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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT
OCTOBER, 1958

Classification Cancelled (Change to

Compiled by
Operation Managers

November 15, 1958

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

PRELIMINARY REPORT

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

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TABLE I. HLO FORCE REPORT AND PERSONNEL STATUS CHANGES

DATE October 31, 1958

	At close of month		At beginning of month		Additions		Separations			
	Exempt	NonExempt	Exempt	NonExempt	Exempt	NonExempt	Exempt	NonExempt		
Chemical Research and Development	123	96	219	122	94	216	1	6	0	4
Reactor & Fuels Research & Development	163	110	273	157	108	265	6	4	0	2
Physics & Instrument Research & Development	63	26	89	62	25	87	1	1	0	0
Biology Operation	36	43	79	36	42	78	0	1	0	0
Operation Res. & Syn.	14	3	17	14	3	17	0	0	0	0
Radiation Protection	34	99	133	34	108	142	0	1	0	10
Laboratory Auxillaries	45	181	226	45	182	227	0	1	0	2
Financial	16	32	48	16	33	49	0	0	0	1
Employee Relations	54	29	83	60	31	91	1	1	7	3
Programming	15	3	18	15	3	18	0	0	0	0
General Totals	<u>1</u> 564	<u>2</u> 624	<u>3</u> 1188	<u>1</u> 562	<u>2</u> 631	<u>3</u> 1193	<u>0</u> 9	<u>0</u> 15	<u>0</u> 7	<u>0</u> 22
Totals excluding Internal Transfers	564	624	1188	562	631	1193	7	6	5	13
Composite Separation Rate	-----									1.8518
Separation Rate (based on separations leaving G. E.)	-----									1.5151
Controllable Separations Rate	-----									.3367

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Costs for October were \$1,478,000, a decrease of \$119,000 from the month of September. Fiscal year-to-date costs are 29% of the budget which reflects the revised authorizations included in the recent Financial Plan for both the 4000 and 6000 Programs.

There are no unsatisfactory cost-budget relationships in the various research programs at this time.

RESEARCH AND DEVELOPMENT1. Reactor and Fuels

Swelling of uranium has been simulated in an ex-reactor experiment using xenon gas in uranium metal. The inert gas, introduced into the uranium by means of an electrical glow discharge at about 700 C, resulted in 3.3 per cent volume increase in two days. Metallographic study of the uranium showed large voids segregated at the grain boundaries.

The 3 x 3 test loop in the Engineering Test Reactor at Arco was completed and three 7-rod clusters have been charged. The fabrication order for the 6 x 9 loop was placed.

An alternate end closure method has been developed for co-extrusion Zircaloy clad fuel rods which eliminates boring out and etching of the uranium core.

A microstructural constituent has been identified by characteristic color in brittle type Al-Si-U compound layers; this colored formation does not appear in non-brittle bonds.

A brief experimental program demonstrated the adequacy of the Panellit protection against flow reductions for an "O" geometry process tube (e.g., B-D-F type) operating with no rear pigtail.

Self-supported I and E fuel elements for the older reactors showed a pressure drop 14% greater than conventional I and E elements. Three-fourths of the coolant flow was through the annulus.

Mixed crystals of $\text{PuO}_2\text{-UO}_2$ compacts have better sinterability than mechanical mixtures of the oxides. In one trial the mixed crystal oxides sintered at 1480 C to 90% theoretical density compared with 76% for the mechanical mixture. The density of the green compacts was 63% of theoretical.

Swaged oxide capsules of enriched UO_2 have reached exposures of 2000 MWD/T. A nine-rod cluster of swaged uranium oxide fuel elements is being irradiated in the Vallecitos Boiling Water Reactor.

Very good progress has been made in attaching spacer ribs to PRTR thin-walled Zircaloy jacket tubing by a high-frequency welding process developed by the New Rochelle Tool Company.

In support of the Gas Cooled Power Reactor Program, heavy-walled quartz capsules containing graphite and carbon dioxide at 200, 300, 400 and 500 psi survived reactor irradiation at about 500 C without fracture.

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PRTR Phase I construction is 35% completed. Phase II construction is 15% completed. The Phase II-A contract has been awarded.

PFPP Phase II construction is 26% completed. Over-all design is 75% completed. All major equipment requisitions have been processed except for the rolling mill and extrusion press.

A project proposal for a PRTR gas loop (for GCPR gas-graphite reaction studies) is being circulated for approval.

2. Chemical Research and Development

Purex process tests with the Mini HA column showed that addition of sodium dichromate prevented the loss of neptunium to the aqueous waste, but a very significant reflux of radiocerium in the column reached a concentration 100 times that of the feed. In the Redox process neptunium cannot be held in an oxidized (and extractable) state with increased dichromate concentration because the required low feed acidity enhances the predominance of non-extractable Np (V).

Tests showed only twenty-five per cent recovery of neptunium was achieved from anion exchange processing of backcycle wastes when high throughputs were imposed by a low column cross section required to be critically safe. Recovery under these conditions is marginal. Flow rate - pressure drop behavior was determined for a full scale engineering column prototype.

Approximately 150 grams of 10 w/o neptunium - aluminum alloy was prepared and cast into 1/2-inch diameter rods for irradiation targets and further chemical studies of plutonium-238 recovery.

Initial test runs in the pilot scale formaldehyde - nitric acid reactor have shown the reaction proceeds smoothly and is easily controlled.

A mixture of aluminum phosphate, ferric phosphate, and sodium borate produced a glass which melted at the surprisingly low temperature of 450 C and may be a suitable matrix for confinement of solid fission product wastes. Long term stability of such a composite must be investigated.

On Non-Production Fuels Reprocessing studies, attention to fuel assembly chopping was intensified and results from tests on a 40 ton hydraulic shear are presented. Experimental weld tests on Hastelloy F coupons were initiated to gain experience prior to fabrication of the pilot scale dissolver. Introduction of some copper along with the stainless steel charge into the Darex pilot plant dissolver confirmed laboratory results and eliminated passivation effects noted earlier.

Ninety-eight per cent of radiothorium was removed from an aluminum-uranium alloy system by a single contact with molten AlCl_3 -KCl mixture. The scheme offers an effective way to decontaminate U-233 - aluminum alloys in which Th-228 "grows in" from U-232 decay and is a precursor of an undesirable short-lived decay chain.

3. Physics and Instrument Research and Development

The permanent body monitor is approaching completion. The shielded cell has been completed. This stage of construction was carefully followed by

Radiological Physics personnel to insure proper cleaning so that low background rates will obtain.

