of fuel elements is not now limiting in the Hanford production reactors. When the fuel elements become more resistant to splitting, as they might with I & E slugs, chromic acid autoclaving would be a valuable aid in corrosion control. The success of this process in controlling fuel element corrosion suggests it might also be applicable to controlling tube corrosion.

The G.E. X-Ray Microscope. A visit was made to the General Electric X-Ray Applications Laboratory in Milwaukee, Wisconsin, on September 30 and October 1 and 2, to witness a demonstration of the G.E. X-Ray microscope and to determine its applicability to aluminum corrosion and alloying studies. It is concluded that, for the present, procurement of an x-ray microscope is not justified solely for Hanford corrosion studies. A trip report describing the microscope and its operating characteristics and capabilities is being issued.

Organic Coolant Studies. Zirconium does not hydride in MIPB (monoisopropylbiphenyl) at temperatures up to 375 C, provided the partial pressure of hydrogen is kept very small. Samples of zirconium were exposed to MIPB under reflux at 300 C and atmospheric pressure with a CO₂ blanket and at 375 C and 50 psig with a helium blanket. The results are shown in the following table:

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<u>Temperature</u>	<u>Pressure</u>	<u>Exposure</u>	<u>Hydrogen Content of Zr</u>
		0	12 ppm
300 C	Atmospheric	12 days	3 ppm
300 C	Atmospheric	22 days	4 ppm
300 C	Atmospheric	130 days	3 ppm
375 C	50 psig	22 days	9 ppm
375 C	50 psig	54 days	2 ppm
375 C	50 psig	100 days	14 ppm

An experimental phase diagram is being prepared for the system, o-terphenyl-m-terphenyl. Although the diagram has not been completed as yet, it has been determined that the mixture which is completely melted at the lowest temperature contains 80 mole percent of o-terphenyl and 20 mole percent m-terphenyl. This mixture is completely melted at 47 C. The chemicals used in this work are 99+ percent pure.

Ceramic Coatings of Uranium. Ceramic coatings of good quality can now be applied at will to four-inch long uranium slugs. Improvements were made in grinding and storing the frit and in the firing atmosphere. The metal surface must be highly polished and free from flaws for successful coatings. These coatings are resistant to abrasion and corrosion, although probably not to the extent needed for practical fuel elements. The coating should make an excellent diffusion barrier, although heat transfer would also be impaired.

Radiometallurgy Examinations

Examination of M-388 Jacketed Hot Spot Failure (RM 197). The examination of the above failure has been completed with a spectrochemical analysis of the can wall and attached compounds. The analysis confirms previous x-ray data which showed the compound on the inside of the can wall in the rupture area contained uranium. In addition, the analysis of the scale from the outside of the can disclosed a high zinc content, believed to have come from the 72S cladding used on the process tube in which the rupture occurred.

Irradiation of Seven-Rod Cluster Fuel Elements (RM 182). A production test of seven-rod cluster fuel elements (PT-IP-46A) was irradiated in a KE through hole to an estimated exposure of 1075 MWD/T to evaluate the effects of radiation on the rod configuration. The test consisted of two elements with 8" long x 0.499" diameter uranium rods canned in stainless steel. Visual examination, as received, indicated that the clusters were susceptible to handling damage after discharge. The spider and rings holding one cluster had been knocked askew and one rod was completely loose. The second cluster was less severely damaged. The individual rods were in good condition, with no visible warp or distortion. Diameter measurements were within the canning tolerances. The uranium was found to have shortened, with length decreases in one cluster of 15 to 24 mils over an 8" length and length decreases of 0 to 16 mils in the second cluster. The center rods showed the largest length decrease.

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Cluster Fuel Test - GEH-4-B (RM 181). A prototype four-rod natural uranium fuel element cluster, clad in 304L stainless steel, was irradiated as GEH-4-B in the Materials Testing Reactor during cycles 84, 85, and 86, to 550 MWD/T. It was discharged 5/6/57, and shipped to the Radiometallurgy Laboratory at the request of Fuel Design Operation, HLO, for post-irradiation examination. Two four-rod cluster elements, previously irradiated to 110 MWD/T in the H-Reactor Loop Facility, exhibited satisfactory reactor experience at low exposures. GEH-4-B is the second of a series of exposures designed to test this type of four-rod cluster for in-reactor performance.

Visual examination of the assembly showed no obvious defects, and a maximum diameter increase of 13 mils was measured.

Factorial UO₂ Capsule Irradiation Experiment (RM 92). Pressed, powdered uranium oxide capsules were irradiated to various degrees of burnup. As previously reported, all 16 capsules have been sampled for fission gas yield. The capsules were then filled with gelatin and have been cut transversely to reveal a varied internal structure. Some pieces have a homogeneous solid appearance, while others are cracked. A few of the cracked pieces were fractured to an extent that large chunks of the oxide were removed during the cutting operation.

Swaged UO₂ Capsules - GEH-3-23 (RM 203). Two capsules of non-sintered UO₂ were prepared by the cold rotary swaging technique and irradiated in the MTR. Both capsules, designated as #1 and #3, were suspected of being ruptured in the reactor and removed. However, visual examination of both capsules in Radiometallurgy revealed no external defects, and no fission gas was detected when the jackets were opened at room temperature.

Upon sectioning of the capsules it was observed by the nature of the cracks appearing in the UO₂ cores that Element #1 had possibly experienced a temperature excursion into the sintering region, while Element #3 had not. Element #3 exhibited cracks running to and through the center of the core, while Element #1 had a major crack which was circular and encompassed the central half of the core.

Basic Metallurgy Studies

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 radiation damage experiments in the Hanford uranium-graphite and the MTR reactors. A sample calculation has been made for the total radiation heating in aluminum in a Hanford reactor. The specific power was assumed to be 50 kilowatts per foot of tube length. The thermal and fast fluxes were taken to be 10¹³ and 10¹², respectively. Gamma heating was found to be 0.065 watt per gram. Neutron absorption heating (by recoil aluminum atoms) was found to be 0.062 watt per gram. Fast neutron collision recoil heating was found to be 0.02 watt per gram. The total heating rate is the sum of these and amounts to 0.15 watt per gram in aluminum.

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Internal Friction. Internal friction depends on the capacity of a solid to convert mechanical energy of vibration into internal energy. This causes gradual damping of the oscillation of a solid even though care is taken to minimize transfer of energy to the surroundings. It is possible to use internal friction measurements as a research tool to study phenomena such as irradiation damage, grain boundary precipitation of impurities, and grain growth. An optical lever system has been added to the torsion pendulum equipment. This lever system will be used as a standard in adjusting the electronic equipment and the inertia member of the torsional pendulum.

Electron and Optical Microscopy. The study of the microstructure of irradiated reactor fuel and its cladding material is a useful means for detecting radiation damage. Replicas prepared before and after irradiation of a uranium specimen irradiated to a burnup of 0.1 a/o are being studied by optical and electron microscope techniques. Definite evidence of microstructural dimensional changes which include rotations within crystallites has been found. This characteristic was not evident in similar specimens irradiated to lower burnup values.

In order to ascertain the relative importance of the thermal effect on the dimensional stability of the uranium, two specimens of uranium have been heated in the hot stage microscope to elevated temperatures and cycled four times; the one specimen from 150-350 C, and the other from 500-600 C. Changes in the microstructure, if any, have not been established. The 16 mm movie film used to record the microstructure is being studied. The hydride impurities present in the field of view did not appear to decompose, presumably due to the fact that they had broken out during the polishing and etching process. Replicas taken of the specimens before heating, after heating, and after a further re-etch will permit examination of the hydrides at additional points on the specimen. Both specimens when heated into the beta temperature zone showed a martensitic transformation. This transformation has been recorded on movie film and will be thoroughly studied.

The specimen with a burnup of 0.1 a/o has been annealed at 600 C for ten hours, and the hardness and x-ray broadening, (154) peak, has been re-determined. Essentially no decrease in hardness occurred; a very slight sharpening of the (154) peak occurred.

An optical and electron microscope study of SNAP, sintered nickel containing discrete aluminum oxide particles, has been conducted. The samples, obtained from MIT, are extremely difficult to etch by conventional methods. Etching by ion bombardment, however, has revealed the structure.

Fission Product Mobility Experiments. The diffusion and agglomeration of the noble gases, krypton and xenon, produced by fissioning of uranium-235 have resulted in pronounced swelling of irradiated fissionable metals. This swelling appears to be markedly dependent on irradiation temperature and uranium 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 or alloys in either single phase or bi-phase has been initiated. The latter alloys are used to determine the effect of a precipitated phase on diffusion.

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It has been established this month that a small amount of cold work in a Ag-7.5 Cu alloy followed by annealing at 770 C for one week coarsens the grain structure until a 1/8-inch diameter grain size is reached at which time the coarsening comes to equilibrium. This coarse grained alloy will now be annealed at 700 C to determine when the precipitation of Cu (over-aging) comes to equilibrium, and 0.010-inch foils will be heat treated accordingly.

The Effect of Present Pile Atmosphere on Uncooled Process Tubes. The rate of reaction of zirconium with gas is affected by ionization of the gas according to short term tests made a few years ago at BMI. Also, it was reported from ORNL that the oxide formed on zirconium exposed to reactor radiation was the cubic form of the oxide instead of the normal monoclinic ZrO_2 . For these and other reasons, there appeared to be some risk in supposing that out-of-reactor gas reaction data would apply in-reactor.

From the results of 100-H Reactor X-test hole exposures of several types of zirconium specimens over the period lasting from September 1954 to July 1957, it appears that in-reactor gas reaction rates are similar to the ex-reactor rates. The Zircaloy-2 and zirconium gained 7.6 and 3.4 Mg/cm², respectively, during two years and nine months exposure to 100-H Reactor gas at temperatures of 400 to 450 C. The oxide scale was tenacious, and the metal was still ductile as determined by bend tests. Hardness and bend tests indicate that much of the strength obtained by cold working zirconium was retained under these exposure conditions.

New Fuel Element Development

Nickel Plating of I & E Wafers. Among the proposed designs of I & E slugs for use in present reactors is the hot-pressed wafer type. Experimental designs require uranium wafers plated in three ways: (a) on the inner and outer cylindrical walls only, (b) on both cylindrical walls plus one flat face, and (c) on both cylindrical walls and both faces. Since existing plating facilities are not adapted to handling work of this type, it has been necessary to design and construct new types of plating racks. A rack and accessories have been developed to accomplish (a) and (b) above; construction is in progress on a different type rack to produce (c) 60 at a time.

Hot-Pressing KER-Size Wafer Fuel Elements. The feasibility of hot-pressing KER-size wafer fuel elements is being investigated. A hot press unit has been designed and partly fabricated. Wafers of various designs are being machined. Components of M-388 and other aluminum alloys for high temperature coolants have been ordered. To expedite the investigation, "C" size components will be used to determine the proper conditions to produce acceptable fuel elements.

Heat Transfer Measurement on Irradiated Slugs. As part of the evaluation of hot-press canned and vacuum canned slugs (PT-IP-44A and PT-IP-45A), a thorough post-irradiation examination is applied to determine whether and/or where any quality deterioration may have resulted from irradiation. Heretofore, no procedure for measuring the heat transfer capacity of

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irradiated fuel elements has been available. An experiment to measure the temperature differential caused by the gamma ray heat dissipation from the irradiated slug was tried. An appreciable difference between the surface temperatures of irradiated and unirradiated fuel elements was readily detected. Positive evaluation of the test procedure must await the finding of an irradiated slug known to have a zone of poor heat transfer. Meanwhile, hot spots on electrically heated simulated slug surfaces under water are being checked for debugging the equipment and techniques.

Self-Supported Fuel Elements. Sixty-eight standard hot dip fuel elements, accepted by standard manufacturing inspection, were made self-supporting by the attachment of short aluminum rails for the PT-IP-84A. The quality of the supports was evaluated prior to autoclaving. After autoclaving, the fuel elements were inspected for surface defects. Three of the sixty-eight fuel elements were rejected for marred surfaces.

Lead-Dip Canned, KER Wafer-Type Fuel Elements. Wafer-type fuel elements have demonstrated desirable reactor properties. The advantages of this type element have justified continued development of tooling and techniques necessary to manipulate the segmented core. The washer container was modified, thereby increasing operator safety during the acid etch. Improved design of canning tongs will minimize fabrication rejects.

AlSi layers between washers in an assembled element were measured to investigate possible expansion of the core due to compound layer formation. Average thickness of this layer was found to be 0.00225". Tru-lining of the washers might reduce thickness of this layer.

Cold Closure Fuel Elements. Present cold closure techniques for fabrication of fuel elements require a machine finishing operation. Experimental work indicates that the cold closure cup can be sized to the finished dimensions, thus improving the economy and time of fabrication.

Techniques are being developed to form I & E elements by the cold closure process.

Fuel Component Fabrication. Equipment to fabricate small amounts of tubing for experimental purposes is being designed and built. This is being done in conjunction with the Structural Materials Development Operation. The tubing (Zr-2 and 3) will be used for fuel element jackets as well as for structural components. The ability to produce small amounts of tubing with various diameters and wall thicknesses, and do it with little or no delay, is of importance to the overall development program.

A continuous tube welding device, similar to those used in industry, is being designed to work in conjunction with the draw bench in the 306 Bldg. The primary tube forming operation is now under way in the 100-H maintenance shop. In this shop, the sheet metal strip is formed into a crude split tube by a press brake, cold forming technique. This technique, as used by NTH Products, Inc., consists of wrapping the strip stock around a cylindrical mandrel by compelling the mandrel to force the strip into a deep cushion of neoprene. In this case the neoprene cushion (or die) is

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held in a long trough on the anvil of a press brake. The mandrel is a long rod fastened, by a web-type member, to the press ram. To date, three 11-foot lengths and one 8-foot length of tubing, approximately two inches in diameter, have been made. These split tubes were made from Zircaloy-3 sheet stock 35 mils thick. They are exceptionally well formed circumferentially and are free from bowing. Tubes of this quality should go through the welding operation without defects. From the press brake forming operation the tube will go through the aforementioned welding step and then be given a final sizing by either swaging or unskanning.

Hot-Pressing of Bond Reject Production Fuel Elements. Three hundred production fuel elements not passing the ultrasonic bond test have been hot-pressed in support of PT-IP-68A-90-FP for the Process Engineering Operation. This production test is expected to determine the significance of void areas as a cause of hot-spot jacket corrosion. The hot-pressed pieces are to comprise one-third of this production test. Fuel elements with large void areas were pressed at 12 tsi for five minutes at a temperature of 535 C. The pieces were cleaned in trichloroethylene and hot nitric acid following the hot pressing. The fuel elements have been released for final autoradiographing prior to reactor charging.

Rod Cluster Fuel. The rod cluster design meets requirements for an extended surface fuel operating in a pressure tube reactor cooled by pressurized water. Four- and seven-rod clusters clad in both stainless steel and Zircaloy-2 have been irradiated during the past two years. To obtain additional experimental data, fifteen feet of four-rod cluster fuel elements were charged into Loop 3 of KER at 100-KE on September 19. These elements contain 0.570-inch diameter uranium rods clad with 0.030-inch stainless steel tubing. Power output is presently 43 kw/ft or 11.3 watts/gm U. The present exposure is about 330 MWD/T. Approximately 70 percent of this exposure has been at a bulk outlet temperature of 235 C.

A four-rod, stainless steel clad cluster irradiated to 550 MWD/T in cold water at the MTR is being examined in a Radiometallurgy cell. No external dimensional changes occurred, but three of the four uranium cores decreased in length by 0.4 percent. Uranium to stainless steel diffusion appears on rod end caps. Some clad-to-core bonding may have occurred.

A four-rod, Zircaloy-2 clad cluster has completed irradiation in the MTR. The final exposure of this fuel, now en route to Hanford Radiometallurgy, is 700 MWD/T. The Zircaloy-2 cladding is in the form of tubing cold swaged onto uranium rods. An interesting comparison may be drawn between this fuel and uranium clad by coextrusion with Zircaloy-2.

A third shipment of coextruded Zircaloy-2 clad uranium rod arrived from Nuclear Metals, Inc. Nuclear is developing a coextrusion process for fuel rods to be used in a cluster element. They will produce 300 feet of reactor grade clad rod before the end of this year. Of this, 100 feet will be with enriched uranium core and 100 feet will include integral end seals.

Corrosion tests of Nuclear Metals Zircaloy-2 clad rod with end seals welded at Hanford show adequate resistance to 350 C water. Rods beta treated after welding, however, reveal breakaway corrosion in the same test. Vapor blasting the beta salt bath scale and bright pickling removes this difficulty. Three 7-rod cluster fuel elements were fabricated for charging in the 3X3 ETR facility. These fuel elements consist of seven 0.460-inch OD natural uranium rods. The rods are clad unbonded in 20-mil stainless steel tubing closed by welding end slugs to the jacket. All rods were autoclaved for 78 hours at 360 C.

Rods are assembled into a cluster geometry by means of spiders welded to a split ring external to the fuel rods.

Fuel elements also were fabricated for a second irradiation in the KE through-hole facility. Exposure goal for the irradiation is 2500 MWD/T. The fuel elements are made from 0.500-inch OD uranium enriched to 1.3 percent U-235 and are to operate at a specific power of 85-100 kw/ft. The purpose of this experiment is to gain data on the stability of uranium irradiated in this geometry. Heat transfer calculations estimate that the central uranium core temperature will be 300 C.

Advanced Studies Program for Tritium Production. The increased severity of operating conditions in advanced design reactors requires that a special study be made of the feasibility of producing tritium in these reactors. A coaxial tube and rod element with a water coolant annulus between the tube and rod has been proposed as a possible element for tritium production in a water cooled reactor operating at a bulk coolant temperature of 300 C. The design proposed calls for the rod or target element in which the tritium is produced to consist of an aluminum clad - Al - 3.5 percent Li alloy, with the tube comprising the fuel bearing portion of the element. From economic and safety considerations, three basic requirements imposed on any target cladding material considered are that it have a low neutron cross section, a low corrosion rate, and low permeability to gases produced in the target material. Two aluminum alloys have been selected as the most likely to meet these requirements. In the initial phase of the experimental work it is planned to investigate the permeation rates of hydrogen through these alloys. The design, construction, and installation of glass apparatus to measure the permeation rates have been completed. The design of a permeation sample holder has been completed and work started on its construction.

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Restraint of Uranium Swelling by Zirconium Cladding - GEH-3-27. Data have been reported on the swelling rates of unrestrained, unalloyed uranium irradiated in the 400-500 C and 600-700 C temperature ranges. To date, no data are available on the swelling of unalloyed uranium restrained by high strength cladding and irradiated with a 300-350 C cladding surface temperature and a maximum fuel temperature in the range of 450-600 C.

The design and heat transfer calculations of a NaK capsule experiment to measure the swelling in a six-inch, 0.570-inch diameter uranium rod co-extruded with a cladding of 0.030-inch Zircaloy-2, have been completed. The capsule is nine inches long and consists of an 0.880-inch OD Zircaloy-2 tube having a wall thickness of 0.075-inch and containing welded end plugs. The clad uranium rod will be centered in the capsule with a thermocouple leading from the center of the uranium out through the capsule end plug to suitable connections outside the reactor. The void space in the capsule will be filled with NaK to a level one-fourth inch above the uranium rod, with the remainder of the void filled with helium. The capsule itself will be placed in a zone of flat neutron flux in one of the X-basket facilities of the MTR. It is planned to irradiate the uranium for six cycles, or approximately 2500 MWD/T.

Flow-Tube Rupture Testing of Insulated Fuel Elements. Insulated fuel elements in which the uranium fuel operates at high surface temperature may prove to be resistant to thermal stress failure. However, the manner in which, or the severity with which, an unbonded insulated fuel element may rupture has not been determined in a reactor. To evaluate the rupture behavior of unbonded, insulated fuel elements (jacketed in Al, insulated with anodized layers), four defected fuel elements of this type have been tested in the ELMO flow loop. The result of this test indicates that the operation of the defected element in the coolant stream in the temperature range of 200-260 C for times ranging from one hour down to 15 minutes will cause the fuel element to swell sufficiently to become stuck or to severely damage the process tube. On the basis of past ELMO flow loop tests, the swelling or tube blockage rate of the unbonded, insulated fuel elements is similar to that of unbonded, zirconium-jacketed fuel elements, and not much greater than that of unbonded (but not insulated) aluminum jacketed fuel elements. Irradiation testing of insulated fuel elements in present HAP0 facilities (production tubes or K through-hole) will not expose the uranium to coolant temperatures as great as those attained in the ELMO loop. The uranium surfaces in an insulated fuel element may operate at temperatures in the range of 250-400 C, but studies of reaction rates of high temperature uranium and water in a high temperature, high pressure loop, indicate that heated uranium in contact with water corrodes no faster than unheated uranium in contact with water of the same temperature.⁽¹⁾

(1) HW-40858, Quarterly Progress Report, Metallurgy Research, October, November, December 1955, p. 416.

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Fuel Elements for Organic Coolant. Candidate fuel elements for high temperature operation are being evaluated for interdiffusion of other interactions between the uranium and the cladding by bake testing elements at 450 C under approximately 1000 psi nitrogen. An unbonded aluminum canned uranium slug with a colloidal graphite diffusion barrier has failed in the bake test after about 1100 hours at 450 C. It was impossible to determine whether the failure had occurred internally or externally, and the latter case is a distinct possibility. A fuel element similar to this but with a diamond knurled uranium surface for mechanical keying has operated successfully in excess of 350 hours without incident. An AlSi dip canned fuel element has been removed from the bake test after about 1500 hours and will be destructively examined. Several rippled areas have developed on this fuel element and frost testing for evaluation of the heat transfer character of the AlSi bond indicates a decreased conductance at these rippled regions. cursory examination of a cross-section of this fuel element reveals a diffusion zone of approximately 0.30-inch depth at the surface of the uranium core. A second AlSi bonded piece has operated for 350 hours without apparent effect, and this piece passed the frost test without indicating any unbonded condition. A nickel plated, hot press canned, uranium fuel element has survived about 1500 hours of the bake test, and frost testing reveals good heat transfer characteristics of the bond. This piece is being baked to a longer time exposure.

The Combined Stresses Existing in Internally Heated Pressure Piping. The pressure piping in the experimental fuel element testing loop of the ETR encounters pressure and thermal stress conditions which are not covered in the pressure piping code. Elastic equations for the minimum total stress have been evaluated which give the pipe thickness for various internal pressures and internal heat generations. The results of these calculations are given in HW-53230. Also, a design note, "Recommendations for Model Testing of ETR Piping," has been written which describes the criteria which should be satisfied for experimentally establishing the operational limits by model testing.

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Calculation of Critical Speed. In the design of shafts, whirling or the possible deflection due to the centrifugal force must be considered. A long shaft used to mix chemicals for the 200 Area had to operate at speeds which could result in an unstable whirling condition. An energy method of approximating the critical speeds for shafts where the shaft weight as well as the weight of a concentrated mass (paddle at the end of the stirring rod) is considered was formulated and described in the note, "Approximate Solution for Critical Speed."

Mechanical Condition of Wafer Fuel Elements. The wafer fuel element design, which places bulkheads of compound or metallic layers between short rods or wafers of fuel material, alters the corrosion, heat transfer, and the mechanical conditions of corresponding rod type fuel elements. The document, "Mechanical Condition in Wafer Fuel Elements," HW-53312, describes some of the mechanical conditions which should be experienced in wafer fuel elements. Through the use of simple mechanical models, the following general conclusion was obtained: the stress condition of the fuel wafer should be less severe than that of the rod element, but the bond layers and jacket will be subjected to more severe mechanical conditions.

Coaxial Tube Fuel Element. The coaxial tube fuel element is of interest because it may offer the split failure resistance of a cored fuel element without the accompanying uranium and reactivity loss. Two coaxial tube fuel elements have been prepared, loaded into their test block and shipped to the MTR for testing. One of these elements contains an axial thermocouple for determination of the fuel element core temperature. Since the test block also contains inlet and outlet thermocouples for power generation determination, the U-U interface conductance values in this fuel element may be calculated. It is hoped that a stepwise startup of the MTR to full power may be permitted and that axial temperature measurements may be made at various power levels to permit the determination of interface conductance as a function of the load (applied by thermal expansion of the axial piece) on the U-U interface. Any additional stepwise return to power after the initial startup may indicate from the thermocouple readings whether any serious ratcheting phenomena is experienced by the coaxial core during power variations or transients. A determination of the effects of initial and subsequent startups on the behavior of the coaxial fuel element must be determined before extensive evaluation of this fuel element concept by long term exposures can be safely made.

Mechanical and Physical Properties of Irradiated Materials. The GEH-3 program at the MTR continued to be used for irradiating metallurgical samples normally requiring a flexible irradiation schedule and/or a high neutron or gamma flux. The following table lists current irradiations and an estimate of accumulated exposures through the last full MTR cycle, cycle 93:

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<u>Irradiation</u>	<u>Sample</u>	<u>Exposure x 10⁻²⁰ nvt</u>	<u>Goal Exposure x 10⁻²⁰ nvt</u>
GEH-3-8 (U-Mg Matrix Slug)	1	5349 MWD/T	10,000 MWD/T
	2	6182 MWD/T	10,000 MWD/T
GEH-3-12 (U-Th Alloy Fuel Material)	H-3	23.70	24
	H-4	23.49	33
	H-5	26.98	42
	H-6	28.85	50
GEH-3-17 (U-Th Alloy Fuel Material)	H-8	26.47	33
	H-9	29.01	50

GEH-3-12 (H-3), a U-Th alloy capsule, was discharged at the end of cycle 93, October 7, after accumulating about 23.7×10^{20} nvt exposure (see table above). The remainder of the 3-12 and 3-17 capsules, which occupy the A-4 NW position in the reactor, was rearranged to take better advantage of the vertical flux distribution.

Fuel Evaluation. The GEH-4 fuel testing facility at the MTR provides Hanford with a tool to investigate new or improved Hanford type fuel elements under a variety of operating conditions. GEH-4-19-E, the Zircaloy clad cluster fuel irradiation was discharged three days after the reactor reached full power at the start of cycle 92 because of an intank equipment failure. Because of reactor operating requirements, the 4-19 irradiation could not be reinserted during the remainder of cycle 92. The added exposure during cycle 92 amounted to 50 MWD/T. This increased the total exposure of 4-19-E to 735 MWD/T, and the decision was made to terminate the irradiation at this exposure value.

The equipment failure was corrected and GEH-4-22-H, a thermocouple-monitored UO_2 fuel irradiation, was charged into the GEH-4 facility at the start of cycle 93, October 7. However, 17 hours after the reactor reached full power, the GEH-4 fission break monitor indicated a fuel element rupture, and the facility was discharged. Periscope inspection of the discharged fuel element was made, but location of the fission break could not be determined by this preliminary technique. The defective fuel element will be returned to Hanford for a complete analysis.

The GEH-4 facility must remain unoccupied during cycle 95, October 28 to November 13, because of requirements established by an "A" priority reactor fuel loading test scheduled for that cycle.

HAP0 Liaison at the MTR. The numerous Hanford irradiation programs at the MTR and ETR have necessitated a continuous liaison contact at the NRTS. Since the setback to the installation schedule for the two Hanford high pressure testing facilities, ETR activities have been restricted to the receiving and storing of equipment. Initial start of Hanford's installation remains at February 15, 1958; this date is contingent, however, on the completion of the GE-ANP installation by the Kaiser Engineering Company.

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2. REACTOR PROGRAM

Coolant Systems Development

Low Temperature Corrosion Studies. An experiment is in progress to determine the separate effect of radiation on corrosion by irradiating aluminum dummy slugs in flowing water at modest temperature. Progress on this experiment comprised the discharge of one tube of dummy slugs for corrosion measurement and recharge for operation with water at 110 C.

An ex-reactor test was initiated using alternating M-388 and 1245 aluminum alloy clad slugs in a B-D-F size tube. In this test an attempt will be made to vary pressures and temperatures so as to duplicate the non-uniform corrosion of alloy M-388 noted in the reactor. It is hoped to determine whether this type of attack is primarily one of corrosion or mechanical abrasion.

Organic Coolant Studies. Data on the irradiation of MIPB and ternary eutectic were compiled and analyzed. It was found that radiolytic and pyrolytic damage rates can be represented by a single equation of the type:

$$F = 1 - \frac{1}{k_1 + k_2} \left[k_1 e^{-(k_1 + k_2)E} \right] + k_2$$

where: F is the fraction of tar

k_1 is the rate constant for radiolytic damage

k_2 is the rate constant for pyrolytic damage

E is exposure

The thermal stability of monomethylbiphenyl was established and was found to be greater than that of MIPB. It can probably be used at temperatures about 50 F higher than MIPB.

Ex-Reactor High Temperature Loop Studies. Stainless steel and aluminum alloy samples are in process of being corrosion tested in the ELMO-2 facility at 180 C and pH 4.0 with phosphate inhibitor. Examination of samples recently removed showed that the corrosion rates of M-388 and some similar alloys were so low that no measurements could be made. M-257 alloy had an appreciable corrosion rate, 0.8 mils per year. This may be an indication that even at the relatively low temperature of 180 C, the 1245 alloy will corrode at a much faster rate than will M-388. These results may be compared with the corrosion rates of M-388 and 1245 determined from in-reactor tests. The latest results from PT IP-42A showed that the 1245 corroded two to three times as fast as the M-388 in process water with slug surface temperatures near 130 C.

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Excess phosphate ion (150 ppm) has been suggested as a suitable corrosion inhibitor for aluminum at temperatures between 200 and 350 C. One test under the proposed conditions (300 C, pH = 4.5, 150 ppm PO_4^{3-}) was recently completed in ELMO-6. The results were discouraging. All of the aluminum samples showed non-uniform attack, probably as a result of erosion-corrosion. The excess phosphate ion probably caused some precipitate to form and this caused the primary erosion. This test did show that some alloys were much more resistant to erosion-corrosion than was M-388. Such alloys will be tested further.

Using the ELMO-4 facility, the rupture of an insulated slug was simulated to enable evaluation of flow channel blockage effects. After being at 240 C for 24 minutes, the flow annulus was essentially plugged. This rupture rate was of the same order as unbonded solid uranium core slugs. The facility is being modified so that tests can be carried out at higher temperatures and flow rates.

High Temperature In-Reactor Loop Tests. Loop KER-1, which is made of carbon steel, was out of service owing to its being reconverted for use with water as a coolant.

Loop KER-2 contains aluminum clad cow slugs and is operating at 180 C and pH 4.5, with phosphate inhibitor. Operation was without incident throughout the month. As soon as suitable fuel elements are available, this loop will operate at higher temperature.

Loop KER-3 contains stainless steel clad rod-cluster fuel elements and operates at 235 C. Owing to equipment difficulties, operation at high temperature was limited to a period of 15 days.

Loop KER-4 contains aluminum clad cow slugs and operates at 200 C and pH 4.5, with phosphate inhibitor. Due to equipment troubles, operation was inefficient, the loop being on process water for 27 hours.

Decontamination Studies. A proprietary compound, Turco 4306 B, is being evaluated as a decontaminant for the rear faces of the present reactors. An experimental flush at H Reactor reduced the rear face activity by 50 percent. A mockup test will continue for a few months to evaluate the residual effects of the flush. Preliminary results show that the Turco corrodes during actual contact and also causes a slightly higher corrosion rate for at least 45 days after the flush. In the tests completed so far, the total corrosion was found to be between 0.2-0.4 mil.

An impeller from one of the KER pumps was decontaminated using the following solutions:

- a. Boiling potassium permanganate with sodium hydroxide.
- b. Boiling solution of ferrous alum and nitric acid.
- c. Boiling solution of reducing acid and chelating agent.
- d. 15% solution of inhibited hydrochloric acid.

These treatments reduced the radioactivity from 100 Mrad to 7 Mrad. The residual activity was found to be extremely difficult to remove.

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Thermal Hydraulic Studies

Flow Hazard Studies. Experimental heat transfer studies of the responses of reactor process tube assemblies to imposed hazardous operating conditions continued. Analysis was completed of the slow plugging of a B-D-F process tube and reported in HW-52424 B. It was concluded that at tube powers above 400 kw, the pressure rise after unstable flow induced by slow plugging is sufficient that a safe reactor shutdown would be secured even if the Panellit system characteristics were such that the trip would not occur until after unstable flow had started. Below tube powers of 400 kw, it is doubtful that unstable flow would ever occur and the pressure buildup associated with the plugging would not be sufficient to cause a high trip.

Additional steady state boiling curves were determined for conditions simulating I & E fuel elements in C Reactor process geometry. A recurring characteristic throughout the thirteen runs was the somewhat unpredictable heat shift between hole and annulus with corresponding changes in pressure drop across the heated section. It is thought that as boiling commenced in one flow channel, an increased pressure drop in that channel caused a tendency for a reduction in flow leading to higher temperatures. This in turn tends to cause a heat shift to the other flow channel. A variety of runs were made at different ratio between annulus and hole flow and for tube powers between 500 and 1250 kw. During one run at constant front header pressure, the tube power was increased to 1067 kw while the hole was completely plugged. Conditions at that point indicated possibilities of unstable flow at higher tube powers.

Analysis of K Reactor transient data was completed and the following conclusions were drawn: (1) unstable flow would not occur at tube powers less than 1000 kw; (2) the data did not demonstrate the feasibility of relying on a high pressure Panellit trip in event of a plug upstream of the Panellit tap. Reliance must be placed on the low pressure Panellit trip in such cases because of the lack of large pressure increases at high water temperatures.

Hydraulic Studies. It was determined that two-phase, steam-water critical flow conditions do exist for K-type rear fittings under conditions of high outlet water temperatures. For example, it was determined that critical flow will occur for rear header pressures below 20 psig at a flow of 50 gpm if the water temperature is 120 C or above. This influences the possibility of correlating the true outlet water temperature with the value indicated by the temperature monitor, for outlet water temperatures above the saturation temperature at the rear header. Preliminary analysis of the data indicates that the location at which critical pressure occurs is not always at the fitting leading to the rear header as was the case for B-D-F geometry. The actual point of critical pressure depends on the pressure, flow rate, and water temperature. The temperature measured at the rear header fitting oscillated in the neighborhood of 120 C with an approximate period of one second under the conditions of critical flow. This is thought to be the result of a pulsating type of boiling.

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Laboratory work has been completed in accumulating data for the basis of a report listing pressure drop-flow relationships for standard process tubes and components for all Hanford reactor types. Preliminary design has been made of a system for studying critical flow behavior and pressure drop with steam-water mixtures at high pressures. The test sections, which will be placed in the high pressure heat transfer facility, will include a momentum detecting device to enable a better understanding of the type of flow pattern encountered. A literature survey regarding flow patterns in two-phase flow was completed and the results reported in HW-52927.

Organic Heat Transfer Coefficients. Five more runs were made to determine heat transfer coefficients of unirradiated MIPB. Data were obtained at bulk fluid temperatures up to 71.1 F and film coefficients were found to be within 13 percent of those predicted by the Dittus-Boelter equation.

Mechanical Equipment Development

Organic Cooling Systems Components. Installation of a component test facility neared completion. Work proceeded on the fabrication of test sections for the evaluation of mechanical pump seals, Parker fittings, screwed fittings, and flanged joints. The design of a special facility for evaluating fire hazards was completed except for the method of heating the fluid. Attempts are being made to locate an electrical heating element on-site to prevent procurement delays.

Irradiation Testing Engineering

Shielding Studies. A special loading of foils was prepared for ordinary concrete and placed in the test well. This new loading was used to accomplish (1) bare gold horizontal traverses in great detail to study streaming problems, (2) fast neutron traverse with sulphur foils all the way through the well, (3) temperature traverses in detail to determine source of heat near back edge of well. The sulphur traverse required the use of large sulphur foils to gain adequate sensitivity. An improved method for preparing such foils was developed.

Ordinary concrete shielding samples were removed from the test well and counting of the foils is about 60 percent complete.

Magnetite concrete shielding samples were baked at 320 C and are now ready for further testing.

An analysis of the information accumulated from the neutron surveys was made and a report (HW-53287) has been completed, comparing the neutron dose rates through the biological shields at the D, C, and KE Reactors. On the front face, the D Reactor which was at about half the power level of KE has less than one-third of the average neutron dose rate measured at KE, but considerably higher dose rates due to neutrons on top of the unit. With the C Reactor operating at about 60 percent of the power level of KE, neutron dose rates were found to be approximately the same on the front faces and on the top of the units. However, the neutron dose rate on the front face at C was found to be higher in several regions due to

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insufficient shielding of dry tubes. The dose rates due to neutrons on top of all three units are significant with whole body dose rates greater than 100 mrem/hour present in some sections. The shield penetrations associated with the vertical safety rods are the apparent sources. The amount of leaking through the shields is insignificant. Approximately 2 mrem/hour was measured coming through the D-DR type top shield and less than 1/3 mrem/hour was detected through the shields at C and KE.

To obtain increased sensitivity and efficiency, the counting room is being equipped with gas flow proportional counters. Tubes were made for four such counters and one assembly is ready for testing. All counting assemblies are identical in construction to those in use in the 329 Building. This will permit the foils to be counted in either facility with comparable results.

Irradiation Testing. The status of production tests of special interest to Hanford Laboratories Operation personnel was reported in HW-53282. PT-IP110-A, to determine the graphite oxidation rate in the 600-700 C temperature range, was charged into KW Reactor on October 16. No irradiation tests were completed during the month. The 600 MWD/T exposure fuel elements from test IP-59-A were discharged October 2, from DR Reactor.

Nonmetallic Materials Development

In-Reactor Graphite Burnout Rates at 600 to 700 C. The initial set of graphite samples monitoring in-reactor burnout rates in a hot spot created at KW Reactor have been charged. Twelve JN columns were loaded in a diamond array surrounding tube 3065-KW containing the samples and are providing the additional heat to reach temperatures in the range 600 to 700 C. A thermocouple was installed from the rear of the channel containing the graphite samples and will provide a complete temperature history for the test. Samples are currently running at 685 C. They will be discharged from time to time during the test to establish the burnout rate. Data obtained in a gas atmosphere ranging from 70 percent helium, 30 percent carbon dioxide to 100 percent helium will be used by IPD in establishing new process standards.