In a series of exponential experiments satisfactory progress was made in determining the neutron physics properties of cluster fuel elements being considered for the NPR. Work began on similar measurements of a large solid fuel element (1.92-inch diameter) and a core was fabricated for use in PCTR measurements on cluster elements.

Nuclear safety work on non-production fuels continued to make progress during the month. Additional experiments were done with 3% enriched uranium rods in simulated dissolver situations and additional data on homogeneous mixtures were also obtained.

Progress was made in the basic study of temperature effects on lattice physics in present reactors through development of a mathematical method which avoided certain technical difficulties inherent in previous methods.

In the basic data field, the experimental work on the neutron age in hydrogenous materials was completed, an examination of our work on the fission cross section of U-235 by a representative of the Tripartite Nuclear Cross Section Committee confirmed its basic soundness, and experiments began with the new neutron spectrometer at KE.

Satisfactory progress was made on the many development projects in the instrument field among which were: A specialized automatic computer for use in the radioanalysis laboratory, air monitoring, a dog counter, a fuel viewer and profilometer for PRP, underwater borescope for I and E slugs.

4. Biology

Activity densities in all wildlife forms dropped during the month except for whitefish. The latter remained below the level anticipated for the season due to local migration.

The temperature of the Columbia River water during the past season was the highest experienced in recent years. While this was associated with a material increase in the incidence of Columnaris infected fish, the population of salmon nesting in the Columbia River reached a record high.

5. Programming

At the request of the Division of Reactor Development calculations of the fuel exposure characteristics of four plutonium fuels of specific isotopic composition in each of three types of reactors have been made. Concurrently ANL is investigating the use of the same plutonium fuels in fast reactors. Also ORNL is studying the use of three plutonium fuel compositions in several thermal reactors. It is planned to compare results of the three studies during November.

The destructive incident in the Borax I reactor was reviewed with the general conclusion that the quantity of material released and readings downwind were about as would be expected from present assumptions.

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A start was made on the organization of a Task Force to study the needs of Radiological Evaluation and the methods of performing these evaluations. Members were tentatively chosen and a proposed program started.

Technical and Other Services

A plutonium contaminated minor injury occurred to a CPD employee. Excision of a small amount of tissue and subsequent cleaning of the wound area reduced the plutonium in the vicinity of the wound from approximately 0.35 μc to approximately 0.008 μc (about one-fifth of the MPL).

Weapons testing at the Nevada Proving Ground was reflected in bomb debris fall-out in the northwest which was 30 to 100 times the normal fallout concentration.

Statistical and mathematical assistance on 22 separate problems was given within HLO and to other departments and operations. Of particular interest was work performed in connection with the general problem of obtaining better ways to describe outgoing quality of fuel elements.

In connection with operations research activities, a rough draft report of the task force for evaluation of capital expenditures was completed and will be issued for comment early in November, a rough draft summary of the analysis of control data from the currently established material balance areas of 234-5 operation was issued, and IPD personnel have adopted recommendations made by operations research personnel for the control of spare part inventory.

There were 18 authorized projects (exclusive of PRTR and PFFP) at month end, with total authorized funds of \$3,952,000. The total estimated cost of these projects is \$8,473,400. Two projects were completed during the month. One project proposal is awaiting AEC authorization. Project proposals for nine new projects are in preparation.

Preliminary cost estimates prepared on Project CG 731, Critical Mass Laboratory, confirm the budget estimates. Design of the Metallurgical Development Facilities, CA-744, is 43% complete.

A proposal to microfilm the classified files document collection is being considered. This program would enable improved service for reading and reproducing old copies and would avoid future storage problems.

Supporting Functions

A modification has been received from HOO-AEC advising of a change in the accounting treatment for transferred capital property and expense portions of construction projects. Generally these changes are (a) transferred capital property will be included in the directive amount and be funded from the project and (b) expense portions of construction projects will be charged to the appropriate operating account.

Budget adjustments were effected during the month to reflect the decrease of \$1,050,000 in 4000 Program funds as reflected in the most recent Financial Plan.

At month's end, the staff of the Hanford Laboratories Operation totalled 1188, including 563 exempt and 625 nonexempt employees. There were 479 exempt

employees possessing technical degrees, including 270 BS, 106 MS, and 103 PhD.

Of the 23 Radiation Protection employees scheduled for a force reduction last June, 18 have been placed elsewhere. Four were laid off on October 31 and one was placed on a temporary assignment.

Laboratories personnel worked a total of 205,345 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,914,467 man-hours have been completed with no disabling injuries. The medical treatment frequency for October was 1.61 as compared with 1.23 during September.

There were 6 security violations during the month, bringing the total for the calendar year to 42.

The HAMTC has notified the Company that they wish to proceed to arbitration in the Wonacott case (radiation monitoring jurisdiction) and have requested that the Federal Mediation and Conciliation Service appoint an arbitrator.

In the Maki arbitration case briefs have been submitted to the arbitrator by Legal and the HAMTC and we are now awaiting the arbitrator's decision.

Two grievances were received during the month of October. One pertained to alleged unauthorized shifts and demanded time and one-half for the time worked until such shifts were negotiated through and approved by the HAMTC. The Step I answer was satisfactory. The second grievance pertained to work claimed by the Teamsters. The Step I answer was unsatisfactory and the grievance scheduled for Step II discussion on November 7.

Offers were extended to two Ph.D. candidates and eight experienced BS/MS candidates. Acceptances were received from eight experienced BS/MS men and five were placed on the roll.

HAPO recruiters visited ten schools for Ph.D. recruiting and eleven for BS/MS recruiting. Results of these trips indicate a tight market in areas of interest to Hanford.

Technical Graduate placement has increased to 19 during the last three months compared with eight placements during the preceding three month period. There are now 37 participants on the program with 5 scheduled for placement on November 1.

Ten suggestions were approved for awards of \$155 at the October meeting of the HLO Suggestion Board. The average year-to-date award is \$23.50 and the ratio of awards to savings is 12.7%.

for Manager,
HANFORD LABORATORIES

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HW-58019

REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATION

TECHNICAL ACTIVITIES

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. METALLURGY PROGRAM

Corrosion Studies - Aluminum

Area Effect. Reduction of corrosion rates in dynamic test loops as aluminum sample area is increased might be the result of (1) increased concentrations of heavy metal ions, or (2) saturation of the water with aluminum. Two alloys were tested, one with high heavy metal concentration (5.5% Ni, 0.3% Fe, 0.1% Ti) and one with lower concentration (1% Ni, 0.5% Fe). Dissolution losses per liter of water were equivalent for the two alloys after one week at 250 C. It appears from these tests that the aluminum corrosion rate was not affected by the difference in heavy metal concentration in the two alloys, but may be a function of dissolved aluminum concentration.