High Temperature Graphite Irradiations. GEH-9-5 irradiation of graphite in the MTR L-42 completed its scheduled four cycles in the MTR successfully at controlled temperatures of 975, 750, 750, and 600 C. Precision of control was within 1 C and accuracy is believed to be within 15 C or better, judged from the reproducibility of start-up data for each cycle. This assembly will be cut up and samples removed the week of November 11. Current plans include returning to Hanford certain thermocouple samples and other parts which may be of interest, as well as the graphite samples.

Thermocouple Development. Chromel-alumel and iron-constantan thermocouples with various types of insulation serving in 50% He, 50% CO₂ at 800 C indicated temperatures less than 700 C after running three weeks. They were removed from the furnace and examined. The sections of chromel wire which operated in the hot zone were very brittle and magnetic. The chromel wire in the sheathed material (304 stainless steel sheath with MgO insulation) was also brittle and magnetic even though the sheath did not appear

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to be degraded. The chromel and alumel wires were examined under a microscope. The alumel wire did not appear to be corroded but the chromel wire was very porous and had lost its metallic luster. The iron wire was also broken and very brittle. It is planned to repeat this experiment as a check on these results. A possible reaction between CO_2 and the metal will be explored.

Chemical Studies of Irradiated Plastics. Vacuum irradiation of Alathon 3, NC-10 polyethylene in various thickness to a total dose of 1×10^8 r has been completed. Approximately 11.8 cc of gas (converted to one atm., and 25 C) was evolved per gram of polyethylene. The gas composition, determined by mass spectrometer, was as follows:

Mass	H_2	CH_4	C_2H_x	O_2	C_3H_x	C_4H_x	C_5H_x	C_6H_x
%	97.5	0.09	1.1	<0.01	0.6	0.4	0.1	0.1

These results are comparable with data as reported by Dole⁽¹⁾ and Charlesby⁽²⁾. As a first approximation, each H_2 molecule evolved may be thought of as part of a reaction mechanism which results in cross-linking, which would increase tensile strength. Each carbon atom liberated is indicative of a chain-cleavage mechanism. Samples irradiated in vacuum showed a 15 percent increase in tensile strength while those irradiated in air decreased in tensile strength by 15 percent. In explaining these results it is postulated that oxidation of the vinylidene group occurs during irradiation in air, and that this reaction prevents cross-linking.

The application of Alathon 3, NC-10 as an approximate dosimeter for gamma irradiation has been demonstrated by the linear variation of $\text{C} = \text{O}$ increase with total dose (in air) from 5×10^6 to 1×10^8 r. Sample thickness is a variable which must also be taken into consideration, and an empirical formula correcting for variations in sample thickness in the range from 1 to 10 mils has been determined.

Using the specific absorption coefficients of Anderson and Seyfried⁽³⁾, the weight fraction of transvinylene and vinylidene unsaturation in Alathon 3, NC-10 has been calculated. The average values at various total doses are given below:

WEIGHT FRACTION OF UNSATURATED GROUPS FOLLOWING GAMMA IRRADIATION

Total Dose, Millions of Roentgens	Vinylidene ($\text{C} = \text{CH}_2$)	Transvinylene ($-\text{CH} = \text{CH}-$)
0	0.71×10^{-4}	0.00×10^{-4}
5	0.53 "	0.35 "
10	0.32 "	0.69 "
50	0.17 "	1.75 "
100	0.00 "	2.83 "
100 (vacuum)	0.32 "	2.83 "

(1) Dole, Malcolm, et al, J. Am. Chem. Soc., 76, 4304 (1954).

(2) Charlesby, A., Nucleonics 12, 18 (1954).

(3) Anderson, J.A. and Seyfried, W.D., Anal. Chem. 20, 498 (1948).

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The fact that some vinylidene remains at 1×10^8 r in vacuo, but not in air, indicates that this group is probably removed by two separate mechanisms: viz., (1) by irradiation alone, and (2) by oxidation in the presence of both air and irradiation. Mechanisms for these results are being considered as well as the effect of material thickness on the chemical changes.

Structural Materials Development

Zircaloy-3 B-D-F Process Tubes. Superior Tube Company successfully straightened the eight 50-foot, Zircaloy-3, B-D-F ribbed process tubes produced last month. The tubes should be received at HAPC during November. The 13 billets remaining on contract DDR-5 were extruded by Chase Brass and Copper Company. The extrusions incorporated an external rib to minimize the variation in the tube wall thickness. The extrusions were of excellent quality. Tube reducing of these extrusions by Superior will be performed during November.

Zircaloy-2 Process Tubes for Project CG-771. A contract proposal for the fabrication of five, 2.7" ID x 0.250" wall x 57' long, Zircaloy-2 process tubes was prepared and delivered to seven vendors (viz., Allegheny Ludlum Steel Corporation, Bridgeport Brass Company, The Carborundum Metals Company, Chase Brass and Copper Company, Curtiss Wright Corporation, Harvey Aluminum Corporation, and Reactive Metals, Inc.). Two slightly different fabricating procedures are permitted. One requires a full length extrusion followed by 20 to 40 percent cold work and the other permits up to two butt welds in the extrusion followed by 20 to 40 percent cold work. Each company was contacted and problems associated with the fabrication of this tubing were discussed. The 57' length was of major concern from a fabricating standpoint, while the brief period provided for bid preparation caused considerable administrative problems. Each company contacted expressed the desire to quote on this work and that they would expend considerable effort to meet the October 31 bid closing date.

Zircaloy Quality Control. Samples of Zircaloy-2 and 3 strip and seamless and welded tubing are undergoing corrosion tests at 360 C and 400 C in water and steam, respectively. The tests have accumulated up to seven (7) days corrosion time and will be approximately two-thirds complete by the end of November. It is anticipated that the results of these tests will provide a basis for an accelerated type quality control test for Zircaloy-2 and 3.

Advance Studies

Pebble Bed Reactor. A cursory evaluation of the fluidized pebble bed reactor was made. It appears that in electrical power ratings of 25 to 100 MW this reactor may have a distinct advantage over other reactor types considered. However, some of the advantages of the fluidized pebble reactor are shared with other light water moderated types. The pebble bed type does appear to have a simpler control system and is distinctly superior in that the lattice spacing can be continuously adjusted in single and multiple regions. Furthermore, if the apparent simplicity of the pebble

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bed reactor can be preserved throughout design, the reactor shows great promise of being mass produced and erected without precision or difficult work by construction forces. Further study is needed to confirm these points and to scrutinize the concept and inherent practical problems.

Homogeneous Reactor. A study has been started on the evaluation of a homogeneous reactor concept. The reactor, described in BAW-7, operates on a U-233-thorium system with a heavy water moderator to produce 520 megawatts of heat. Additional comments from CPD, CR&D, and IPD are expected at month's end.

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C. CUSTOMER WORK

Radiometallurgy Service

Examination of Two 5/8-Inch Cored Slugs from IP-30-A (RM-192). Two 5/8-inch enriched (1.44% U-235) cored slugs from IP-30-A (formerly PT 105-637-A-77MT) were submitted to the Radiometallurgy Laboratory by Research and Engineering Operation, IPD, for examination. The slugs, which were irradiated in tubes 3472-C and 4080-C, were part of the "enriched 5/8-inch cored run to rupture" phase of the production test and were located adjacent to failures.

Preliminary examination of the slugs showed an ellipticity of 50 mils at one inch from the cap end of 192-A (3472-C) and an ellipticity of 48 mils at one inch from the base end of 192-B (4080-C). The centers and opposite ends of the pieces were normal.

Project CG-660 (Metallographic Cell Modifications). Project forces have started the installation of equipment connected with this project. Metallographic services are now being moved to E Cell to satisfy requests during the period of construction.

Metallography Service

Samples of broken parts from the 200 Area continuous calciners were examined during the month. Three of the sections were wrought stainless steel and all of them had failed by fatigue as evidenced by the typical fatigue-type fractures. The failure of a fourth sample, a cast stainless steel, originated in a weld, but so little of the weld remained on the section that virtually little other information could be derived as to the cause for failure. No evidence of fatigue-type failure was noted on the cast sample.

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During some recent work involving the metallography of commercially pure titanium, a procedure was developed which appears to be an improvement over any currently reported in the literature for viewing the microstructure of titanium under polarized light illumination. Although the principal polishing techniques for titanium have been altered to some degree, the basic difference is in the use of an anodizing treatment as the final step in its preparation. The anodizing treatment, originally devised at ORNL for the microstructural examination of zirconium, produces improved contrast between individual grains which facilitates examination and improves photomicrographs.

Samples Processed During the Month

Total samples processed: 208

Photographs:

Micrographs	252
Macrographs	<u>90</u>
Total	342

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-53299 A2.

J. 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
JA Ayres RL Dillon	10/4	Kaiser Aluminum Co., Spokane, Wn.	Confer on aluminum alloys	D Smith	No
RH Purcell DE Rasmussen	10/14	Aeroquip Corp., Burbank, Calif. AeroBending Co., Sun Valley, " Alliance Tube Bending, Burbank, Calif. LeFiell Mfg. Co., Los Angeles, Calif. Western Piping & Eng. Co., Los Angeles, Calif. Tube Specialists of Calif., Santa Ana, Calif. Precision Tube Bending & Eng. Co., Whitter, Calif. Proto Tool Co., Los Angeles, Calif. Ilco Tube Bending & Eng. Co., Los Angeles, Calif. Industrial Tools Mfg. Co., Huntington Park, Calif. Powis Machinery Sales Co., Hawthorne, Calif. Precision Sheet Metal, Inc., Los Angeles, Calif. Western Piping & Eng. Co., San Francisco, Calif. TUBESALES, San Francisco, Calif. Oscar Krena, Inc., Berkeley, Calif. Northwest Copper Works, Inc., Portland, Ore.	Technical consultation on bending jumpers and development of special tools for PRTR.	ES Clark W Kiszkl C Lindstrom TE Watkins GK LeFiell DW Strom CC Buck WE Mayo RE Benny JE Edmiston D Windust NE Nelson SW Powis R Nutter L Lee J Zimmerman WC Tagmyer KC Hancock D Quinn	No " " " " " " " " " " " " " " " " "
	10/15				
	10/16				
	10/17				
	10/18				
JM Davidson	10/16	GE - ANP, Evendale, O.	Attend AEC-sponsored MTR-ETR Users meeting.	JL LeRome	Yes

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VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JM Davidson WA Snyder	10/28-31	American Nuclear Society, New York, N.Y.	Attend 2nd winter meeting. Present paper.	--	No
VH Troutner	10/1-2	GE - X-Ray Applications Lab., Milwaukee, Wis.	Demonstration of x-ray microscope applications to HAPO research projects.	SE Summers	No
WF Hall	10/14	ANL, Lemont, Ill.	Discuss high temperature thermal conductivity measurements	KF Smith MV Nevitt LE Richards A Roswell FH Norton JJ Meers	Yes " " No "
HP Oakes FB Quinlan	10/7 10/9 10/10 10/11	NTH Products, Inc. El Cajon, Calif. Carpenter Steel, Corp., Union, N.J. Precision Die Casting Co., Fayetteville, N.Y. Wolverine Tube Co., Fellow Gear Shaper Co., Detroit, Mich. Carpenter Steel Corp., Union, N. J.	Consultation of Zr tube processing & fabrication equipment	W Miller N Chernick -- Mr. Paul --	" " " " "
JW Riches	10/31 10/16 10/17 10/18 10/21 10/22	Carborundum Metals Co., Akron, N.Y. Curtiss Wright Corp., Buffalo, N.Y. Allegheny Ludlum Steel Watervliet, N.Y. Bridgeport Brass & Copper, Bridgeport, Conn. Chase Brass & Copper Co., Waterbury, Conn.	Consultation on the fab- rication of Zr. " " " " " "	N Chernick HA Andersen Mr. Bartholomew MW Isacson RE Rohrabugh JH Estes RS French Dr. Crampton	" " " " " " "

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VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JW Riches	10/23	Reactive Metals, Inc. New York, N.Y.	Consultation on the fabrication of Zr	Mr. Chisholm WC Greenleaf P Wiggins	No " "
	10/24-25	Harvey Aluminum, Torrance, Calif. Hunter Douglas Corp., Riverside, Calif.		RA Quadt	"
RL Hales	10/14	ANL, Lemont, Ill.	Discuss measurement of thermal & electrical conductivity of metals	KF Smith	Yes
	10/15	NBS, Washington, DC		LE Richards	No
	10/16	GE-Res. Lab., Schenectady		JW Corbett	No
	10/17	GE-KAPL, Schenectady		DJ Ruggiero	Yes
	10/18	BMI, Columbus, O.		HW Deem	"
DR Stenquist	10/16	Gladding McBean & Co., Los Angeles, Calif. American Ceramic Soc., San Francisco, Calif.	Consultation on ceramic fabrication methods. Present paper.	Mr. Saginar --	No "
JE Minor	10/16	GE-ANP, Evendale, O. Natl. Lead Co., Cincinnati, O.	Test Reactors Users Mtg. Consultation on fabrication problems	JL LeRome A Stewart	Yes Yes
JM Tobin	10/15	ANL, Lemont, Ill.	Discuss EBWR fuel.	S Rothman	Yes
	10/16-17	Michigan State U., E. Lansing, Mich.	PhD recruiting.	JF Schumar --	No
AL Bement HJ Pessl	10/17	Wilson & Sprow Co., Spokane, Wn.	Discuss die designs for tru-line washers.	HE Wilson	No
SH Bush	10/21-25	U of Michigan, Ann Arbor, Mich.	PhD recruiting.	--	No
WE Roake	10/28	Northwestern U., Evanston, Ill.	PhD recruiting.	--	No

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VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
LG Merker	10/21-26	True-Trace Co., Los Angeles, Calif.	Acceptance inspection on milling machine	LM Cross	No
WB Weihermiller LC Cox	10/27-31	Do-All Company Des Plaines, Ill.	Attend inspection program	Mr. Volk	"
JR Triplett	10/28-31	American Nuclear Society and AEC Computing Facility, New York University, N.Y.	Attend meeting and consultations on reactor calculations	RD Richtmyer R VanNorton	No "
RM Fryar	10/29-31	Atomic Industrial Forum, New York	Present paper	--	No

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
DE Coates JJ Matthew HE Tilbe	10/2 10/3	Canadian GE, Ontario, Can.	Discuss reactor design & estimating of PRTR Discuss UO fuel tech- nology & PRTR program	RM Fryar & staff FW Albaugh JJ Cadwell EA Evans WE Roake	No Yes	713, 700 328, 300 326, 325, 300
DE Coates	10/4	Canadian GE	Discuss 1706-KER facil- ities & testing cap- abilities	DR Doman KD Hayden RJ Lobsinger	No	1704-K, 100-K
HE Tilbe DE Coates	10/2	Canadian GE	Discuss mechanical com- ponents, thermal hy- draulics & coolant systems development	RH Purcell JM Batch JA Ayres	No	328, 300

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VISITS TO HANFORD WORKS (CONT.)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
OJC Runnalls GH Chalder	10/3	AECL, Chalk River, Ontario, Canada	Discuss UO fuel technology & PRTR program	JJ Cadwell EA Evans WE Roake	Yes	326, 325, 300
RL Beck	10/17	Canadian GE, Ontario, Canada	Discuss experience with organic coolants and proposal for irradiation of candidate fuel elements in the PRTR	JJ Cadwell EA Evans WE Roake	Yes	326, 325, 300
WM Campbell AM Ward JN Fairle JP Dyne		AECL, Chalk River, Ontario, Canada		JW Goffard RG Wheeler		
PD Hodel	10/17	Huntington Rubber Mills, Portland, Ore.	Engineering discussions re nonmetallic materials.	R Harrington	No	326, 300
J Jepson WD Deker WJ Ramsey M Harris	10/21	U of Calif. Rad. Lab., Livermore, Calif.	Discuss metallurgy fabrication problems	OJ Wick ID Thomas MD Freshley TC Nelson	Yes	234-5, 200-W Purex, 200-E 105-KE, 105-KW, 100-K
ER Wittry	10/21-24	"	Discuss research & development program	"	Yes	"
JH Erwin	10/25-24	ORNL, Oak Ridge, Tenn.	Discuss manufacture of Pu-Al fuel elements.	OJ Wick	Yes	234-5, 200-W

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

Al-Pu Capsules for MTR Irradiation (GEH-3-24). Capsules of Al-1.65 w/o Pu and Al-12 w/o Si-1.65 w/o Pu alloy have been and are being irradiated in the MTR to determine the irradiation behavior of this fuel material. The four capsules successfully completed the in-reactor exposure periods; however, monitoring of the flux wire indicated that the samples were exposed to a lower flux than was requested. Examination of two of the capsules in the Radiometallurgy Laboratory has been essentially completed. Reliable post-irradiation dimensional measurements of the fuel cores could not be obtained because of surface damage incurred during the dejacketing operation; however, no visual indication of dimensional instability was noted. Hardness measurements were made on the fuel material before and after irradiation. The hardness of the Al-1.64 w/o Pu alloy increased from 46 to 94 on the Rockwell "H" scale and the hardness of Al-12 w/o Si-1.61 w/o Pu alloy increased from 86 to 102. Photomicrographs were made and no changes in the microstructure due to irradiation were observed. The other two capsules were visually examined and returned to the reactor for recharging on September 16, 1957. It was requested that the two specimens remain in the reactor for two cycles which would be equivalent to 50-60 percent burnup of the Pu atoms.

Fission gas activity was detected in the MTR and the capsules were discharged prematurely along with other experiments. Though the Pu-Al samples were among the capsules suspected of releasing the fission gas, the MTR noted activity when it started up again without these particular specimens. Current plans are to monitor the flux measuring wire which was attached to the capsule holder and if the accumulated flux values are sufficiently high, the capsules will not be recharged. In the event the values are too low, the capsules would be recharged again at the start of cycle 95 on November 18, 1957.

Al-Pu Alloy Clusters for KER Irradiation. A Zircaloy-clad, four-rod cluster with swaged and drawn Al cores was fabricated and delivered for testing in the ELMO-7 out-of-pile loop facility. The end cap welds were made in the vacuum welding box and "bubble" tested for leaks. The bright color of the welds indicated that a very good inert atmosphere was obtained in the welding box. This cluster is to be tested in pressurized water at 300 C for 50 to 60 days initially and then to a total of about 120 days. This sample is a forerunner of similarly designed clusters which will contain Al-3 w/o Pu and Al-12 w/o Si-8 w/o Pu alloy fuel material cores and which will be irradiated in the KER loop facility. Overall length of these clusters is 11 inches. A new "spider" design is also being evaluated during this test. Casting of the Pu-bearing fuel materials and examination and fabrication of the jacketing components for this irradiation test are continuing. A rough draft of the proposed KER loop tests has been completed. Target date for completion of three clusters with plutonium-bearing cores in Zircaloy-3 jackets has been tentatively set for December 1, 1957.

Vacuum Injection Casting. Developmental work is continuing on the injection casting process for fabrication of Al-Pu fuel elements. Preliminary work with Al and stainless steel has demonstrated the feasibility of the process. Work is now being directed toward refining the process and making actual fuel elements with Al-Pu. One problem with vacuum casting Al-Pu alloy directly onto Zircaloy jacketing is that the external surface of the jacket must be completely free of contamination. To accomplish this, it is planned that the entire jacket with one end sealed, be supported in an open front hood which would in turn be connected to a closed hood and a dip tube will supply the molten metal to the jacket. A method of making the final weld closure is being evaluated. Sections of 3/4" stainless steel tubing were reduced at one end by swaging to 1/4" pipe diameter and threaded. The end was then screwed into 1/4" dip tubes through which aluminum was injected into the main tube. After the metal in the dip tube solidified, it was possible to unscrew the pipe connection and break the aluminum casting inside the coupling due to its reduced diameter. A cap design is being tested which would permit making a contamination free weld on the external surface of the reduced tube end rather than on the edge of the internal surface as would be required with a plug type end cap. The cup-shaped end cap that is to be used with the swaged tube end can be welded at any distance back from the end of the tube. This appears to be a feasible method of effecting end closures and will be tried with Al-Pu containing fuel elements.

Pressure Injection Casting. Forcing molten Al-Pu alloys into Zircaloy or stainless steel jackets under some positive gage pressure should yield a better product than that cast by atmospheric pressure only. Two different devices were designed which would permit the evacuation of the fuel element jacket before forcing molten alloy into the jacket under gas pressures ranging from 0-150 psig. Fabrication of one device was completed and installation was started. Components for another type of injection casting machine which uses a piston to exert the pressure have been fabricated and are ready for assembly. A frame for the entire unit has been fabricated and is in position. The hydraulic cylinder will be mounted on the frame and thus provide support for the casting cylinder. The three pieces which were sent off-site to be nitrided have been returned and are being ground to remove surface decarburization. Final diametral clearance between piston and cylinder will be 0.002 inch. The hydraulic feed system has been designed around the extrusion press pump, utilizing a pressure reducing valve. Work on adapting the extrusion pump system to the injection casting unit will begin shortly and it is planned that initial castings can be made November 1.

Extrusion Program. A developmental program was initiated to determine the capabilities of the 125-ton extrusion press before it is permanently installed in the hood. Primary objectives of the tests were to define operating procedures and investigate die design and lubricants. Initially, a hydraulic pump is being used which restricts the maximum working pressure of the press to 50 tons. Delivery of the larger pump unit is expected before the first of the year. Five, 1100 alloy aluminum cast billets were extruded with flat face shear dies with an extrusion ratio of 9 to 1.

Billet and container temperatures were maintained at 375 C and oil dag was used as a lubricant. Of the five billets extruded, two were unsatisfactory. Failure was attributed to inadequate lubrication in one case and insufficient heating time in the other. In addition to the cast Al billets, two powdered compact

billets and three AlSi billets were extruded. Only one of the three AlSi billets extruded properly. The 50-ton capacity was not sufficient to reach the higher break thru pressures required to extrude AlSi. Improved die design and lubrication may lower this pressure to a value where extrusions can be made with the present press capacity.

Powder Compact Extrusion. Three powdered Al compacts of 92.3 percent theoretical density were hot extruded to 0.508" diameter rod. Two of the three compacts were extruded simultaneously from the same container. Shear dies were used with an extrusion ratio of 9 to 1 and billet and container temperatures were maintained at 375 C. Both extrusions had excellent surfaces and the juncture where the two compacts butted together was not discernible in the final extruded rod. A 180° bend test failed to break the jacketed rod at any point. The final extrusions were 100 percent of theoretical density.

Roll Cladding. At the present time proper closed pass rolls for roll cladding Al cores in Al jackets are not available on-site. Ten M-329 Al thick-walled production cans and two steel canning sleeves were sent off-site for rolling tests to determine the best closed pass pattern for hot co-rolling to a 0.510" diameter rod. This optimum pass pattern will be incorporated in the 8" Stanat rolling mill.

Thermal Expansion Considerations. Differential thermal expansion between the Al and Zircaloy may be a problem with long, small diameter fuel elements as planned for the PRPR. As an approximation of this problem, a stainless steel clad Al rod with no end clearances was heated to 400 C without rupturing the jacket; however, after cooling, the Al core rattled in the jacket and there was evidence of necking of one of the welds. Since it was necessary to make length measurements in a constant temperature room, no accurate length change was measured.

Fuel Element Cluster Studies. The wire wrapping apparatus for the 19-rod cluster fuel element design has been fabricated and the developmental work in the assembly operations is progressing satisfactorily. The tubing for the two test clusters has been checked by radiography and eddy current methods by the Radiographic Testing Operation. From 63, 8-foot lengths of stainless steel tubing, only 34 were without questionable flaws. Twenty good tubes have been set aside for the Al-Pu core 19-rod cluster. The remaining 14 good tubes and five of the questionable ones have been cut to length for fabrication of the 19-rod cluster to be used for hydraulic tests. This cluster will contain pure Al cores. The bottom end fittings have been welded in the tube and helium tested for leaks. All tubes were leak tight. The Al rods which were swaged and drawn to PRP core size were warped to such an extent that they could not be inserted into the tube. After annealing and straightening, they were easily inserted into the tubes. This cluster is expected to be ready for testing by November 1.

Zircaloy-3 Tubing for PRPR Fuel Element Development. Examination of six pieces of Zircaloy-3 tubing received from Wolverine Tube Company and to be used for PRPR fuel element development is continuing. Surface finish measurements were delayed because of repair work on the profilometer.

Plutonium Fabrication Pilot Plant. A fabrication facility for producing plutonium-bearing sintered oxide fuel elements has been designed and incorporated into the scoping of the Plutonium Fabrication Pilot Plant. The oxide fabrication facility will have a process capacity of about 10 pounds per hour which is adequate to provide plutonium-containing oxide fuel elements for continuing operation of the PRPR in the form of uniform enrichment. General hood construction criteria pertaining to materials of construction, ventilation and construction details have been specified for the use of the Construction Engineering Operation.

UO₂ Fuel Development

Thermal Conductivity Specimens. It has been frequently suggested that the thermal conductivity of UO₂ will be decreased by a factor of as much as two as a result of irradiation. No experimental evidence is available. In order to obtain unbroken irradiated 1/4" diameter by 3" long rods of uranium dioxide for thermal conductivity studies in collaboration with BMI, it is necessary to enclose the uranium dioxide rods in special test slugs of aluminum. Such slugs have been designed and fabricated and after loading will be enclosed in a standard Hanford aluminum can. Thirty-two feet of 7/16" diameter extruded rod were extruded and sintered for these thermal conductivity studies. The required densities of 91 and 95 percent of the theoretical were obtained. Upon completion of centerless grinding, the sintered and ground rods will be cut into 3" pieces for canning and irradiation.

Fabrication of Uranium Dioxide by Combined Pressing and Sintering. The sintering of uranium dioxide under pressure is being investigated as a possible technique for reducing the time and cost of fabricating a high density dimensionally uniform oxide element. Initial experiments are being conducted with slightly modified, presently available equipment which will provide information about this process at temperatures up to at least 600 C and at pressures of approximately 10 tsi.

Swaging of Uranium Dioxide. A study is in progress to determine the important variables in the swaging process and the reproducibility of results. Various uranium dioxide powders previously have been swaged into 0.318" diameter rods having densities up to 94 percent of the theoretical density of uranium dioxide. During the past month arc-fused oxide from the Norton Company was investigated. It was compacted to 88 percent of the theoretical density by cold swaging; this compares to a density of 90 percent of the theoretical, previously obtained by cold swaging sintered and ground uranium dioxide powder. Exploratory experiments also are being conducted to determine lengths and diameters feasible with swaged elements. Rods were swaged to approximately 7 feet in length and 0.318 inch in diameter. Capsules containing uranium dioxide were swaged to 0.514 inch in diameter; the densities were approximately equal to those obtained with the smaller diameter rods. Swaging studies are now being directed toward the development of fabrication techniques for complete Zircaloy-clad fuel elements, consisting of either a single, large-diameter rod or a cluster of smaller diameter rods.

Fabrication of I & E Oxide Cores. To obtain statistically significant irradiation experience with tubular oxide elements, it will be necessary to fabricate and irradiate a number of these elements at HAP0. Final grinding has been completed on uranium dioxide fuel cores 1.378" OD x 0.524" ID, and these cores will be used in assembling of eight-inch fuel elements for irradiation.

Fabrication of PCTR "Core C" Cores. The inner tube of a two-component nested tube assembly for the PCTR has been completed through the sintering operation. Densities of approximately 94 percent of the density of uranium dioxide were obtained by ball milling the uranium dioxide forty-eight hours and sintering at 1650 C for eight hours.

"Garbage-Container" Elements. Three Ni-Al clad elements containing non-sintered, enriched uranium dioxide powder were fabricated by isostatic pressing, and one of them will be irradiated in the MTR to determine the feasibility of combining oxide core and aluminum cladding fabrication steps. The irradiation of these elements is now being delayed by difficulties in obtaining final closures which are free of voids or cracks.

High Temperature Studies of Uranium Dioxide. The high temperature characteristics of uranium dioxide are being investigated by means of an electron beam gun, and by induction heating. The localized high temperatures obtained in the electron beam gun failed to melt the uranium dioxide. However, unexpected vaporization and recrystallization characteristics were observed. Further investigations are being conducted to relate these observations to the behavior of certain uranium dioxide elements during in-reactor testing. The proper design of a fuel element for the PRPR requires a knowledge of the volume change of uranium dioxide on melting. A small, glass, high temperature vacuum induction furnace has been designed and fabricated to help provide this information. The density of liquid uranium dioxide will be measured by means of tungsten pycnometers.

Uranium Dioxide Fuel Element Core Temperature Measurements. Calculation of core temperatures of tubular uranium dioxide fuel elements requires several assumptions concerning thermal conductivity, bond coefficients, and thermal cracking. An aluminum alloy (M-388) clad, internally and externally cooled, uranium dioxide fuel element containing a stainless steel sheathed, MgO insulated thermocouple was assembled and irradiated in the MTR GEH-4 facility. Temperatures of 800-950 C were recorded, as compared to a predicted temperature of 868 C. However, the measured power generation was only about 60 percent of the expected 52 kw/ft. Possible causes for the core temperature discrepancy are being examined.

Aluminum Clad KER-Size Elements. Relatively little information is available regarding the structural properties of Ni-Al cans under various conditions of temperature and pressure. To obtain data on M-388 cans and to determine whether M-388 clad oxide elements should be irradiated in KER loops, five M-388 I & E cans were loaded with uranium dioxide and welded. Wall thickness of the M-388 material varied between 0.040 and 0.050". The finished slugs were then autoclaved for sixteen hours each by the Corrosion and Coatings Operation, with the results shown below:

<u>Test</u>	<u>Pressure, psi</u>	<u>Temp., °C</u>	<u>Distortion</u>
1	1000	225	Extreme can distortion with cladding extruded into void spaces between sections of fuel.
2	600	235	Same as 1.
3	300	200	Very minor distortion. No extrusion into void space above fuel.
4	300	180	No distortion visually apparent but some was detectable with a micrometer.
5	500	175	Same as 4.

The above preliminary data indicate that for oxide-containing elements the structural behavior of Ni-Al cans is at least as important a variable as the corrosion resistance of the aluminum alloy. Further tests will be conducted as soon as thicker can wall material is available.

Welding Closures for PRPR Fuel Elements. A vacuum welding box designed for handling fuel elements up to 20 feet long and up to six inches in diameter has been designed and fabricated. The unit is now being assembled in the basement of the 325 Building. This facility is designed for experimental closures as well as production. The unit is expected to be in operation by December 15, 1957.

Mechanical Equipment Development

Construction of the Single Tube Prototype Facility, Phase I, is now approximately 25 percent completed; however, this rate of progress will not be maintained due to long term delivery items such as pumps, valves, and instrument panels. An order for a semi-prototypical pump was placed with the Byron Jackson Company. Delivery of this pump is expected in May 1958. Bids were received and reviewed for a 15 gpm pump for injection of water into the seals of the primary pump. Design of the Single Tube Prototype Facility, Phase II, continued. An order was placed with the Byron Jackson Company for the PRPR Primary Process Pump with a 350 hp single speed motor. It is expected that an alteration will be issued to provide a 350/38.9 hp, 1800/600 rpm double winding motor. The delivery of the pump is scheduled for November 1958. A bid was received only from the William Powell Company for a 14-inch gate valve and an 8-inch check valve. Bid review is in progress and an order is expected to be placed shortly.

Three different types of dump valves are now on order for the calandria prototype. Two dump valve actuators have been ordered for testing. Scoping is now under way to provide adequate instrumentation for the dump and level control tests. The process tube inlet bellows were tested during the month. The bellows lasted for 15,000 cycles before leaking, 28,000 cycles before complete failure and are deemed satisfactory. The testing machine was torn down for modification to test the

shroud tube bellows. It was discovered that regular Garlock valve stem packing crumbled during the first high temperature test and is not acceptable for high temperature seals. Rope asbestos packing is now being used in the test facility. The "as-scoped" nozzle to process tube connection failed to pass a hydrostatic test of 3000 psi using a tightening torque of 500 ft-lb. The test assembly is being revised to use wedge seals, metallic profile gaskets and Flexitallic gaskets rather than a solid metallic O ring.

Two nozzle cap assemblies are now under test. Cap assembly (A) which failed to pass the 2500 psi hydrostatic test requirement was revised for use with a Flexitallic gasket on one end and an O ring groove was left on the other end. Sealing faces were machined to 32 microinches. In addition, the sealing cylinders were changed from a 300 series stainless steel to a hardened 416 stainless steel. The revised test assembly was hydrostatically tested at 3000 psi. The Flexitallic gasket was leaking only slightly and the self-energized O ring held. Additional hydrostatic testing will be performed before the assembly is tested at high temperatures on ELMO-7. Cap assembly (B) was also subjected to hydrostatic testing. A Bridgeman type nozzle cap end passed the test at 3000 psi with a tightening torque of only 85 ft-lb. A tapered plug seating against an O ring failed at a pressure of 2000 psi with a tightening torque of 350 ft-lb.

The outlet jumper fitting to the outlet nozzle assembly passed a 3000 psi hydrostatic test. A wrench was designed and is now being fabricated to measure the tightening torque of this fitting assembly. The inlet jumper to process tube assembly is now being reflared. Detailed drawings for the inlet jumper piping were completed. On-site attempts to form the necessary bends were unsuccessful. A trip to Los Angeles, San Francisco, and Portland resulted in identifying nine qualified bidders. Fabrication work continued on special tools for assembling and removing the jumpers.

Coolant Systems Development

Alternate use of aluminum process tubes instead of zirconium tubes during initial operation of the PRPR has been evaluated to determine optimum moderator and primary coolant pH and temperature conditions to provide acceptably low corrosion of aluminum shroud and process tubes. Proper adjustment of coolant-moderator pH and temperatures should result in minimum corrosion of aluminum shroud tube and calandria surfaces, without undue sacrifice of aluminum process tube life. A report is being prepared specifying the pH and temperature in accordance with the best available information.

Use of softened well water for secondary cooling (boiler feed water) of PRPR may cause chloride stress cracking of stainless steel surfaces of the primary PRPR heat exchanger. The relative resistances of various material combinations (carbon steel with stainless cladding, all stainless steel, monel, etc.) to chloride stress cracking are being evaluated to scope the necessary corrosion testing of promising materials under simulated PRPR conditions.

Thermal-Hydraulics Studies

Report HW-53320 was issued concerning the results of preliminary tests of candidate flow nozzles which will feed the moderator into the PRPR calandria. After observing the flow characteristics of sixteen different types of flow injectors, it was decided to use a large number of 1/2 inch thin plate orifices in the initial tests on the full scale calandria mockup.

Fabrication of a full scale mockup of the PRPR calandria and moderator tank was completed and installation in the 185-D Building started. This mockup will be used for flow mixing tests of the moderator fluid and for tests involving the moderator level control and dump characteristics.

Calculations were completed and reported in HW-53319 to determine the dimensions and operating conditions, as determined from heat transfer considerations, for two tubular PRPR fuel elements. The elements, designated Mark II and Mark III, are a three-piece element consisting of a solid rod surrounded by two concentric shells and a two-piece element consisting of two concentric shells. It was found that it was possible to design a Mark II element within specifications. While a Mark III element was also designed, its heat flux was higher than that listed in the specification. It was concluded that both elements would operate with surface boiling but that operation at heat fluxes below those associated with subcooled burnout could be assured only for the Mark II element.

Shielding

The shielding requirements for penetrations through the PRPR shields for water, gas, and instrument lines were determined and reported in HW-53003.

Process Tube Development

Investigations by Chase Brass and Copper Company into new drawing lubricants and die materials have resulted in the successful plug drawing of PRPR type Zircaloy-2 process tubes. This development will permit accurate sizing of extrusions and improved surface quality. Delays in the procurement of tooling have postponed the tube reducing of three (3) tube blanks extruded by Allegheny Ludlum Steel Corporation until mid-November.

Replies to the inquiries prepared last month for the fabrication of five PRP process tubes, complete with flange and taper, will not be received until November 4. Several companies have expressed interest in the fabrication of these tubes and are developing new fabrication techniques to provide the flanged and tapered portions of the tube.

Jacket Sheathing

Fabrication by several vendors of 30-mil wall Zircaloy-3 jacket tubing for both the 19-rod cluster element and the two- and three-component nested tubular elements continued during the month. Both Carpenter Steel Company and Wolverine Tube Company made substantial progress in the fabrication of 0.5" to 1.0" ID tubing with deliveries promised for late November or early December. The NTH Company has overcome

the problem of galling during sizing and straightening by the use of Textolite as a die material. NTH personnel are now quite optimistic that they can fabricate the 3.0" ID jacket tubing within specifications.

Solubility of Aluminum Oxide in High Temperature Water

Corrosion results accumulated by both Corrosion and Coatings Operation and Coolant Systems Development Operation have suggested aluminum oxide has a significant solubility in high temperature water. There are at least two ways in which oxide solubility could be an adverse factor in high temperature water-cooled reactors. Protective oxide may be dissolved away increasing corrosion rates, and deposition of oxide on cooled heat-exchanger surfaces might impair the rate of heat transfer.

Experiments conducted in the stirred autoclave with metered flow of 250 C deionized water (for refreshing the system) have shown the solubility of aluminum oxide to be approximately 0.1 ppm. The same solubility value was obtained at two pumping rates, 2.1 and 4.6 gallons per hour. From the agreement in solubility found at these two pumping rates, it is assumed that the system was saturated with aluminum oxide. Studies are continuing to investigate the effect of temperature and pH on aluminum oxide solubility and rates of dissolution.

Aluminum Corrosion Product Studies

Electron microscope examination of the corrosion product films formed on aluminum in high temperature water has shown that corrosion penetration into the grain boundaries of the aluminum occurs during both uniform corrosion and intergranular corrosion. However, this penetration is apparently quite shallow during uniform corrosion. Examination has also failed to show the presence of cracks in the corrosion product film. These cracks have been postulated by several investigators as being the cause of the change from uniform to intergranular corrosion at elevated temperatures.