Dynamic Corrosion Tests - The Effect of Flow Rate. The new high temperature loop in 314 Building, with its three test sections in parallel, is ideally suited to the determination of the effect of flow rate on aluminum corrosion. Extent of aluminum corrosion in 300 C water has been determined for X-8001 alloy (e.g., M-388) at three flow rates, 4, 19 and 38 fps velocity past the test samples. There is some dependence on sample position within the sample holder, but the rates compared refer to downstream samples where effect of position was negligible. After one month in 300 C water, rates were: 1.7, 1.5, 1.2 mils/mo for 38, 19, and 4 fps, respectively.

Dynamic Corrosion Tests - Corrosion of Sample Replacement. Both Argonne and Chalk River observed anomalously high corrosion rates for replacement samples in dynamic systems. Replacement samples recently withdrawn from a Hanford dynamic autoclave operating at 250 C with deionized water have not confirmed these earlier observations. Replacement samples after one-month exposure had corroded to approximately the same extent as the original loading with one-month exposure.

The Accelerated Corrosion Mechanism. Temperature affects the type of oxide-metal interface formed on aluminum which is corroding by the accelerated high-temperature process. In annealed 1245 alloy, grain boundaries are attacked at 270 C, but a clean, sharp interface is found for specimens corroded at 300, 325, and 340 C. The accelerated process, in water, appears essentially uniform, and the intergranular corrosion process may be associated with it as a competing corrosion process at lower temperatures.

New Alloys. Samples of X-8001 exceeding tolerance specifications in magnesium are being compared with the standard alloy for resistance to accelerated attack. After 240 hours, no differences are apparent.

An aluminum alloy (0.6% Ni, 2.1% Fe) has now been under test in 360 C water for 3600 hours. This alloy has now slightly deviated from the logarithmic corrosion curve. The extent of corrosion is still far less than the parabolic corrosion process would predict, e.g., 0.75 mil compared with approximately two mils by the parabolic process.

Examination of the corrosion product detached from samples of 198X alloy corroding by the logarithmic corrosion process in 360 C water has shown them to contain a substantially lower percentage of water than samples with similar exposure corroding by a parabolic corrosion process.

Corrosion Studies - Zirconium

The use of a microbalance has greatly increased the precision of short term corrosion tests on zirconium alloys and has thrown light on which variables should be maintained constant for reproducible test results. This new technique appears to offer promise of improving the predictive power of short term corrosion tests. Experiments employing the microbalance showed that the presence of nitric acid in the aluminum nitrate rinse slightly increased the amount of corrosion in a subsequent 66-hour autoclaving test at 400 C and 1500 psi steam. For optimum resolution, in a laboratory test, the aluminum nitrate solution should contain no nitric acid. However, for optimum rinsing in a production plant, a small concentration of nitric acid in the aluminum nitrate is helpful to dissolve dried or partially dried hydrous zirconium oxides.

Rinsing in tap water was shown to involve the risk of precipitating CaF_2 or MgF_2 , each of which can cause staining of the Zircaloy-2 surface upon autoclaving. Deionized water rinses avoid this problem by eliminating the calcium and magnesium ion. Aluminum nitrate may be used to complex the fluoride ion.

Radiometallurgy Laboratory Studies

Radiometallurgy activities during the month in support of the 2000 Program have included the following work: the preliminary examination of a U-Mg alloy slug which was irradiated in the MTR to 9900 MWD/T, according to GEH-3-8; the complete examination and measurement of a coaxial fuel element (GEH-4-31); a continued study of a 4-rod stainless steel clad cluster (KER-1 & 2 and KER-3-2); the crystallographic study of one uranium wafer that had been irradiated using low exposure temperatures; preliminary studies of the restraint of uranium swelling by zirconium cladding (GEH-3-31); and the preparation of Faxfilm replicas of 1000 MWD/T fractographic samples. Pertinent results and conclusions are reported in detail in connection with the respective development programs.

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Basic Metallurgy Studies

Recrystallization and Recovery of Zirconium Alloys. The kinetics of recrystallization and recovery in zirconium, Zircaloy-2, and Zircaloy-3 are being determined to establish the optimum conditions of heat treatment during fabrication operations. Percent cold work, temperature, time and heat-treating atmosphere have been selected as the independent variables. The corrosion testing of Zircaloy-2 and Zircaloy-3 specimens has been completed. The final group of specimens consisted of material heat treated in vacuum at 300 to 800 C for times of 10 to 1000 minutes. The corrosion tests were stopped after 308 days. None of the samples exceeded weight gains of 70 mg/dm². Both the vacuum melted Zircaloy-3, argon melted Zircaloy-3, and Zircaloy-2 showed the transition to "break-away" at 252 days. In all cases (with the exception of Zircaloy-2 heat treated 1000 minutes at 800 C) heat treatment slightly improves the corrosion resistance over that of the cold worked metal. Vacuum heat treatments are superior to the corresponding treatments in air or helium.

Diffusion Studies. A knowledge of various uranium/barrier metal/clad metal combinations is important in the design of fuel elements. An estimation of the maximum times and temperatures at which slugs could be run during tests in the KER pressurized water loop without failure due to cladding penetrations will be required in the near future. Penetration into the X-8001 cladding in AlSi bonded depleted uranium slugs is now being studied.

Electron and Optical Microscopy. The study of the microstructure of cladding and fuel materials is a direct way of detecting radiation damage in these materials. Two techniques are being used: (1) metallographic examination of polished and etched surfaces, and (2) fractographic studies. In support of studies being conducted on the Whitney program, the fracture surfaces of plutonium metal have been studied in the electron microscope. The main features being considered are porosity as a function of temperature of fracturing, effect of prior thermal cycling, and various casting variables. Problems associated with making and preparing replicas for the electron microscope are being evaluated.

Two specimens of the bond formed between uranium and 13.5 percent silicon in aluminum have been studied metallographically for FPD. The width of the compound layers varies directly with the temperature of the AlSi. Essentially no difference in microstructure between bonds formed in 13.5 percent silicon or 11 percent silicon eutectic was detected.

The interface between AlSi and Pb which exists in the duplex canning bath has been studied by microautoradiographic techniques. The presence of a uranium rich phase in the AlSi phase near the AlSi/Pb interface was unambiguously established. Essentially no evidence for the presence of uranium in the Pb phase was found.

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Annealed discs of uranium, precharacterized by metallography, x-ray diffraction, hardness, and geometry are being canned in Zircaloy-2 capsules containing NaK for subsequent irradiation studies. A control specimen heated in NaK at a temperature of 600 C for 20 days is being studied. No change in microhardness has occurred. Although some of the initially present x-ray diffraction peaks from planes parallel to the specimen surface have decreased in intensity, a high intensity peak in the 2θ range of 152-155 degrees for $\text{CuK}\alpha$ radiation has persisted. This peak shows essentially no change in breadth at half height.

In-Reactor Temperature Measurement. A device for application as a temperature standard at high temperatures within a reactor has been designed, and preliminary laboratory tests have been made. This device utilizes a thin diaphragm (0.001 inch nickel) as a null pressure detector between a gas thermometer bulb and a known pressure applied from outside the reactor. Tests of the initial design indicated that ± 2 C accuracy should be possible. Several necessary modifications in design are now being made.

Annealing of Radiation Damage in Molybdenum. The annealing of gross damage to the crystal structure of molybdenum irradiated to 1.2×10^{20} nvt (fast flux) is being studied by x-ray diffraction. The as-irradiated diffraction lines from this material are very broad. A reversal occurs in net lattice expansion from 0.050 percent at an exposure of 6.0×10^{19} nvt to a net contraction of 0.004 percent at an exposure of 1.2×10^{20} nvt for the specimens under investigation. An annealing treatment at 100 C for one hour resulted in a small amount of damage recovery as evidenced by a sharpening of the lines. Further annealing at 100 C for 100 hours, 200 C for 100 hours, 300 C for 100 hours, 400 C for 100 hours, and 500 C for 100 hours did not give any additional changes in the diffraction pattern as checked periodically. However, a treatment of 600 C for 7.5 hours gave a definite, though only partial recovery of damage. The diffraction lines became sharper and an expansion of lattice dimensions to a value equal to that in the unirradiated state occurred. The line shapes will be analyzed to determine the type of damage that has annealed at each of the two levels.

An X-Ray Method for Extending Radiation Dosage Measurements. A study showing the feasibility of applying x-ray fluorescence to the determination of total radiation dosage on exposed photographic film is being conducted at the request of Radiation Protection Operation. It has been shown that results from the x-ray technique not only correlate with those from existing dosage monitoring methods, but also extend the exposure limit from approximately 40 roentgens to 2000 roentgens. By the x-ray method the amount of deposited silver on the exposed film is determined by exciting the characteristic x-radiation of the silver and measuring this emitted radiation by diffraction from an analyzing crystal. The study is to be extended in order to determine calibrations for several film types.

Effects of Low Temperature Irradiations on the Properties of Uranium.

X-ray diffraction studies have been made of uranium specimens irradiated to 0.0023 percent burnup in a flux of 2.5×10^{12} nvt at a temperature of 50 C. Definite damage to the crystal structure has been observed. A shift of the (040) diffracted peak position accompanied by a line broadening characterizes the damage. These changes in the diffraction pattern could result from the introduction into the crystal lattice of "stacking faults". These stacking faults could be characterized by a slip of the (001) close packed planes in an $[010]$ direction. The diffraction data indicate that a relatively large concentration of these defects are retained at the low temperature of exposure.

New Fuel Element Development

Bending of Tubes. Since the NPR design may employ graphite support blocks to prevent the Zircaloy process tubes from touching the entire graphite channel, a study has been made of stresses in the tubes as a function of support placement. It is concluded that the lateral deflections of pressure tubes undergoing small bending stresses can be approximated with elastic theory if a pseudo elastic modulus is used. Results are reported in HW-57802.

Fuel Element Testing Facilities. Installation of the Hanford P733 reflector position in the ETR was completed during October. The in-pile section was the last portion of the facility to be installed, and this was done without difficulty. Shakedown tests employing a gamma-heating experiment in the process tube were performed at a pressure of 2100 psi and 100 F water temperature during ETR Cycle 7. However, a successful run was marred by operations shutting off both primary circulating pumps shortly before the reactor shutdown. Although this incident caused overheating of the in-reactor experiment (temperatures between 1300 F and 2000 F were estimated), subsequent boroscope examination of the process tube disclosed that no damage occurred requiring its replacement.

Bending of Horizontal Fuel Elements. Since bending or lateral deflections can create length limitations on the distance between fuel element supports, an approximate method of analysis suitable for determining tube deflections for fuel elements whose cladding and fuel material both offer resistance to bending is included in the rough draft section for HW-51000. A description of problems encountered with cyclic thermal operation is included, but no theoretical method of analysis was found to describe this phenomenon.

Restraint of Uranium Swelling by Zirconium Cladding. The swelling behavior of unalloyed clad uranium operating with a cladding surface temperature of 250-350 C and a maximum fuel temperature of 450-600 C is of importance for Hanford's fuel element development work. In order to provide such swelling data, five experimental assemblies with Zircaloy-2 clad coextruded uranium fuel rods have been completed and shipped to the MTR and ETR for irradiation. One fuel rod, GEH-3-31, which operated at an average maximum uranium temperature of 400 C and has an estimated exposure of 2100 MWD/T, has been returned to Hanford for examination. GEH-3-32,

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presently undergoing irradiation in the MTR, has approximately one-third of the 3500 MWD/T goal exposure. Neither of these fuel rods has operated in the desired maximum uranium temperature range of 450-600 C. The remaining fuel rods, GEH-3-57, 3-58, and 3-59 should be charged in the ETR during October and November. Post-irradiation measurements of GEH-3-31 have revealed a 0.4 percent increase in the outside diameter. The uranium expanded into the 0.025 inch gap between the end caps and the original free uranium surfaces. With the above length and diameter increases, the corresponding volume increase is 1.9 percent. Density measurements will be made to confirm this value.

The assembly of swelling capsules designed for irradiation in Hanford reactors is proceeding. The irradiation of these capsules should determine the dependence of fuel element swelling upon cladding and uranium temperatures, cladding thickness, and exposure. An initial capsule was charged late in September in the DR Reactor at Hanford. This capsule is being irradiated in order to obtain experimental verification of the physics and heat transfer calculations. This verification must be obtained before the remaining capsules can be assembled.