Plutonium Fuel Cycle Analyses

The generalized Pu recycle analysis program has been completed and the IBM 650 program cards are being punched. Several new reactor operating situations have been incorporated since the September report:

- a) Pu-241 decay within the reactor is now accounted for.
- b) U-235 spike cases may be run.
- c) The cycle average specific heat generation of the spike and feed zones need not be equal.

The output of the program will provide the following information:

- a) Cycle average concentrations of all elements in both feed and spike.
- b) Final concentrations of all elements in both feed and spike.
- c) Reactor average concentrations of all elements.
- d) f, p and η .
- e) Process, bleed-off and decay losses.
- f) MWD/T in feed, MWD per initial fissionable gram in spike.
- g) Initial conversion ratio.

- h) T, flux time of a cycle.
- i) Q, volume flux ratio of the zones.
- j) r, the Westcott spectral index which is determined by an iterative process for the spike cases.
- k) Specific heat generation ratios.
- l) Westcott cross sections if desired.

Experimental Reactor Design

General. No major scope changes were incorporated in the PRPR design during the month. Design for the Phase I bid package was completed during the month, and the bid package was transmitted to the AEC for comment on October 15. It is anticipated that the bid package will be approved by the AEC during the first week of November. The Phase I bid package includes the containment shell, a major portion of the structural concrete below the 0'-0" level, the storage basin and tunnel area, and certain essential services to the building.

Estimated design completion for the entire PRPR project is 18%. The scale model of the PRPR is estimated to be 95% complete.

A new compilation of engineering data was issued during the month.

Discussions were held with Canadian General Electric Engineers on process tube design, charge-discharge, and component testing programs.

Core Components. Two shroud tube bellows have been received by MEDO for testing. The appearance of these bellows is marred by a poor joint between the stainless steel bellows section and the aluminum end rings. It appears that the stainless steel was coated with a silver brazing alloy and brazed to the aluminum end rings with a second alloy. The entire assembly will be tested to determine its operating characteristics.

Process Tubes and Reactor Piping. Process tube, nozzle, and jumper fittings are being modified by MEDO for thermal cycling tests in November. Inlet bellows cycling tests were completed and judged satisfactory for reactor use. The expected completion date for seal testing is April 1958.

Design of the jumper piping by CEO has begun. As anticipated, it will be necessary to add some expansion bends in the jumper piping to accommodate thermal expansion of the ring headers, process tubes, and jumpers. Revision to the outlet lines will be minor, but inlet lines will require more extensive rearrangement.

Shutdown Cooling. Shutdown cooling requirements were analyzed and cost estimates were developed as an aid to comparing several alternative proposals. System requirements were based upon reactor heat dissipation beyond 15 minutes following shutdown, maximum bulk coolant temperature below 140 F, and minimum coolant flow of 10 gpm in any process tube. Of the proposals considered, the installation of extra windings and associated switchgear to provide for the operation of two primary pumps (with one spare) at one-third speed appears to be the most economical arrangement for shutdown cooling. An alternate proposal would require the installation of two 1200 gpm shutdown cooling pumps, with extra piping, fittings, and with increased D₂O holdup.

Estimated additional costs of equipping the primary pumps for two-speed operation is \$15,100. The installation of two auxiliary shutdown pumps, by comparison, would cost an estimated \$40,700.

Flow Capacity of Vented Process Tubes. The coolant flow capacity of PRPR process tubes, vented by removal of nozzle caps (during fuel handling operations), was calculated to be in excess of 50 gpm per tube without overflow. Calculations were based on: (1) center process tube, (2) shutdown cooling conditions (140 F coolant exit temperature), (3) full outlet jumper with expansion loop, and (4) gutter flow in the outlet ring header.

This flow rate exceeds by a factor of more than 15 the average tube coolant flow required to remove reactor heat after 15 minutes following shutdown.

D₂O Storage. A review of heavy water holdup requirements during normal reactor operation was undertaken to determine the operating reserve available in the moderator storage tank. With the present system design and operating philosophy, a minimum operating reserve of 884 gallons, with a probable maximum of 970 gallons, will be contained in the storage tank.

Control and Safety Systems. A purchase requisition for design and fabrication of the PRPR shim control assemblies was submitted. Purchasing responsibility for these assemblies has been assumed by the AEC, since General Electric Company's APED has expressed a desire to bid. The design and fabrication contract on the shim control assemblies will include furnishing prototype models for testing. Negotiations for subsequent fabrication of the control assemblies will be made following completion of the testing phase.

Instrumentation. A study has been undertaken to determine the groupings of instrumentation and valve and motor controls which would be advantageous from an operating standpoint. Some conflict exists among the design criteria as regards location of these controls and duplication of certain controls in different portions of the building. A prime objective of the study is the resolution of these differences by providing the most workable combinations of controls.

Charge-Discharge System. Purchasing arrangements for the charge-discharge equipment have been assumed by the AEC, since General Electric Company's APED has expressed a desire to bid.

The design criteria description of fuel element cooling provisions is not sufficiently complete to insure an adequate design. Previous cooling calculations show that it will be necessary to channel flow past the fuel element surface and perhaps provide greater air flow. Means of doing this without interfering with other fueling vehicle functions are being evaluated.

Shielding. The availability of chilled iron shot in larger sizes than at first believed possible has been established. Sizes approaching 1/4 inch in diameter are available. Corrosion resistance tests for the various types of shot are being requested.

Use of Organics in PRPR. The preliminary rough draft feasibility report completed in September is being followed by a more detailed study that is now in progress.

PRPR Power Supply. A report on the alternate methods of supplying power to the PRPR is being written and will probably be issued in November.

Reactor Physics

Improved Cell Flux Approximation. A generalized diffusion approximation is being constructed to yield more reliable cell flux values than those obtained from P_1 and Richards approximations. The integral transport equation (assuming one-velocity neutrons, isotropic scattering, and constant total mean free path) is replaced by a finite order differential equation. This results from an approximation of the transformed kernel in the form of a rational polynomial expression.

Neutron Spectra and Effective Cross Sections. A Savannah River IBM 650 program for calculating neutron energy spectra in light or heavy water has been requested to facilitate effective reactor cross section studies. This code provides for the numerical solution of the Wigner-Wilkins equation, modified to include velocity dependent hydrogen scattering and reactor absorption cross sections.

Work on the Wilkins equation for heavy moderators is being continued. Evaluation of boundary conditions to provide initial conditions for the analog computer solution is now under way.

Economic Analyses

Preliminary flowcharts of the fuel economics program have been formulated and a coding for the IBM 650 is under way. The main object of the code is to permit determination of fuel compositions, exposures, etc., that minimize the total fuel costs. A sub-routine for the IBM 650 program has been developed to determine the direct burnout charge. This sub-routine includes equations to calculate the value of the in-reactor inventory at various enrichments dependent on elapsed flux-time. The loss of weight of the fuel elements passing through the reactor is insignificant and will be ignored in the program. However, the decay of Pu-241 during the processing of the fuel elements will be accounted for. Separations costs will be prorated to U and Pu according to their relative value.

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATIONMONTHLY REPORTOCTOBER 1957FISSIONABLE MATERIALS - 2000 PROGRAMMETALLURGYNuclear Safety, Critical Mass Consultations

- a. Discussions were held with F.P.D. personnel presenting the basis for nuclear safety specifications of shipping, storage, and handling 0.94 percent enriched uranium fuels. There is great economic advantage to increasing the allowable masses per shipment.
- b. Savings could be made in the reprocessing of canned reject fuel elements of 0.94 percent enrichment if the allowable number of slugs in the pickling tank could be increased. For economic operations, it is also required that the same pickling solution be used for a number of days. This procedure involves a system in which the fuel elements are both moderated and reflected by uranium solutions of the same U-235 enrichment. A study is being made of the relationship between the calculated reduction in reactivity due to U-238 in solution between fuel elements and the increased reactivity resulting from the better reflector savings which are achieved with a uranium solution rather than water. The P₃ program for the IBM-650 is being used to calculate the thermal utilization for such systems. The other reactivity parameters will also be calculated in order to completely specify the system.

REACTORSTUDIES RELATED TO PRESENT PRODUCTION PILESDry 7-1/2" Lattice Temperature Coefficient

Initial measurements of the temperature coefficient of the PCTR with oven and test core in place gave 0.12 cents/°C independent of the condition of the central test cell. This positive core temperature coefficient was about 40 times larger than that expected from the central test cell and is believed due to the change in poisoning power of the oven and heating elements with temperature of the neutrons. This large effect will make difficult the determination of the change due to the central cell which is the quantity required to determine the temperature coefficient of the test lattice.

Neutron Energy Spectrum in a Medium with a Temperature Discontinuity

An CMNICODE program for the numerical computation of the flux (as a function of energy and position) from the analytical results previously obtained has been assembled and is ready for testing. A preliminary program to compute a set of associated functions was assembled; testing is now in progress.

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In consultation with Dr. John Powell, consideration has been given to an alternative method for solving the partial differential equation involved in this problem. The method, which uses a set of difference equations on a network of discrete points, has been shown to converge and appears to be suitable for machine computation. This scheme can handle an arbitrary temperature distribution in the moderator, and thus is more general than the analytical method, which is restricted to a pure step function.

Lattice Neutron Temperature Study

A heat barrier is being installed between the thermal column oven and the TTR reflector. A final flux traverse will be made before power is applied to the oven. All other traverses in the cold oven have been completed.

STUDIES RELATED TO FUTURE PRODUCTION PILES

Lattice Measurements with 1.66" Fuel Elements

The buckling for the 5-3/16" lattice with 1.66" fuel elements and MIPB coolant is $-253 \times 10^{-6} \text{ cm}^{-2}$. The counting data taken with air coolant, when appropriately plotted, do not give a straight line, but show considerable curvature, the origin and effects of which are being considered. The buckling appears to be between -500 and $-600 \times 10^{-6} \text{ cm}^{-2}$. The RaBe source in this low buckling pile may be responsible for the observed curvature by contributing a larger than usual source correction. Horizontal flux traverse measurements are being made in this stack to determine its effective size more precisely.

Lattice Studies with 7-Rod Cluster of 0.926" Fuel Elements

The intermediate sized pile with a 7" lattice spacing to contain 7-rod clusters of 0.926" O.D. fuel elements has been constructed. Measurements in this pile and its neighbor, with an 8-3/8" spacing, will begin shortly.

Fast Effect Calculations

The ratio of the total-to-thermal fissions that occur in a fuel element, is dependent upon the probability that a fission neutron will undergo a collision before it escapes into the moderator. The thermal neutron distribution obtained from diffusion theory has been used in the past for the source distribution for fission neutrons. Knowing that diffusion theory does not accurately describe the neutron distribution within a fuel element, a study is being carried out to determine the magnitude of the error resulting from its use. It is hoped that by incorporating the transport theory expressions for the neutron distribution in the calculation of first flight probabilities, the resulting values of fast effect will be in better agreement with experimental values than can be presently obtained.

An analysis of the magnitude of the error involved in the experimental procedure and results is also nearing completion.

The effect of temperature change on fast effect has been studied, and even though a portion of this effect is dependent upon the first flight probabilities, the total effect will probably be small.

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Reactor Lattice Parameter Theory Survey

An investigation has been undertaken to study the basic theoretical foundations of certain reactor lattice parameters. A fundamental investigation of η , ϵ , p , f , L^2 , τ , M^2 , and k has been started. A more detailed analysis has been undertaken concerning the interdependence of the factors in the four factor formula.

At present the relationship between p and f is being examined. There appears to be some disagreement as to the basic formulations of these parameters and their interdependence. The discrepancy seems to be in determining which part of the spectrum should be considered in formulating the definitions for thermal utilization and resonance escape probability. For work involving the actual calculation of these two factors the energy dependence or independence of f plays an important part. One formulation of p makes f energy dependent. These energy relationships determine to some extent the ease of calculation of p .

Instrumentation

Development continued on the circuitry for the experimental Cross-Correlation Detector. The mechanical switch, a 60-cycle synchronous chopper, was modified to eliminate some undesirable effects, and the laboratory-type pulse generators were replaced by other circuitry.

STUDIES RELATED TO SEPARATIONS PLANTS

Buckling Measurement for Fuel Elements in Random Array

To investigate the possibility of using enriched uranium in the present dissolver, the first buckling measurements were taken for a random array of fuel elements as might exist in a dissolver. The fuel elements were 0.925" in diameter and 4" in length; the H_2O/U volume ratio for these elements, when dropped at random into a tank, was 0.87. The previous buckling measurements for these fuel elements in a uniform array did not extend below a H_2O/U volume ratio of 1.37. The uncertainty in extrapolating the data for the uniform distribution from an H_2O/U ratio of 1.37 to 0.87 is rather large; the measured buckling for the random distribution of these fuel elements appears to be within this uncertainty. In the H_2O/U region of 0.87, the buckling is a rapidly changing function of the H_2O/U ratio. Consequently, variations in the H_2O/U volume ratio, which result from variations in the randomness of the fuel element distribution within the tank, cause large errors in the measured bucklings. Measurements are planned for these fuel elements in a uniform array at an H_2O/U ratio of 0.87.

The water-to-uranium volume ratio has been measured for 1.66" O.D., 0.94" I.D. fuel elements in a random distribution in a tank; these fuel elements were 4" in length. The H_2O/U ratio was 1.65 which is near the volume ratio at which these 1 percent enriched fuel elements have the maximum buckling when in a uniform array.

The water-to-uranium volume ratio was also measured for a 1.44 percent enriched I and E canned fuel element; the canned fuel element was 8.6" in length with an O.D. of 1.47" and an I.D. of 0.37". The measured volume ratio was 2.15. The maximum buckling for these fuel elements positioned in uniform array occurs at a H_2O/U ratio of about 1.8.

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Upon completion of the buckling measurements with the 0.925" fuel elements in a random array, similar type measurements will be taken for the I and E fuel elements.

Results of Criticality Experiment for Enriched Homogeneous Mixtures of UO_3 and H_2O

The data analysis has been completed for the determination of k_{∞} for enriched homogeneous mixtures of UO_3 and H_2O . The results are summarized in the following table:

k_{∞} of Homogeneous Mixtures of Enriched Uranyl Oxide and Water

<u>Percent Enrichment</u>	<u>H/U Ratio</u>	<u>k_{∞}</u>
1.010	6.23	0.986 ± 0.006
1.003	6.95	0.974 ± 0.006
1.006	7.52	0.961 ± 0.006
1.072	5.84	1.005 ± 0.006
1.070	7.14	0.993 ± 0.006
1.155	5.99	1.031 ± 0.005
1.159	6.90	1.030 ± 0.006
1.157	7.52	1.018 ± 0.005

These data indicate the maximum k_{∞} to occur at smaller H/U ratios than those used in the experiments. At this time the maximum enrichment, for which all mixtures of UO_3 and H_2O will have a $k_{\infty} < 1$, is estimated to be at about 1.03 percent; the measurements are being extended to include an H/U ratio of 4 in order to determine this enrichment value more precisely.

Nuclear Safety, Critical Mass Consultation

234-5 Building Nuclear Safety

- A new machining hood design is being made for the machining of model Pit 65. Criteria for the safe storage of plutonium metal castings within the machining hood have been given.
- Nuclear safety requirements in the design of the cooling block facilities for 4 model Pit 65 units and their central plugs have been established.
- A new off-gas filter system for the continuous hydrofluorinator in the continuous Task I - Task II operation is required. A safe design and location for such a filter has been determined.
- The filters in the process ventilating system have been picking up appreciable quantities of plutonium. Estimated minimum critical masses for these systems have been determined. This is required to fix the need for a new ventilating filter system as well as the necessity for periodically cleaning the plutonium from the present facilities.

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Redox Operation

A review of Redox Processing specifications for critical mass control has been completed; these specifications are being circulated for the required signatures.

Purex Operation

The new L-cell package for the Purex plant has been inspected and the positioning of catwalks throughout the package to insure nuclear safety as well as to facilitate contact maintenance operations has been determined.

E-Metal Dissolvers

The nuclear safety of processing E-metal in the present dissolvers has been reviewed. Previous safe mass limits for the dissolvers were based on a water reflected sphere. It is not likely that the uranium, when dropped at random into the dissolver, could stack in such a manner as to form a sphere; in any other geometry, it will take a larger quantity of uranium to obtain criticality. The critical mass has been estimated for a water moderated and reflected hemisphere at enrichments of 0.98 percent and 1.007 percent for several different fuel element types. If it can be assured that the fuel elements will not stack in an array more reactive than a hemisphere (both a square cylinder and a cube would be more reactive) then it would be possible to increase the batch limit for the E-metal in the present dissolvers by about 40 percent over that for a water reflected sphere.

Neutron Age Measurement

A preliminary analysis of the first run of the monoenergetic age measurement has been completed. This analysis gave a value of 13.9 cm^2 for the age to indium resonance of 1.0 Mev neutrons. This compares with a rough theoretical estimate of 15 cm^2 . The observed flux distribution was considerably different from that anticipated on the basis of measurements with Ra-Be sources. Several modifications have been made to the experimental procedure for the future measurements based on the results of this preliminary run.

Mass Spectrometer for Plutonium Analyses

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

REACTOR DEVELOPMENT - 4000 PROGRAM

STUDIES RELATED TO THE PLUTONIUM RECYCLE PROGRAM

k_{∞} Values for 19-Rod Cluster of UO_2 and Pu-Al Fuel Rods

Final values for k_{∞} and f for the 8" D_2O lattice with a mixture of 16 UO_2 and 3 Pu-Al rods are listed below. It is suggested that f for the 7" lattice with D_2O coolant should be 0.899, rather than 0.905 as previously reported, from the fact that this case alone (out of 4) shows an increase of f upon loss of coolant.

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	$\frac{V_{mod}}{V_{UO_2}}$	$\frac{V_{coolant}}{V_{mod}}$	$\frac{V_{Al}}{V_{UO_2}}$	$\frac{V_{Pu-Al}}{V_{UO_2}}$	f	k_{∞}
Air	14.023		1.192	.1875	.904	1.117
D ₂ O	14.023	0.093	1.192	.1875	.898	1.112

Pu composition - 239, 93.6 wt. %; 240, 5.9%; 241, 0.46%. Zr-2 clad on PuAl - 0.030".

Nuclear Safety in Fabricating Plutonium Containing Fuel Rods

The plutonium alloy fabrication requirements for a plutonium fabrication facility have been reviewed. Design criteria for the safe handling of plutonium metal, plutonium-aluminum alloys, plutonium oxides, as well as mixtures of plutonium-uranium oxides have been given to serve as the basis for starting the preliminary design of such a facility.

Theoretical PCTR Studies

The thermal neutron flux at any point in an infinite moderating medium with a thermal line source of neutrons near a cylindrical cavity has been derived.

Power Coefficient for 19-Rod UO₂ Cluster

The fuel temperature coefficient of k_{∞} for 19-rod clusters of UO₂ in an 8" D₂O lattice with air coolant has been analyzed far enough to give a preliminary value of $\frac{1}{k_{\infty}} \frac{dk_{\infty}}{dT} = -2.4 \pm 0.3 \times 10^{-5}/^{\circ}\text{C}$ over the temperature range of $\sim 26^{\circ}\text{C}$

to 310°C . The error has not been precisely determined and represents our present guess as to its magnitude.

Instrumentation

An investigation of possible methods of PRPR slug rupture detection indicates that gamma detection of each tube sample with a G-M detector has advantages over other methods. Investigations of commercially available G-M tubes will indicate the feasibility of this type of system. A commercial readout system of a type manufactured by Beckman is presently being considered for data presentation.

Analog Computing

The mock-up to be used in the study of the gas and water dynamics for PRPR was inspected. A program to help evaluate the results and to use the information obtained in simulation studies has been started.

The power decay curve was run for assistance in the design of the fly-wheel necessary to assure sufficient cooling of the fuel elements after shutdown.

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CROSS SECTION PROGRAMU-235 Low Energy Cross Sections

Data has been received from ANL on fast chopper measured fission and total cross sections of U-235 in the thermal energy region. These data confirm the shapes of these cross section variations previously measured on the HLO crystal spectrometer. The precision of the agreement is about ± 0.5 percent deviation over the energy range 0.03 ev. to 0.1 - 0.15 ev for both cross sections. This result virtually eliminates the possibility that the low value obtained for the 2200 m/s fission cross section of U-235 was based on an incorrect shape of the cross section variation.

U-235 Ternary Fission

An experiment has been performed to determine if the ratio of ternary to binary fission would be a sensitive indicator of the fission mode through the low energy resonances. Measurements on the crystal spectrometer have determined that the ratio is a constant to a very good precision over the energy region up to about 10 ev. Measurements were made of the total fission rate from a thin U-235 fission foil and the ternary fission rate from the long range (about 18 Mev) alpha particles emitted through an aluminum filter from a thick U-235 foil. The results of these measurements are tabulated below:

<u>Energy Region</u>	<u>Ternary/Binary Fission Ratio</u>	<u>Statistical Precision</u>
0.04 - 0.4 ev (monoenergetic)	1.00 (ave.)	$\pm 1.5\%$ (max. deviation)
0.6 - 0.7 ev "	1.03 (ave.)	$\pm 3\%$ (std. deviation)
1.1 ev (poor resolution)	0.98	$\pm 3\%$ " "
8.7 ev (poor resolution)	0.97	$\pm 11\%$ " "
0.4 - 10 ev (Cd filter - Boron filter)	1.02	$\pm 2\%$ " "
0.4 - (Cd filter)	1.13	$\pm 2\%$ " "

Low Energy Fission - Pu Isotopes

Measurements have begun to determine the fission cross sections of Pu-239 and Pu-241 for cold neutrons (0.005 ev) using the liquid nitrogen cooled beryllium filtered beam of the crystal spectrometer.

Time-of-Flight Equipment

Work has progressed on the Van de Graaff beam sweeping oscillator to obtain a higher voltage (about 10 kv) and to produce time mark pulses for the chronotron.

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Subthreshold Fission Measurements

Attempts by Physical Metallurgy to electrodeposit Np-237 foils for fission measurements have proved unsuccessful and the problem has been given to Analytical Laboratories Operation.

Three Crystal Spectrometer

CEO Project Engineering has issued a Field Release to start construction installation of the three crystal diffraction spectrometer at KE. Completion is scheduled for April 1, 1958.

TEST REACTOR OPERATION

There were no unscheduled shutdowns during the month. Operation was for the temperature reactivity experiment using natural uranium in the test region. All equipment performed satisfactorily and a temperature of 400° C was reached. Heating of the reactor outside the core was limited to about 2° C. One full week of three-shift operation was scheduled and several extra shifts were also required.

A new resistance thermometer for measurement of the reactor temperature outside the core was installed although calibration was not complete. This will be finished after the present series of experiments is completed. Measurement of temperature changes can be made to less than 0.01 C. A new safety circuit period amplifier was installed in Channel 2. The original was revised to operate as a spare on either Channel 2 or Channel 5.

The project proposal for the addition to the 305-B Building has been forwarded by the Commission to Washington, D. C.

There was one unscheduled TTR scram caused by instrument malfunction. Operation was primarily for flux measurements in the thermal column. One sample of aluminum adhesive was checked for reactivity effect.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

One field experiment designed to measure the ground-level distribution of concentration in an unstable atmosphere and with an elevated source was completed. Successful measurements were made to a distance of one-half mile from the source but a wide variation in wind direction prevented a complete description of the concentration pattern.

Final installation of high-speed instruments on the Portable Mast was completed and one field experiment was completed. During this experiment the "background" of natural dust during a period of light winds was measured. These data were required for future measurements during periods of erosive wind speeds.

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A one-hundred foot length of high-vacuum hose was acquired and ten millipore filter assemblies were placed along the length of the hose. Flow rates through each filter were measured to determine uniformity of air sampling. These flow rates were found to be uniform. This assembly was designed as a basic sampling unit for measuring the vertical distribution of concentration downwind from a ground source under light wind conditions - the "worst" case in the reactor hazards problem. Calculations were also completed to check the feasibility of measuring deposition rates by determining the differential flux of tracer materials through sequential vertical cross-wind planes. The proposed experimental facility appeared to be entirely adequate for this purpose.

Preparations for preliminary measurements of the distribution of contaminant materials originating in the 100 Areas and traveling across the Wahluke Slope were completed. These experiments are to be undertaken as soon as favorable winds occur.

DOSIMETRY

The large plastic scintillator was used to measure gamma radiation levels on the Columbia River from White Bluffs to above the reactor areas. The results were promising; they indicated some changes in equipment and procedure were desirable. The equipment was slightly damaged when the wake of a passing tugboat caused the boat to roll badly. The equipment changes were made. A new box was made for the scintillator that should eliminate damage from rolling and that is small enough to fit in the patrol airplane.

Several more rocks, sands, and slags were tested for radioactivity; all were high. Large samples were obtained of the talc, soapstone, and olivine that were previously tested and found low. The low radioactivity of the talc and soapstone was confirmed; the olivine had a trace of radioactivity. A shield (made of talc or soapstone) for a four-foot cube low background facility would weigh twice as much as a shield made of lead but would cost one tenth as much. Plans were prepared for such a rock shielded facility.

A mineral oil light pipe was made for the plutonium coincidence counter. The purpose was to see if the background with the lucite light pipe was due to Cerenkov radiation or to weak scintillations in the lucite. Apparently they were due to Cerenkov radiation. This may make their elimination impossible.

The discrepancy in the calibration of the electron Van de Graaff calorimeter by different methods was found to be due to the time it takes for the calorimeter to come to temperature equilibrium. Thermistors in different parts of the calorimeter gave different results depending on where the heat was introduced. Putting the thermistors in parallel reduced the difference considerably. The zero drifts of the calorimeter were reduced to less than 10^{-4} of the signals to be used in the experiment by placing massive aluminum heat shields around it. The bellows for coupling the calorimeter vacuum jacket directly to the Van de Graaff was completed and is being vacuum tested.

A study group concerned with the stopping powers used in cavity chamber dosimetry was organized for the National Committee on Radiation Protection and Measurement, Subcommittee M-2-3. Members of the group are F. H. Attix (ACF Industries), W. Gross (Columbia Univ.), W. C. Roesch (General Electric - HAP0), chairman, and G. N. Whyte (National Research Council of Canada). The group

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will prepare a report which will be the basis for NCRPM recommendations to the International Commission on Radiological Units and Measurement in 1959.

The Van de Graaff accelerator operated satisfactorily during the month. Wiring of the background suppressors was completed and installation of their water lines is continuing.

The relative sensitivity of a long counter for 16.7-Mev neutrons was measured. $T(d,n)O^0$ and $T(p,n)O^0$ neutrons from the same target were used. Neutron emissions were normalized with known cross sections and measurements of integrated beam current. The efficiency at 16.7 Mev is 70% of the efficiency for 1-Mev neutrons.

Assistance was given groups making use of the moderated neutron dosimeter. Calibrations Operation is preparing to replace the Neut with these instruments. Two groups are concerned with reducing neutron exposures in the 234-5 building.

The vernier chronotron system is about ready to be installed in the Van de Graaff building. A method for establishing zero time markers must be worked out yet.

The operation of the chamber for the proton w measurements was improved by adding a Frisch grid. This doubled the pulse height from the chamber and reduced the electron transit time.

INSTRUMENTATION

The Transistorized Scintillation Alpha Hand Counter is still waiting for one small commercial component. Using an alternate component, the instrument was tested for about two months with no malfunctioning.

The final printed circuit for the standardization of portable instruments was designed and tested, thus completing the necessary group of such plug-in printed circuits. This particular circuit is being incorporated in two Fast Neutron Scintillation Exposure-Rate Meters now being fabricated.

Evaluation and "debugging" of the Scintillation Dose-Rate Meters was carried further to eliminate a nonlinearity of the least sensitive range (0-5 R/hr). This effect is due to phototube saturation.

A portable instrument subminiaturized single-channel pulse-height analyzer circuit has been developed and is being tested. The circuit, all battery-operated, uses mostly transistors and corresponds in operation to a standard a-c-operated pulse-height analyzer. The device will cover the gamma energy spectrum over the range from 100 Kev to 2.0 Mev with a minimum window width of about 30 Kev. Preliminary tests have shown good results on the Cs^{137} (661 Kev) photopeak. The instrument is expected to be useful in field survey work where it is desirable to know the energies of the incident gamma rays. A completed prototype instrument will weigh approximately seven pounds and will include the high voltage supply, amplifier, pulse-height analyzer and count-rate meter circuits.

Design work is continuing on the central station equipment for the Radio-telemetry project. The readout devices are being tested and modified to accept the data properly. The relay portions of the central station equip-

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ment for the coding and sequence timing are being tested.

Testing is continuing on the zinc sulfide particle detector for the Atmospheric Physics Operation. Various activator source strengths of Pu and Am electro-deposited on mesh are being tried to obtain optimum results with as small a source as possible.

An interesting phenomenon concerning the direct-impacting dust particle detector is being investigated. Dust particles, pulled through a critical orifice, can be impacted directly on the glass face of a phototube with resultant voltage pulses appearing at the phototube anode of sufficient magnitude for analyzation. No phosphor coating is needed. The output pulse heights seem to be related to particle size, and definite pulse height distributions have been observed using the 20-channel analyzer.

One method of proximity detection for the robot monitoring project has been tested in some phases. This method uses a 22 KCS ultrasonic signal and appropriate transducers.

The recording of pulse height information on inexpensive tape recorder is still being investigated with various circuits designed for pulse stretching while retaining necessary relative pulse information.

Acceptance tests were finished on 30 Scintillation Portable Poppies (for alpha) built to our design. Acceptance tests were continued on 5,000 pocket dosimeters and on 22 CP-TP high range extended-probe ionization chamber-type portable instruments. Several lectures were given on field methods and instruments for personnel survey.

WASHINGTON DESIGNATED PROGRAMS

Mass Spectrometer Construction

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

CUSTOMER WORK

Analog Computing

As a result of the discussions held with the Goodyear Aircraft Corporation service, sales and engineering personnel, the following program was established to assure satisfactory computer operations:

The warranty on the Hanford A-14 has been extended for 6 months.
The warranty was to expire January 7, 1958.

All service for Hanford's computer will now be performed by a West Coast representative. He will be available at all times and will make monthly visits to Hanford.

Goodyear agrees to make all new A-14 computer modifications, that improve reliability and performance, on the Hanford unit for the period of the warranty.

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To improve maintenance procedures Goodyear Aircraft would like Hanford to send the Engineering Assistant of the computer group to Akron, Ohio, for a 2-week period to observe the check-out of a production A-14 computer.

An attempt was made to solve the set of partial differential equations describing a changing buckling condition on the rabbit reactor. The attempt was unsuccessful and new techniques for the solution of a partial differential equation on the analog computer are being tried.

Weather Forecasting and Meteorology Service

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	93	85.6
24-Hour General	62	80.9
Special	142	92.3

Continuing assistance was provided the Industrial Hygiene Operation in the monitoring of acid fumes and mists in the vicinity of the 313 Bldg.

Nearly 6,500 calls were answered by the telephone giving recorded forecasts in the five-week period ending November 3.

Summary of the Weather

October was cold and wet with temperatures averaging 2.5 degrees below normal and with precipitation totaling 2.72 inches. The precipitation total was more than four times the monthly normal and was the greatest October amount in 45 years of record for the Hanford area. More than 70% of this occurred on the 1st and 2nd when 2-hour and 24-hour totals amounted, respectively, to 0.88 inch and 1.91 inches. Both were new 12-year records for rainfall intensity at the station. Snow on the evening of the 22nd was the first measurable amount ever recorded in the Hanford area during October.

Optical Service

A Leeds and Northrup Optical Pyrometer was fitted with a suitable filter combination to permit its use in conjunction with a standard optical pyrometer in the determination of color temperatures and emissivities. A study is also being made of the feasibility of using a three-color technique to get even more accurate results. At the moment it appears that no increase in accuracy will result.

A visit was made to 105-F to discuss the problem of providing periscopes for use in the sighting holes now being cut in the shield wall on the rear of the reactor. Portable periscopes similar to those which are used in the 100-DR Area were recommended, and an estimate for fabricating them was obtained.

A limited study was completed to determine a simpler method for relamping the silo area at the Redox Building. Two methods employing light pipes and which reduce radiation exposure to the personnel changing the lamps were suggested.

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A final design of a periscope to be used in remotely positioning the reactor charging machine was worked out. The device is now being fabricated.

The assembly and testing of the Underwater Borescope continued and was essentially completed.

The routine optical shop work included the fabrication of 25 glass bearings, a magnifying glass viewer, the Underwater Borescope optical components, and 80% of a borescope head section. Two Redox crane periscope heads, a projection comparator, two 100-DR portable periscopes and a borescope were serviced. Other work included the preparing of four mica strips for calibrating an ultrasonic bond tester, the collimating of two pairs of binoculars, the boring of a glass pipe to increase the bore size, and the preparing of twenty lithium targets for the positive ion accelerator.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

PF Gast:mcs

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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
Ron Merritt	10/1	Ron Merritt Co. Seattle, Wash.	Demonstrate instrument.	IT Myers LV Zuerner	No	300: 329
JG Simmons	10/8-11	Goodyear Aircraft Corp. Long Beach, Calif.	Service Analog Computer.	AE Tucker	No	300: 326
CD Morrill	10/10-11	St. Louis, Mo.				
J Herrel	10/10-11	Los Angeles, Calif.				
CA Nelson	10/22	Director, Division of Inspection AEC, Washington, DC	Inspection of Facilities.	JJ Fuquay	Yes	200-W: 622
EB Johnson	10/22	Div. Inspector AEC, Washington, DC	Inspection of Facilities.	JJ Fuquay	Yes	200-W: 622
WB Ray ST Stephenson	10/23	Wash. State College Pullman, Wash.	Discuss IT Myer's thesis project.	IT Myers LV Zuerner	No	300: 329
Lewis Hyde	10/24	American Optical Co. South Bridge, Mass.	Demonstrate Periscope.	BB Brenden	No	300: 3708
JL Powell	10/28	University of Oregon Eugene, Oregon	Consultant.	JE Faulkner	Yes	300: 326
Geo. Tames	10/28	New York Times New York, N. Y.	Photographer	HL Henry	No	300: 305-B
LB Larson	10/30	U. S. Weather Bureau Walla Walla, Wash.	Confer on meteorological observation and weather forecast problems.	JJ Fuquay DE Jenne	No	200-W: 622

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VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company Visited and Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
WC Roesch	10/14	NYOO-AEC New York City, N.Y.	Visit classified sites.	Leonard Solon	Yes
	10/15-16	US Naval Res. Labs. AEC Wash. Div. of Military Application Washington, D. C.	Project Tutor	AD Starbird	Yes
	10/17	National Bureau of Standards, Washington, DC	Study Neutron Dosime- try Program.	RS Caswell HO Wyckoff	No
	10/19	NCRPM Stopping Power Study Group Columbia University Washington, D. C.	Attend Meeting of NCRPM Subcommittee M-2-3.	GN Whyte FH Attix W Gross	No
GE Driver	10/24-26	Kansas State College Kansas City, Mo.	Present talk to students.	--	No
HE Handler	10/24-26	Oak Ridge National Lab. Oak Ridge, Tenn.	To discuss critical mass experiments.	AD Callihan	Yes
N Ketzlach	10/24-25	Knolls Atomic Power Lab. Schenectady, N. Y.	Discuss methods of calc. nuclear safety.	RT Frost	Yes
	10/31	McGraw-Hill Publishing Schenectady, N. Y.	Meet with Editor of Engineering Books.	Kenneth Zeigler	No
PF Gast	10/24-25	Oak Ridge National Lab. Oak Ridge, Tenn.	Review Reactor Physics Program.	AM Weinberg	Yes
	10/28	New York, N. Y.	Attend ANS Meeting.	--	No
	10/29	Hartford, Conn.	Attend Atmospheric Pollution Conference.	--	No

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VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company Visited and Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
PF Gast	10/30-31	New York, N. Y.	AEC Reactor Physics Planning Group Meeting.	--	No
JL Carter	10/25	Brookhaven National Lab. Upton, New York	Discuss theoretical reactor physics.	JB Sampson	No
JL Carter HE Handler N Ketzlach	10/28-31	American Nuclear Society New York, N. Y.	Present paper.	--	No
GR Hilst	10/28-29	Travelers Insurance Co. Hartford, Conn.	Meeting of American Meteorological Society.	TF Malone	No
	10/31	Air Force Cambridge Research Center Boston, Mass.	Discuss diffusion data.	ML Barad	No
	11/1	University of Chicago Chicago, Ill.	Discuss meteorological data.	HR Byers	No

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Chemical Research and Development

ORGANIZATION AND PERSONNEL

G. B. Barton, Scientist, transferred from San Jose, Calif., and was assigned to Chemical Research.

R. W. Stromatt, Engineer, was hired and assigned to Chemical Research.

R. E. Ewing, Chemist, transferred from Chemical Effluents Technology to Chemical Processing Department.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Analytical Services

Infra-red absorption is used to measure percentages of m-terphenyl, o-terphenyl, and biphenyl. Biphenyl is now being measured at 9.48μ where m- and o- do not interfere.

For the first time, isotopic compositions were obtained for reactor raw (river) water, treated water, and filtered water. Measurements were made for 100-F reactor at a time when Turco 4306-B was used for rear-face header decontamination at 100-H reactor (up-stream from 100-F). The data were needed to show whether Turco would remove contamination in 100-F filter beds. P-32 and As-76 concentrations in treated filtered water were only one-tenth those of river water. Cu-64 was about half that of the river water.

Wet chemical separations have been recalled for Cr-51, Np-239, and As-76 in KER (high pressure and temperature) pile cooling water. Gamma spectrometry fails because their energy peaks are obliterated by higher gamma energies. Mn-56 (0.8 Mev), for example, is several-fold more concentrated than in unpressurized aqueous pile coolant.

Automatic Analyzing Monitor

Rework of a small room in 146-FR Building, 100-F Area, was completed and the monitor installed. After re-assembly, the instrument showed no serious malfunction. The background of the beta proportional counter was three times that experienced in the 300 Area. Additional shielding may be required to achieve the necessary sensitivity for the P32 measurement. Resolution losses of the Streeter-Amet printer were found to be considerably higher than anticipated, hence a higher scaling factor will be required to reduce the input pulse rate. The monitor was operated using 107-F effluent water during testing.