Uranium-Magnesium Matrix Fuel Material. Radiometallurgical examination is being made of a U-Mg matrix fuel element which was irradiated in the MTR to a calculated 9900 MWD/T. The fuel element was dimensionally stable, having decreased 0.004 inch in its 4.4-inch length and increased 0.007 inch in its 1.120-inch diameter. The swelling of the fuel material U-Mg core was restrained by the 0.060 inch Zircaloy-2 wall of the fuel element cladding. Based upon past experiments with U-Mg fuel elements, swelling of this material does occur, but this swelling is limited by the restraint of the cladding material. Metallographic examination, including electron microscopy, of the U-Mg fuel will be made.

Coaxial Fuel Element. The third MTR irradiation test of the coaxial fuel element concept is being examined at the HAP0 Radiometallurgy Laboratory. Examination of the thermocouple showed that it was in excellent condition; thus, reliable data should have been obtained during the whole 850 MWD/T exposure of the fuel element. At initial startup when the heat generation was 88 kw/ft, the maximum temperature was 670 C. The temperature increased gradually during the first 300 MWD/T exposure. The temperature stabilized at 750 C, and the power generation remained at 88 kw/ft for the duration of the exposure. The power-temperature relationship of the element was not affected by cyclic operation caused by the MTR Pu fuel experiment. A second fuel element of this third irradiation test continues to be irradiated at the MTR, with a goal exposure of 1500 MWD/T.

Gamma Heating in the ETR 3x3 Facility. The first experiment in HAP0's ETR 3x3 fuel element test facility has been completed. Its purpose was to measure the magnitude of gamma heating in the facility. The gamma heating value of 1.3 watts/gram was obtained, based upon differential temperatures developed in a stainless steel slug.

Thermal Contact Conductance of Fuel Element Materials. The conductance of two AlSi brazed joints between uranium and aluminum was measured. One of these joints was prepared to be non-brittle and the other to be a brittle bond. Conductance of the good bond was beyond the limit of detection of the equipment. Conductance of the brittle bond appeared to be between 5,000 and 20,000 BTU/hr/ft²/°F. The large uncertainty is due largely to the uncertainty in uranium conductivity. The apparent conductance of the brittle bond was improved by pressure on the joint, but it was unaffected by changing from a vacuum to a helium atmosphere.

The contact conductance of smooth surfaces of aluminum and uranium in contact was not improved appreciably by a layer of colloidal graphite in the joint. (Some oxidation of the uranium surface occurs in the "vacuum" of the system.) The conductance of the joint containing graphite exceeded the detection limit when one-half atmosphere of helium was introduced.

A mockup of the four-rod cluster to be used in the 3x3 ETR loop for measuring pressure dependence of contact conductance was flow tested. Two of the rods in the cluster will contain thermocouples measuring axial temperature. The other two rods are hollow aluminum dummies.

Cluster Fuel Elements. Three seven-rod cluster fuel elements fabricated from 0.593-inch OD coextruded Zircaloy-2 natural uranium rods were charged into the ETR GEH-10 loop facility. This irradiation is designated as GEH-10-2. The fuel should operate at a specific power of 83 kw/ft with 200 C inlet water temperature. Goal exposure for this irradiation is 1500 MWD/T.

One hundred and twenty-six coextruded fuel rods are being fabricated into seven-rod cluster fuel elements for charging into the KER loop facilities. At present, twenty-eight 1.6 percent enriched fuel rods, 0.593-inch OD, and with 30-mil thick jackets, are ready for assembly. In addition, end caps have been welded on fourteen, 30-mil and thirty-six, 20-mil coextruded 1.6 percent enriched rods. These rods have also been heat treated. Forty-nine rods have been machined, nitric acid etched, pickled, and are presently being closed by welding end caps in place. Present schedules call for delivery of four, 7-rod cluster fuel elements and one 3-foot, 3-rod cluster fuel element formed from integral end closed rod to the reactor on November 15, 1958. Components for the three-rod cluster have been fabricated and assembly of the fuel is presently being under taken. Rods used for this fuel element are 0.593-inch OD with 30 mils of Zircaloy-2 jacket. The uranium is unalloyed and contains 1.6 percent enrichment. In addition, a seven-rod cluster fuel element is being fabricated from identical rod for irradiation in the GEH-10 loop facility. This fuel element will be 18" in length and is scheduled to be shipped to the ETR next month.

In order to eliminate the boring out of uranium and the etching procedures presently used in preparing coextruded rod for end closure, end caps were successfully slipped over the clad rods, welded to the

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Zircaloy-2 cladding, and swaged to the original rod diameter. The rods were autoclaved for 100 hours at 350 C in water. Micrographs prepared after autoclaving showed no uranium contamination in the weld.

The cluster fuel element has a much higher heat transfer surface to volume ratio than massive or I & E slugs. A seven-rod cluster design is being considered for the NPR. KER Loops 1 and 3 are currently testing cluster elements with Zircaloy-2 clad coextruded uranium rod. The Loop 1 test consists of two, 7-rod clusters with 0.630" diameter and 0.050" rod spacing. The present exposure of these elements is 640 MWD/T. The Loop 3 test consists of two, 3-rod clusters with lengths of 24 and 36 inches. The amount of rod bowing will be measured. The present exposure of this test is 800 MWD/T. Loop 1 operates at 270 C and Loop 3 at 200 C maximum coolant temperature.

Radiometallurgy has measured the fuel core of a stainless steel clad element exposed to 2250 MWD/T at KER Loop 3. The fuel cladding did not change in dimensions. The fuel core diameter increased from 0.570 to 0.575", while its length increased from 8.000 to 8.033 inches. Evidently swelling was restrained by the steel cladding.

Rod and Tube Fuel. Four Zircaloy-2 clad rod and tube assemblies were fabricated for testing in KER Loop 2. The element dimensions are:

Rod			Tube			
O.D.	Cladding	Length	O.D.	I.D.	Cladding	Length
1.004	0.020	36"	1.785"	1.380"	0.030"	36"

Two elements have integral end sealed tubes; the remaining rods and tubes are closed by vacuum welding. Two rods failed during autoclave testing. These failures appear to be due to end cap leaks. A change in end cap design is under way. A new set of rods will be ready for charging at Loop 2 by November 14. All four tubes passed 350 C autoclave tests.

Brittle Bonds. As a result of continued research into the AlSi brittle bond problem, it is now possible to draw a few generalizations which may be assumed to apply in practically all cases:

1. The brittle type of Al-Si-U compound layer is characterized by a structure which, in the as-polished condition, appears bluish-purple, and highly textured under polarized light of proper orientation and degree of extinction. The chemical composition of this structure has not yet been identified.
2. Regions of the compound layer in which this structure appears are typically disrupted by circumferential cracks, ranging from very short ones (0.0005" to 0.001") in mild cases to essentially complete peripheral separation in the most aggravated cases.

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3. There appears to be little relationship between bond strength and bond brittleness. An extremely strong bond may be quite brittle.
4. The effect of long-term, intermediate temperature (250 C) heating is to cause enlargement of existing cracks (frequently until they join each other), as well as the development of new cracks in the brittle phase of the compound layer. Since this effect increases with time at constant temperature, it appears that the tensile stress across the compound layer set up by the larger differential expansive tendency of the aluminum jacket eventually, through a process akin to creep, causes deformation of the compound layer, with fracture where the latter is brittle. The deterioration of the compound layer and its conversion to the commonly observed gray powdery substance may then be merely due to the mechanical subdivision of the lustrous compound material by the network of cracks. If this is true, it may be possible to use the baking test in conjunction with a bond integrity test for the nondestructive testing of non-brittle bonded slugs, while those with brittle bonds, which become casualties as a result of the testing, may be eliminated.
5. The tough bond is characterized by a compound layer essentially devoid of the zones which appear blue-purple under polarized light. The uranium/compound layer interface is typically irregularly serrated and the layer adjacent to the uranium is of the composition now recognized in metallographic examination as UAl_3 . The outermost layer of the compound, thought to be $U-Si_3$, is typically flaked in appearance and the interstices between the flakes, which tend generally to retain their relative orientation become filled with the $AlSi$ matrix.
6. Both the tough bond and the brittle bond may frequently be found on the same slug. Where the compound layer formed during the canning process is disrupted, as by the evolution of a gas bubble from the uranium, the tough type bond is commonly generated at the zone immediately surrounding the point of evolution, presumably by the mechanical action of the escaping bubble. This accounts for the commonly observed fact that canned slugs with porous bonds also have tougher bonds than void-free ones.

The next step in the study will be to determine the conditions that lead to the formation of each type of bond. Since both types are found to form on the same slug simultaneously, an important factor may be the nature of the uranium core.

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Closure of Coextruded Rod Fuel Elements. Closing of coextruded rod elements by a brazed and welded end cap joint would permit an end cap design which would not require uranium machining and pickling. This design would produce an element with excellent heat transfer characteristics at the ends and a double seal against water entry into the uranium. Work is in progress to develop a suitable braze alloy for this application. The silver-copper alloys are under evaluation. These alloys are placed in the cup type caps, and the lip of the cap is rapidly welded to the rod wall. Then, a diffuse brazing heat is applied to the head of the cap, and the cap is brazed to the clad. The rod ends have been swaged permitting use of an end cap with the same OD as the rod. This design makes it possible to use a shorter cap lip, thus placing the weld nearer the end and minimizing the amount of uranium encased by a double-thickness Zircaloy clad wall. Under certain conditions a Zircaloy diffusion bond has been obtained between the cap and the rod wall. If a consistent diffusion bond can be produced between the cap and the clad, a durable seal can be obtained without the use of brazing material.

Self-Supported Fuel Elements. Self-supported fuel elements are designed to accurately position elements in smooth bore process tubes. Fabrication of limited numbers of I & E M-388 jacketed self-supported fuel elements for Production Test loadings are now being made.

The rod and tube Zircaloy-2 clad coextruded fuel element concept requires the attachment of supports to the 0.020" Zircaloy-2 cladding. Four 36" elements with supports attached by resistance spot welding were fabricated. All evaluations made in this type of element were satisfactory which indicates that this is one candidate method of attaching supports to coextruded fuel element jackets.

The ultrasonic welding method of support attachment is also being investigated. A contract with Aeroprojects, Inc., is being negotiated which should permit determination of the merits of this process as compared with the presently used method of resistance spot welding.

Cold Closure. The work in cold closure is presently centered around developing a reliable method of cold closing the I & E fuel element geometry. Attempts are now being made to close the I & E element by forcing the rings of internal and external jacket material to flow over the end of the element and meet in an annular ring joint at the end of the element core. This method has failed to date because of the inability to obtain a cold pressure weld in this ring joint.

Tests are now being conducted to determine the weld surface preparation and the sidewise growth of the weld interface to ensure a cold pressure weld. The sidewise growth of the weld interface necessary for a pressure weld may require a small annular groove in the core below the ring joint. This would approximate the action of the 1/8" hole in the solid closure and be in addition to extruding the metal interface up through the pouch as was done initially without success.

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PRTR Tube Tapering. Further attempts have been made to produce a 10° taper on a process tube. The taper is to end in a 2-1/16" cylindrical section approximately 12" long. Using a section of schedule 80 pipe as a mandrel has made the swaging operation much easier. It has also prevented overloading of the swage. This lighter mandrel, however, does not do as good a job in preventing wrinkling of the inner surface of the process tube. The last attempts at tapering, which were done with a vacuum anneal between the first and second stage reductions, were closer to requirements. A second vacuum anneal, half way through the second stage die, should prevent the cracking that occurs in the 2-1/16" diameter section. A test was made to observe the effect of hot swaging a Zircaloy-2 jacket onto a uranium rod. All of the components were thoroughly cleaned, outgassed, and then assembled by electron beam welding. This assembling technique produced a high vacuum in the finished piece. The evacuated Zircaloy uranium assembly was heated in a salt bath to 650 C, and then hot swaged from 1.200" diameter to 1.175" diameter. This operation resulted in an apparently tight fitting or bonded jacket. Further heating at 650 C, and swaging in 0.025" steps tended to destroy the good contact initially obtained. The progressive loss of contact was very noticeable as the piece was withdrawn from the salt bath. Dark blotches on an otherwise uniformly red hot element were indicative of poor bond and poor heat transfer. These dark blotches grew in area as the swaging progressed.

Direct Casting of Uranium into Zircaloy-2 Cans. Work has continued in the direct casting of uranium metal into Zircaloy-2 cans. The castings were bonded very heavily near the top; however, the bottom alloy zone was extremely weak. Heavy shrinkage was noted in each casting. Several sections of these castings were subjected to cycles of beta heat treatments. Results, while still incomplete, indicate that the grain size is refined to a size of less than 0.6 mm with two beta treatments. A third treatment did not change the structure significantly.

Hot Press I & E "C" Size Production Test. A third attempt to produce an acceptable production test for hot press I & E "C" size fuel elements is under way. The pressing cycle is one of a three-minute time delay following die seating, and a five-minute pressing cycle at 12 tsi and 600 C. Undercutting tests showed slight undercutting near one end of the fuel element. This was later reduced by a second outgassing. Hydrogen had apparently been absorbed on the surface of the unplated elements during storage prior to plating. This hydrogen was released from the hydride during pressing, forming channels under the plate. The present test is about one-third complete and progressing at the rate of approximately 20 elements per day.