An exhibit was proposed and described for the Geneva Conference in 1958. The analyzing monitor would be demonstrated at this conference, should the exhibit be accepted.

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Process Assistance

Waste disposal aspects of cleaning rear face piping at 105-H Area on September 23, 1957, were reviewed. The purposes of this test were to determine if Turco-4306-B could be used for improving contamination and exposure rate conditions in reactor discharge areas and to investigate possible problems arising from the disposal of the reagent. The tentative conclusion has been made that release of the spent cleaning solution caused no significant change in river conditions. It appears feasible to use similar quantities of Turco 4306-B for this purpose without elaborate monitoring or restrictions. A more detailed study of the analytical results from the test is in progress. The data and its interpretation will be documented in the near future.

Of the four proposals submitted for comments by the Irradiation Processing Department for altering the reactor cooling water disposal facilities, the direct line system was considered the best. Consequently, it was recommended that it be considered for the FY-1960 construction budget. The main advantage of this system is that it essentially eliminates the release of contamination along the shoreline. However, in order to minimize the river contamination an adequate by-pass system must be provided for off-standard effluent. This could probably be done by using present basins and cribs for accepting batches of off-standard wastes such as ruptured slug effluents. The nearly empty basins would have over two hours of effluent capacity. After a settling period the contents of the basin would be sent to the crib for disposal.

SEPARATIONS PROCESSES

Purex Phase II Flowsheet

The effects of backcycling anion exchange wastes which contain traces of the products formed by chemical degradation of the anion exchange resin have been examined further. Feeds for these tests were prepared by digesting 7.2 molar nitric acid solution with Dowex-1 anion exchange resin. Digestion of the nitric acid solution with the resin for ten minutes (simulating steady state operation of the continuous ion exchange equipment) increased the disengaging time for this solution against 30 percent TBP by 20 to 40 percent. Fission product decontamination was not altered on digesting the nitric acid solution with resin for 16 hours, although results reported last month indicated that fission product decontamination was reduced by a factor of about ten on exposure of the resin to 7.2 molar nitric acid for 70 hours at 60 C.

Ten-fold dilutions (in 2 M HNO_3) of the synthetic 7.2 M HNO_3 wastes resulting from ten minute and 16 hour exposures to the resin at 60 C produced, respectively, no change and a two-fold increase in disengaging time against 30 percent TBP.

In view of the dilution which the anion exchange waste receives in the phase II backcycle operation, it appears extremely unlikely that steady state backcycle of anion exchange wastes on the phase II flowsheet will alter fission product behavior in the HA column or will alter phase disengaging characteristics sufficiently to change pulse column performance.

Anion Exchange Process

Dowex 1, X-4 (50 to 100 mesh) anion exchange resin was found to be severely damaged upon standing in contact with static 7 M HNO_3 at elevated temperature. After a

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contact time of 14 days at 60 C the resin had swelled and become so gelatinous that it was not usable. The solution in contact with this resin was found to contain large quantities of nitrite. In order to avoid this nitrite buildup the static experiment was repeated with sulfamic acid added, and a column experiment was set up in which fresh nitric acid flowed through the resin at elevated temperature. The flowing system was adjusted so that the acid had a 10 to 15 minute residence time in contact with the resin. Neither the resin in contact with the flowing 7 M HNO_3 nor the resin in contact with the static 7 M HNO_3 containing sulfamic acid show any physical damage after 21 days at 60 C.

Metal Dissolution

Slug Distribution in an Annular Dissolver. One test charging of the full-scale mock-up of the proposed Redox annular dissolver was made during the month. The dissolver mock-up used is described in last month's report (HW-52859-C). The slug chute was modified so as to elevate the slug bucket tripping mechanism by seven feet. The higher tripping mechanism would provide better visibility when dumping slugs into the plant dissolvers. For this test charging, the slug chute incline supported a tapered triangular deflector one foot high at the lower end.

Dummy slugs (steel bars 1-1/2 inches in diameter and 8.9 inches long) were charged from standard slug buckets, each containing 236 stacked slugs. The first bucket was dumped slowly, and all subsequent dumps were made by dropping the bucket after it was engaged in the chute tripping mechanism. No difficulties were encountered during the test charging, and, as shown below, results were similar to those obtained previously:

Charge Number	Approx. No. of Slugs Charged	Max. Slug Depth, In.	Avg. Slug Depth, In.	Percent Void Vol.	Ht. of Tripping Mechanism Top of Incline
2(1)	1430	60	43.2	56.5	10-1/2 in.
4	1430	57	41.5	54.3	7 ft. 9-1/2 in.

Note: (1) Reported last month and shown here for comparison.
The chute used also had the deflector on the incline.

Solvent Extraction

Purex 1C Column. Studies directed toward development of a cartridge for the Purex 1C Column to provide increased capacity under Phase II flowsheet (HW-47889) were continued.

Nine additional cartridges were tested in a nine-foot-high, 3-inch-diameter glass pulse column. Phase II flowsheet conditions, with aqueous phase continuous and a 0.5-inch pulse amplitude were used for all runs.

Results of the first ten cartridges tested were reported last month in HW-52859 C. The latest cartridge configurations tested include:

Cartridge No. 11: One linear polyethylene sieve plate (0.1875-inch-hole

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diameter, 33 percent free area) at bottom, followed by four stainless steel sieve plates (0.125-inch-hole diameter, 23 percent free area); remainder of cartridge composed of one plastic plate alternated with six steel plates; two-inch spacing.

Cartridge No. 12: One linear polyethylene sieve plate (0.1875-inch-hole diameter, 33 percent free area) at bottom of cartridge, followed by two stainless steel sieve plates (0.080-inch-hole diameter, 21 percent free area); remainder of cartridge composed of single polyethylene plates alternated with five stainless steel plates; two-inch spacing.

Cartridge No. 13: Upper two feet composed of 20 stainless steel sieve plates (0.125-inch-hole diameter, 23 percent free area); remainder of cartridge composed of single polyethylene sieve plates (0.1875-inch-hole diameter, 33 percent free area) alternated with seven steel plates; one-inch spacing.

Cartridge No. 14: Ten stainless steel sieve plates (0.125-inch hole diameter, 23 percent free area) at bottom of cartridge followed by a single polyethylene plastic sieve plate (0.1875-inch hole diameter, 33 percent free area) and ten additional steel plates; remainder of cartridge composed of single plastic plates alternated with 20 steel plates; one-inch spacing.

Cartridge No. 15: Five stainless steel nozzle plates (0.1875-inch-hole diameter, 23 percent free area) alternated with single polyethylene sieve plates (0.1875-inch-hole diameter, 23 percent free area); four-inch spacing.

Cartridge No. 16: Stainless steel nozzle plates (0.1875-inch-nozzle diameter, 23 percent free area) on one-inch spacing.

Cartridge No. 17: Lower 3-ft section: Nine stainless steel sieve plates (0.1875-inch-hole diameter; 23 percent free area) on four-inch spacing. Middle 3-foot section: alternate single stainless steel sieve plates and polyethylene sieve plates (0.1875-inch-hole diameter, 23 percent free area) on two-inch spacing. Upper 3-foot section: twelve stainless steel sieve plates on two-inch spacing.

Cartridge No. 18: Lower 3-ft. section: Ten stainless steel sieve plates (0.1875-inch-hole diameter, 23 percent free area) on four-inch spacing. Middle 3-foot section: Same plates on three-inch spacing. Upper 3-ft section: Same plates on two-inch spacing.

Cartridge No. 19: Composed of 28 stainless steel sieve plates (0.1875-inch hole diameter, 23 percent free area) and 8 polyethylene sieve plates (0.1875-inch hole diameter, 23 percent free area) arranged as follows:

Plates 1 bottom through 3 on 4-inch spacing.
Plates 3 bottom through 7 on 3-1/2 inch spacing.
Plates 7 bottom through 14 on 3-inch spacing.
Plates 14 bottom through 24 on 2-1/2 inch spacing.
Plates 24 bottom through 36 on 2-inch spacing.
Plates 4, 11, 17, 22, 26, 30, 33, 35 are plastic.

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Capacity findings are summarized below:

Cartridge No.	Flooding VV ⁽¹⁾ at 60 cycles/min	Flooding Frequency (cycles/min)	
		VV = 670 ⁽¹⁾	VV = 1173 ⁽¹⁾
11		> 110	
12		> 110	
13	1257	100 ± 5	80 ± 5
14	1173	105 ± 5	60
15		130 ± 5	
16	1173	110 ± 5	80 ± 5
17	1340	110 ± 5	90 ± 5
18	1424	120 ± 5	100 ± 5
19	1675	110 ± 5	

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.

Operation of all cartridges, except number 18, was characterized by the absence of a color line (indicative of efficient operation) at frequencies below flooding minus 5 cycles/min. With cartridge 18, color lines were observed at frequencies 20 cycles/min. below flooding.

To date, various configurations of nozzle plates, sieve plates, graded cartridges, and mixed plate cartridges have been tested in an effort to produce a cartridge giving satisfactory operation at a Purex Plant capacity factor of 4. When sufficient capacity is achieved, the flooding frequencies at low capacities are above the range of the plant pulse generators (110 cycles/min) and poor efficiency is evidenced at frequencies in plant range. It, therefore, appears that flowsheet modifications should be incorporated into the test program.

Plastic Plate Geometry

The program to evaluate the wetting characteristics of plastic plates continued. Studies were carried out in a 3-foot-high, 3-inch-diameter glass pulse column through which an aqueous phase containing 7 g./l. uranium and 126 g./l. nitric acid and an organic phase containing 55 g./l. uranium and 13 g./l. nitric acid were recirculated. The following ranges of variables were tested to determine their effect on the coalescence produced by linear polyethylene sieve plates on one-inch spacing in a mixed cartridge:

Interface position: Top and bottom
Pulse amplitude: 0.3 to 1.2 inches
Aqueous to organic flow ratio: 0.2 to 0.6
Volume velocity: 420 to 840 gal./hr./sq. ft.
Plate free area: 10 to 40 percent
Plate hole size: 0.05 to 0.25 inch.

The following general observations were made:

1. At a volume velocity of 420 gal./hr./sq.ft., a pulse amplitude of 0.6 inch, and an A/O of 0.2, plate geometry had very little influence on

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- capacity (less than 10 cycles/min. difference in flooding frequency).
2. Under conditions as in 1, little difference in coalescence was observed from 23 to 40 percent free area, with hole sizes of 0.125 and 0.188 inch diameter. Lower free area and/or smaller hole size markedly impaired coalescence.
 3. At volume velocities of 420 and 840 gal./hr./sq.ft., 33 percent free area, 0.188-inch-diameter hole plastic plates, and constant amplitude changes in A/O between 0.2 and 0.6 had essentially no effect on either capacity or coalescence.
 4. Under conditions as in 3, except constant A/O, an increase in amplitude reduced flooding frequency as expected. Coalescence was decreased slightly at 0.3-inch amplitude, optimum at 0.6-inch amplitude, and markedly poorer at 0.9-inch amplitude.

Plastic Coated Sieve Plates

As reported last month (HW-52859-C), stainless steel sieve plates coated with linear, polyethylene failed to exhibit coalescing properties similar to solid plastic plates. A "Surfindicator" used to measure the surface finish showed that the solid plates had a finish of 30 microinches (20-60 microinch range) while the coated plates had an 80 microinch finish (50-250 microinch range). To improve the surface finish, two plates coated with Super Dylan applied as a dispersion coating, were lapped on an oil stone. The holes were drilled to the metal hole dimension. The treatment actually roughened the finish to 120 microinches; but did improve the coalescing properties, although it was still not equal to that of solid plates.

A second set of plates, coated with Super Dylan by the Whirlclad process, was pressed between Teflon sheets at the melting point of polyethylene (135 C). The surface finish was improved to 22 microinches. After drilling the holes to the metal hole dimension, coalescence resulted which was identical to that obtained with solid plates.

Spiral Cartridges

If a spiral or "auger" is inserted into a pulse column and sieve plates are placed horizontally along the spiral, the effective counter-current contact length is increased. Thus, increased efficiency per unit column height should result. To investigate spiral pulse column operability, spirals with a pitch (distance between the vanes) of 3 and 6 inches were fabricated and tested under Purex A-Type column conditions in a 3-inch-diameter column. Under extraction conditions with the aqueous phase continuous, the complete flooding frequencies obtained with the spiral column were generally lower than obtained with a standard cartridge. However, the unstable operating range was small, and the operable pulse frequencies were essentially equal to those of the standard cartridge. Preliminary efficiency results indicate appreciably lower waste losses with the spiral column. A-type column scrub section capacity tests yielded the following results:

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Spiral Column Capacity Tests

Flowsheet: Purex A-type scrub section
 Interface position: Top
 Cartridge Height: 3 feet
 Sieve Plates: 1/8-inch-diameter holes, 23 percent free area,
 2-inch spacing

<u>Amplitude-Frequency Product, In./Min.</u>	<u>Max. Flooding Vol. Vel., Gal./Hr./Sq.Ft.</u>	
	<u>Standard Cartridge</u>	<u>Spiral Cartridge</u>
35	700	600 (1)
60	400	200 (1)
30	650	540 (2)
40	580	320 (2)

Notes: (1) Spiral pitch = 6 in.
 (2) Spiral pitch = 3 in.

In this case, capacity appears to be lower for the spiral cartridge than for the standard cartridge.

Continuous CalcinationLongitudinal Blade Spacing

The 321 Building 16-inch diameter by 8-foot long continuous calciner was operated to determine the effect of increased longitudinal agitator blade clearance at the feed points.

The study consisted of three separate runs, each differing only by the blade-free spacing around the feed points of 2 (normal operation), 4, and 6 inches, respectively. Feed point and discharge temperatures of 260 C and 300 C, agitator speed of 66 rpm, and production rate of approximately 150 lb UO₃/hr were maintained throughout the study. At the end of each run, the top of the calciner was removed and observations made of the agitator, shell, and feed points. Findings include:

- (a) No caking or build-up on the shell or agitator was observed throughout the study.
- (b) Product particle size and appearance were uniform for all runs.
- (c) A 3-inch-diameter chalk-like build-up at each feed point was observed after running at 4-inch spacing.
- (d) A 5-inch-diameter chalk-like build-up at two feed points was observed after the run having 6-inch spacing.
- (e) The agitator drive power requirements did not differ for any runs.
- (f) It was possible to achieve equivalent heat input for all runs. However, with the 4-inch and particularly the 6-inch spacing hot spots

developed on the shell in the feed point zone, and a large amount of heat input control was required.

Paddle Arms Design

A hinged-arm agitator paddle and arm assembly (SK-2-43236) has been fabricated and installed in the 224UA, H-Cell calciner for in-plant testing. The design was developed when analysis showed the need for strengthening the arms. The swinging feature was incorporated to protect the calciner shell when unusual loads are applied. The design was adapted to existing hubs giving an added measure of flexibility.

Consultations held with Electric Steel Foundry Company personnel disclosed that the cast version of the hinged-arm agitator will be less costly than the one-piece design currently used. A fabricated assembly design (SK-2-43238) based on the cast design, proposed by Electric Steel, was prepared to allow fabrication of replacement assemblies in HAPO shops until cast assemblies are available.

234-5 Processes

Porous Carbon Off-Gas Filter

An assembly, intended as a possible replacement for the present 234-5 Task II off-gas filter, was fabricated. The filter element consisted of a porous carbon element 4.5-inches O.D. by 2-1/8-inches I.D. by 6-inches long having a porosity of 60 microns. To test methods of cake removal, a cake of uranium tetrafluoride was built up by drawing dispersed UF_4 in dry, heated air through the unit. The cake collected quite evenly to an average thickness of 0.03 inch. At this point, the pressure drop across the filter element was 20 inches of water. The cake was completely removed by vacuum reversal. Other tests using a vibrator for cake removal are planned.

Mechanical Processing Assistance

At the request of Final Products Technology development activities aimed at improving the performance of mechanical equipment in the powder system of the continuous Task I and II process have been undertaken. A one-inch diameter Hastelloy C - fluorothene rotary feed valve was designed and fabricated for testing. A 1-5/8-inch inside diameter Teflon bellows (Resistoflex Corp. corrugated Teflon tubing) was procured and offered for consideration as a replacement for the metal bellows that have failed in service. Four seamless monel bellows were purchased but were not recommended because they do not offer the flexibility required for reasonable life.

WASTE TREATMENT, FISSION PRODUCT RECOVERY

Silver Iodide Exchange Reactor Development

The rate of exchange of iodine from a gas phase with iodine contained in solid AgI appears to be about the same as the rate of reaction of gaseous iodine with metallic silver under comparable conditions of gas temperature, flow rate, iodine concentration and solid surface. Experimentally, the rate of uptake of I-131-traced gaseous iodine on thin layers of silver metal and silver iodide was measured. Surfaces having the same geometry and the same quantity of silver

deposited over the surface, as silver metal in one case and AgI in the other, were exposed to a stream of air (at 300 C, atmospheric pressure) containing 2×10^{-4} atmospheres of I-131-traced I_2 . The rates of build-up of activity on the two surfaces were nearly equal.

Submerged Combustion

The equipment has been operated through a total of 17 runs. The variables studied include:

- (1) Boil up rate.
- (2) Percent freeboard.
- (3) Foaming.
- (4) Vapor velocity effects on wire mesh deentrainment performance.
- (5) Steam and water atomizing spray for entrainment removal.
- (6) Percent excess air to the burner.

Indications are that the particles entrained in the vapor stream range in size from 0.01 to 1 micron. The amount of excess air to the burner was the only variable studied that significantly affected the decontamination. These results suggest that gas temperature may affect the amount of entrainment. Verification of this will be sought.

Simulated Purex Underground Waste

A "cold" 200 liter batch of Purex underground waste was prepared in a 55-gallon drum. The molarities of the various components added were:

Na ⁺	9
Fe ⁺⁺⁺	0.34
Al ⁺⁺⁺	0.21
NO ₃ ⁻	2.14
NO ₂ ⁻	3.6
CO ₃ ⁼	0.86
PO ₄ ⁼	0.05
SO ₄ ⁼	0.51
OH ⁻	2.04

The pH was 11.2 and the specific gravity at the boiling point (113 C.) was 1.42. An air lift recirculator fabricated from a 21-inch length of 2-inch pipe was installed in the drum.

Pertinent observations were:

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1. Although the recirculator moved the waste solution without difficulty, it did not prevent a hard sludge layer of ferric hydroxide from forming on the bottom of the drum. All of the ferric hydroxide was easily suspended by an agitator which directed the waste solution against the drum bottom.
2. Distributing the motive air through twenty-one, 1/16-inch-diameter holes or through one, 1/2-inch-diameter hole produced no significant change in the recirculation rate.
3. The waste was boiled down to a 13 M sodium concentration followed by a dilution to a 7 M sodium concentration. A series of samples were taken during the course of the dilution. At room temperature, all samples greater than 9.5 M sodium contained crystals in addition to the ferric hydroxide precipitate.
4. A sample 7.3 M in sodium, was taken immediately after the initial solution make-up. This initial sample had a deep brown ferric hydroxide precipitate which occupied 29 percent of the sample volume. By contrast, the 7 M sample taken during the above-mentioned dilution had a rust-colored precipitate that occupied 39 percent of the sample volume.

Cesium Isolation and Packaging

The evaluation of processes to convert an aqueous slurry of cesium zinc ferrocyanide into cesium chloride has been completed. The following specific processes were intensively studied for the preparation of a comprehensive rating: (1) sodium tetraphenyl boron, (2) ion exchange, (3) hydrolysis, (4) calcination, (5) chlorination, (6) cesium volatilization, (7) sulfate dissolution, and (8) mercury dissolution.

Based upon the present knowledge of the chemical processing features, safety, mechanical equipment requirements, and relative reagent and processing costs, the hydrolysis process was selected as the most favorable, with the ion exchange process as the next favorable.

Special Geological Studies

Satisfactory progress continued on the CA-700 drilling project; about 1300 feet were drilled in October. One Geological Survey crew was terminated during October, the second will be terminated in November on completion of their portion of the CA-700 project.

All three drilling crews are working in the region west of 200 West Area to define the thickness of the aquifer above the basalt, hence a measure of the volumes of natural ground water entering the Hanford project, as compared to the volumes discharged to ground in the Separations areas. A well at coordinates N17,000 W93,000 was relocated to N20,000 W87,000 when basalt was encountered at about 35 feet.

Observation Wells

Samples of water from a monitoring well adjacent to the abandoned 216-S-1 & 2 cribs continued to show Sr⁹⁰ contamination with an average concentration of 1.0×10^{-6} uc/cc. No other monitoring wells were found to contain Sr⁹⁰, and

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none contained detectable Cs¹³⁷.

Samples from several wells located east and southeast of 200 West Area were found to contain trace concentrations of radioactive material. In each case the contamination was found in just one of two or more samples obtained from each of these wells during the month. Experience has shown that this behavior may indicate the gradual underground migration of radioactive material into the region, although more data will be needed to confirm the movement.

An old farm well located at the Benson Ranch site was cleaned out and renovated to permit the measurement of the water table level. The level was found to be 80 feet higher than that in a well about one mile to the northeast. This very significant difference in the water level suggests that the ground water reservoirs of the two locations are separated by an impermeable barrier that isolates one from the other. The water in the Benson Ranch well was found to have a temperature of 58.5° F., which is nearly 7° F cooler than that of wells located to the north and east, again tending to indicate separate water bodies. It is believed that the two ground water reservoirs are separated by the buried south-eastward extension of the Yakima Ridge. These new findings tend to indicate that the ridge is a continuous impermeable barrier. Thus, ground water contamination from the 200 Areas would have little opportunity to reach the sub-surface flow in Cold Creek Valley, and surface drainage from Rattlesnake Mountain would not influence the ground water flow under the northern and eastern portions of the plant.

Disposal to Ground

Additional tests were completed to evaluate the life of the crib receiving Purex tank condensate (216-A-8). The results of two soil column tests performed earlier had indicated the possibility of Sr⁹⁰ breakthrough after the passage of 7-9 column volumes. The latest results indicate that the crib may be able to receive somewhat more waste than was determined by the earlier data. Two soil column tests, using samples of A-8 waste obtained at different times during the summer, indicated breakthrough of Sr⁹⁰ at 19 and 31 column volumes respectively. These results are partially attributed to a somewhat lower strontium concentration than that in samples previously tested, but also display some of the statistical variability of this determination. The actual life of the A-8 crib is established by the integrated total of all wastes discharged to it and may be only approximated by the few point determinations it is possible to perform. The conservative interpretation of such data would be the acceptance of the minimum crib life determined.

Studies to improve laboratory techniques for evaluating wastes were directed primarily at the establishment of standard operating conditions for future soil column tests. The solution found to be most suitable for this work is a solution containing 1000 ppm Mg⁺⁺ and 0.1 ppm Sr⁺⁺ traced with Sr⁹⁰. Analytical data from initial investigations of the influence of temperature on soil column performance are not yet available, but qualitative results tend to indicate a somewhat more rapid breakthrough of Sr⁹⁰ at elevated temperatures. The two temperatures thus far investigated are 29° C and 58° C.

Three soil column experiments conducted to evaluate the beneficial influence of calcite and phosphate ion on the uptake of Sr⁹⁰ from A-8 wastes were completed. No positive evidence of breakthrough of Sr⁹⁰ from the "control" column was ob-

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tained, although greater than 25 column volumes of effluent were collected from the column. These columns were provided with a somewhat lower flow rate than that used in previous tests, which may account for the higher capacity for strontium removal exhibited.

Preliminary tests were conducted to investigate the use of I^{131} as a radioactive tracer for water movement. The tracer is to be used in laboratory models of ground disposal facilities to study the flow patterns beneath a crib. Tests are continuing to resolve some anomalies in the behavior of the iodine tracer in a soil-solution system.

The three batches of in-farm supernates (20, 21, and 22) that were scavenged this month contained Co^{60} below the recommended test disposal limit of 4×10^{-4} uc/cc. However, since batches 21 and 22 demonstrated poor cesium adsorption in soil column tests, they were disposed of to the 216-BC specific retention trenches. Batch 20, which met crib disposal criteria, was discharged to the 216-BC-6 crib.

Recommendations for locating an additional specific retention trench to accommodate approximately 2 million gallons of non-cribbable scavenged supernatant were forwarded to the Chemical Processing Department. The trench will be located in the BC Area. Adequate monitoring coverage will be provided by existing ground water wells in the area.

An analysis of the proposed plans to recycle a fraction of the Purex tank farm condensates to the #1 Purex acid concentrator was made. It was determined that the disadvantage of a slight increase of flow to the 216-A-5 crib was far outweighed by the over-all reduction of total fission products being disposed of to the ground by the Purex Operation. Based on present sample analyses the total curies discharged to the ground would drop from about 500 curies down to about 15 curies per month.

Gelling of Wastes - Field Work

Observation of the aluminosilicate gel in the test disposal pit east of the 300 Area revealed that the gel now occupies only 60% of the original volume. The moisture content of the gel (wet basis) has decreased from 78% to 74% over a 30-day period. The comparatively large decrease in gel volume is apparently due to a change in the physical nature of the gel rather than to moisture loss. The material in the lower half of the bed now has a pasty appearance while the material above it still retains the characteristic gel appearance.

Arrangements were made with Chemical Processing Department to obtain a one-half liter sample of coating waste supernatant from the 107-S storage tank which is currently receiving Redox coating waste. Radio and chemical analyses of this sample should produce results which are representative of separations plants coating waste. Sludge depth measurements will be taken in the tank to determine the amount of precipitate formed during storage. Radiation readings of the sample and radioanalysis results will be used to determine shielding requirements for a field disposal test of "hot" coating waste gel.

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ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Analytical Services

Nitrogen oxides in solidified nitric acid were measured. As the mixture came to room temperature the gases were trapped in 0.1 N sulfuric acid containing hydrogen peroxide. The peroxide oxidized the nitrogen oxides to nitrate which was determined colorimetrically with phenoldisulfonic acid.

Inactive ruthenium in nitric acid was measured by reducing to metal and weighing. Precipitation as RuS_2 was followed by hydrogen reduction.

Bromide interferes with ceric sulfate titration of uranium. Results are about 0.4% high because ceric slowly oxidizes bromide along with the uranium. Uranium was recently measured in nine Savannah River aluminum-uranium (5%) slugs. Other sites made the same analyses. Our results indicated a slight (L 0.5%) bias on the high side. The bias was caused by incompletely removing bromide. It came from bromine used (along with hydrochloric acid) to dissolve the slugs.

Bromine can still be used but it should be boiled off before Jones reduction. The boil-off can be done by oxidizing bromide to bromine with ceric itself. One could also dissolve the slug in mixed nitric and hydrochloric acids. Nitrate could be decomposed with formic acid.

ANALYTICAL DEVELOPMENT AND INSTRUMENTATION

Spectrographic Analysis

A mechano-optical system for spectrograph aligning has been devised for each of five Hanford spectrographs in order to simplify optical checking and re-alignment which is required every few months. Alignment instructions will be issued for each instrument.

Fission Counter Development

The development of an improved gas scintillation fission counter by using ultra-violet sensitive multiplier phototubes (RCA-6903) was completed. The ultra-violet sensitive phototubes can detect a gas scintillation in a pure rare gas without a wavelength shifter such as nitrogen (five percent nitrogen in argon was previously used). The principal incentive for this change was to permit the use of a pure gas instead of a mixture because the argon-nitrogen mixtures obtained from commercial sources have frequently been air contaminated and unusable.

An improved fission counter operating procedure was devised to simplify routine counting and guarantee the proper discriminator settings.

Controlled Potential Coulometry

A more versatile controlled potential coulometer has been built for the study of plutonium titrations. Controlled potential coulometry has been used to determine the plutonium content of solutions over a wide concentration range with a precision (95 percent confidence level) of from ± 0.1 percent to $\pm$ one

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percent on samples containing from 2 to 0.05 mg Pu, respectively. Plutonium metal samples are dissolved in hydrochloric acid, and a sufficient sample is taken to yield the best precision. The titration is carried out in a citrate buffer solution using a mercury pool electrode.

For the lower concentration levels of plutonium, such as those encountered in dissolver solutions, a nitric acid medium and platinum electrodes are preferred. A precision of about ± 0.25 percent and an accuracy of ± 0.5 percent have been demonstrated with synthetic dissolver solutions without fission products. Uranium does not interfere. Fission product interference is now being studied with full level dissolver solutions.

EQUIPMENT AND MATERIALS

Pumps

Johnston Splined Shaft No. 1. A deepwell turbine pump equipped with glass bearings has operated satisfactorily for 2320 hours pumping 100 percent UNH solution at the 224-U Building. This is the only splined shaft pump installed in the production plants. It will be operated to failure after which it will be dismantled for inspection.

Johnston Splined Shaft No. 2. A deepwell turbine pump equipped with graphite bearings was dismantled for inspection after 2135 hours operation. The pump has been pumping 60 percent nitric acid at 55 GPM against a 144 foot head. About 72 hours of the 2135 operating hours were dry operation (liquid level in the tank below the pump suction). The liquid throttle bushing which was protected by a conical slinger had worn 4.3 mils. On the other hand, the top bowl bearing had worn 7.6 mils and the column bearing had worn 5.2 mils diametrically. The 17-4 PH stainless steel journal surfaces had not worn significantly.

Considerable sand was found on ledges in the pump when it was disassembled. The wear and scoring of the bearings was undoubtedly accelerated by the sand. On the other hand, the journals performed exceptionally well considering that abrasive solids were in the solution pumped.

Pogostick No. 1. An air operated sampling pump was made inoperative when two of the three solenoid valves failed. The pump had operated about 14,000 hours (1.6 years) in continuous operation. One solenoid valve failed because of a rupture of a neoprene gasket and the coil burned out on the other solenoid.

Valves

HAPO Plug Valve. A modification of the valve originally designed by Process Design and Development (Dwg. H-2-3253) has operated smoothly on a 10-second cycle (5 on, 5 off) for about 69,000 cycles. Some leakage past the closed plug has been noted. The 17-4 PH stainless steel plug has been scored by the Teflon seat indicating that more compatible materials of construction should be sought.

Bearing - Journal Tests

The new bearing test machine has been operated to determine the wear characteristics of graphite bearing materials operating on stainless steel and titanium

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journals. In addition Linde flame plated aluminum oxide surfaces have been operated as a combination journal and bearing. The test specimens are nominally one inch in diameter by one inch long, operating at 1770 rpm submerged in tap water ranging from 20 to 30 C in temperature. The circumferential surface finishes of the journals have ranged from 3 to 7 microinches RMS.

Preliminary data indicate the following trends:

1. Graphite Bearings

- (a) CS-312 operating on 17-4 PH stainless steel wore approximately $3/4$ microinch per hour per pound of load in the load range from 15 to 60 pounds.
- (b) CSGBF operating on Type 347 stainless steel wore approximately 1 microinch per hour per pound of load in the load range from 15 to 60 pounds.
- (c) AP-80 operating on titanium wore approximately 5 microinches per hour per pound of load in the range from 7 to 30 pounds.

2. Flame Plated Aluminum Oxide (Linde process)

A pair of stainless steel bearing and journal surfaced with aluminum oxide showed less than $1/10$ microinch per hour wear in the load range from 15 to 60 pounds.

3. Sintered Aluminum Oxide Bearing

During one hour of operation a 17-4 PH stainless steel (Rockwell C-44) journal wore 0.011 inch at 15 pounds load while the bearing wore 0.009 inch.

CSGBF graphite was boiled in simulated Purex HAF solution for 120 hours. There was no appreciable change in dimension or weight. These results indicate that liquid throttle bushing failures in Purex Plant are not attributable to the solutions pumped.

Corrosion Studies

Pertinent to Processing of Zircaloy Clad Elements. During decladding of Zircaloy clad fuel elements with ammonium fluoride, a small amount of a metal uranium core is converted to uranium(IV) fluoride. Tests were made to determine the feasibility of dissolving the core plus adherent UF_4 with $HNO_3 - Al(NO_3)_3$ solutions in a stainless steel container. Corrosion rates for Types 347 and 316 stainless steels (sensitized for one hour at 1250 F) were determined. Solutions used simulated initial, mid-point, and end of dissolution conditions with fluoride concentration constant at 0.08 M and with Al/F mole ratios of 6.25, 1.25, and 0.75. Exposure times (at boiling) were 36 hours for initial, and 140 hours for mid- and end-point conditions. An Al/F mole ratio of about six appears necessary to hold corrosion of the two steels to ca. 1 mil/mo under the initial dissolution conditions while at the mid- and end-points, corrosion was < 1 mil/mo even at the minimum Al/F ratio used (0.75). Dissolution of the cores plus adherent UF_4 in stainless steel containers appears feasible from a

corrosion standpoint. The amount of aluminum required is less than necessary for salting in the Redox Process.

Type 304-L stainless steel (sensitized) corroded at an excessive rate (8 mils/mo with pitting) in 3 M NH_4F - 3 M HF. Interest in this solution derived from a desire for more rapid zirconium dissolving than is obtained with 4 M NH_4F . Corrosion rates of 304-L stainless steel in boiling 4 M NH_4F - 0.2 M NH_4NO_3 and 4 M NH_4F - 0.5 M NH_4NO_3 solutions were not measurably different than for 4 M NH_4F alone. Use of ammonium nitrate in ammonium fluoride solution is under consideration as a means for dissolving the tin in Zircaloy-2.

Commercial grade zirconium obtained from the Bureau of Standards and material from a single heat of Zircaloy-2 dissolved relatively rapidly (ca. 10 mils/hr.) in dilute aqua regia. Many other heats of zirconium and Zircaloy-2 tested in dilute aqua regia have shown erratic but generally low dissolution rates.

Preliminary test data indicate that Haynes 25 (a cobalt steel) is a satisfactory material of construction, from a corrosion standpoint, for decladding zirconium clad fuel elements under Zirflex (ammonium fluoride) conditions. These observations are of particular interest since BMI data indicate that the cobalt alloys, while not as corrosion resistant as titanium, may be satisfactory for Darex feed preparation equipment. Further work will be required to determine the corrosion resistance of Haynes 25 under core dissolution conditions (nitric acid).

Pertinent to Processing of Stainless Steel Clad Elements. Coupons of commercially pure titanium and tantalum were exposed to Darex dissolver solution (5 M HNO_3 - 2 M HCl) in sealed glass capsules at temperatures from 115 to 145 C. Time studies were made to assure equilibrium corrosion rates had been reached. No significant decomposition of the corrodant occurred during these tests. Equilibrium corrosion rates obtained were as follows:

Corrosion Rates, Mils/Mo, at Temperatures, C.

<u>Material</u>	<u>115</u>	<u>125</u>	<u>135</u>	<u>145</u>
Titanium	0.9	2.0	3.5	5.3
Tantalum	Nil*	Nil	Nil	Nil

* Showed slight weight gain or no weight loss.

The tantalum samples retained their original finish after exposures as high as 200 hours.

Studies are in progress to determine the corrosion of Carpenter 20 in dilute sulfuric acid as a function of temperature and acid concentration in order to assess its usefulness as a material of construction for Sulfex process (dissolution of stainless steel cladding by sulfuric acid) dissolvers. Carpenter 20 has shown excellent corrosion resistance during test exposures to typical Zirflex Process solutions (4 M NH_4F and 1 M $(\text{NH}_4)_2\text{ZrF}_6$). The objective is to find a material of construction adequately resistant to process conditions for decladding fuel elements clad with either zirconium or stainless steel.

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Pertinent to the Flurex Process. The Flurex process, as presently envisioned, requires concentration and recycle of a catholyte solution containing ca. 0.2 M UO_2F_2 , 1.0 M HF, 0.05 M NH_4F , and possibly small amounts of nitrate ion. Exposures (50-70 hours) of a series of alloys to boiling catholyte solution containing 0 M and 0.2 M HNO_3 produced corrosion rate data as follows:

<u>Material</u>	<u>Corrosion Rate, Mils/Mo</u>	
	<u>0.0 M HNO_3</u>	<u>0.2 M HNO_3</u>
Hastelloy B	29	22
Chlorimet 3	4.4	5.4
Haynes 25	1.4	1.7
309 SCb	1.1	19
Carpenter 20	5.4	28

Only the Haynes 25 exhibited a satisfactorily low corrosion rate with nitrate present. Further tests with this alloy at higher temperatures to simulate heat transfer surfaces are in progress.

Plant Assistance Problems. The second set of test coupons was removed from the Purex 101-A underground waste storage tank on October 24. Aside from some difficulty due to sticking lead radiation shield plugs, the removal was without incident. This set of samples was in the tank for about 21 months. Cleaning and examination of the coupons will be done by Radiometallurgy Operation.

Two samples of Type 347 Cb/Ta stainless steel tubing exhibited corrosion rates greater than 2 mils/mo under Huey test conditions. The attack appeared to be uniform over the samples and was not due to localized carburization.

In a study of the effect of $\text{Al}(\text{NO}_3)_3$ on the corrosion of stainless steel (304 L) by boiling 2 M HNO_3 - 1 M HF, it was found that an Al/F mole ratio of 1 was required to prevent severe attack. At this ratio, the corrosion rate was 3.2 mils/mo while at a ratio of 1/2 it was 226 mils/mo. These results are somewhat at variance with similar studies made at du Pont (DP-204) which showed satisfactory inhibition at a mole ratio of 1/3 in solutions held at 40 C. The difference may be due to greater dissociation of the aluminum-fluoride complex at the boiling point. These studies were made in connection with Recuplex dissolver conditions.

Protective Coatings

Carboline 2710. In September it was reported (HW-52859 C) that this material could not be applied on itself. The manufacturer's representative has reported that the catalyst shipped from their plant was faulty.

NEW PROCESSES

Dissolution of Zircaloy Clads in Ammonium Fluoride (The "Zirflex" Process)

In an effort to obtain information on the fate of plutonium in the "Zirflex" decladding operation, plutonium (IV) nitrate was spiked into 6 M NH_4F to a concentration of 0.08 g/l Pu. This solution was then boiled for 2.5 hours in contact with a wafer of metallic uranium. The hot solution which resulted from this operation contained 5.0 g/l U and 0.002 g/l Pu. On cooling to room temperature additional uranium precipitated so that the cooled solution contained only 1.9 g/l U and 0.00068 g/l Pu, indicating that more than 99 per-

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cent of the plutonium added had been scavenged by the uranium (IV) fluoride precipitate formed.