2. REACTOR PROGRAM

Coolant Systems Development

Corrosion of "HiTank" Carbon Steel in filtered water is apparently inhibited by 500 ppm dichromate and pH adjustment (NaOH) to 10.0. One thousand ppm of filming amine also reduces carbon steel corrosion. After 15 days exposure, samples in uninhibited filtered water had thick rust on

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all surfaces, samples in filtered water with 500 ppm dichromate showed only a few tiny rust spots on machined surfaces only, and samples in filtered water with 1000 ppm proprietary filming amine (octadecyl amine base) showed some rust on machined surfaces only. All samples received prior immersion in Turco 4306-B solution. The September monthly report incorrectly reported 500 ppm dichromate as ineffective. Only 100 ppm dichromate was used in the tests reported in September. One hundred ppm dichromate did not inhibit carbon steel corrosion.

Rust Removal From Carbon Steel Heat Exchangers. Several solutions were evaluated for their effectiveness in removing rust from the cooling side of the ELMO-1 heat exchanger. This heat exchanger has a carbon steel shell and stainless steel tubes. The more effective rust removers such as HCl or Turco 4306-B can't be used because they may induce stress cracking in the stainless steel. Many of the solutions worked effectively as rust removers, but they also removed excessive quantities of base metal. A 10% sulfuric acid solution inhibited with Rodine 81 removed the rust rapidly with little metal loss. The commercial rust removers tested removed the rust without any metal loss but required about twenty times as long as the inhibited sulfuric acid solution. The tests were run on rust samples taken from the ELMO-1 heat exchanger and on rusty high temperature steam pipe. Metal loss with this solution in one-half hour is 0.1 mil for carbon steel and 0.001 mil for stainless steel.

Raw Water Heat Exchanger Tests. The heat exchangers in this test have been operated for a total time of 120 days using raw Columbia River water as the coolant. The raw water conditions are 7fps velocity, inlet temperature 57 F, outlet temperature 212 F, and a maximum pipe wall temperature 323 F. The over-all heat transfer coefficient has dropped only about 5% during this period. The maximum pipe wall temperature, located on the cooling water side of the last exchanger, has increased from 310 to 323 F, indicating that some scale is forming on this particular section of the exchanger.

In-Reactor Loop Testing. A document has been prepared showing the present charges in the KER Loops, new charges being considered, and changes in operation. This document, HW-57948, will supersede all previous schedules.

The use of a phosphate-regenerated deionizing resin for cleanup, started in September, has proved successful in greatly reducing the activity of the loop water and in halting an increase in activity of the piping surfaces. The use of a similar resin has been started in Loop 4.

Thermocouple Slug. The Doe alloy thermocouple slug in the high flux region of KER Loop 4 has apparently leveled off at 290-295 C, confirming the predicted cladding temperature behavior. Two thermocouples still read within 10 C, while the other continues to read about 25 C lower.

A seven-rod cluster element with holders for positioning thermocouples to read temperatures near the central rod and by one of the outer rods has been placed in ELMO-7 for out-of-reactor testing to determine the

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possibility of fretting corrosion. If adverse corrosion is not observed, one of the next in-reactor thermocouple measurements will be made on a seven-rod cluster to determine the mixing of the coolant.

Decontamination Testing. Eight dynamic decontamination tests have been conducted in ELMO-10 in the 1706-KE Building. All of these tests have been run with contaminated SLW Boiler tubing. The results of two tests of special interest are shown below:

Test No.	Process Tested	Processing Time	Processing Temperature	Results (D.F.)
1	Turco-4501	1 hr	125 C	D.F. = 222
	Turco-4502 (2 lb/gal)	1 "	100	
	HNO ₃ (25% Vol)	1/2 "	30	
2	NaOH (1.5 lb/gal)	1 "	95-100	D.F. = 2,770
	KMnO ₄ (0.25 lb/gal)			
	(NH ₄) ₂ Citrate (0.85 lb/gal) EDTA* (13.3 gm/gal)	1 "	80-85	

*(ethylene diamine tetra-acetic acid (Versine)).

A decontamination factor of four or five would be considered good here, and these values of over 200 are excellent. The outstanding performance of the material of Test No. 2, which is of known composition and free from chlorides and fluorides is especially gratifying. Chlorides cause stress corrosion cracking of stainless steels.

Corrosion of 8001 and 1245 Aluminum. Initial results from the Turco 4306-B flush at approximately 5 gpm and 50 C at a concentration of 6 oz/gal for 40 minutes showed that the corrosion penetration for X-8001 is 0.086 mil and for 1245 aluminum is 0.16 mil. However, with an additional 15-day exposure the corrosion rate of 1245 increased by 30% and the X-8001 showed no additional corrosion. The testing is continuing to determine the long term effects.

Decontaminating Solutions. The corrosiveness of Turco 4306-B, 4506-1A and 4506-1B cleaners on several metals was compared. The 4506-1A and 4506-1B are modifications of the 4306-B solution, which has been used as a decontaminant on the production reactors in experimental quantities. The corrosion of clean aluminum alloys, copper, brass, mild steel, 304-L stainless steel and Zircaloy-2 by these solutions at 50 C and 6 oz/gal Turco concentrations was approximately linear for one hour. The iron and copper alloys corroded less than 0.01 mil/hr; the aluminum alloys corroded 1 to 2 mils/hr; and Zircaloy-2 corroded more than 2 mils/hr. A small stagnant system showed a water-line pitting attack on copper, presumably due to atmospheric oxygen. No localized corrosion was noted on fully submerged samples.

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H-Reactor Pigtails. A stainless steel pigtail, which failed in H Reactor, is being examined metallographically. Many cracks were found in the failed area and adjacent sections. All cracks which do not extend through the tube wall started on the outside and progressed inward in a manner characteristic of stress corrosion or corrosion fatigue. The failure is not a straight fatigue-type. H Reactor was once decontaminated with Turco 4306-B, which contains chlorides.

Organic Clean-Up Studies. Testing continued on the dehydration of MIPB at room temperature with silica gel and calcium sulfate. The capacities of both were determined to be about equal. Using MIPB containing about 120 ppm H_2O , it requires about one gram per 100 ml to reduce the water content to about 30 ppm, two grams for 15 ppm, and four to five grams per 100 ml will reduce the residual water concentration to five ppm, which is the lowest concentration that can be measured with the present analytical method.