A portion of the green salt formed in this operation was digested with 5 M KOH for 30 minutes at 100 C and the solid then washed twice with 0.5 M KOH. Only 0.04 percent of the plutonium in the solid was lost to the alkaline solutions. Addition of nitric acid to the solid resulted in rapid dissolution of nearly all the solid although a small residue remained. The nitric acid solution contained 0.69 g U and 0.00069 g Pu. The fluoride/uranium ratio had been reduced by a factor of 500 by the treatment with potassium hydroxide. The nitric acid insoluble residue dissolved readily in hot nitric acid - aluminum nitrate solution and was found to contain 0.00033 g U and 0.00082 g Pu.

These results indicate that, at least for plutonium (IV), losses of plutonium to the ammonium fluoride decladding solution will be minor but that conversion of fluorides of Pu (IV) to fluoride-free nitric acid soluble forms will be more difficult than for U (IV).

Uranium-plutonium alloys have been prepared and it is expected that study of these will provide more accurate information on the behavior of plutonium in reactor fuels in the Zirflex decladding operation.

A sample of 1.5 percent plutonium-aluminum alloy was exposed to boiling 6 M NH_4F for six hours. The alloy reacted vigorously initially but the reaction subsided after a few minutes, presumably due to the formation of a protective white coating on the alloy. The supernatant solution also contained a suspended white solid. The supernatant solution contained 2.1 mg/l Pu after 15 minutes exposure but this decreased over the six hour digestion period, reaching a final value of ca. 1 mg/l Pu. The suspended white solid proved to be soluble in nitric acid but apparently contained no plutonium.

Applying the maximum solubility of 2.1 mg/l Pu observed to the decladding of a typical PRP plutonium-aluminum alloy fuel rod (1.5 w/o Pu-Al cylinder 9 feet long by 0.5 inches diameter clad in 0.030 inches Zircaloy-2 and capped with 0.5 inches end caps of Zircaloy-2) the plutonium loss to the decladding solution has been estimated at only 0.1 percent. Thus, it is believed that the Zirflex process can be applied to the decladding of plutonium-aluminum alloy PRP fuels.

Exploratory studies have been made of possible means of handling the tin in Zircaloy-2 in the Zirflex process. The tin in Zircaloy-2 apparently remains behind as a metallic residue on dissolving Zircaloy-2 in ammonium fluoride solution. On subsequent dissolution of core materials in nitric acid, however, the tin dissolves and reprecipitates, presumably as metastannic acid, and may be expected to scavenge a portion of the plutonium out of the feed solution. In an effort to avoid this, exploratory studies have been made to determine the feasibility of dissolving the tin along with the zirconium in the decladding step. Results of preliminary studies indicate that the tin can be dissolved at an appropriate rate by addition of ammonium nitrate to the ammonium fluoride decladding solution. The concentration of nitrate ion required to effect solution of the tin increases as the concentration of free fluoride decreases. Thus, on dissolution of Zircaloy-2 in a sufficient quantity of 6 M NH_4F to yield a terminal fluoride to zirconium ratio of ten, 0.2 M nitrate sufficed to dissolve the tin. When the quantity of 6 M NH_4F was reduced to

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yield a terminal fluoride to zirconium ratio of seven, 1.0 M nitrate was necessary to obtain an appropriate rate of dissolution of the tin.

The effect of nitrate ion on solubilizing uranium in ammonium fluoride is under study at the present time. Results of preliminary studies are encouraging. For example, exposure of uranium metal to boiling 6 M NH_4F , 0.5 M NH_4NO_3 for six hours resulted in dissolution of uranium to the extent of only 2 g U/liter.

Pyrochemical Processing Studies

A program has been initiated to devise and test pyrochemical processing methods applicable to Hanford fuels. The initial phase of this program will have for its goals the establishment of methods and techniques for studying the chemistry of the systems under consideration.

Currently, the use of anhydrous AlCl_3 as a solvent for UO_2 is being explored. The utility of the highly volatile AlCl_3 (sublimation temperature 180 C) as a solvent for UO_2 has been extended by reacting it with KCl to form a less volatile compound. The resulting material, possibly KAlCl_4 , melts at about 260 C and does not evolve observable volatiles at temperatures up to 770 C. Two grams of ground sintered UO_2 dissolved in a five fold excess of the reagent in two hours (final temperature 770 C), the alumina appearing as coarse crystalline Al_2O_3 of surprisingly large crystal size. The red melt (uranium-IV) solidified to a green solid readily soluble in water to form a green solution from which the alumina was easily filtered. A solution rate of about 6 mg/(min)(cm^2) was measured for massive sintered UO_2 in KAlCl_4 at 750 C in a single ten minute test.

Reprocessing of Propulsion and Power Reactor Fuels

A summary study of candidate processing techniques for HAPD processing of power reactor fuels is in preparation. The aim of this study is to document the requirements, economics, and applicability of various proposed processing techniques. A tabulation of required development effort, to fill in areas of missing or incomplete technology, is included. Priorities, for development studies, are evident by cost, and completion time estimates.

This study has suggested that the removal of chloride from Darex type feeds may be done economically by installing a solvent extraction cycle in U Plant. This would replace the expensive chloride stripping step. Laboratory study has been initiated.

Power and Propulsion Reactor Fuel Reprocessing

Work was undertaken to compare the economics of alternate processes and equipment assemblies for the facilities to be provided at 221-U Building for the interim chemical processing of power and propulsion reactor fuels. Although initially only dissolution and preliminary feed preparation of solutions for delivery to Redox was proposed, it may be preferable to separate plutonium at 221-U in order to minimize clean-up problems at Redox during the conduct of this program along with the regular commitments at this plant. These studies are being directed toward getting answers and information on such problems and involvements.

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Flurex Development

Flurex development work for this month has included primarily verification and extension of previously reported data defining expected cell performance under varying operating conditions. Further studies on the back-transference of sodium, ammonium, calcium, and hydrogen ions from the anolyte may be summarized as follows:

1. Calcium ion back-transfers at a significantly lower rate than monovalent ions (ca. 0.5 that for ammonium ion) at comparable concentration and anion membrane current density. The feasibility of using calcium nitrate as an anolyte is questionable since back-transferred calcium ultimately appears as an undesirable contaminant in the cell product.
2. A loss in current efficiency for uranium transfer due to back-transfer of ammonium ion ranging from 5 to 10 percent will occur if ammonium nitrate in concentrations up to 0.5 M is used as anolyte.
3. Sodium ion back-transfer is about equal to that for ammonium ion at comparable concentrations and anion membrane current density.
4. Hydrogen ion back-transfer rates are much higher than the rates (under comparable conditions) for the other ions tested. Loss of current efficiency for uranium transfer ranging from 30 to 50 percent will occur if nitric acid in concentrations up to 0.4 M is used as anolyte.
5. Back-transference of all of the ions studied decreases as temperature is increased and increases as anion membrane current density is increased.
6. Specially prepared anion exchange membrane samples containing, in one instance more, and in another less, resin per unit area than the stock membrane (3148) were obtained from Permutit. These were proposed by Permutit personnel as a possible means of varying permselectivity of the membrane. Tests of hydrogen ion back-transference showed no significant difference between these two membranes and the stock membrane.

A series of runs aimed at isolating the current loss for uranium transfer due to hydrogen ion in the feed solution is in progress. Calcium nitrate is used as anolyte to minimize back-transfer of cations from the anolyte. Current efficiency for an acid deficient (-0.30 M HNO_3) was about 95 percent. For near neutral feed (-0.02 M HNO_3) it was about 90 percent. Runs with acidic feeds are not yet complete.

Further study of the transfer of nitrate ion into and out of the cathode compartment and possible reduction of nitrate at the cathode indicate that reduction at the cathode does occur and that this reaction in combination with back-transfer of nitrate to the feed compartment will keep the equilibrium concentration of nitrate in the catholyte very low. However, experimental work on this problem is not complete and a reliable figure for nitrate concentration at equilibrium cannot now be given.

Changes in physical and electrochemical properties of membranes in use in operating cells for appreciable times corresponded in general to those observed when the membranes were exposed to process solutions without applied

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potential. These observations lend confidence to application of data obtained in the latter manner to prediction of the useful life of membranes in use.

UO₃ Studies

Because of the reported improvement in reaction characteristics of UO₃ produced by the pot calcination of UNH containing added ammonia, several runs were made in the laboratory scale unit to evaluate the effect of ammonia in the continuous calcination process. (See accompanying table.)

Experiments were performed to characterize the UO₃ products of these runs by thermobalance analyses of their reduction with hydrogen. In addition, denitration experiments were performed in the differential thermal analysis (DTA) apparatus to gain understanding of the role of ammonia as an activating agent. The following conclusions have been drawn from the brief studies made:

1. The presence of ammonia increased the denitration rate by perhaps as much as ten percent for an NH₄⁺/U weight ratio of 0.01 in the feed solution.
2. The denitration of the ammonia treated solution as studied by DTA is not greatly different from that of uranyl nitrate. Differential thermal analyses suggest that ammonia causes a decrease in the temperature required for rapid calcination. This effect may stem from partial conversion of the UNH to a basic salt which more readily undergoes decomposition. (British researchers have identified UO₂(NO₃)_{1.5}(OH)_{0.5} as a metastable intermediate in the calcination of UNH.)
3. With 2500 ppm sulfur present, ammonia had little effect on the reduction kinetics of UO₃. In the absence of sulfur the reduction rate was markedly reduced apparently in accordance with the reduction in surface area.
4. The off-gas from the calciner did not constitute an explosion hazard. Hydrogen content was about 0.9 volume percent on a water and nitric oxide-free basis. In operation the hydrogen content is estimated at about 0.3 percent, well under the explosion limit of four percent for dry air which is highly conservative for a system containing water and nitric oxide.
5. Essentially no ammonium ion (less than 0.01 percent) remains in the UO₃ after calcination.
6. Calcination of the ammonium nitrate formed by the addition of ammonia does not significantly affect the heat of reaction of the calcination process.

PROCESS CONTROL DEVELOPMENT

Magnetic Flowmeter

A program for testing and evaluating magnetic flowmeters is underway. A reliable flowmeter of the 0-0.5 gal./min. range for use in continuous calciner feed system is needed. To date, attempts to operate a modified Foxboro 0-10 gal./min. meter in the 0-0.5 gal./min. range have not proved satisfactory.

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EFFECT OF ADDED AMMONIA IN CONTINUOUS CALCINATION PROCESS

Run No.	Feed Composition		Production (a)		Properties of Powder			
	NH ₄ ⁺ /U Wt. %	H ₂ O/U Mole Ratio	Rate Lb./Hr.	Sulfur PPM (b)	Reactivity Ratio (c)	Surface Area m ² /g	Time (Sec) for 97% Reduction	
							As Produced	200 Mesh
B-1	0	6.4	4.6	2520	0.70 - 0.87	0.89	965	730
A-3	0.87	5.1	5.1	2510	0.89	0.77	1205	735
A-2	1.93	7.5	5.5	1950	0.87	0.91	1505	1030
A-4	1.98	7.6	5.5	0	0.92	0.27	(d)	2300

- (a) Corrected to a feed H₂O/U ratio of 6.
- (b) Sulfur content of feed in first three runs 2500 ppm U.
- (c) Reduction at 925 C, hydrofluorination at 600 C.
- (d) Reduced only 15 percent in 2000 seconds.

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Absorptometers

The Recuplex CCP, thulium-170 sourced, absorptometer was restored to service by minor adjustments of the instrument's electronic components. The instrument had been out of service for several months as the thulium source had decayed below the minimum intensity for which the monitor had been designed. The adjustments were temporary in nature and are intended only to extend the usable life of the absorptometer until such time as the existing thulium source can be replaced. Operations personnel expect a replacement thulium source to be received early next month.

The calibration of the Purex XCP, americium-241 sourced, absorptometer has continued. Due to the lucite construction of the calibration sample cell, the preliminary calibration data were found to be in error. A second steel sample cell was fabricated and has produced data closely conforming to theoretical calculations. Calibration of this instrument by means of a facsimile cell is necessary as the actual sample cell is installed in the ion exchange hood and is unavailable for calibration work. The low source intensity, revealed during the calibration work, has resulted in modifications to the ionization chamber detector and to the source holder. Modifications to the sample cell may prove to be necessary to further increase the signal strength if the gamma activity of the sample proves to contribute a significant portion of the total signal from the detector.

Redox F-1 pH Prototype

All solenoid valves on F-1 (IAFS) pH monitor buffer and rinse line have been replaced with manually operated valves, in order to improve the reliability of the system. This necessitates manual bufferings but assures a more reliable standardization. When the valves were replaced, the sampling system was also cleaned out. The monitor has now operated continually for a period of 48 or more hours without being shut down because of the plugged sample jet. The electrodes are stable and do not appear to be flow sensitive.

Assistance to Project CG-686

The installation of the sampling equipment for the six gamma monitors scheduled for the first phase of CG-686 at Redox is complete. The electronic equipment for these monitors will be delivered during the first week of November to be installed in the silo operating gallery.

A problem has come up with the device for remotely indicating sample flow. A recent change in the measuring circuit, by the manufacturer, has made the instrument inoperable with more than 250 feet of cable. (Two installations will require 310 feet of cable.) Tests now underway in the laboratory indicate that the sensitivity may be increased by rather minor circuit modifications as well as changing the indicating float from 300 series to a 400 series stainless steel.

Assistance to the Pu Resin Column Controls

Instrumentation for the resin column is undergoing checkout procedures during the cold runs. The C column conductivity system alternately operates the XCP and XSW streams as required by the flowsheet. The speed of response of the

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conductivity probes has been slow due to the screen protecting the electrodes from the resin. Laboratory tests are underway to evaluate conductivity measurements in direct contact with the resin. If such measurements are reliable, the response time of the system will be reduced by eliminating the screens. The other instrumentation will be checked out during November in preparation for the December 1, 1957 hot startup date.

TRANSURANUM AND FISSION PRODUCT RECOVERY

Neptunium Recovery

Vanadium (V) has been reported by workers at Savannah River to be a potentially valuable reagent for oxidizing neptunium to the hexavalent oxidation state in order to insure its co-extraction with uranium and plutonium in the first column of the Purex process. Experiments were accordingly undertaken to evaluate this reaction for possible application to the Hanford HA Purex column.

The following table shows the effect of vanadium concentration on neptunium extraction employing carbonate washed laboratory solvent.

Effect of Vanadium (V) on Extraction of Neptunium (VI)

Aqueous: 2 M HNO_3 , tracer Np-239 in the plusfive oxidation state, indicated NaVO_3 . Organic: 30 percent TBP - Shell E-2342, carbonate washed. Equal volume, five minute contactings. Room temperature.

<u>M NaVO_3</u>	<u>Np E_a^0</u>
0	0.05
0.025	5.7
0.05	9.1
0.10	9.8

For comparison, values of 0.02 and 12 were obtained for neptunium (V) and neptunium (VI) distribution ratios, respectively, in earlier work. It would appear that 0.05 to 0.10 M sodium meta-vanadate oxidized most of the neptunium to the plus six oxidation state in five minutes.

Laboratory experiments performed to investigate the effect of stirring time indicate that the oxidation reaction is complete in five minutes or less.

Several experiments were also run with second cycle plant solvent to determine whether degradation products or reducing impurities normally present in this material would limit the application of vanadium oxidation or require excessive concentrations of reagent. Nearly complete oxidation of neptunium (V) to neptunium (VI) in five minutes was found possible with 0.0075 M V (V), indicating little, if any, interference by second cycle plant solvent.

The first numbers from the new plant sampling program have been obtained. The object of this series is to better define the path of neptunium in the Purex process and to determine the effect of Phase II changes on this routing. Samples taken on September 22 indicated that essentially all of the neptunium

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followed uranium and plutonium through the first cycle to the LAF. Eighteen percent was lost to the LAW and 13 percent to the LBP. Of the neptunium reaching the 2D column, about 37 percent split into the waste (desired routing) and the rest went into the uranium product.

It was suggested earlier that the gassing difficulty experienced when plant 2DW is evaporated, given a Savannah River type "heat kill" treatment, and passed through a Dowex-1, X-4 anion resin column may be caused by traces of solvent degradation products formed during boil-down. This was tested by spiking Shell E-2342 into a synthetic feed followed by boil-down, etc. No gassing was observed.

Cesium Recovery and Waste Treatment

A study was completed of the characteristics of the hydrous metal oxide cake which is produced when a Purex LWV type waste is neutralized as a first step in cesium recovery. A report, "The Precipitation of Iron, Uranium, and Aluminum with Sodium Hydroxide and Gaseous Ammonia," HW-53367, H. H. Van Tuyl, was issued summarizing the results. Briefly, it was found that high temperature digestion and slow neutralization with gaseous ammonia resulted in the most compact and most easily filterable precipitate. This technique will be employed in the liter scale, multicurie cell flowsheet tests.

A survey was made of the chemical problems associated with the "ultimate disposal" of Purex wastes. Topics considered included volume reduction, denitration, calcination, the effect of fission product recovery on ultimate disposal, and potential recovery of waste uranium and plutonium. The conclusions and recommendations for an experimental program are included in a report, "Ultimate Disposal of Purex Wastes," HW-52824, H. H. Van Tuyl.

Cerium Recovery

Cerium may be recovered with the other rare earths, strontium, cesium, etc., as one of the products from the "Integral" fission product recovery flowsheet. In event there were a demand for sizeable quantities of cerium alone, however, a simple process for the direct recovery of this fission product would be desirable. Such a process was reported recently. This involved oxidation of the cerium with persulfate followed by precipitation with iodate. The precipitate was then dissolved in nitric acid and the cerium re-precipitated as the oxalate for further purification. Excellent results were obtained in experiments with synthetic solutions traced with a small spike of plant LWV. Due to analytical difficulties indistinguishing between cerium and rare earths, subsequent experiments aimed at optimizing the conditions were traced with cerium-144. The results were much inferior to those initially reported, and further work has been necessary to elucidate the reasons for this behavior.

It has been shown that the fission product stand-ins (inert ruthenium, zirconium, niobium, strontium, cesium, neodymium, and yttrium) were largely responsible for the efficient cerium carrying. In particular, the neodymium chloride was responsible for most of this effect. Thus, only two percent of the cerium was precipitated with iodate when cerium only was present. This increased to four percent with the other fission products, except for neodymium, and to 86 percent when neodymium chloride was present. Neodymium nitrate gave about 40 percent cerium recovery. It is believed that an insoluble neodymium

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iodate is responsible for part of the carrying and silver chloride (from the silver used as oxidation catalyst) for the rest. Seventy-nine percent cerium recovery was observed when ozone oxidation was used in place of persulfate. In other experiments, lead iodate was found to show promise as a cerium scavenger. Addition of iodate prior to the oxidizing step, rather than after oxidation, also appeared to give superior results. The deleterious effect on cerium carrying of very high iron concentrations can apparently be overcome by sequestering the iron with oxalate or phosphate.

Krypton-85 Recovery Process

Process and equipment descriptions for krypton-85 recovery operations at alternate plant locations were established so that cost estimates could be made. Although potential production from the power reactor fuel processing plant to be constructed at HAP0 may be relatively small, interest in krypton recovery from future private fuel processing facilities encourages study of this alternate in order to determine economic feasibility. Liquid nitrogen scrubbing of dissolver off-gases, with concentration and recovery of the krypton and xenon on silica gel, is the proposed process.

REACTOR DEVELOPMENT - 4000 PROGRAM

PLUTONIUM RECYCLE PROGRAM

Processing PRP Fuels by Anion Exchange

The feasibility of obtaining "complete" fission product decontamination of PRP fuels by anion exchange was tested in a two-cycle run. Feed for this run was prepared from Purex dissolver solution and contained 7.7 M HNO_3 , 104 g/l U, 0.47 g/l Pu (IV), 1.1×10^9 γ/m , ml Zr-Nb and 1.6×10^7 γ/m , ml Ru-Rh. This feed was filtered twice through a glass wool filter in an effort to remove solids which filtered out on the resin column in earlier runs.

The Dowex-1, X-4 (100 to 200 mesh) column was loaded to 95 percent capacity at 55 C and was then washed at the same temperature with 60 column volumes of 7.5 M HNO_3 . The wash effluent gamma activity decreased rapidly from 7×10^7 GSC c/m, ml to 4×10^5 GSC c/m, ml on passage of 12 column volumes of wash solution. The wash activity decreased only a factor of ten on passage of an additional 45 column volumes of wash.

The plutonium was eluted off the resin at a concentration of 19 g/l Pu with 0.35 M HNO_3 at 55 C. The gross gamma decontamination factor through this cycle was 2.1×10^4 . Niobium accounted for 85 percent of the gamma activity in the product, zirconium the remainder.

The product from this run was acidified and used as feed for a second cycle. The plutonium was loaded on a second Dowex-1, X-4 (100 to 200 mesh) column at 55 C, and eluted at a concentration of 26 g/l with 0.35 M HNO_3 . Gross gamma decontamination through the two cycles of anion exchange was 3×10^7 . As measured on the Gamma Scintillation Counter, 99.3 percent of the gamma activity in this product was due to plutonium, only 0.7 percent to the fission products.

The efficiency of the new Dow anion exchange resin, Dowex-21 K, for fission product decontamination was compared with Dowex-1, X-4 (50 to 100 mesh) in runs employing 1000-fold dilutions of Purex dissolver solution as feed. Under essentially identical conditions the one-cycle fission product decontamination

was substantially worse for the Dowex-21 K resin, the zirconium-niobium decontamination being 950 for the Dowex-21 K resin versus 7500 for the Dowex-1 resin. The wash effluent activity varied in substantially the same fashion in the two runs, but more activity was eluted with the plutonium product in the run with Dowex-21 K than with Dowex-1. In the run with Dowex-21 K zirconium and niobium were the only fission products detected in the product and niobium accounted for 85 percent of the gamma activity in the product.

The efficiency of separation of uranium from plutonium by the anion exchange process has been studied in a series of seven runs. Results of these runs are summarized in the accompanying table. It appears that uranium decontamination factors of 10^6 and greater can be readily obtained by operating the anion exchange process at elevated temperatures (60 C).

SEPARATION OF URANIUM FROM PLUTONIUM BY ANION EXCHANGE

Resin: Dowex-1, X-4 (50 to 100 mesh)

<u>Run No.</u>	<u>9-II</u>	<u>9-I</u>	<u>9-III</u>	<u>9-IV</u>	<u>9-V</u>	<u>10-I</u>	<u>10-II</u>
<u>Temperature, °C</u>	25	60	60	60	60	60	60
<u>Feed</u>							
g/l Pu	0.406	0.406	0.401	0.408	0.405	0.204	0.626
g/l U	42.0	42.0	24.2	83.3	120	60.6	184
U/Pu	103	103	60.5	204	296	298	294
<u>Flowrate</u> ml/m, cm ²	23	17	21	20	18	21	14
<u>Product</u>							
g/l Pu	15.5	36.3	47.3	39.3	38.4	34.8	46.5
g/l U	0.33	0.043	0.008	0.029	0.006	0.010	0.002
<u>Resin Capacity</u>							
g Pu/l resin at 50% breakthrough	23(a)	83(a)	94(a)	63(a)	48(a)	44(a)	45(a)
<u>U Decontamination</u> <u>Factor</u>	4.9×10^3	8.8×10^4	3.6×10^5	2.8×10^5	1.9×10^6	1.0×10^6	6.8×10^6

- (a) Resin which had been partially degraded by prolonged exposure to nitric acid solutions was used in these runs and is presumed to be responsible for the lower resin capacity observed in these runs.

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Reprocessing of PRP Fuels by Amine Extraction

The results of scouting experiments on the use of trialkyl amines to extract neptunium and plutonium from aqueous solutions were reported recently (HW-51958), and it was pointed out that this type of extractant shows much promise for certain applications. In particular, the selectivity for plutonium (IV), good decontamination from fission product elements, and the resistance of the solvent to large doses of radiation suggest use to recover plutonium from irradiated PRP type fuel elements. Work is in progress to exploit this application. New experimental results are described below.

The effect of amine concentration on the extraction of plutonium was determined in a series of experiments in which the concentration of tri-n-octylamine in xylene was varied from 0.1 volume percent to 100 percent. The organic phases were pre-equilibrated with 2 M nitric acid, and the extraction coefficients of plutonium (IV) measured from 2 M HNO_3 , 0.03 M NaNO_2 . Both "forward" and "reverse" measurements were made, i. e., in the latter plutonium was extracted into the organic and this organic then contacted with a "cold" aqueous to minimize the spurious effect of other alpha emitters. The two types of measurements were generally in good agreement except when the extraction coefficients were large (>100), in which case the back extraction values are probably the better. Extraction coefficients varied from values of the order of 0.1 at 0.1 percent tri-n-octylamine to 2670 at 100 percent. The extraction exhibited an approximate second power amine dependence for concentrations up to about ten percent, suggesting that the extracted species contains two amine molecules per plutonium (the same behavior that was observed with neptunium). For amine concentrations above ten percent, phase separation was somewhat sluggish.

The effect of acidity was explored in a series with ten percent tri-n-octylamine in xylene and variable aqueous acidity. The plutonium extraction coefficient, E_a^O , increased slightly as the acidity decreased from eight molar to two molar and then decreased at lower acidities. Below one molar the results were erratic, and below 0.1 molar the plutonium tended to precipitate at the interface. In other experiments with nitric acid-perchloric acid mixtures, it was found that the extraction has a very high (but non-integral) nitrate dependence. Thus, E_a^O for plutonium (IV) increased from 0.04 to 124 as the nitrate concentration was increased from 0.8 to 2.0 molar at two molar total acid.

An attempt was also made to measure the solubility of plutonium nitrate in tri-n-octylamine. A 2 M nitric acid solution containing 57.8 g/l plutonium (IV) was contacted with an equal volume of ten percent tri-n-octylamine in xylene (pre-equilibrated with 2 M nitric acid). Two organic phases were formed. One contained 41 g/l plutonium and constituted about 30 percent of the volume of the total organic. The other contained only 0.07 g/l plutonium, and the aqueous contained 24.9 g/l. Warming the three phase system to about 90 C caused the two organic phases to coalesce. Unless a satisfactory diluent can be found which will prevent the formation of three phases, the application of amine extraction may be limited in applications, such as Recuplex, where high plutonium concentrations are desired.

A number of other diluents were also tested. Conditions were similar to the above experiment. Diluents tested included Amsco, methylisobutyl carbinol, carbon tetrachloride, chloroform, nitro-methane, orthodichlorobenzene, and ethylenedibromide. Amsco formed a third phase with nitric acid alone, and

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Dissolution of Pu-Al-Si Alloy

The addition of hydrofluoric acid to 8 M HNO_3 - 0.003 M Hg^{++} resulted in an initial large (possibly ten-fold) increase in the dissolution rate of 1.65 w/o Pu - 11.5 w/o Si-Al alloy. However, after sufficient aluminum and silicon had dissolved to complex the fluoride, the reaction rate returned to that observed in the absence of fluoride.

Non-Rigid Fuel Core Studies

The gamma-ray absorption technique has proven practical for studying the dispersion of UO_2 in bismuth within a stainless steel capsule. Dispersions were successfully created by shaking a capsule charged with bismuth-bismuth oxide-uranium at ten minute intervals while holding it at 1250 to 1275 C for an hour. The resulting mass was completely metallic in appearance and X-ray analysis disclosed the presence of bismuth and uranium dioxide. A part of this piece was remelted in a porcelain crucible under a pressure of 0.5 microns. A slag was observed to form at the surface, but this was readily dispersed by gentle agitation to leave a shiny metallic surface. Other experiments have successfully produced dispersions of UO_2 in bismuth. Although no accurate quantitative data are available, the following tentative conclusions have been drawn from semi-quantitative measurements and visual observation.

1. It is possible to reproducibly prepare an uranium oxide-bismuth slurry. It is not known whether the dispersed phase is wetted by the bismuth or is only physically entrained.
2. In some of the dispersed systems a part of the oxide segregates rapidly as determined by gamma absorption. The remainder segregates at a much slower rate, apparently stable for perhaps several hours.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Environmental and Radiation Chemistry

The Zn^{65} content of string beans, okra, tomatoes, blackeye peas, corn, and grapes raised on Franklin County Irrigation District No. 1 land was measured and found to be about 0.30×10^{-6} $\mu\text{c/g}$ with values ranging from 0.09×10^{-6} for grapes to 0.55×10^{-6} for blackeye peas. The values for this produce are thus only about 2 to 11 percent that for the milk previously reported as 4.88×10^{-6} $\mu\text{c/ml}$. The values for steer meat, fat and bones were found to be 5.23×10^{-6} , 1.49×10^{-6} , and 5.80×10^{-6} $\mu\text{c/g}$, respectively. These values may be lower than a true equilibrium value since for four months prior to butchering this animal had been fed hay presumably uncontaminated with Zn^{65} rather than the Zn^{65} -containing pasturage. Certain organs from animals raised on this pasturage (such as the liver) might be expected to contain much more Zn^{65} than the muscle analyzed. Meat and milk thus appear to be the major sources of Zn^{65} for humans living on food raised on land irrigated by water containing reactor effluent isotopes.

Samples of barley and barley straw raised by the Biology Operation on reactor effluent water were analyzed for gamma emitters. Barley straw contained 474×10^{-6} $\mu\text{c/g}$ Cr^{51} and 11.3×10^{-6} $\mu\text{c/g}$ Zn^{65} . Barley seed contained 50.9×10^{-6} $\mu\text{c/g}$ Cr^{51} and 8.6×10^{-6} $\mu\text{c/g}$ Zn^{65} . These plants received about 35 inches of

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methylisobutyl carbinol was excessively soluble in the aqueous phase. Carbon tetrachloride appeared to form a small volume of a third phase. Chloroform gave only one organic phase but contained only 4.3 g/l plutonium, Nitromethane, orthodichlorobenzene, and ethylenedibromide gave single organic phases containing 26, 11.5, and 8.9 g/l plutonium, respectively.

Another series of experiments compared a series of tertiary amines as plutonium extractants. The results are shown below.

EXTRACTION OF PLUTONIUM WITH TERTIARY AMINES

All ten volume percent in xylene. Aqueous 2 M nitric acid, trace plutonium, room temperature.

<u>Amine</u>	<u>Plutonium (IV) E_a^0</u>
Tri-n-propylamine	0.039
Tri-n-butylamine	0.021
Tri-isobutylamine	0.027
Tri-n-amylamine	Formed two organic phases with nitric acid alone.
Tri-isoamylamine	Formed two organic phases with nitric acid alone.
Tri-n-hexylamine	85
Tri-n-heptylamine	92
Tri-n-octylamine	65
Tri-iso-octylamine	310
Tri-benzylamine	Amine nitrate insoluble in both phases.
Tri-phenylamine	0.0016

The poor extraction with the lower members of the series is probably due to solubility of the amine nitrate in the aqueous phase or to insolubility of the amine-plutonium complex in the organic phase. From these numbers, it appears that tri-iso-octylamine is at least as powerful an extractant as tri-n-octylamine. It also has the important advantage of being cheaper.

Two extraction-scrub studies were made using some year-old dissolver solution as feed and ten percent tri-n-octylamine in xylene as extractant. The beta and gamma distribution coefficients were quite low on the extraction step (0.0015 to 0.0055); however, the activity that did extract was not readily removed by scrubbing or by a strip operation. The tri-n-octylamine used was commercial as-received material and had received no further purification or pre-treatment. The stripping of plutonium was also somewhat less efficient than expected.

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reactor water from F reactor which would correspond to Cr^{51} and Zn^{65} values of about $0.5 \mu\text{c}/\text{in}^2$ and $0.01 \mu\text{c}/\text{in}^2$ land, respectively.

An X-ray-gamma-ray coincidence apparatus was set up and successfully applied to the standardization of Cr^{51} , Mn^{54} and Zn^{65} sources. These isotopes decay mainly by K-capture and cannot be standardized by the usual techniques. Counters may now be calibrated using these sources so that accurate disintegration rate measurements can be obtained for radiation hazard estimation.

In order to obtain biological reference points for the radiation sensitivity scale of compounds as determined by the erioglaucine protection technique, several compounds known to provide protection to mice from lethal radiation dosages were examined. It was found that cysteine and glutathione which offer partial protection to mice, have protective indices of about 0.2 while those such as sodium diethyldithiocarbamate and resorcinol which offer fairly complete mouse protection to a minimum lethal dose have protective indices greater than 0.5. These results indicate that the erioglaucine system may be a tool for screening protective agents prior to animal experimentation.

Environmental Analytical Service

Multi-channel gamma energy analysis sometimes gives wrong answers for vegetation. $\text{Ce}^{141-144}$ was negative on two "hot" ($0.0002 \mu\text{c}/\text{g}$) samples. Other isotopes were high: Ba-La 140 , 55%; Zr-Nb 95 , 22%; Ru $^{103-106}$, about 13%; and I 131 , 10%. The high counting rates shifted the discriminator bias which caused improper data storage in the cerium channels. Fresh bomb fall-out gives high results due to Mo 99 (67 hour) and Te-I 132 (77 hour). Sample aging or expensive chemical separation is needed.

Geology and Hydrology

Geologic mapping of the basalts continued, combined with well drilling on the western edge of the project, to better define the surface and structure of the basalts. Detailed geologic mapping east of Priest Rapids disclosed no evidence of the continuation of the Umtanum thrust fault from the Priest Rapids dam site toward 100-B Area. Several lines of geologic evidence in 100-B Area suggest a fault there. Proof of the absence or existence of a fault may require the use of geophysical seismic methods.

Determination of the presence or absence of faults in the Umtanum Ridge area will define the probability of faults elsewhere in the Pasco Basin area, for the basalts were subjected to more intense folding, hence potentially faulting, there than elsewhere. Determination of the true earthquake potential, and the possibility of waste containment at intermediate to great depths, rests in part on the presence or absence of faults.

A well performance test was conducted by a drilling contractor for the U. S. Army at an installation on Wahluke slope. The local aquifer at that site occurs in the conglomerate zone of the Ringold formation. Evaluation of the pumping test data indicates a coefficient of transmissibility of 70,000 gal/day/ft and an average permeability of 350 gal/day/ft 2 . At other locations on the plant similar tests of aquifers occurring in the same formation resulted in permeabilities ranging from 150 to 400 gal/day/ft 2 . This is an additional

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indication that a rather narrow range of permeabilities may be assigned to a specific formation, regardless of its location.

A laboratory model was constructed that contains 187 compartmented flow collectors across the bottom. The model is designed to measure the distribution of flow from model cribs constructed in the soil with which the box is filled. This study is a preliminary step in the construction of a "two dimensional" model of a crib. This model will represent a thin section through a simulated disposal structure in which flow patterns can be traced with dyes or radioactive tracers. The present device is expected to evaluate the significance of any "wall effect" on the vertical flow patterns that would interfere with the performance of the two-dimensional model. Data obtained to date show a rather surprising uniformity of flow across the model. No evidence of any wall effect is found in the data.

Gelling of Wastes

The retention of radioisotopes in a sodium aluminum silicate gel formed from synthetic aluminum coating waste was studied. It was earlier found that these gels tend to lose liquid or "bleed" upon standing and that the liquid thus drained from the gel contains significant concentrations of the radioisotopes in the original waste. The addition of 0.5% clay to the mixture before gelling did not appreciably affect the liquid loss from the gel or improve the retention of radioisotopes, but did seem to prevent the total breakdown of the gel which occasionally occurs. The addition of 0.5% CaCl_2 to the waste before gelling reduced the liquid lost over a two-week period from its previous average of 7% to about 1%. No improvement in the concentration of radioisotopes in the drained liquid was found in this case. The addition of 0.05% by weight of phosphate ion to the waste reduced the concentration of Sr^{90} in the liquid drained from the gel from its previous value of about 50% of the waste concentration to about 16% of the waste concentration. The method or order of addition of chemicals to the gel mixture and the degree of mixing of the material was found to have no effect on the retention of radioisotopes. The radioisotopes in liquid drained from the gels are adsorbed on soils to about the same degree as from other high-salt wastes.

It was found that simple precipitation of aluminum hydroxide from the coating waste solution resulted in somewhat better reduction in radioisotope concentration than was achieved in the liquid drained from a gel, with the single exception of Cs^{137} .

Soil Chemistry and Geochemistry

Study of the calcite-phosphate-strontium system was continued to determine the reaction mechanism. Research was performed by using a single, carefully measured cleavage of calcite as a reaction surface. Data obtained from systems of this nature are anomalous with that obtained in other systems. These new data tend to point to a simple adsorption mechanism but such a mechanism cannot be used to explain the strontium uptake from phosphate solutions achieved in columns of crushed limestone. One such column has received 188 column volumes of solutions containing about 2 ppm strontium traced with Sr^{90} without detectable breakthrough of strontium. Further work is planned to resolve the conflicts in these results.

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Laboratory research was conducted to study the ion dilution technique for measuring the cation exchange capacity of soils. The technique is of interest because it involves a minimum of chemical treatment and can employ any cation for which soil uptake is to be studied. The method involves saturation of the soil with stable cation of the material followed by equilibration with a solution of the cation traced with its radioisotope. The amount of radioactive material remaining on the soil may be used to calculate the cation exchange capacity of the soil for that cation. The results obtained with this method were found to be generally lower than those obtained with the standard sodium acetate method. This was not unexpected, however, because the measured cation exchange capacity of soils is recognized to depend upon the method employed. The results are believed to be as reliable as those obtained by other procedures.

Field Apparatus Development

Shaped charge perforating equipment was received during the month. The equipment consists of shaped charges, detonators, charge carriers, end plugs, wire line, primacord, and seals. The shaped charges are made from about 5 gm of waxed RDX (a mixture of trinitrotoluene and cyclonite) pressed into a steel tube, and followed by a cone-shaped copper insert. In use, the shaped charges are inserted into ports in the wall of a heavy tube (carrier). Each 5' long carrier will accommodate 64 shaped charges in a single loading. Charges are detonated by a length of primacord passing through the center of the carrier and contacting the shaped charges. The primacord is detonated with an electric cap inserted in the upper end of the carrier. When charges are fired inside of a well casing, a high velocity jet is produced on the axis of each charge which perforates the well casing and penetrates several inches into the surrounding formation.

An engineer representative from the vendor spent several days training personnel in the use of the equipment. A facility was set up near the west end of Gable Mountain to test the perforator on schedule 30 and the lighter gage "Kaiwell" casing. Perforations from 5/16" in diameter to 3/8" in diameter were formed in the schedule 30 pipe, with somewhat larger holes, to 1/2", in the "Kaiwell" casing. Performance in these tests was considered satisfactory although some damage to the "Kaiwell" casing occurred. This was believed to be due to the manner of supporting which did not simulate the actual casing which would normally be backed with soil. Further tests are planned. An in-well perforation of 64 holes simultaneously placed in a casing was successfully accomplished.

The shaped charge perforator will permit a well to be perforated quickly and easily using light duty hoisting equipment. Other advantages include reproducible perforations, and accurate spacing and orientation in the well casing.

An investigation was started to determine the feasibility of using thermistors to measure very low water velocities for possible application to ground water velocity measurements. Using a simple bridge circuit and measuring the current needed to maintain the thermistor at a constant temperature as water flowed past the thermistor, it was possible to detect flow velocities of the order of one cm per minute (about 100 feet per day). A calibration curve was prepared for this arrangement.

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Radioisotopes in Reactor Effluent

Another in-pile experiment was conducted in which sodium arsenate was added to the water charged to a single process tube in the KE Reactor. The concentration added to this experiment was ten times that previously used to assure that the incremental increase in As^{76} in the effluent was directly proportional to the arsenic content of the process water. The increase in As^{76} observed from this test tended to confirm the linearity of this relationship. The following data summarize the results:

<u>Concentration of Arsenic Added</u>	<u>Ave. As^{76} in Effluent, d/m/ml</u>	<u>Calculated Hold- up Time, Hours</u>
0	800	--
9.3×10^{-5} ppm	2181	20.4
9.3×10^{-4} ppm	21800	24.6

From these data it was determined that a concentration of 6×10^{-5} ppm arsenic in the process water would provide the average concentration of As^{76} found in the effluent.

L. P. Buyp

Acting Manager
Chemical Research & Development

LP Buyp:mcs

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VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
H. Goeller	10/1/	Oak Ridge National Lab. Oak Ridge, Tenn.	Discuss power fuel reactor processing.	WH Reas RL Moore CA Rohrmann HE Hanthorn	Yes
Babb & Marr	10/1/	Univ. of Washington Seattle, Wash.	Pulse column technology.	RG Geier	Yes
D. H. Ahmann	10/3-4/	G. E. Vallecitos Lab. Vallecitos, Calif.	Discuss power reactor fuel reprocessing and analytical and chemical effluents technology.	EW Christopherson DW Pearce WH Reas	Yes
D. G. Sturges	10/4/	The Carboreundum Co. Niagara Falls, N. Y.	Refractory materials applications to pyrochemical processing.	WL Lyon HT Hahn WR DeHollander	Yes
O. J. C. Runnalls	10/4/	Chalk River Project Ontario, Canada	Discuss preparation of plutonium alloys.	WL Lyon	Yes
R. L. Nace V. T. Stringfield	10/8-9/	U. S. Geological Survey Washington, D. C.	Discuss waste disposal research.	JF Honstead JR McHenry PP Rowe LL Ames DJ Brown WH Bierschenk DW Pearce	Yes
C. V. Theis	10/8-9/	U. S. Geological Survey Albuquerque, N. M.	Discuss waste disposal research.	DW Pearce	Yes
R. E. Newcomb	10/8-9/	U. S. Geological Survey Portland, Ore.	Discuss waste disposal research.	DW Pearce	Yes
Robert Fletcher	10/10/1	Phillips Petroleum Co. Idaho Falls, Idaho	Discuss permanent waste storage problems.	RL Moore KH Hammill AS Wilson MT Walling EE Voiland WH Reas	Yes

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VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
E. L. Gillingham	10/14-18/	Jet Research Center Arlington, Texas	Consultation and training in use of jet perforators.	JF Honstead DJ Brown WH Bierschenk JR Raymond LC Schwendiman	No
George W. Watt	10/14-18/	University of Texas Austin, Texas	Technical Consultation.	LP Bupp RE Burns OF Hill WH Reas EE Voiland MT Walling	Yes
R. B. Craig R. E. Troeltzsch	10/14-17/	Dow Chemical Co. Rocky Flats Plant Denver, Colo.	Discuss uranium chemistry, separations, and flurex processes.	W Schulz WH Reas EJ Wheelwright DR DeHollander EE Voiland	Yes
Peter Dyne	10/17/	Atomic Energy Comm. Chalk River, Ltd. Canada	Discuss organic coolant analyses.	EW Christopherson HJ Anderson FE Holt HE Palmer DL Reid	Yes
Prof. Scott	10/28/	Reed College Portland, Oregon	Discussion on iodine chemistry.	WH Reas RL Moore JM Nielsen	No
N. F. Hindle	10/29/	University of Idaho Moscow, Idaho	Inspection of project facilities.	AE Smith	Yes
George Tames	10/30/	New York Times New York, N. Y.	Public Relations.	HJ Anderson WH Reas EA Berreth	No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access Restriction Data
K. H. Hammill	10/1-2/	Oak Ridge National Lab. Oak Ridge, Tenn.	Discuss design and operating experience in high level chemistry facilities.	Frank Ring, Jr.	Yes
	10/3-4/	Savannah River Lab. Augusta, Ga.	" " "	GJ Deilly	Yes
C. A. Rohrmann	10/7-11/	Oak Ridge National Lab. Oak Ridge, Tenn.	Attend Chemistry & Chemical Technology Program Review.	FL Culler	Yes
A. C. Leaf	10/9-13/	Idaho Falls, Idaho	Sampling activities.	--	No
P. P. Rowe	10/11/	Washington State College Pullman, Wash.	Present talk to seminar group at college.	--	No
V. P. Kelly	10/11/	Electric Steel & Foundry Co., Portland, Oreg.	Discuss hub and paddle castings.	E. Leisure	No
H. A. Treibs	10/14-17/	Victoreen Instrument Co. Cleveland, Ohio	Discuss analytical methods and inspect equipment to be purchased.	Frank Mannine, Jr.	No
R. J. Sloat	10/14-15/	Phillips Petroleum Co. Idaho Falls, Idaho	Research & development activities related to interim propulsion and power reactor fuels re-processing program.	JL Schwennessen	Yes
	10/17-18/	Oak Ridge National Lab. Oak Ridge, Tenn.		H Goeller	Yes
L. R. Duncan	10/27-31/	Atomics International A Div. of NAA, Inc. Conoga Park, Calif.	Obtain information on experimental organic pile coolant studies.	HA Gercke	Yes
P. P. Rowe W. H. Bierschenk J. R. Raymond	10/28-30	Washington State College Pullman, Wash.	Attend Regional AGU meeting.	--	No

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A. Organization and Personnel

Capt. Donald Anderson and Capt. George Smith, of the USAF Veterinary Corps, were assigned to the Biology Operation for training in radiation biology. During their two-year assignment, they will perform research and receive training in the various components of the Biology Operation.

B. TECHNICAL ACTIVITIES

FISSIONABLE MATERIALS - 2000 PROGRAM

BIOLOGICAL MONITORING

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

Atmospheric Contamination

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

<u>Collection Site</u>	<u>mc I^{131}/g thyroid</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Four miles SW of Redox	4×10^{-3}	1×10^{-2}	+ 7
Meteorology Tower	3×10^{-3}	1×10^{-2}	+ 3
East of 200 East Area	3×10^{-3}	5×10^{-3}	-
West of 200 West Area	3×10^{-3}	4×10^{-3}	-
Prosser Barricade	2×10^{-3}	5×10^{-3}	+ 7
100-B Area	2×10^{-3}	4×10^{-3}	-
One mile SE of Redox	2×10^{-3}	2×10^{-3}	-
Wahluke Slope, ENE	6×10^{-3}	7×10^{-3}	+15 *
Route 2S, mile 3	5×10^{-3}	8×10^{-3}	+ 6 *
Five miles SE of Redox	3×10^{-3}	5×10^{-3}	+ 4 *
Wahluke Slope, N	3×10^{-3}	4×10^{-3}	+10 *

* The last four trend factors compare values with samples obtained in August rather than September, because collections are made at these locations bi-monthly.

Current values are approximately three times greater than those observed one year ago.

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Fission products were present in rabbits in the following concentrations:

<u>Sample Type</u>	<u>µc FP's/g sample</u>	<u>Trend Factor</u>
	<u>Average</u>	
Bone	7×10^{-5}	- 3
Feces	1×10^{-4}	+ 2
Liver	2×10^{-5}	-

These values for liver and feces are two to three times greater than for the same period last year.

Columbia River Contamination

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

<u>Sample Type</u>	<u>Collection Site</u>	<u>µc beta emitters/g wet wt. tissue</u>		<u>Trend Factor</u>
		<u>Average</u>	<u>Maximum</u>	
Minnows (entire)	Hanford	2×10^{-2}	2×10^{-2}	-
Whitefish flesh	Priest Rapids	8×10^{-6}	8×10^{-6}	- 6
Whitefish flesh	Ringold	1×10^{-3}	5×10^{-3}	-
Shorebirds flesh	Hanford Res.	7×10^{-3}	1×10^{-2}	-
Mergansers "	"	4×10^{-3}	7×10^{-3}	-
Gulls "	"	2×10^{-3}	5×10^{-3}	-
Grebes "	"	6×10^{-4}	2×10^{-3}	- 5
Coots "	"	2×10^{-4}	4×10^{-4}	- 3
Diving ducks	"	5×10^{-5}	2×10^{-4}	-

The concentration of beta emitters were about the same as for the same period last year, with the exception of minnows which were about twice as radioactive this year.

Effect of Reactor Effluent on Aquatic Organisms

At the end of five months' exposure, young whitefish were not adversely affected by a fluctuating concentration of reactor effluent designed to simulate conditions which might result in the Columbia River from power production at Priest Rapids Dam. The whitefish are to be replaced in this test with chinook salmon eggs as soon as they are available next month.

Water temperatures 2 C and 3 C above normal for the Columbia continued to cause increased mortality among young whitefish. An adverse effect was first observed among the incubating eggs last winter. No significant effect was evident during the spring months, but an appreciable temperature effect again occurred during the late summer during peak temperature conditions for the river.

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Fluorescein dye is to be added to the 100-K reactor effluent by IPD for a period of about two hours in connection with replacement of the outfall line (Project GG-704). Concentration in the effluent will be 3 ppm. To test for a possible effect on Columbia River fish, juvenile whitefish were exposed to concentrations of 3, 1, or 0.3 ppm for two hours. There was no adverse effect at any of these concentrations -- all far greater than will exist in the Columbia River after mixing.

BIOLOGY AND MEDICINE - 6000 PROGRAM

METABOLISM AND TOXICITY OF RADIOACTIVE MATERIALS

Phosphorus

Trout which have consumed P^{32} at the rate of $0.6 \mu\text{c}$ or $0.06 \mu\text{c/g}$ body weight/day showed no gross symptoms of radiation damage after six weeks except for a loosening of the scales. On the last day of the month several of the fish in the $0.6 \mu\text{c/g/day}$ group refused food. No effect was evident in the third group which received $0.006 \mu\text{c/g/day}$. Uptake and deposition of the isotope was rapid and the concentration in most hard tissues, such as scales, bone, and fins, was equal to or greater than that in soft tissues after 16 hours. There was some indication that the concentration of the P^{32} in the fish had reached a steady state after chronic feeding for about two weeks.

Autoradiographs have been obtained illustrating the non-uniformity of P^{32} distribution in the ovary of the rat at short times following administration. A quantitative interpretation of these results, in terms of relative radiation dosage to genetically sensitive regions, has not been completed.

Zinc

Rats used in the experiment studying excretion of Zn^{65} were sacrificed 152 days after injection of the radioisotope. At this time fecal excretion amounted to about 0.02 per cent of administered dose per day, and total retention in the animals averaged 7.3 per cent of the administered dose. The fecal excretion curve was resolved into exponential components with biological half-lives of 1, 5, and 25 days, accounting for the loss of 85, 4, and 1 per cent, respectively, of the administered dose.

Strontium

Data are now complete for barley harvested from the Sr^{90} milliacre plots and for one harvest of alfalfa. There is no longer an increased uptake of Sr^{90} from cultivated plots but instead there is a suggestion that uptake is greater from uncultivated plots both in barley and alfalfa. The concentration of Sr^{90} is from two to four times higher in alfalfa than in young barley. The trend toward increasing uptake of Sr^{90} with time appears to have shifted this year with the concentration in the mature barley no higher than it was in the first year of the experiment. However, the concentration of Sr^{90} is lower in the

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mature barley than in young plants while in previous years the concentration has increased as the plants matured. On the assumption that an error might have been made in assaying the mature barley, the Sr^{90} content is being re-evaluated.

Radishes planted following harvesting the barley contained about the same concentration of Sr^{90} as did young barley plants. The Sr^{90} concentration in radish leaves is 2 to 4 times greater than in the fleshy portion of the root.

Iodine

Two pregnant swine fed 45 μc of I^{131} daily for over 11 months were autopsied. The thyroid gland of only one of them appeared damaged grossly. It was shrunken and infiltrated with fibrous connective tissue. The thyroid dose was in the 15,000 to 20,000 rad range.

A single dose of 3 mc of I^{131} was administered to 17 (excess) ewe lambs. The estimated dose to the thyroid was about 35,000 rads. This is approximately equivalent to the thyroid dose in the ewes that developed tumors after being fed 5 μc of I^{131} a day for five years. These ewe lambs will be kept at the off-project control farm for six years.

Biological Transfer of Radioisotopes

Cs^{137} in the spiked pond was virtually all in the organisms and bottom mud. The water contained only slightly above background amounts. Plankton organisms collected with a standard plankton net (net plankton) contained more cesium than equal masses of smaller organisms which passed through the net (nanno plankton). This is in contrast to expectations and results from similar studies with Ca^{45} and P^{32} .

Plutonium

Experiments were initiated to study several possible treatments for removal of plutonium from the lung. Plutonium was administered to rats, intratracheally, followed by exposure of the animals to aerosols containing EDTA or Chel 330. Results are not yet available.

Electrophoretic study of urine collected 30 minutes following intravenous injection of plutonium, indicates nine anodic and several cathodic peaks of plutonium activity. The correlation with electrophoretic behavior of simultaneously administered radiophosphorous is being studied.

Gastrointestinal Radiation Injury

Plasma alkaline phosphatase levels are reduced to 25 per cent of control levels, 3 days following X-irradiation (1500 r) of the exteriorized rat intestine. Enzyme levels return to normal by the tenth day following irradiation. This effect is not shown by surgical controls, but is seen in fasted animals.

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In confirmation of reports in the Russian literature, homogenates of the intestine of rats exposed to 1500 r whole-body irradiation have caused death when injected intraperitoneally into normal rats. The symptoms shown by these animals is in many respects similar to the intestinal radiation syndrome. Further investigation of this effect is in progress.

Irradiation of Skin

No change has occurred during the past 18 months in the skin of swine irradiated with radioruthenium particles 32 to 40 months ago. Only areas exposed to 400 μ c hours or more are detectable.

Radioactive Particles

Results from the first experiment on the pathological effects of lung-deposited radioactive particles are complete. Suspensions of $\text{Ru}^{106}\text{O}_2$ and $\text{Pu}^{239}\text{O}_2$ in Tween-80 were administered intratracheally to mice. There was no apparent relationship between the appearance of non-malignant papillary cystadenomas and malignant tumors. Widespread necrosis and infection due to epithelial damage was commonly observed in mice treated with radioactive particles. The latent period for neoplastic growths was about 200 days. Twelve per cent of the mice examined showed evidence of squamous cell carcinoma 400 days after intratracheal administration of 0.06 μ c $\text{Pu}^{239}\text{O}_2$. Although both Ru^{106} and Pu^{239} are apparently bone seekers, no evidence of a bone tumor was seen in radiograms of these mice. No changes in hematology were observed.

Six weeks after inhalation of $\text{Pu}^{239}\text{O}_2$ six per cent of the original body burden remained in the mice.

The search for agents to promote the removal of lung deposited particles was continued. Histadyl, epinephrine, heparin, histamine, potassium iodide, chlorine gas, and Alevoire have been administered to mice having lung burdens of $\text{Sr}^{90}\text{SO}_4$ particles. The results are not complete.

Mice are being exposed daily to air containing $\text{Sr}^{90}\text{SO}_4$ particles to study the effects of chronically administered radioactive particles. Separate chambers are being used to study three levels of aerosol concentration: 10^{-9} , 10^{-7} and 10^{-5} μ c $\text{Sr}^{90}\text{SO}_4$ per ml of air.

Relative Biological Effectiveness

Finely divided platinum with Po^{210} adsorbed on its surface was suspended with yeast cells to determine whether the Po^{210} remained fixed or moved to the yeast cells. Over a 40-hour period there was no evidence that the Po^{210} became attached to the yeast cells. Analytical Chemistry is making tests to determine whether chemical dosimetry is possible when platinum particles are suspended in the dosimeter solution. These tests, in addition to some others on dosimeter values for P^{32} and S^{35} , should clear the way for a critical evaluation of beta and alpha RBE values.

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Preliminary tests on non-dividing cultures of yeast cells gave RBE values quite different from those obtained on growing cultures. These tests will be repeated to insure that extraneous factors are not influencing the results.

Spectrophotometric determination of the amount of cellular material diffusing into the culture medium is improved if cells are incubated in tris(hydroxymethyl)aminomethane buffer. Measurement of radiation damage by the diffusion of materials out of cells appears practical only in non-dividing cultures. In growing cultures there is too little material accumulated in the medium to permit its measurement.

Yeast cells deficient in cytochrome are 50 per cent more radiosensitive than are normal cells. Although induction of cytochrome deficiency has been reported to follow treatment with ultra violet light, no such induction has been observed to follow X-ray treatment. It is possible that the increased sensitivity may be related to the failure to identify mutation induction.

Research Services

Another steer bearing an exteriorized pancreatic duct cannula was injected with Zn^{65} . About ten liters of Zn^{65} -labeled pancreatic juice was collected before the cannulation failed.

HA Kornberg
Manager
BIOLOGY OPERATION

HA Kornberg:es

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C. Offsite Visits and HMA Visitors

Name	Dates of Visit	Company or Organization Represented and Address
Dr. Hardin B. Jones	10/9/57	Donner Lab, U. of Calif., Berkeley, Calif.
Messrs. Fields, Derry	10/10/57	AEC, Washington, D.C.
Dr. Henry Quastler	10/22/57	Brookhaven Nat'l Lab. Upton, L.I., New York
Drs. Thorpe, Lehman, Scott	10/28/57	Good Samaritan Hosp. and U. of Ore. Med. School, Portland, Ore.
Messrs. Soderstrom, Edson, and Chupp	10/23	U.S. Fish and Wildlife Service.
Tri-City Clergymen	10/28	Tri-City Area
George Tames	10/29	New York Times

VISITS TO OTHER INSTALLATIONS

F. P. Huncate	10/7-8/57	Brookhaven Nat'l Lab. Upton, L.I. New York
H. A. Kornberg	10/17-23/57	AEC, Washington, D.C.

Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
Tour facilities and present a seminar.	Bustad, Kornberg, Thompson	No	100-F, 108, 141, 146 - 300, 3760
Inspect facilities, discuss current programs.	Kornberg	No	100-F, 108, 141, 146, 1705
Discuss current program and present a seminar.	Foster Sullivan	No	100-F, 108, 141, 146, 1705
Discuss radioiodine work.	Kornberg Bustad	No	100-F, 108, 141, 146, 1705
Discuss possible effects of Benjamin Franklin Dam.	Foster, Davis, Hanson, Watson, Olson	No	100-F, 146
Tour Aquatic Biology and Exptl. Animal Farm.	Foster Bustad	No	100-F, 146, 141
Tour Biology facilities.	Warner, Foster, Bustad, Davis	No	100-F, 108, 146, 141
Attend AEC Bio-Medical Directors Meeting	L.F. Nims	Yes	
Attend special conferences on Plant-Soil relationships and one on Sr90 hazards.	P.B. Pearson R.F. Reitemeier	Yes	

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D. Lectures

a. Papers presented at meetings

None

b. Seminars

Dr. Hardin B. Jones, "Factors Influencing Health and the Life Span,"
October 9, 1957.

Dr. Henry Quastler, "Cell Renewal Systems," October 22, 1957.

E. Publications

a. HW Documents

Hackett, P.L., T.W. Galbraith, C.A. Bennett, and L.K. Bustad,
"Changes in Blood Constituents in Sheep Following Prolonged
Daily Administration of I¹³¹," Document HW-48743 (UNCLASSIFIED)
August 6, 1957.

Ballou, J.E. and R.C. Thompson, "Physiological Parameters for Assessing
the Hazard of Exposure to Ruthenium Radioisotopes. II. Chronic
Exposure Studies," December 1, 1956, Document HW-46409 (UNCLASSIFIED).

Ballou, J.E. and R.C. Thompson, "The Long Term Retention of Cesium
in the Rat Following a Single Intraperitoneal Injection,"
Document HW-46150, April 1, 1957 (UNCLASSIFIED).

b. Open Literature

Sullivan, M.F. and R.C. Thompson, "Absence of Lethal Radiation Effects
Following Massive Oral Administration of Plutonium," Nature 180, 651 (1957).

Olson, P.A. and R.F. Foster, "Temperature Tolerance of Eggs and Young
of Columbia River Chinook Salmon," Transactions of the American
Fisheries Society 85, 203-207 (1955).

Henderson, C. and R. F. Foster, "Studies of Smallmouth Black Bass in
the Columbia River near Richland, Washington," Transactions of the
American Fisheries Society 86, 112-127 (1956).

Marks, S., L.A. George, and L.K. Bustad, "Fibrosarcoma Involving the
Thyroid Gland of a Sheep Given I¹³¹ Daily," Cancer 10, No. 3, 587-591
(May - June 1957).

George, L.A., P.L. Hackett, and L.K. Bustad, "Leukocytic Response in Lambs
Exposed to Whole-Body X Irradiation," Am. J. of Vet. Res. XVIII, No. 68
631-633 (July 1957).

Bair, W.J. and F.P. Hungate, "Effect of EDTA on the Apparent Radiosensitivity
of Yeast," Radiation Research 7, No. 3 (Sept. 1957).

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OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

October, 1957

ORGANIZATION AND PERSONNEL

One secretary was placed on pregnancy leave and the vacancy filled by a transfer from within HLO.

OPERATIONS RESEARCH ACTIVITIES

Economic Studies

A preliminary investigation of the feasibility and desirability of a physical and financial input-output analysis of HAPO operations has been undertaken and will be completed in November. Work continued on the study of the economic evaluation of capital expenditures and the relationship of product value to historical operating and capital costs.

Matrix Method of Cost Allocation

A rough draft report on the subject was discussed extensively with financial and other personnel. During these discussions, it became apparent that the initial system would have to be revised to embrace all aspects of the cost problem rather than just the problem of cost allocation. Such a revision has been undertaken and a revised version of the report is now being written.

Attitude Survey

Coordination of the attitude survey is essentially complete. Reports to all levels of management were issued during October and reports to employees are scheduled to be released the first part of November.

Inventory Control

Examination of the economic order quantity formula employed by Central Stores continued. At their request this work has been broadened to include a study of optimum reorder points.

CPD Control Study

Some preliminary work in connection with the proposed study of control procedures in separations and fabrication plants has been started. In particular, an up-to-date flow model of CPD operations is being constructed to use as a basic reference for the study.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Metallurgy

A study has been started of the class of solutions possessed by a certain linear, non-homogeneous differential equation and associated boundary

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conditions, to determine if the classical mathematical model currently being employed to study the spacial and time behavior of a gas-catalytic reactor is adequate to describe the complex processes which have been observed in actual practice.

2000 Program - Reactor

Assistance was given in determining the accuracy with which slug cross section total flux can be measured empirically using indicator pins. Various numerical integration procedures are being adapted to the problem and the estimational accuracy of each assayed.

4000 Program - PRP

Assistance was given in designing an experimental program to investigate the functional dependency of the successful hot pressing of UO_2 powder on temperature, pressure and time.

6000 Program - Biological Research

First crop data from a Plant Nutrition and Microbiology Operation experiment to investigate the effect of various Ca compounds in the soil on the uptake of Sr-90 by plants were statistically analyzed and the results reported orally to interested persons. Second crop data are currently being analyzed.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

FUELS PREPARATION DEPARTMENT

Process Control

The effects of the amounts of iron and lead in the canning baths on poor bond reject rates were evaluated and reported to Quality Control Engineering personnel. (Letter, 10-29-57, "Effect of Canning Bath Contaminants on Poor Bond Rejects.") Recommendations for using control charts to control the levels of these contaminants were included in this report.

An analysis of analytical sampling results is proceeding with a view toward the reduction of such sampling. Concentrations are being determined as functions of process throughput. If these functions are well enough defined, it is anticipated that throughput can be used to estimate concentrations, thus reducing the amount of analytical work required.

Assistance was given in setting up control charts on the yield of I and E fuel elements.

Confidence limits for the average iron content in incoming lots of cans based on three spectrographic measurements were determined.

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Process Experimentation

The effects of a different canning bath composition on reject rates are being investigated for all reject categories.

Other

The relationship between test reactor reactivity values and the isotopic analyses reported by the fabricator is being investigated to evaluate the possibility of using reactivity values to accept shipments of enriched slugs.

The relationship between void reject rates and slug rupture rates was investigated and reported. (Unclassified Rough Draft, 10-14-57, "Relationship between Pile Failure Rate and Void Reject Rate for Canned Fuel Elements.")

IRRADIATION PROCESSING DEPARTMENT

Rupture Analyses

Data have been collected and calculations are being performed in connection with the estimation of a discriminant function which will attempt to predict, based on certain reject rate data, which lots are likely to produce a rupture. This function is being estimated from ten months' data, and its effectiveness will be tested using three months' additional data.

Rupture data often consist of k ruptures observed in n tubes which have reached a given exposure. These data become more meaningful when confidence limits on the true rupture rates are made available. Curves useful in determining such limits as a function of n for a number of combinations of k and the confidence level desired were prepared as requested.

Production Test Analysis

Production Test IP-56-A is concerned with an evaluation of low hydrogen dingot metal. Dimensional distortion data from twelve tubes of alternate charged dingot and regular metal were analyzed. The presence of significant interaction effects complicated the interpretation of the main effects. (HW-53358 RD, 10-24-57, "Analysis of Dimensional Distortion Data from Production Test IP-56-A.")

Other

A method of controlling the distribution of overtime within a given job was developed. This was based on the amount of variation that would be expected to occur in the total accumulated hours of overtime if each hour were randomly assigned. (Unclassified letter, 10-17-57, "Controls on Overtime Distribution.")

The sample size required to evaluate the possible adverse effects of the decontamination of rear pigtails in a given reactor was found.

Certain simplifications had been made in handling the probability aspects of the technique for determining optimum power. Assistance has been given personnel

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of the Process Engineering Operation in putting these techniques in such workable form that they can be included in a manual that is being prepared for use by operating personnel.

An investigation was made of the current procedure for accepting pressure vessels on the basis of a spot examination of welds. A graph was prepared giving the probability of accepting a defective vessel as a function of the number of weld defects.

Work continued on the fitting of an analytical expression to data related to a two-phase flow problem.

CHEMICAL PROCESSING DEPARTMENT

Final Products Specifications

The tolerance statements required to demonstrate that weapons parts met specifications were prepared for parts shipped during the third quarter of calendar year 1957.

Control Studies

A complete review of the effects of measurement errors on plutonium accountability is being made in order to assist in locating sources of existing difficulties in Chemical Processing Department accountability. This review represents one phase of the systematic over-all review of measurement reliabilities and requirements in the separations plants and 234-5 Building which is the initial phase of the CPD control study.

Other

A confidence interval about a difference between medians was found for personnel of the Facilities Engineering Operation in connection with contamination of shipments of fuel elements between the 100 Areas and the 200 Areas. Lidless containers were compared with regular containers in this study.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

Activities for Other Operations

A member of the ORSO is serving on a task force organized to study SS Accountability problems existing between the Chemical Processing and Irradiation Processing Departments. The first objective is a review of the prediction equations used to estimate the amount of plutonium as a function of exposure. Tests to estimate these relationships for different reactor - slug geometry combinations were proposed at a meeting of the Task Force. Subsequent to this, a report was prepared on the uncertainties associated with parameter estimates in the proposed tests.

Assistance is being given personnel of the SS Measurements Operation in determining the reliability of certain accountability measurements related to the storing and processing of pre-irradiated fuel elements.

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Activities within HLO

Statistical analysis of mass spectroscopic determinations of the U-235 content of monthly UO_2 production composites was continued for Spectrochemical Analysis Operation.

The sample size required to detect a given improvement in bad weld reject rates was found for personnel of the Fuels Development Operation.

Evaluation of data from referee and standard analyses by the General Chemical Analysis Operation was continued as the first step in determining the need for a quality control program to insure adequate analytical precision.

Financial Operation has requested statistical assistance in determining whether HLO male and female absenteeism rates are in line with other departments. HLO rates are also being compared with previously determined expected rates.

Discussions were held with the Instrument Research and Development Operation concerning the solution of a three variable system of transcendental equations arising from analysis of three color optical pyrometer data. An approximate solution to the system was suggested.

Interstation correlations of FY-1957 rabbit thyroid I_{131} data have been completed, and data from several stations have been correlated with total stack I_{131} emission. Results were discussed at the last environmental monitoring study group meeting. Similar correlations are being computed for FY-1956 and FY-1958 data. Analytical data on vegetation from sampling locations adjacent to rabbit stations are being processed from the daily RAD-001 record for correlation with both rabbit and stack emission data.

Statistical and Mathematical Research and Development

Exact small sample Poisson prediction intervals are being constructed with the aid of the binomial distribution tables. These intervals will have immediate use in evaluating security violations, radiation incidents and slug rupture data.

The distribution theory of generalized linear estimation in a structural equation is being derived for use in economic demand analysis.

OFFSITE VISITS AND VISITORS

W. H. Bloodworth of the OR & S Consulting Service, Management Consultation Services, visited the Operations Research & Synthesis Operation on October 8 and 9 for consultation on operations research organization and methods.

C. A. Bennett visited the Argonne National Laboratories in Chicago, Illinois on October 11 for consultation on Washington designated program.

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C. A. Bennett visited the AEC, Division of Research in Washington, D.C. on October 28, 29 and 30 for consultation on Washington designated programs.

C. A. Bennett visited the Operations Research and Synthesis Consulting Service in New York on October 31 for general discussions of operations research.

Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

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RADIATION PROTECTION OPERATION
MONTHLY REPORT - OCTOBER, 1957

A. ORGANIZATION AND PERSONNEL

Organization

No significant changes in organization occurred.

Force Summary

	<u>9-30-57</u>	<u>10-31-57</u>
Exempt	44	44
Nonexempt	<u>179</u>	<u>177</u>
Total	223	221

B. ACTIVITIES

Radiation Monitoring

In the reactor areas, monitoring services were provided on ten work orders involving all reactor areas on projects undertaken by the Construction Engineering Operation. Major projects such as CG-558 were nearing completion. Trace contamination was detected on some surplus and salvage material at warehousing facilities. Routine surveys of all R&U facilities and military installations were completed with no contamination of HAPO origin being detected.

Experiments involving significant quantities of plutonium were continued at Biology Research without incident. Orientation was provided for new employees and refresher lectures were presented to all railroad personnel working out of the Hanford facility.

In the chemical processing areas, the Hot Semi-Works was winterized, and new radiation zone boundaries were established in the air treatment room. Monitoring services were frequently required by the Radiographic Testing Operation, but no unusual radiation problems occurred. Radiation monitoring was provided for construction forces at 202-S, 222-U, 224-U, 224-UA, 231 buildings, and the 241-SX tank farm. Personnel installing a hose reel in the 202-S Building canyon were working in dose rates of 4 r/hour. Maximum radiation measurement observed at this location was 25 rads/hour including 4 r/hour at 6 inches. Tie-ins were made to the 233-S Building exhaust duct-work, which was highly contaminated by a process blowback in June of 1956, and to the exhaust stack. Contamination control was good.

In the 300 Area, high dosage rates were encountered while decontaminating C cell in the 327 Building. Radiation and contamination up to 200 rads/hour was measured on the floor of this cell. After cleaning and removal of equipment, radiation levels were reduced to 10 mr/hour.

Training talks on radiation protection were given on eight different occasions to approximately eighty HLO employees. Radiation problems were discussed on five occasions with FPD personnel, and one session was held with forty Relations and Utilities' employees. Four information meetings on radiation protection were given to Patrol and CEO Planning and Drafting personnel.

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A detailed report of Radiation Monitoring is contained in HW-53465.

Regional Monitoring

The average daily stack emission of I^{131} was 0.4 curie. The average daily emission rate for the past year continued to be 1.2 curie. The nitric acid recovery operations, which started at Redox on October 30 and which are planned for Purex, should keep I^{131} emission in good control. Iodine-131 deposition on vegetation increased approximately ten-fold to an average of 1.6×10^{-5} $\mu\text{c/gm}$ throughout many northwest regions as a result of nuclear test bomb debris. Fission products, excluding I^{131} , increased several fold to an average of 2.7×10^{-4} $\mu\text{c/gm}$.

Isotopic analysis of raw water at 100-F Area showed an average of approximately 5.3% of the continuous occupational MPC_{GI} . Raw water at the Pasco filter plant showed an average of 1.7% of the continuous occupational MPC_{GI} .

A measurement of the Zn^{65} content of several common vegetables raised on Franklin County Irrigation District No. 1 land averaged about 0.3×10^{-6} $\mu\text{c/gm}$. Assuming a daily intake of 200 gms of such crops, the intake rate of Zn^{65} would be equivalent to 7×10^{-5} of the maximum permissible intake rate. A similar analysis of beef and milk indicated the equivalent of 5×10^{-4} of the maximum permissible intake rate assuming a daily intake of 400 gm/day of beef and milk.

A detailed report of waste disposal monitoring is contained in HW-52872.

Exposure Evaluation and Records

Two cases of plutonium deposition and one case of fission product deposition were confirmed during the month. All were less than 1% of the MPC. The total number of cases of plutonium deposition on record is 209.

Bids for self-service badge racks were opened, and the low bidder was about one-half of the preliminary estimates. Installation of the first racks will be made in 200-East Area in November.

The programming of bioassay data continued. All areas were placed on an exchange badge system.

Heating and ventilation revisions to the Bioassay Laboratory were started. Bids were obtained on the bioassay sample flask containers. Ordering of the equipment awaits the approval of AEC-HOO.

Radiological Development

Additional equipment for the badge processing machine was ordered, including an Electropneumatic timer, air cylinders, a pressure regulator, and machine controls. The checking of all of the eight basic drawings and details of the machine was completed.

The study of the use of monochromatic light with the densitometer used to read badge film was completed. The expected gain in sensitivity was not realized. Further work on this problem was abandoned when an improvement in sensitivity of only 5% was indicated.

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The initial bioassay samples run, using commercial grade acid for the wet ashing step, indicated that this acid would be usable routinely. Comparable efficiencies were obtained.

Decontamination tests of the 105-H rear face piping, using the Turco 4306-B reagent, was completed. No significant problems were encountered. The waste disposal aspects of this decontamination will be reported by Chemical Effluents Technology, and the user viewpoint will be reported by IPD. Further use of this reagent was planned, but not definitely scheduled, for other reactors. The rear face radiation level is being checked to determine the rate of build-up of the contamination level.

A review of the present skin decontamination methods was initiated. There is a need to establish decontamination procedures for organic coolants. The presently used diphenyls apparently can be removed by the use of soap and water. A literature review indicates that skin absorption is rapid and the decontamination should be done promptly. At the present time the organic coolants under test are not in contact with fuel elements.

Efforts continued on the debugging of the low-level pencil reading device. Problems persist because of insulation leakage and grid current in the high resistance circuits required to measure the minute current.

Calibrations

Work proceeded normally in Calibrations. The transition from a two-shift operation to a straight-day operation was completed with a minimum of work disruption. The total effect of this change has been a reduction of two employees.

Radiological Consultation

Discussions were held with members of the Biology Operation on the application of the power function to calculation of the uptake of strontium and calcium following chronic administration, and on equations involved in estimating the effect of the time of mixing of strontium in the environment on the relative uptake of calcium and strontium.

Problems involved in arriving at limits for the quantities of various radioactive materials emitted from the stacks of production plants at Hanford have been reviewed. The primary objective of this study is to provide limits for Sr^{89} , Sr^{90} , Ru^{103} , Ru^{106} , Zr^{95} - Nb^{95} , and certain of the rare earths. Preliminary limits for the quantities of certain of these isotopes on the ground as based on the uptake into plants have been tentatively established, and work is proceeding to relate these to the quantity emitted from the stack.

The status of integrating and optimizing of biological and regional monitoring was reviewed. Statistical analyses show good correlation for I^{131} between cumulative stack emissions and deposition in rabbit thyroids, with a 12-day lag. Cost data are being compiled to show effects of present and future changes. A reduction of on-site rabbit and vegetation sampling is indicated.

Radiological Disaster Studies

Calculations on the potential damage from a reactor accident were continued. Values of the integrated concentration versus time down-wind from both a ground source and

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a 200-foot elevated source have been completed for emissions into winds at speeds of 1 meter/second, 5 meters/second, and 10 meters/second under strong inversion conditions, moderate inversion conditions, neutral conditions, and unstable conditions. Information was also developed to permit estimates of the areas affected at various levels of exposure in the environment. These calculations were all performed on the basis of one curie emitted so that variations in quantities emitted and in time of emission may be taken into account by the use of the same curves. Revised estimates of the areas and distances which would be involved for a prolonged emission from a 200-foot stack of 25 per cent of the fission products from various power levels between 0.5 and 500 MW were made using these data. It was assumed that the 25 per cent release included all of the noble gases, the bulk of the halogens, but only 10 per cent of the other materials. Under these conditions, the estimates of areas affected and distances involved are drastically changed from previous computations.

Radiological Standards

The standard Part V, "Special Radiological Conditions," was reviewed with representatives of IPD, CPD, FPD, and HLO. Part V contains radiological stipulations which are included in certain AEC contracts let to construction. The revised Part V will be forwarded to HAPO Counsel offices for comment and further forwarding to the Atomic Energy Commission.

A listing of the probable changes in the Radiation Protection Standards to be undertaken this fall was made to radiation monitoring groups. It was indicated that no major change in existing standards are presently contemplated and that an additional standard, RPS 7.2, Radioactive Liquid Waste Disposal, will be issued shortly.

Proposed revisions to AEC Manual Chapter 5170, Utilization and Disposal of Excess and Surplus Personal Property, were prepared for forwarding to AEC-HOO. Comments were forwarded on the proposed revision of AEC Chapter 0550, Codes and Standards for Health, Safety, and Fire Protection. Work continued on the proposed revision and modification to AEC Manual Chapter 0230, Appendix 092, Records Disposition Policies and Regulations. Presently under consideration is a separate radiation protection retention schedule as an improvement over the present scattering of radiation protection records in separate schedules.

Columbia River Studies

Calculations were made on the isotopes, which should be analyzed-for, in order to account for a sufficiently large fraction of the potential environmental exposure from drinking river water. The analysis, based on data provided by Analytical Chemistry, showed that 8 identified radioisotopes cause about 75 per cent of the potential exposure, 15 cause about 90 per cent, 20 cause 95 per cent, etc.

C. EMPLOYEE RELATIONS

Safety and Security

There were two medical treatment injuries for a frequency of 0.52. No security violations occurred.

Suggestions

Radiation Protection personnel submitted four suggestions. Five suggestions were received for evaluation and a total of nine suggestions remains to be evaluated.

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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
R. H. Owens	10/15/57	Knolls Atomic Power Laboratory - AEC Schenectady, New York	Discuss self-service badge procedures.	HA Meloeny	No	3705:300
R. L. Bouque	10/18/57	Booz-Allen & Hamilton San Francisco, Calif.	Discuss radiation protection policies and procedures.	AR Keene & Staff	No	3746,329 300 Area
Charles Freeling	10/24-25/57	Product Engineering Co. Portland, Oregon	Discuss detailed badge processing procedures.	RL Junkins IF Kocher	No	3706:300

VISITS TO OTHER INSTALLATIONS

J. W. Healy	10/7-8/57	Brookhaven National Laboratory, New York	Attend meeting of Program Directors of Division of Biology & Medicine, AEC	CL Dunham JB Cooper FP Cowan	Yes	
	10/9/57	Knolls Atomic Power Laboratory - GE Schenectady, New York	Discuss radiation protection problems.	LJ Cherubin JJ Fitzgerald	Yes	
	10/28-31/57	American Nuclear Society Atomic Industrial Forum New York, NY	Attend meetings - Reactor safety conference.	JD Luntz E. A. Wiggin	No	
H. V. Clukey	10/23/57	U.S. Army Corps of Eng. Wenatchee, Washington	Attend public hearings on Columbia River Basin Development.	Gen. LH Foote	No	

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REGIONAL MONITORING

The general findings are summarized in the following:

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Average Activity Density</u> <u>/uc/cc</u>	<u>Trend*</u> <u>Factor</u>
<u>Drinking Water and Related Materials</u>			
Benton City Water Co. Well	alpha	1.2×10^{-8}	--
100 Areas	beta	$(0.007 \text{ to } 1.5) \times 10^{-5}$	+2
200 Areas	beta	$(0.8 \text{ to } 1.9) \times 10^{-7}$	--
Pasco, Kennewick, McNary Dam	beta	$(0.03 \text{ to } 3.7) \times 10^{-6}$	--
Backwash Solids -			
Pasco Filter Plant	beta	0.16 /uc/gm	-2
Backwash Liquids -			
Pasco Filter Plant	beta	3.5×10^{-6}	--
Anthracite, Sand Filter -			
Pasco Filter Plant	beta	8.0×10^{-4} /uc/gm	--
<u>Other Waters and Related Materials</u>			
200 West Wells	beta	$< 2 \times 10^{-7}$ to 3.2×10^{-3}	--
200 East Wells	beta	$< 2 \times 10^{-7}$ to 6.2×10^{-2}	--
Wells Near 200 Areas	beta	$< 2 \times 10^{-7}$ to 1.4×10^{-6}	--
Outlying Wells	beta	$< 2 \times 10^{-7}$	--
Columbia River -			
Hanford Ferry	beta	4.8×10^{-5}	--
Columbia River -			
Below Reactors	beta	3.7×10^{-5}	--
Columbia River -			
Paterson to McNary	beta	1.5×10^{-6}	+2
Columbia River - Mud	beta	$(0.3 \text{ to } 2.3) \times 10^{-4}$	--
Raw Water - Operating Areas	beta	$(0.02 \text{ to } 3.3) \times 10^{-5}$	--
Reactor Effluent Retention	beta	13,000 to 48,000 /uc/sec/reactor	--
Basins to River		$(4.0 \text{ to } 8.6) \times 10^{-3}$	--
Reactor Effluent Retention	alpha	< 0.04 /uc/sec/reactor	--
Basins to River		$< 5 \times 10^{-2}$	--
I-131 in Farm Wastes to			
River	I-131	1.6×10^{-6}	+2
I-131 in Columbia River -			
Hanford	I-131	9.5×10^{-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.

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<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Average Activity Density</u> <u>/uc/cc</u>	<u>Trend*</u> <u>Factor</u>
<u>Atmospheric Pollution</u>			
Gross Alpha Emitters	alpha	$(< 0.2 \text{ to } 3.9) \times 10^{-15}$	-2
Gross Dose Rate - Separations Areas	beta-gamma	0.7 to 3.9 mrad/day	--
Gross Dose Rate - Residential Areas	beta-gamma	1.1 mrad/day	--
Active Particles - Separations Areas	beta	$(0.6 \text{ to } 1.8) \times 10^{-12}$	+2
I-131 Separations Areas	I-131	$(0.3 \text{ to } 2.1) \times 10^{-12}$	+2
I-131 Separations Stacks	I-131	0.4 curie/day	--
Ruthenium - Separations Stacks	Ru-103-106	0.05 curie/day	+2
Active Particles - Wash., Idaho, Ore., Mont	--	0.028 to 0.85 ptle/m ³	+12
Active Particles - Project	--	0.006 to 0.10 ptle/m ³	--
<u>Vegetation</u>			
Environs of Separations Areas	I-131	1.8×10^{-5} /uc/gm	+9
Residential Areas	I-131	1.6×10^{-5} /uc/gm	+8
Eastern Washington and Oregon	I-131	1.6×10^{-5} /uc/gm	+8
Fission Products Less I-131 Wash. and Ore.	beta	2.7×10^{-4} /uc/gm	+3
Alpha Emitters - Separations Areas	alpha	$(0.2 \text{ to } 4.1) \times 10^{-6}$ /uc/gm	+2

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

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RADIATION MONITORING

	<u>Hanford Laboratories</u>	<u>Minor & Major Construction</u>	<u>Others</u>	<u>Oct.</u>	<u>Year to Date</u>
Special Work Permits	1907	334	119	2360	26,522
Routine and Special Surveys	906	435	215	1556	23,489
Air Samples	2173	89	193	2455	23,348
Skin Contamination	7	6	0	13	195
*Class II Radiation Incidents	0	0	0	0	1
**Class II Radiation Incidents	0	0	0	0	6

EXPOSURE EVALUATION AND RECORDS

<u>Gamma Pencils</u>	<u>Pencils Processed</u>	<u>Paired Readings 180-280 mr</u>	<u>Paired Readings Over 280 mr</u>	<u>Lost Readings</u>
October	141,648	6	6	8
1957 to Date	2,092,372	125	110	85

300-L Area

October	17,412	2	1	6
1957 to Date	93,558	22	12	11

Beta-Gamma Film Badges

	<u>Badges Processed</u>	<u>Readings 100-300 mrad</u>	<u>Readings 300-500 mrad</u>	<u>Readings Over 500 mrad</u>	<u>Lost Readings</u>	<u>Average Dose Per Film Packet mrad(ow)</u>	<u>mr(s)</u>
October	26,821	833	27	5	70	2.23	5.50
1957 to Date	430,887	6,865	270	66	735	1.72	3.85

Slow Neutron Pencils

	<u>Pencils Processed</u>	<u>Paired Readings 4-12 mrem</u>	<u>Paired Readings Over 12 mrem</u>	<u>Lost Readings</u>
October	3,276	55	16	2
1957 to Date	27,368	356	117	19

Fast Neutron Film Badges

	<u>Badges Processed</u>	<u>Readings Above 50 mrem</u>	<u>Lost Readings</u>
October	1,318	1	0
1957 to Date	9,784	6	11

Bioassay

	<u>October</u>	<u>1957 to Date</u>
Plutonium: Samples Assayed	1,308	11,843
Results above 2.2×10^{-8} $\mu\text{c/sample}$	38	319
Fission Product: Samples Assayed	1,350	12,957
Results above 1.3×10^{-5} $\mu\text{c FP/sample}$	2	15
Uranium: Samples Assayed	376	4,062

*HLC Radiation Monitoring Customers

**Other Plant Components

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Uranium Analyses

<u>Sample Description</u>	<u>Following Exposure</u>			<u>Following Period of No Exposure</u>		
	<u>Units of 10^{-9} μc U/cc</u>		<u>Number</u>	<u>Units of 10^{-9} μc U/cc</u>		<u>Number</u>
	<u>Maximum</u>	<u>Average</u>	<u>Samples</u>	<u>Maximum</u>	<u>Average</u>	<u>Samples</u>
Fuels Preparation	17.8	3.66	59	12.3	2.98	38
Hanford Laboratories	11.4	3.19	11	4.95	1.70	13
Chemical Processing	98.7	11.3	106	53.7	6.85	97
Chemical Processing*	64.8	17.9	31	38.4	12.2	18
Special Incidents	1.36	1.08	3	--	--	--
Random	0	0	0	--	--	--

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

Tritium Analyses

	<u>October</u>	<u>1957 to Date</u>
Samples Assayed	0	59

Thyroid Checks

Checks Taken	9	318
Checks Indicating .01 μ c	0	1

Hand Checks

Checks Taken - Alpha	36,328	518,864
Beta-Gamma	27,444	474,692

CALIBRATIONS

	<u>Number of Units Calibrated</u>	
	<u>October</u>	<u>1957 to Date</u>
CP Meter	1,000	10,366
Juno	355	3,542
GM	1,292	13,644
Other	217	1,760
Total	2,864	29,312

Personnel Meters

Badge Film	1,824	21,306
Pencils	13,609	60,570
Other	350	2,065
Total	15,783	83,941

Miscellaneous Special Services

2,298 5,820

Total Number of Calibrations

20,945 119,073

A. R. Keene, Manager
RADIATION PROTECTION

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LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - OCTOBER, 1957

General

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 2.3 per cent which is down 1.5% from September and well below recent experience.

The absenteeism rate was 4.81 per cent, an increase of about 1.37% above September experience.

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

A grievance involving craft jurisdiction was submitted by the sheet metal craft. The step one reply by the Manager, Technical Shops, was not satisfactory to the aggrieved.

Facilities Engineering Operation

FEO Drafting and Reproduction section was given the responsibility of establishing and maintaining a Visual Aid filing and storage facility for all HLO work produced since its organization in October, 1956, and for any future work that will be done for HLO; this group was also given the responsibility of preparing a book entitled "Graphics Standards Manual". The manual is presently being compiled and written.

Currently there are 32 active HLO Equipment and Plant Acquisition and Construction projects, totaling an estimated expenditure of approximately \$15,200,000 excluding PRTR. Of these, 22 projects have been approved and funds in the amount of \$4,216,400 have been authorized. The lack of a financial plan for this year's projects imposes a difficult job of planning and scheduling project activities. Many projects submitted to the Commission for approval as early as April, 1957 have not been authorized and others have been authorized with a minimum of funds.

Indications are that should all planned projects be authorized at this time the result will be a large fund carryover into FY 1959. Also, those projects approved with limited funds are in difficulty. For instance, Project CG-747, Plutonium Fabrication Pilot Plant, which is of highest priority--the rate of expenditure for work on this project indicates all work will cease in November due to the lack of funds, unless additional funds are released by Washington.

The current status of HLO project activity is summarized on the attached report. Planned action was initiated for budgeted FY 1959 projects. Budget study work has been initiated for Equipment, Plant Acquisition and Construction Projects for FY 1960, and Revisions for FY 1959.

The following is the status of jobs under \$5,000 which are currently active in FEO:

1. Steam Line Alterations and Addition, 141-F, 141-FS and 141-N Bldgs. Plant Forces Work Review approved 10-18-57. Requested estimate from 100-F Area Maintenance.

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2. Dog Pen Drainage and Kennel Repair. Plant Forces Work Review approved 10-18-57.
3. 100-F Area Pasture. Work complete.
4. 108-F Train Shed - winterizing of ventilation unit. Work proceeding.
5. Manure Auger, 141-F Bldg. Work Order A-57793 issued to 100-F Maintenance. Work proceeding.
6. Whole Body Animal Counting Room, 141-F. Work assigned to Construction Forces. Estimate received.
7. Hood Repair and Relocation, 329 Bldg. Work to proceed when Plant Forces are available.
8. The correction of 306 Bldg. heating and ventilation system is continuing. This work is estimated as 60% complete.
9. The procurement and installation of the Shielded Cave in the 325 Bldg. (AR-57-HL2-47) is progressing as follows: Expenditures and commitments as of 10-25 were \$19,096; balance left is \$2,234; work is estimated to be 90 per cent complete. Work to be completed consists of installing monorail, placing face bricks, testing system for leaks and labeling of flow diagram on operating face of cave.
10. The survey and inspections of HLO Unfired Pressure Vessels and Pressure Piping Systems is continuing. Percentage of completion is estimated to be 5 per cent.
11. The recommendations in the engineering study for rearrangement of Library and Files Building offices were partially adopted resulting in the issuance of the necessary work order. The remainder of the recommended work is still under review, but the required partitions have been requested.
12. A roof for covering the gas cylinders on the loading dock at 326 Bldg. is under construction by Construction Forces.

A Property Disposal Request was issued to remove the underground water and sewage facilities, located at P-11, from HLO Plant Accounts. The book value of these facilities is \$23,588. HLO is relieved of further accountability for the P-11 Project, except for the Butler experimental building and exclusion fence.

All facilities at the Hot Semiworks, which is on standby, have been winterized.

An Operating Procedure, Job Hazard Breakdown and Emergency Alarm Notice was prepared for each of the five elevators located in the HLO buildings in 300 Area.

Photographs of the majority of HLO structures have been taken. These will be used by the building engineer and others.

Five purchase requisitions were processed for an estimated cost of \$300. Two bid reviews and two emergency purchases were also processed.

Third Party Inspection of the elevator in 108-F Bldg. was made on 10-23.

The Drafting Operation produced and revised about 187 drawings. The backlog of work is heavy. Work in the 231-Z Bldg. is very heavy and is being farmed out to CEO. The backlog in 1707-D approximates one man year's work. Graphics work is being performed in FEO; however, the load is heavy and the majority is being

farmed out to R & U. Approximately 11,700 square feet of drawings were reproduced on the ozalid print machine during the month. Some of the major designs in progress are as follows:

1. "Re-design of Hanford Slave Manipulator" - J. E. Jelacie, Engineering Designer - C. L. Boyd, Engineer. Design layout completed and approved - Detail drafting 95 per cent complete.
2. "Hot Press Die Unit" - R. H. Somerville, Engineering Designer - T. C. Tverberg, Engineer - L. G. Sagerser, Draftsman. The purpose of this furnace design is to provide Hot Press Die assembly for experimental slugs. Design complete and approved - drafting 85 per cent complete.
3. "Chamber Shield" - Engineering Designer, E. J. Middlebrough - Engineer, W. J. Friesen. The purpose of this design is to provide a shield and drive assembly for the comparison fission chamber. Design 30 per cent complete.
4. "Vacuum Canner" - Engineering Designer, J. E. Jelacie, Engineer Wyman. The purpose of this design - to provide necessary equipment to enable operator to weld/can 10 slugs per each vacuum pump-out of facility instead of one which is the limit of existing machines.
5. Zirconium Welding Jig - Engineering Designer, R. H. Somerville, Detail Draftsman, V. L. Seaberg. This design is to provide means of welding experimental sections of Zr2 in inert atmosphere.
6. "Welding Chucks" - Engineering Designer, R. C. Carlson, D. Kaulitz, Engineer. Chucks were designed to rotate Oxide fuel elements during case welding.

A consolidated file of electrical data, drawings, loads and the like for HLO buildings in the 300 Area is being set up.

The last two Information Meetings covering Unfired Pressure Vessels and Piping systems were presented on October 4 and 11. The average attendance per meeting for the four meetings was 47 persons. This average is approximately 10 per cent of our exempt roll. Comments from those in attendance concerning the importance, organization and presentation were exceedingly complimentary. The AEC requested and received a complete summary of these information meetings.

Routine reports were issued on Bismuth, Gadolinium and Europium forecasts for FY 1958 through 1961; and, AEC Bulletin #17.

A report on the status of General Plant Projects for FY 1958 was issued.

A report of expenditures on all HLO projects through the fourth quarter, FY 1959, was issued.

Technical Shops Operation

Total productive time for the month was 13,735 hours. The total shop work backlog is 27,200 hours of which 40% is scheduled to be completed by December 1. Overtime worked during the month was 3.9% (725 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
Fuels Preparation Department	2246	16.4
Irradiation Processing Department	3015	22.0
Chemical Processing Department	1915	13.9
Hanford Laboratories Operation	6239	45.3
Construction Engineering Operation	-	-
Miscellaneous	320	2.4

Customer demands for service remained firm in all components of the operation. Requests for priority service decreased permitting a reduction in overtime work from a high of 7.4% the previous month to 3.9% for the current month. The latter figure is above the estimated overtime requirements by approximately 25% and emphasis shall be placed on customer cooperation and judicious scheduling to attempt a reduction in the overtime required.

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

One jurisdictional grievance was received from the sheet metal craft protesting the assignment of work to the millwright craft. The step one answer was considered unsatisfactory.

Technical Information Operation

A decision to proceed with the planned modification of the IBM system used in the Classified Files was made sooner than anticipated because of special circumstances. The Data Processing Operation, while attempting to correct an out-of-sequence condition in the records of document activity, had to carry out about a fourth of the planned conversion. It appeared that considerable savings could be achieved by going forward with the entire conversion at once. The conversion is proceeding satisfactorily and should be completed shortly.

The new procedure for field routing of classified documents became effective October 14. Letters to the Level 2 Managers pointed out (1) that the procedure was not to be used for documents having circulation restrictions, and (2) that the procedure was being given a trial and would be discontinued if it proved impractical or unsatisfactory.

Comments were prepared for the HLO Manager on AEC Manual Chapter 3202, "Printing and Dissemination of Information Resulting from AEC Research and Development Activities". This important chapter has not yet been officially received from the Commission. In the meantime, Contract Administration Operation is collecting comments on the chapter from the HAPO Departments.

Possible procedures which could be used to obtain compliance with the AEC's new requirement that all unclassified reports and papers be reviewed by the Patent Branch prior to release from Hanford have been appraised. On October 25, a letter was received from the Patent Branch in Washington suggesting that papers be categorized on the basis of the likelihood that they would contain patentable information. HAPO has not yet adopted a final position on the matter. It is intended to submit a letter to the AEC asking whether HAPO's present procedures do not meet the Commission's requirements, and pointing out that if they do not, HAPO will require more time to study the entire matter. Comments will also be sought from HAPO components on the category plan suggested by the AEC.

At the request of the HLO Manager, a study was made of the reason for the delays in publishing formal research and development reports. It was concluded that the time required for publication could be substantially reduced only if a Publication Operation were created that could do the entire job within its own shop. Since this would undoubtedly increase costs and would entail some capital expenditures, no change is expected. A number of improvements within the present framework will be attempted without materially increasing costs. These include additional editorial help, more messenger time allotted to the pick-up and delivery of formal report components, addition of a graphics illustrator to the drafting room, etc.

Procedures to obtain HAPO compliance with appropriate classification requirements are being worked out. A revised Hanford Classification Guide will be prepared and revisions of certain basic AEC guides may be suggested in order to obtain a Hanford Guide that is compatible with HAPO operation.

The Specialist, Classification-Declassification met with representatives from other HAPO Departments to consider a program to accomplish the following objectives:

1. Submit proposed revisions for basic AEC guides and get AEC approval prior to submission of a revised Hanford Guide.
2. Define areas where compliance with the present Hanford Guide would seriously disrupt our production effort.

3. Prepare, submit and obtain AEC approval of a revised Hanford Guide by January 17, 1958.

Arrangements have been completed for a tour of the library on November 9 by the members of the Puget Sound Chapter of the Special Libraries Association.

There was one minor mishap during the period. A Files messenger failed to set the emergency brake on his truck so it rolled backwards and the door caught on a post. Damage was minor.

Returns continued to come in to the letter of September 3 which asked for Departmental authorizations to send periodicals to plant personnel. To remind customers of the need to respond, additional notices were put in What's New In the Library and in Management News Bulletins. Those who did not respond have been cut off from all regular circulation of periodicals. Net result of the efforts to reduce periodical circulation has been a reduction of about 60 per cent.

The rearrangement of furniture and equipment in the main file room in 3760 Building has been completed. The new arrangement appears to be thoroughly practical. The location of the IBM tub files in the center of the room with the desks around the outer edge created a much quieter and more efficient work area. The arrangement also gives freer aisle space and better work flow.

New shelves have been built to improve efficiency. Corner shelves now store documents awaiting processing. Specially designed document sorting shelves have been installed in the vault. Placing the messengers in the vault has cut down document handling and eliminated noise and confusion in the main File room. A work order has also been issued to construct some specially designed shelves for the package wrapping area.

The 100-H Extension Files were moved to the 1761-H Building. The new space is much more pleasant and will be more convenient for IPD management. A request to consider smaller quarters in the 703 Building for the 700 Extension Files has been received. The new space offered was very unsatisfactory. We proposed that part of the space presently occupied be released; about 288 square feet would be kept for the Files office, which would be adequate for two clerks.

Work Load Statistics

	<u>September</u>	<u>October</u>
Documents routed and discharged	20,934	17,338
Documents issued	18,658	13,806
Documents destroyed	3,430	5,403
Reports abstracted	169	233

Work Load Statistics (cont'd)

	<u>September</u>	<u>October</u>
Formal R & D reports issued	19	17
Document classification changes	886	648
Books circulated	2,143	1,971
Periodicals circulated	5,382	3,214
Volumes added to the collection	289	221

Radiographic Testing Operation

A high point in Radiographic Testing Operation activity was achieved for the month of October as reflected in the number of tests performed. A total of 1084 tests were made of which 642 were radiographic exposures (including x-ray and gamma-ray exposures) and 442 were supplementary tests. The supplementary tests consisted of work with dye penetrant, dimensional checking, eddy current, leak detection, magnetic particle, and ultrasonics. Work was done for 20 different organizational components representing all of the operating departments and service operations. A total of 15 reports were issued detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on 23 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated under Testing Statistics.

Major work done this month can be divided into four different categories: Maintenance (including preventative maintenance), assistance in research and development programs, new fabrications and testing of as-received materials and stores.

Maintenance - Two different jobs were involved with pressure vessel inspections and compliance with code requirements. Work was continued on the pressure vessel survey being conducted in the 100-D and DR Areas. Almost all of the vessels examined to date were found to be outside of code requirements. Suspected welding on the autoclaves in the 303 Area likewise proved to be deficient in regard to code work. Continuation of the examination of various stainless steel process lines in the Redox building was extended to pipe sizes other than the 2" size examined to date. One inch, three inch, and four inch lines were successfully examined and the results reported confirming previous findings. Out of nine lines examined, two 2" lines showed signs of excessive corrosion. Preliminary tests were run with the gamma survey equipment recently fabricated for the detection of incipient rotting in power poles. The sensitivity of this equipment was found to be so great that additional shielding will be required for effective operation. Attempts were made to locate cracks in the far downcomer of the 100-DR reactor using a Halogen leak detector. Due to lack of satisfactory site preparation, satisfactory operation of the test was not possible. In the course of preparing the downcomer for further examination, a hydrostatic test proved to be effective in locating the leaks and further leak detection work by Radiographic Testing

Operation was suspended. Examination of a damaged crank shaft from one of the large diesel coaches for possible cracks was made at the request of the Transportation Operation, Relations and Utilities Operation. Magnetic particle methods were used and the part proved to be sound and useful.

Assistance in research and development programs. A large part of the work had to do with fuel elements of various configurations and components. Two different fuel element designs were examined for integrity of closure welds and the homogeneity of aluminum cans was determined for a co-extruded element. Zirconium tubing continues to be an area of prime interest revolving about both process tubes and various sized zirconium tubing for fuel element components. Testing techniques are continually being improved to give more accurate results in a shorter time. Satisfactory fabrication of zirconium continues to appear to be troublesome as evidenced by the quantity of defective material discovered. Miscellaneous work in the Research and Development effort included zirconium test coupons encapsulated in aluminum cans filled with NaK for effective heat transfer and continued work on a thermocouple reference capsule for insertion in a reactor tube.

Vessel fabrication. Work was continued on three vessels currently being fabricated. The HA column and the Redox dissolver have essentially been completed with only a small number of closure joints to be made. The discovery of defective longitudinally welded pipe in the L-cell package has extended the amount of work to be done on this assembly. Three new vessels were examined for conformance with code fabrication, including two small air receivers and one pressurizer vessel.

Testing of as-received material or store stocks. The quality of stainless steel pipe continues to be of interest and both longitudinally welded and seamless material was examined for two different jobs. The homogeneity of shielding lead in a storage cask was determined to be satisfactory for the required application. As a check on the parts to be used in the charge-discharge machine, cast iron shives and bolts were examined for defective material. Though the shives were found to contain casting defects, they were determined to be within limits required for the intended application.

Testing Statistics

<u>Component</u>	<u>No. of Tests</u>	<u>Ft. of Weld or Material</u>	<u>No. of Pieces</u>	<u>Description</u>
A. Chemical Processing Department	141	454	51	Stainless steel process vessels and piping.
B. Construction Engineering Operation	79	47	14	Carbon steel & stainless steel pressure vessels & piping.
C. Fuels Preparation Department	18	35-1/2	12	Carbon steel pressure vessels and Al cans.

Testing Statistics (cont'd)

<u>Component</u>	<u>No. of Tests</u>	<u>Ft. of Weld or Material</u>	<u>No. of Pieces</u>	<u>Description</u>
D. Hanford Laboratories Operation	660	2794-1/2	226	Zirconium and stainless steel process and PWR tubing. Composite U, UO ₂ , Pb, NaK, steel and aluminum elements. Pb shielding. Carbon steel structural welds.
E. Irradiation Processing Department	276	300	82	Cast iron machine parts. Carbon steel and stainless steel pressure vessels and piping.
F. Relations and Utilities Operation	55	65	21	Wooden power poles, and forged steel crankshaft.
Totals	1084	3553	470	

Laboratories Administration and Technical Liaison

Four new Organizational and Policy Guides were issued. Timely revisions were issued on specific sections to seven existing guides. "Authorization and Performance of Work" was reviewed for issuance when the AEC Manual Chapters on this subject are accepted by G.E.

The following contracts were approved:

MRO-12 RCA Service Co., Inc., for service to electron microscope.

MRO-13 North American Philips Co., Inc. for service of electron microscope.

SA-34 Future Farmers of America, Inc. for care of sheep.

DDR-24 Nuclear Metals, Inc. for research and development services.

There were no new requests for Assistance to Hanford and for service under the KAPL program.

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

- (a) Two sedan deliveries were assigned to Technical Information Operation. These vehicles were previously withdrawn daily from the 300 Area Motor Pool.

- (b) One panel truck was assigned to Ceramic Fuels Operation from a temporary loan basis.
- (c) One new panel truck replacing one in service.

Difficulties continued in the securing of inter-area transportation from the 300 Area Motor Pool. Changes made late in the month by Transportation and Maintenance Operation are expected to minimize future difficulties.

A request for the temporary assignment of three pickup trucks for field work by Atomospheric Physics Operation was filled with Transportation and Maintenance Operation.

Itineraries of visits for five groups to the Hanford Laboratories facilities were arranged and conducted.

Technical papers for the 1958 Nuclear Congress and Geneva Conference were coordinated.

Manager,
Laboratory Auxiliaries

JL Boyd:lt

MONTHLY PROJECT REPORT

 HW-53299 DEL
 OCTOBER 1957

PROJECT NUMBER	TITLE	HANFORD LABORATORIES OPERATION										OCTOBER 1957	
		USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION	PROJECT PROGRESS IN PER CENT			STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE	DESIGN CONST.		
General AEC-2-21	Plant Projects - FY 1956 AEC-2-21X-56-L-2	Reactor & Fuels	\$140,000	\$140,000* 4-4-57	100	5	100	5-23-56	As	12-7-56	Completed	9-28-56	5-1-58
REMARKS: Construction Operation initiated fabrication this month and is proceeding satisfactorily.													
General AEC-2-21	Engineer: R. W. Dascenzo Plant Projects - FY 1957 AEC-2-21-57-N-2	Radiation Protection	\$150,000	\$150,000 2-4-57	100	N. S.	100	2-18-57	6-15-58*	12-15-57*	6-15-58*	11-15-57*	7-15-58*
CA-608	Shielded Personnel Monitoring Station - 747 Building Engineer: D. S. Jackson	REMARKS: The Architect-Engineer submitted his final design for review on 10-18-57. It appears it is approximately 80% complete. The funds available for G. E. review of design have been expended. The project presently appears to be about 7½ months behind schedule. A meeting was held between Company and AEC representatives in an attempt to expedite this project to completion. The Commission has not revised the project schedule. *Estimated dates. Present directive completion date is 12-31-57.											
CA-608	Corrosion Testing Facilities - 314 Building Engineer: R. W. Dascenzo	Reactor & Fuels	\$135,000	\$135,000 5-2-57	100	55	100	10-3-56	2-2-58	5-2-57	1-25-57	3-2-58	
CA-700	Geological and Hydrological Wells - FY 1957 Engineer: D. S. Jackson	Chemical Research	\$122,000	\$122,000 6-27-57	100	97	100	11-8-56	As Wells	10-24-56	Completed	12-10-57*	
CA-700	REMARKS: USGS has completed 14 wells and a total of 5620 feet. The Fixed Price Contractor has completed 17 wells and 5172 feet of hole. USGS is an estimated 99% complete. The Fixed Price Contractor is 85% complete. *Since 3 wells have been added to the Fixed Price Contract it will eventually be necessary to extend the contract completion to approximately December 31, 1957.												
CA-724	High Level Exposure Facility Addition - 141-H Building Engineer: J. T. Lloyd	Biology Research	\$26,000	\$26,000 2-11-57	100	61	100	3-11-57	10-1-57	7-16-57	6-20-57	12-5-57*	
REMARKS: Customer has beneficial use. Three minor exceptions are still incomplete. *Directive completion date 1-15-58.													

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

HW-53299

October, 1957

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE		BENEFICIAL USE DATE	PROJECT COMP. DATE
				AMOUNT DATE		DESIGN SCHED ACTUAL	CONST. SCHED ACTUAL	DATE	DESIGN CONST.			
CA-720	Ventilation System Improvements- 222-B Building	Chemical Research	\$ 73,000	\$ 73,000		100	22	4-23-57	7-15-57	12-15-57	5-28-57	12-15-57*
		REMARKS: The Fixed Price Contractor started work at the job site on October 17, 1957. The foundations and slabs for the equipment have been poured. The condensate line on the east side has been tied into the sewer and the installation of the 28" duct on the roof has been started. Reworking of the existing unit on the north end has been started. Construction Operation and Plant Forces performed very little work during the month.										
CG-733	Plutonium Metallurgy Facility	Reactor & Fuels	\$295,000	\$295,000		100	22	5-14-57	6-10-57	Completed	10-1-57	6-15-58
		REMARKS: Bids for the Fixed-Price Contract were opened on 10-22-57. Seven bids were received and are being reviewed. Work on the Fixed-Price Contract will probably start 11-4-57. Construction Operation has completed removal of all partitions and decontamination work. New concrete block walls require plastering and painting. Sub-grade piping is complete except for resurfacing the backfill. Work has been started on installation of ventilation ducts and piping.										
IR-224	Biology Controlled Activity Water System	Biology Research	\$ 19,900	\$ 19,900		100	Not Sched	1-2-57	7-22-57	11-8-57	4-11-57	11-8-57*
		REMARKS: All piping has been installed. The pumps and pressure tank are in place. The building is nearly complete. Installation of tank fittings, sprinkle system and final electrical tie-in remain to be completed.										
General AEC-2-23-58-L	Engineer: D. S. Jackson Plant Projects - FY 1958	Chemical Research	\$ 77,500	None to Date	None to Date	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 Building and to let one Fixed-Price Contract. It is planned to add this project to other project activities in this building and all will be part of budget item 58-b-4. *Months after authorization.										
CG-757	Coolant Radio-Analysis Laboratory Addition - 1706-KE	Engineer: R. W. Dascenzo										
		REMARKS: Project Proposal and Plant and Equipment Analysis Report being revised.										
CA-760	Expansion of the 3745-B Building	Physics & Instr.	\$200,000	None to date	None to date	To be est	To be est	1*	9*	16*	6*	16*
		REMARKS: Project Proposal and Plant and Equipment Analysis Report being revised.										
	Engineer: R. C. Ingersoll											

G-13

MONTHLY PROJECT REPORT

HW-5329

OCT 1957

MONTHLY PROJECT REPORT															HW-5329' DECL 1957	
HANFORD LABORATORIES OPERATION																
PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT				STARTING DATE		BENEFICIAL USE DATE	PROJECT COMP. DATE			
				AMOUNT	DATE	DESIGN SCHED	ACTUAL	CONST. SCHED	ACTUAL	DATE	DESIGN CONST.		DATE	DESIGN CONST.		
CA-266	Addition to the 314 Building Engineer: A. W. Hervin	Reactor & Fuels	\$ 46,000	\$ 6,800	10-3-57	100*	To be est	10-14-57*	0	4-20-58	10-4-58	3-4-58	10-4-58			
		REMARKS: Directive No. AEC-117 was issued on October 3, 1957 authorizing the Commission \$6,800 which is an interim design authorization. A Work Authority to General Electric Company was issued by the Commission on October 4, 1957, authorizing \$4,500 for preparation of design criteria and review of A-E's work. *The design criteria is currently being routed for signature and preliminary design is completed.														
CA-269	Additions to the 622 Building Engineer: J. T. Lloyd	Physics & Instr.	\$ 80,000	None to date		0	0	1-1-58*	0	8-1-58*	1-1-59*	7-15-58*	2-1-59*			
		REMARKS: Project proposal awaiting AEC approval. HLO agreed if limited funds are available at present that interim authorization of design funds is desirable. *Based on AEC approval prior to 12-1-57.														
	Alterations to the 327 Building Engineer: A. W. Hervin	Reactor & Fuels	\$ 80,000	None to date		0	0	1-1-58*	0	5-1-58*	12-1-58*	3-15-58*	1-1-59*			
		REMARKS: Project proposal is being revised. *Based on AEC approval by December 1, 1957.														
CA-278	Expansion of the 305-B Building Engineer: R. C. Ingersoll	Physics & Instr.	\$ 55,000	None to date		0	0	12-1-57*	0	5-15-58*	9-1-58*	4-1-58*	10-1-58*			
		REMARKS: Project proposal approved by the AEC-HOO 10-25-57 and forwarded to the AEC Washington for approval. *Based on AEC approval by November 1, 1957.														
IR-232	Repair Damage and Additions to Heating System - 747 Building Engineer: J. T. Lloyd	Laboratory Aux.	\$ 15,000	\$ 15,000	8-29-57	90	To be est	7-1-57	15	10-24-57	As Completed	8-12-57	12-29-57			
		REMARKS: Contract was awarded to Mokler Plumbing & Heating Company. Work was started on 10-24-57. All G. E. purchased materials are on hand. Steam line for heaters is being fabricated.														

PROJECT NUMBER	TITLE	ENGINEER	HANFORD LABORATORIES OPERATION										BENEFICIAL USE DATE	PROJECT COMP. DATE	
			USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE					
					AMOUNT	DATE	DESIGN SCHED	CONSTR. SCHED	ACTUAL	DATE	DESIGN CONST.				
CP-600	Alterations to the 321 Building	Engineer: J. T. Lloyd	Chemical Research	\$ 63,000	None to date	None to date	0	0	0	0	2-17-58*	6-17-58*	4-17-58*	8-17-58*	
			REMARKS: Project proposal was given to AEC on 10-17-57. Information on prototype, requested by AEC is being routed through proper channels.												
			*Based on AEC approval by January 15, 1958.												
IR-234	Storm Windows and Sun Shades - 326 Building	Engineer: J. T. Lloyd	HLO	\$ 14,000	10-31-57	90	90	0	0	8-1-57	2-1-58	11-15-57	2-15-58		
			REMARKS: The AEC Project Review Board recommended approval of the IR. AEC requests GE furnish specifications and drawings for the bid package. A simplified specification will be presented.												
			This is an AEC managed job.												
CP-620	Equipment Not Included in Construction Projects - Program Class 2900	Engineer: J. T. Lloyd	Reactor & Fuels	\$120,000	2-7-57	100	100	100	100*	5-1-56	12-15-57**	4-1-57	9-30-57		
			REMARKS: *The Physical Completion notice dated 9-30-57 will be issued with \$18,000 in accruals to complete exceptions. Exceptions are: reinstallation of a M-G set that is being repaired by vendor. Sub-contractor was to complete tests by 10-22-57. Shipping date is uncertain. Centrifugal casting mechanism was scheduled for completion 10-25-57. No further word has been received. Installation contractor has submitted an estimate to install this equipment.												
			REMARKS: **Beneficial use date changed from 8-31-57 due to delay in delivery of M-G set.												
CP-660	Modifications and Additions to the Metallographic Cell - 327 Building	Engineer: D. S. Jackson	Reactor & Fuels	\$147,000	3-15-57	100	100	72	50	3-27-57	12-31-57	4-1-57	12-31-57		
			REMARKS: The cell was released to plant forces on 10-18-57. Construction is in the steep part of the schedule at present. The 50% vs 72% represents a lag of less than 2 weeks behind schedule. The project should be completed by the Directive completion date and within the authorized funds. The major uncertainty at present is the Metallographic Sample Manipulator which is scheduled for delivery 12-20-57. Efforts are under way to expedite this delivery.												

MONTHLY PROJECT REPORT

HW-5329C
October, 1957

DEF 1957

MONTHLY PROJECT REPORT														HW-5329C October, 1957		DEL	
PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE						
				AMOUNT	DATE	DESIGN SCHED	CONST. SCHED	ACTUAL			ACTUAL	DESIGN CONST.	DATE				
CG-661	Additional Heat Generation Facility - 189-D Building Engineer: A. W. Hervin	Reactor & Fuels	\$664,000	\$664,000	9-18-57	30	0	0	12-6-56	9-30-59	11-1-58	8-31-59					
		REMARKS:				39	0	0	1-15-59								
The Purchase Specification HWS-6189 for the Direct Current Power Supply - 189-D Building is being routed for signatures. Invitations have been let for bids on the Heat Exchangers. Future design activity will be slow pending receipt of vendor information.																	
CG-672	Monochromatic Neutron Beam Facility - 105-KE Building Engineer: H. Radow	Physics & Instr.	\$195,000	\$195,000	8-12-57	100	4	1	5-21-56	6-1-58	10-1-58	5-1-58					
		REMARKS:				100	1		11-1-57								
Work Release was issued on 10-15-57 to Construction Operation for the installation of project equipment. Installation of beam shutter is in progress.																	
CA-681	Hanford Equipment in the ETR Engineer: H. Radow	Reactor & Fuels	\$1,200,000	\$900,000	8-12-57	100	0	0	9-17-56	12-1-58	5-29-57	10-15-58					
		REMARKS:				100	0		2-15-58								
AEC-100 hasn't changed installation starting date of 2-15-58. AEC-HOO currently preparing a letter reviewing the overall ETR material status and outlining the areas, based on available materials, in which work could be presently performed. The vendor's approval drawings on the heat exchanger have been received and design drawings are being revised accordingly. Phillips still needs to furnish design information on the common relief header.																	
CG-682	High Level Cut-Off and Examination Cell - 327 Bldg. Engineer: A. W. Hervin	Reactor & Fuels	\$430,000	\$430,000	8-20-57	100	0	0	7-18-56	10-1-58	6-26-57	10-1-58					
		REMARKS:				100	0		3-1-58								
Six bids have been received on the Meehanite cell and these are being reviewed at the present time for compliance with the specifications. Quotations on other equipment such as the Positioner, Ammeter, and the motor control center have been considerably less than estimated.																	
CA-695	Radio Telemetering Network Engineer: J. T. Lloyd	Physics & Instr.	\$89,000	\$89,000	1-10-57	100	Not Sched	20*	2-22-57	4-15-58	5-27-57	5-15-58					
		REMARKS:				100			7-25-57								
Specifications were approved. AEC sent out advance notice. Bid package will go out 11-1-57 to selected bidders. Bid opening will be on December 4, 1957.																	
*Wind charger contract only.																	

MONTHLY PROJECT REPORT

HW-53299

October, 1957

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE		BENEFICIAL USE DATE	PROJECT COMP. DATE	
				AMOUNT DATE	SCHED ACTUAL	DESIGN SCHED ACTUAL	CONST. SCHED ACTUAL	DATE	DESIGN CONST.	DATE		DESIGN CONST.	
TR-241	Padraborse Alterations for Self-Service - 100 and 200 Areas Engineer: D. S. Jackson	Radiation Protection	\$ 18,500	\$ 18,500		100	0	0	7-1-57	As Completed	9-15-57 2-1-58		
		REMARKS:											
		Bids for the fabrication of the badge racks were opened on October 30, 1957. The Madison Lumber and Mill Company, of Kennewick, Washington was the apparent low bidder with a bid of \$4,000 for fabricating the 33 racks.											
	In-Reactor Studies Equipment -- 105-KW Building Engineer: H. Radow	Reactor & Fuels	\$ 15,000*	To be Est. To be Est.	0 0	0 0	0 0	To be Est. To be Est.	To be Est. To be Est.	To be Est. To be Est.	To be det. To be det.		
		REMARKS:											
		Submission of project proposal requesting \$15,000 for preliminary design and establishment of total design cost estimates is being held pending review by Reactor and Fuels.											
New Construction - FY 1958	Critical Mass Laboratory Engineer: R. W. Dascenzo	Physics & Instr.	\$2,000,000	None to date None to date	To be Est. To be Est.	0 0	0 0	None Est. None Est.	None Est. None Est.	None Est. None Est.	None Est. None Est.		
		REMARKS:											
		A new project proposal requesting complete design funds has been prepared and is currently being reviewed and approved by Chemical Processing Department.											
CG-731	Metallurgical Development Facility Engineer: R. W. Dascenzo	Reactor & Fuels	\$2,600,000	None to date None to date	To be Est. To be Est.	0 0	0 0	None Est. None Est.	None Est. None Est.	None Est. None Est.	None Est. None Est.		
		REMARKS:											
		A revised project proposal is being prepared by FEO with a reduced scope of work.											
CG-744	Plutonium Fabrication Pilot Plant Engineer: D.S. Jackson	Reactor & Fuels	\$4,000,000	\$100,000* 4-12-57*	N.S. 7	0 0	0 0	4-22-57 1-15-58	Partial 4-1-59	10-1-58 8-31-60			
		REMARKS:											
		Expenditures for design through 11-2-57 will be approximately \$95,000. Using the allowable 10% over-run on this project it is anticipated all presently available funds will be expended by November 20, 1957. Specifications for some engineered equipment are ready to go out for bids. No authorization has been received to date permitting procurement on this project. No funds are available for obligation. Changes in the equipment list and building (Continued on next page)											
CG-747		Reactor & Fuels	\$4,000,000	\$100,000* 4-12-57*	N.S. 7	0 0	0 0	4-22-57 1-15-58	Partial 4-1-59	10-1-58 8-31-60			
		REMARKS:											
		Expenditures for design through 11-2-57 will be approximately \$95,000. Using the allowable 10% over-run on this project it is anticipated all presently available funds will be expended by November 20, 1957. Specifications for some engineered equipment are ready to go out for bids. No authorization has been received to date permitting procurement on this project. No funds are available for obligation. Changes in the equipment list and building (Continued on next page)											

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October, 1957

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

LABORATORY AUXILIARIES MONTHLY REPORT

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
W. M. Aschhoff	10-23-57	Oregon Metallurgical Company, Albany, Ore.	To discuss melting and casting of zirconium and titanium	R.S. Kemper L.J. Chockie R.B. Socky E.A. Evans T.C. Evans S.H. Bush J.E. Minor	Yes	(325 - 300 (326 (327 (329
24 Washington State College Students	10-11-57	Washington State College, Pullman Washington	Tour	R.W. Benoliel & others	No	(321 - 300 (325 (326 (327 (329 141-M, 100-F 146-FR, 100-F

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
R. B. Socky	10-7-57	NTH Products, Inc. El Cajon, Calif.	To consult and advise on testing progress in efforts to develop sources of supply of zirconium tubing for reactor application.	W. Miller	None
	10-9-57	Carpenter Steel Co. Union, New Jersey		N. Chernick	None
	10-11-57	Wolverine Tube Co. Detroit, Michigan		W.E. Sartor	None
P.F.X. Dunigan	9/30 & 10-1-57	Argonne National Laboratory Chicago, Illinois	To attend Hot Laboratory Committee Meeting	R. Goertz, ANL and other Hot Laboratory Committee members	Yes

EMPLOYEE RELATIONS OPERATION MONTHLY REPORT

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GENERAL

On October 31, 1957 the staff of the Hanford Laboratories Operation totalled 1,169 including 498 exempt and 671 nonexempt employees. Of the total exempt employees there were 432 with college degrees including 414 technical degrees as follows:

<u>BS</u>	<u>MS</u>	<u>PhD</u>
218	102	94

In addition, there were 38 nonexempt employees with college degrees.

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

PERSONNEL DEVELOPMENT AND COMMUNICATIONS

The proposal for Hanford's portion of the 1958 AEC-ASEE Summer Institute of Nuclear Energy for Engineering College Faculty Members was forwarded to HOO-AEC early in the month. It is expected that a decision regarding the proposal will be made early in November.

The AEC has requested that the HLO Short Course proposal be reviewed and modified to include a combination of proposed courses.

Twenty-seven Technical Graduates and 6 Technician Trainees were on assignments within Laboratories at month's end. Twenty-five and 10 were on assignments in the respective categories in September.

HLO attendance at training courses was as follows:

Management Conference on Communications (R & U)	36	
Data Processing (R & U)	10	
Unfired Pressure Vessels and Pressure Piping Systems	46	(Average HLO attendance at each of 4 sessions)
Written Communications	16	
Conference Leading	10	
Understanding People (R & U)	10	

Approximately 70 secretaries and clerks participated in a typing and secretarial proficiency session presented by Miss Mary Stewart of IBM Corporation. One HLO secretary attended an instructor workshop.

Four Manager's luncheons were held for 27 nonexempt employees and 81 exempt employees.

Five HLO employees participated in the October Area Tours for Women.

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

PERSONNEL PRACTICES

Two former G.E. employees were rehired during the month - a Machinist Journeyman

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and Secretary. All other HLO openings were filled by transfers.

Oral notice was given to 22 Radiation Monitors and written notice was given 2 Servicemen and 1 Calibrator during the month. Eleven of the Radiation Monitors will bump to monitoring positions in other HAPO Departments.

Three nonexempt employees were transferred within HLO during the month and 1 new nonexempt transfer request was received.

One 1-year, one 2-year, and one 4-year attendance awards were issued during the month of October.

<u>Service Recognition</u>	<u>5 Years</u>	<u>10 Years</u>	<u>15 Years</u>	<u>20 Years</u>	<u>25 Years</u>	<u>Total</u>
Pins issued this month	4	8				12
Total pins out	482	219	1	2	1	705

BENEFITS AND SERVICES

The Hanford Laboratories Suggestion Board Meeting was not held during the month of October as budget difficulties have not been resolved. As of September 30, 1957, Hanford Laboratories had 31 suggestions pending with recommended awards of approximately \$1915 representing savings of \$18,446.59.

Sixteen suggestions were submitted by Hanford Laboratories employees during October.

A suggestion meeting was called by Contract Administration of Relations and Utilities for the purpose of making uniform the items listed in the Quarterly Suggestion Report, and the method of handling budgeted suggestion funds. Representatives of Employee Relations and Financial Operations were present. A satisfactory agreement was reached by all. As a result of the agreement no change will be made in the past practice in Hanford Laboratories Operation.

The annual General Electric pensioners' dinner was held October 15, 1957 at the Kennewick Social Club. There were 129 pensioners present. H. M. Parker, T. G. Marshall, and J. B. Thompson from Hanford Laboratories Operation were present.

No further action by Contract Administration has been taken regarding the changes to Appendix B regarding benefits for employees entering the Armed Forces. As a result we are unable to issue our OPG covering the subject.

Deferment requests were discontinued for two exempt employees at the request of their supervisors. These employees have been removed from our critical lists and placed in the non-veteran file.

The following is a comparison of participation in the Employee Benefit Plans with other components and HAPO as of September 30, 1957.

	<u>HAPO</u>	<u>HLO</u>	<u>IPD</u>	<u>CEO</u>	<u>R&U</u>	<u>FPD</u>	<u>CPD</u>
Insurance	99.7	99.6	99.8	99.7	99.6	100.	99.8
Pension	99.4	98.6	99.7	98.8	99.6	99.6	99.1
Savings & Stock Bonus	58.8	59.4	61.6	75.1	54.2	56.7	58.2
Savings Plan	11.	8.3	11.6	12.4	9.9	8.9	14.4

Hanford Laboratories participation in the Employee Benefit Plans as of October 31 is listed below:

Insurance	99.6
Pension Plan	98.5
Savings & Stock Bonus	59.2
Savings Plan.	7.9

Hanford Laboratories safety award selection cards were forwarded by this office to 39 former Hanford Laboratories employees who qualified for the safety award and have since been transferred to other components, retired or removed from the payroll for illness or leave of absence. Orders have been placed with Stores for these awards.

Military status of HLO employees is as follows:

<u>STATUS</u>		<u>Non- Technical</u>	<u>Technical</u>	<u>Non- Technical 1-A</u>	<u>*Critical</u>	<u>TOTAL</u>
<u>Reservists</u>	Standby	11	32	0	0	43
	Ready	20	21	6	1	48
	Total	31	53	6	1	91
Non-Veterans		31	38	23	41	133
TOTAL		62	91	29	42	224

Deferments requests pending	7	*Critical refers to employees for whom deferments are currently being requested.
Deferments denied, appealed and pending	0	
Deferments pending at Presidential appeal level	0	

UNION RELATIONS

Discussions are continuing between the Company and the HAMTC regarding the overtime distribution procedure for Radiation Monitors.

There were no developments during the month regarding the negotiations with the Regional Monitors.

Three grievances were received during October. All were jurisdictional grievances pertaining to misassignment of work, and two were filed by employees of FPD. All of these are currently at the Step II level.

The grievances processed by this Operation since January 1, 1957 now total 20. This number includes one non-unit grievance. The following is a breakdown as to the status of these grievances.

<u>Step I</u>		<u>Step II</u>	
Answered satisfactorily*	9	Pending Step II discussion	0
Pending time limit	2	Pending Step II answer	1
		Answered	
		Satisfactorily**	7
		Pending time limit	1

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step I.

**Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

TECHNICAL PERSONNEL PLACEMENT

During the month five PhD candidates visited HLO for interviews; four offers were extended and two acceptances and three rejections were received; and two were placed on the roll.

PhD - HLO - 9/1/57 to date

<u>Cases Considered</u>	<u>Visited</u>	<u>Offers</u>				<u>On the Roll</u>
		<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	<u>Rejected</u>	
60	15	22	5	10	7	4

Offer totals include 14 offers extended during the last recruiting season which were open on September 1, 1957.

Offers accepted do not include 7 acceptances received during the last recruiting season from people who were not on our payroll on September 1. Three of the 7 carry-over acceptances have reported on the roll to date.

A summary of PhD recruiting statistics appear in Table III.

During the month two BS/MS Experienced candidates visited HLO for interviews; no offers were extended; and two offer rejections were received.

BS/MS - HLO - 9/1/57 to date

<u>Cases Considered</u>	<u>Visited</u>	<u>Offers</u>				<u>On the Roll</u>
		<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	<u>Rejected</u>	
36	5	2	0	0	2	2

Two people reported on the roll during September as a result of offers accepted prior to September 1, 1957.

A summary of BS/MS experienced recruiting appears in Table III.

Three Technical Graduates were placed on permanent assignment within Hanford Laboratories during the month.

There were no new transfer requests during the month. One case was closed by transfer to other HAPO effective in September.

Exempt transfer statistics appear in Table IV.

The attrition of exempt personnel for HLO for October:

Transfers	2
Terminations and Deactivates	1 (summer employee - Grad. Student)

HEALTH, SAFETY, AND SECURITY

During October, Laboratories personnel worked a total of 296,223 hours with no disabling injuries. Since September 1, 1956, a total of 2,646,301 hours has been completed with no disabling injuries.

At midnight October 1, HLO completed 396 days or 2,445,878 hours without a disabling injury to qualify for the Manager's Safety Award. Orders for the awards were let on October 28.

There were 29 medical treatment injuries with a frequency of 1.39 as compared to 1.68 last month. For the year to date, the frequency is 1.72.

One fire in a 325 Building laboratory burned insulation and parts on an electrical timer, causing \$50 damage.

Two security violations in October brought the HLO total to 81 for 1957.

The effectiveness of fire warning and fire warden systems was tested in twelve major HLO buildings in fire drills held during Fire Prevention Month. The buildings required from 1.0 to 2.5 minutes to evacuate.

Consultations were held with and approvals given to nine Operations as follows:

- a. with Laboratory Auxiliaries, CEO, and AEC on fire prevention aspects of hot cell addition to 325 Building.
- b. with Plutonium Metallurgy on procedure for obtaining approval of a pressure vessel.
- c. with Radiometallurgy on protective equipment and on Civil Defense
- d. with Mechanical Equipment Development on preparation of safety rules and job hazard breakdowns.
- e. with Process Demonstration & Analysis on explosives handling and use of compressed gas.
- f. with Thermal Hydraulics on safe installation of a vapor degreaser and a ceramic spray facility.
- g. with Radiation Protection Instruments on safety aspect of Plant standard for instrument mounting.
- h. with Technical Shops on substitution of a silver flux with less hazard from fluoride fumes.
- i. to Thermal Hydraulics for enclosure of a high pressure loop.
- j. to Laboratory Auxiliaries for dual use of a compressor.
- k. to construction personnel for welding and cutting on 326 loading dock.

Consultation was also given to Mr. Ed Sadowski of Vallecitos on programming safety for that site.

Assistance in preparation of safety and security meeting material was given to five Operations:

Financial
Operations Research
Technical Shops
Plutonium Metallurgy
Semi Works

Information on zirconium-acid reaction hazards was forwarded to Chemical Development Operation. Information on the Windscale Incident was distributed to many of the research and development operations.

Scheduled medical examinations were 90 per cent completed this month.

SALARY & WAGE ADMINISTRATION

The major efforts of the group were devoted to setting up a tentative schedule and target dates with supporting pertinent data for annual performance appraisal "season" and salary review which will be conducted during November and December.

In support of the December review, up-to-date median salary curves for HLO exempt contributors were prepared and forwarded to each level 3 component manager.

The following position auditing was completed during the month:

Laboratory Auxiliaries	3
Radiation Protection	1
Chemical Research & Development	1

At the end of October, 44 per cent of all HLO exempt positions have been audited since the beginning of calendar 1957 (42 per cent considered on schedule).

One new position, Specialist, Reactor Theory, was approved for use within HLO during the month.

A report on all reconciliation work carried on with other components of the Company since reorganization has been completed and forwarded to level 3 HLO component managers.

Two information meetings were attended with level 4 components to discuss the philosophy, policies, and procedures of the Salary Plan. It is anticipated that further such meetings will be held as a result of the review of the Attitude Survey results.

The following items on the attitude survey were completed by the Specialist, Wage Administration by month's end:

- a. The analysis of the supplementary survey was completed with the results being forwarded to HLO Managers.
- b. The report to employees was forwarded to Printing.

- c. The Attitude Survey data was distributed to each level 3 manager for their respective components.

Minor revisions have been made to the HAPO secretarial compensation plan and distributed to HLO managers and/or supervisors.

Following discussions with HLO supervision, the semi-technical job evaluation plan is being revised and will be fully implemented for use during November.

Advice and counsel was provided on the write-up and classification of 11 nonexempt jobs.

Manager
Employee Relations

TG Marshall:tr

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VISITORS TO HLO

<u>Name</u>	<u>Dates of Visit</u>	<u>Company or Organization Represented</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>	<u>Areas and Buildings Visited</u>
Miss Mary Stewart	10/15	International Business Machines Corporation	Conduct class in typing proficiency	JP Crewdson	None	3760 - 300
Mark J. D'Arcangelo	10/31	GE - Public & Employee Relations Services	Attitude Survey	HM Parker Level 3 Mgrs.	None	703 - 700

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TABLE III. EMPLOYMENT - TECHNICAL PERSONNEL STATUSI. Employment

<u>Non-Exempt Employment Status</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Non-Exempt Transfer Requests</u>	<u>Sept.</u>	<u>Oct.</u>
Requisitions					
At end of month	13	12	Transfer cases		
Cancelled	2	1	Active cases at end		
Received during month	11	14	of month	51	49
Filled during month	22	14	Cancelled	3	0
Candidates considered			New during month	9	1
Total applications	23	14	Transfers effected	1	3
Total transfer requests			Planned transfers		
from other at HAPO	3	6	Effective during month	2	2
Total interviewed	0	0			

II. Technical Personnel Placement

Ph.D. Recruiting - HLO

	Cases Con- sidered	VISITS TO RICHLAND				OFFERS			On The Roll
		Extended	Visited	To Visit	Open Invite.	* Extended	Accepted	Open	
Engineering:									
Chemical	19	8	1	2	3	3	1	2	-
Electrical	5	2	-	2	-	2	-	1	-
Mechanical	8	3	1	2	-	2	-	-	-
Metallurgy & Ceramics	28	14	3	4	6	3	-	2	1
Other	2	-	-	-	-	-	-	-	-
Science:									
Chemistry	54	18	5	6	5	6	3	3	2
Physics	84	37	5	16	13	6	1	2	-
Math-Stat.	8	1	-	-	1	-	-	-	-
Other	12	1	-	1	-	-	-	-	1
TOTALS	220	84	15	33	28	22	5	10	4

*Offer totals include 14 Ph.D. open offers as of Sept. 1, 1957

BS/MS Experienced Recruiting - HLO

	Cases Con- sidered	VISITS TO RICHLAND				OFFERS			On The Roll
		Extended	Visited	To Visit	Open Invite.	Extended	Accepted	Open	
Engineering:									
Chemical	4	2		1					
Electrical	5	1	1						
Mechanical	9	4	3			2			
Metallurgy & Ceramics	1								
Other	2								
Science:									
Chemistry	6								2
Physics	1								
Math-Stat.	1	1	1						
Other	7								
TOTALS	36	8	5	1	0	2	0	0	2

TABLE IV. Exempt Transfer Cases

	<u>Oct.</u> <u>20</u>	<u>Sept.</u> <u>21</u>	<u>Total</u>
Active cases at <u>beginning</u> of month			
New cases: Initiated by employee			
Initiated by management*			
Cases reactivated	<u>20</u>	<u>21</u>	
Cases closed: Transfers: Within HLO			3
Within HAPO	1		3
Other G. E.			7
Withdrawn			7
Terminated	<u>19</u>	<u>1</u> <u>20</u>	<u>9</u> <u>29</u>
Active cases at <u>end</u> of month	19		<u>19</u>
Total cases - January 1, 1957 to date			48
Initiated by employee	25		
Initiated by management*	23		

*Includes ROF's, transfers proposed by employee's management, and requests from other G. E. departments.

TABLE V. Union RelationsGrievances Processed - January 1, 1957 to date

Total Processed 20 (includes 1 non-unit grievance)

Step I

Answered satisfactorily*	9
Pending time limit	2

Step II

Pending Step II discussion	0
Pending Step II answer	1
Answered	
Satisfactorily**	7
Pending time limit	1

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step I.

** Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

FINANCIAL OPERATION MONTHLY REPORT
October 1957

Compiled by Members of the
FINANCIAL OPERATION
HANFORD LABORATORIES OPERATION

Personnel

There were no personnel changes in the Financial Operation during October.

Activities

General Accounting Operation

A report of findings in connection with the physical inventory of uninstalled cataloged equipment in the custody of Physics & Instruments Research and Development Operation was prepared in October. The inventory consisted of 937 pieces of equipment, valued at \$701,947. The physical count failed to locate 25 pieces of equipment valued at \$7,250. One hundred and twenty-four items valued at \$35,334 were physically located during the inventory for which no record could be found. A journal entry was prepared adding to record unrecorded items and transferring unlocated items into a special code to be held until located or until the entire HLO inventory is completed.

All field work in connection with the physical inventory of uninstalled cataloged equipment in the custody of Reactor and Fuels Research and Development Operation is complete and the reconciliation of physical count to property records is in progress. It is expected that the reconciliation will be completed and a report of findings issued in November.

The physical inventory of uninstalled cataloged equipment in the custody of Chemical Research and Development Operation scheduled to begin October 28, 1957 did not start until October 30, due to the failure of IBM to provide us with an inventory equipment list.

Upon completion of the physical inventory and reconciliation of equipment in custody of Chemical Research and Development Operation, the current HLO physical inventory of uninstalled cataloged equipment will be complete.

Reconciliation of the physical inventory of reactor and other special materials witnessed by financial personnel is still in progress. A report of findings will be issued in November.

A forecast of Hanford Laboratories Operation requirements for gadolinium and europium was prepared and submitted to Contract Administration covering FY 1958 through FY 1961.

At the request of Financial Consolidations, a review was made of Hanford Laboratories Operation spare parts to determine plant and equipment items being carried in Spare Parts Inventory Accounts. The review indicated that no HLO equipment was being carried in the inventory account.

At the request of Relations & Utilities Operation, a review was made of all returnable containers assigned to Hanford Laboratories Operation, to determine those containers which will not be returned to the vendor. This was necessary in order that the vendors could be notified and demurrage charges discontinued. The review indicated that of the 83 containers assigned to HLO, 10 would be purchased, 28 had previously been returned to Stores, 2 were in the possession of IPD, and the balance were still in use.

A review made of paper work generated by Property Accounting resulted in a reduction in report preparation, by eliminating 9 reconciliation reports and substituting reports prepared for and issued to Contract Administration. Another saving of paper work will be made when we combine the present tagging request with the new Custodial field cards.

In conjunction with efforts to reduce paper work, the following has been accomplished:

1. Reconciliations of certain general ledger accounts that utilize less than one-half page of space are being combined so that two or more reconciliations appear on a single page.
2. The second copy of cash disbursement receipts will be eliminated. A notation on the Travel Order will indicate that cash has been disbursed.
3. The separate file folder of copies of vouchers in support of entertaining expenses will be eliminated; this information is available from the posting reference file.

A reconciliation was made of the utilization of HLO fee funds for calendar year 1957 as reallocated in July 1957. The current estimate of funds required for the total year indicates that funds allocated for travel and living expense variation and conference expenses for level 3 components will be underexpended by 18% and 50%, respectively. Funds provided for weekly luncheons will be underexpended by 25%. However, it is anticipated that these funds will be used for other purposes.

A study was made of the percentage of total travel in terms of travel days and costs, by level 3 components for the purpose of attending meetings of professional and trade societies during the period from September 1, 1956 through August 31, 1957. In terms of cost and travel days, 12% and 16% respectively of the total travel of HLO was for the purpose of attending meetings of professional and trade societies.

The HAPO accounts payable procedure has been further revised to provide for the respective Managers of Finance to initiate checks in payment to:

1. Other G.E. components for pro-rated portions of earned vacations of transferred employees.
2. Employees for contaminated personal effects.

As a result of this revised procedure, General Books will maintain a file of all reports of contaminated personal effects submitted by Hanford Laboratories Operation personnel.

We have been concerned as to whether we are receiving copies of HO-199 forms in all cases where there is a consideration of billing for services rendered to visitors of HLO personnel. A comparison was made of the visits to HLO personnel during June, July and August 1957 per the HLO Monthly Reports with the record of visits per copies of HO-199 forms received for the same period. During the three months, there were eight instances in which HO-199 forms were not received for visitors on access permits to confer with HLO personnel. We understand that arrangements are being made by Contract Administration with the Commission to effect more complete distribution on HO-199 forms.

The Biology Operation was notified that all their equipment funds applicable to the 6000 Program were either expended, committed or in process.

Reactor and Fuels Research and Development Operation was notified that of their \$2,664,600 allocation for 2000 Program equipment, \$2,646,600 has been expended, committed or is in process, leaving an unencumbered balance of \$18,000 for FY 1958.

Letters seeking AEC approval or agreement were prepared and submitted covering participation of two members of Hanford Laboratories Operation in a conference in Paris, France beginning November 18, and the extrusion of uranium dioxide pellets for APED at San Jose. The letter covering extrusion of the uranium dioxide pellets was withdrawn after informal discussions with the AEC and additional information is being obtained. The letter seeking approval for the participation of Hanford Laboratories Operation personnel in the Paris conference was still in the hands of Contract Administration at month's end but has since been forwarded to the Commission.

Custodians of SS Materials were advised as to the requirements for approved inventory write-offs and that under normal circumstances prior approval was required before materials were discarded. The third review of diversions inside production channels was completed and submitted to SS Accountability Operation.

Following an exchange of correspondence, arrangements with respect to authorizing billings for consultation services performed for HLO by APED personnel were completed and documented. HLO management was advised of these arrangements by letter on October 17.

Cost Accounting Operation

The FY 1958 Revised Budget was adjusted during October to reflect revisions to authorizations that have occurred in the past few months. Programs that were adjusted are as follows:

	<u>FY 1958 Revised Budget</u>	<u>New Authorization</u>
Research and Development		
CPD Weapons Program	\$172 000	\$ 86 000
Processing Technology - For CPD	697 500	577 500
- For IPD	416 000	367 500
Washington Designated Programs		
Project Cad (excludes equipment)	-0-	75 600
Test Program on Irradiated Metals (excludes equipment)	-0-	44 500

The letter to level three managers outlining plans for preparation of the FY 1958 Midyear Budget Review was prepared during October. Detailed budgets are not required, therefore, it was proposed that this review be accomplished by obtaining current and pertinent information from operating components through a series of meetings. The information will then be used to adjust the FY 1958 Revised Budget to reflect HLO's current requirements which will constitute the Midyear Budget Review. By using this procedure, the FY 1958 Midyear Budget Review can be accomplished with a minimum of time and effort for everyone concerned. Research and Development Proposals are not required for the review, however, increases over current authorizations will require narrative justifications.

Two new program codes were established in October to record and report operating costs and capital equipment associated with the new Washington Designated Program entitled "Test Program on Irradiated Metals". Codes and authorized amounts are as follows:

	<u>Code</u>	<u>Authorization</u>
Operating Costs	.82	\$44 500
Capital Equipment	.83	8 000
		<u>\$52 500</u>

A new organizational cost code, 7570, was established for Reactor and Fuels Research and Development Operation entitled Plutonium Recycle Reactor Operation. Costs associated with individuals working on the operational techniques of the reactor will be accumulated under this code.

A system of coding has been established to accumulate the costs of various prototypes associated with the Plutonium Recycle Test Reactor in the field of mechanical equipment development. Approximate costs of these prototypes are \$400,000.

During October HOO-AEC passed Hanford Laboratories a credit of \$15,475 which represents the cost of machined graphite bars and machining of certain process holes associated with an exponential pile which HOO-AEC sold to the University of Washington. The purpose of the credit billing to Hanford Laboratories is to finance related costs associated with fabricating a replacement pile. The credit has been placed in undistributed costs and will be off-set by the replacement costs incurred during FY 1958.

An exchange of correspondence with the University of California Radiation Laboratory financial personnel occurred during the month for the purpose of re-establishing the time schedules and the kind of monthly cost and commitment data to be submitted to UCRL on Project Whitney. Monthly expenditures related to the purchase orders for operating costs and capital equipment are to be teletyped to UCRL by noon on the 7th working day of the month. Capital equipment commitments are to be transmitted by letter by the 20th of each month.

Several discussions were held with P. M. Thompson of Operations Research and Synthesis concerning his study of adopting the present Hanford Laboratories cost account system to the matrix method which utilizes integrated data processing. Discussions to date have centered around defining (1) the intricacies of the cost accounting system, (2) the data needed by management to effectively manage the business and (3) the matrix method.

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An improved method of identifying absence time of exempt employees for purposes of cost coding the monthly time cards was adopted at the suggestion of several cost clerks in Technology Cost. Approximately eight hours a month are saved by utilizing a routine IBM run provided by Personnel Accounting which required the run for other purposes, therefore, there are no additional Data Processing costs incurred.

Work is underway in calculating the amount of budget transfers to the product departments associated with the transfer of radiation monitors from Hanford Laboratories on November 18, 1957.

Effective this month total general overhead costs of Biology, Financial and Employee Relations Operations will be liquidated to HLO General Overhead so that there will be no liquidation variance carried in the operations. Standard IME rates will no longer be necessary for liquidating costs of the Biology Operation and estimating costs of Financial and Employee Relations is no longer necessary. This has been made possible through improved procedures within the Cost Accounting Operation.

Detailed listings of equipment activity for the first quarter were prepared for Reactor and Fuels R&D, Physics and Instrument R&D and Chemical R&D Operations for purposes of analysis and control of future expenditures.

Personnel Accounting Operation

As a result of the .59% cost of living adjustment effective 10-28-57 the annual base rate of non-exempt employees of HLO will be increased approximately \$15,467 per annum. Isolation pay for non-exempt employees will be increased \$415 per annum and the area differential pay to exempt employees will be increased \$343 per annum.

This increased the weekly isolation pay for non-exempt employees from \$9.83 per week to \$9.88 per week, and the exempt area differential from \$42.74 per month to \$42.96 per month.

Revision to present shift schedules was reviewed and approved. Five hundred 8½ x 11 schedules and three hundred wallet size schedules were ordered for distribution to HLO employees in 1958.

Revised payroll register was designed, approved and ordered in October to be used commensurate with January 1, 1958. This new register is similar to the present exempt payroll register. It is anticipated that the new register will eliminate several statistical reports now being prepared by Data Processing.

The U. S. Treasury Department has changed from a paper stock form of U. S. Savings Bonds Series E to a punched card bond. This new type of bond assembly will be used in the purchase of October bonds to be delivered to employees in November. The custody receipt formerly used in the case of the Stock Bonus Plan will be replaced by a copy of the registration of the bond purchased.

Quarterly State and Federal Tax reports, returns and summaries were prepared, payments made and transmitted to the respective recipients.

Auditing

The Suggestion Plan audit report was issued in the latter part of September.

Field work on the Cost Accounting audit continued throughout the month and is over half complete. So far, there have been no definite findings of significance.

Measurements

The unit cost study concerning badge meter, pencil meter and records costs was completed through cooperative effort between Cost Accounting and Measurements. Letters were sent to four Laboratory components within the Company in an effort to compare costs of Financial Services. Inquiries were made of several HAPO sources to determine costs per hour of Technical Shop services outside HAPO. C. A. Gillespie, Consultant Measurements from Schenectady visited HLO on Tuesday October 22.

Procedures

The Specialist, Office Procedures attended the Advanced Financial Training Seminar on Office Procedures held by Accounting Services in New York during the week of October 21 - 25. A visit was also made to Schenectady to review computer procedures, paper work problems and establish communication lines for future contacts.

Payroll StatisticsNumber of HLO EmployeesChanges During Month

	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on Payroll at Beginning of Month	1 162	494	668
Additions and Transfers in	16	6	10
Removals and Transfers Out	(9)	(1)	(8)
Transfers from Exempt to Non-Exempt		(1)	1
Employees on Payroll at End of Month	<u>1 169</u>	<u>498</u>	<u>671</u>

Overtime Payments During Month

	<u>October</u>	<u>September</u>
Exempt	\$1 386	\$1 114
Non-Exempt	6 736	7 958
	<u>\$8 122</u>	<u>\$9 072</u>

Gross Payroll Paid During Month

Exempt	\$366 637	\$367 955
Non-Exempt	272 303	259 400
	<u>\$638 940</u>	<u>\$627 355</u>

Participation in Employee Benefit Plans at Month End

	<u>Number Participating</u> <u>October</u>	<u>Number Participating</u> <u>September</u>	<u>Percent Participating</u> <u>October</u>	<u>Percent Participating</u> <u>September</u>
Pension Plan	1 103	1 090	98.5	98.6
Insurance Plan				
Personal Coverage	1 190	1 184	99.6	99.6
Dependent Coverage	730	719		
U. S. Saving Bonds				
Stock Bonus Plan	692	689	59.2	59.4
Savings Plan	92	96	7.9	8.3

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<u>Insurance Claims Paid</u>	<u>October</u>		<u>September</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee				
Life Insurance	0	0	2	\$30 341
Weekly Sickness & Accident	12	1 210	17	1 073
Comprehensive Medical	39	5 374	33	4 881
Dependent				
Comprehensive Medical	57	5 862	49	5 924
Total	<u>108</u>	<u>\$12 446</u>	<u>101</u>	<u>\$42 219</u>

Good Neighbor Fund

	<u>October</u>	<u>September</u>
Number Participating	759	755
Percent Participating	64.8	64.9

Other StatisticsCash Advances and Travel Expenses

	<u>No.</u>	<u>October</u>	<u>No.</u>	<u>September</u>
Accounts Outstanding at Beginning		\$15 238		\$14 540
Charges:				
Cash issued - by checks	45	6 291	35	3 476
- by currency	56	6 035	51	5 390
Transportation		8 681		11 633
Other - (Billings from other GE				
Components, moving expense, etc.)		682		1 319
		<u>36 927</u>		<u>36 358</u>
Less:				
Expense vouchers processed				
Travel expense accounts	53	11 453	75	14 097
Other (moving expenses, conference				
expenses, etc.)	12	79	29	1 505
Refund of advances	55	4 623	59	5 526
Billings to and from HAPO Components-Net		768		(8)
		<u>16 923</u>		<u>21 120</u>
Accounts Outstanding at Close	73	<u>\$20 004</u>	47	<u>\$15 238</u>

R. D. Warburton

for W. Sale
November 8, 1957

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VISITS TO OTHER SITES

<u>Name of Person Making Visit</u>	<u>Dates of Visit</u>	<u>Company Visited</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access To Restricted Data</u>
G. E. Pilcher	10/17 10/18	General Electric Schenectady, N.Y.	Contact Consultants in Office Procedures Services on computer procedures and paperwork problems.	W. H. Leavitt J. W. Pontius H. E. Carter H. J. Lee	None
	10/21 10/25	General Electric Forrest Hills, N.Y.	Attend Advanced Financial Training Seminar.	A. V. Simpson Office Procedures Service and staff.	None

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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.

INVENTORTITLE OF INVENTION OR DISCOVERY

B. M. Johnson, Jr.

Chemical Process Equipment - A Variable-Flow Control-Pressure, Relief Valve

R. H. Moore

A Pyrochemical Method for Dissolution of Uranium Oxides

R. A. Harvey

Cross-Correlation Radiation Detector

END

**DATE
FILMED**

8 / 27 / 92