Nonmetallic Materials Development

Graphite Development. In a cooperative program with carbon manufacturers for the development of reactor grade graphite, tests of process variation have been studied. Recent samples submitted by the National Carbon Company have been measured in the Hanford Test Pile to determine the effect on purity. The results, expressed in terms of process variations, are as follows:

- (a) Change in Loading Capacity. Previous tests have indicated that some gain in purity might be obtained through increased furnace loads. The results of current tests do not substantiate this finding but do lend encouragement in terms of production efficiencies of satisfactory purity. Samples from a furnace loading 40% larger than normal indicated a small decrease in purity. The normal d.i.h. purity expected from AGOT processing is $+0.255 \pm 0.075$. The average for the samples tested was $+0.198$ with all values within the range expected for AGOT material.
- (b) Resin Impregnation, Bake, F-Process. AGOT processed bars given one resin impregnation and bake followed by "F" process purification resulted in an average d.i.h. purity of $+1.011$, which is well within the expected range of $+0.96$ to $+1.10$ for "F" processed graphite.
- (c) Low Permeability, High Strength and Density. A series of graphites of low permeability, high strength and high density (1.8 to 1.9 gm/cc) were produced with a pressure forming and baking process. Material of this type when given an "F" purification resulted in a d.i.h. purity of $+0.382$. The same material given two resin impregnations and bakes before purification resulted in a d.i.h. purity of -3.150 .

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- (d) Low Inherent Boron. Pressure baking and forming of material selected for its low original boron and ash content resulted in a d.i.h. purity of -0.274 for AGOT graphitization. Other material from the same batch gave a d.i.h. purity of -1.308 when AGOT graphitized and then subjected to two resin impregnations and bakes. When first AGOT graphitized then resin impregnated and baked followed by regraphitization, the observed d.i.h. purity was -0.246.

X-Ray Study of Radiation Damage. X-ray data from a series of 14 CSF graphite samples irradiated up to an exposure of 5700 MWD/AT at 30 C were obtained and lattice parameters were determined after applying correction factors to the diffraction line. In the following table the old and new C_0 values are presented to indicate the magnitude of the correction:

Corrected Values As a Function of Exposure

Exposure MWD/AT	0	1000	2000	3000	4000	5000	6000
Old C_0 Value Å	6.71	7.16	7.48	7.65	7.73	7.78	7.78
Corrected Value Å	6.71	7.05	7.20	7.27	7.32	7.35	7.43

In addition, as previously reported, there is evidence of a slight decrease in the spacing beyond 6000 MWD/AT to 8400 MWD/AT, the limit of the data at present. Currently, the corrections are being applied to x-ray data from samples irradiated in the MTR to determine if there exists any qualitative difference in the radiation damage effects on the lattice parameters between MTR and Hanford radiations.

Stored Energy Monitoring. Total stored energy measurements of graphite cores taken from B Reactor have confirmed earlier estimates from C_0 changes. A total of 285 cal/g was found in cores taken at the position of maximum stack expansion, 9-1/2 feet from the Van Stone flange in a channel which has been uncooled for four years. This should represent an upper limit to the stored energy accumulated in filler-block graphite. Stored energy at other positions along the channel and in the newer reactors which have not had a long history of low temperature operation is much lower.

Of more significance than total stored energy is the amount of energy releasable over any given temperature range. While a total of 285 cal/g is not alarmingly high in itself, annealing studies will be conducted to determine the energy releasable over several temperature intervals.

Radiation Induced Oxidation of Plastics. Oxidation damage in gamma irradiated polyethylene is found to be a sensitive function of the gamma dose rate. After a total dose of 10^8 r/hr, samples exposed at 10^7 r/hr contained approximately 40% more carbonyl at 9 mils from the surface than samples exposed at 10^1 r/hr. An extension of the theory previously reported⁽¹⁾ will adequately predict this distributional change.

(1) HW-57057, "Analysis of Oxygen Diffusion and Reaction in Polyethylene," R. C. Giberson.

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Structural Materials Development

Zircaloy Process Tubing for NPR. The five NPR process tubes procured under contract DDR-28 have been formally rejected. Two of the five were of good quality except for below-tolerance thin spots in the wall caused by excessive grinding to remove surface defects. Several companies are actively engaged in development programs for fabricating Zircaloy-2 process tubing for the NPR.

Thermal Hydraulics Studies

Reactor Flow Hazard Studies. A brief transient experimental program was conducted to determine the hazards resulting from a loss of coolant flow to an "O" geometry tube (e.g., B-D-F size) operating with a missing rear pigtail. The program was prompted by the desire to continue operation of a reactor which has lost a rear pigtail until a shutdown is convenient. Among the requirements to make the continued operation feasible, the Panellit protection system must be capable of guarding against flow reductions to the tube without the rear pigtail. The experimental program demonstrated that the present Panellit protection procedures are adequate. In particular for the questionable case, that of a plugging incident upstream of the Panellit tap, the behavior of a tube without a rear pigtail is comparable to that of a normal tube. As such, the pressurization due to critical flow in the outlet fitting is sufficient that a high Panellit trip would be secured if a low Panellit trip should be missed.

A brief series of transient runs was made to determine the effective lumped heat capacity of the low pressure apparatus test section with respect to the outlet water temperature. This information is of value in comparing the thermal characteristics of the test section to those of a reactor.

Hydraulic Studies. A test section was built to measure the response time of temperature measuring elements. The response times of various RTD's (Resistance Temperature Detectors) were determined for IPD. The times to reach 94 percent of a step change ranged from two to fifteen seconds, reflecting the variable quality in the design and fabrication of the RTD's.

The hydraulic characteristics were determined for self-supported I & E slugs proposed for use in ribless tubes in the "O" reactors (B, D, DR, F, H). The pressure drop for these slugs is about 14 percent greater than the pressure drop for the normal "O" geometry I & E case. The annulus to hole flow ratio was found to be about 3.0.

Work was started on measuring pressure fluctuations along the flow path of the hydraulic apparatus from the pump to the rear header. Similar measurements will be taken on the low pressure heat transfer apparatus. Should the data show that the Panellit pressure fluctuations arise in the process tube and not in the external piping, and if the Panellit pressure fluctuations of the test apparatuses are comparable to those of a reactor, the search for the causes and methods of elimination of the fluctuations can be conducted in the laboratory.

About 190 critical flow experimental runs have been made in twelve test nozzles. The data have yet to be analyzed.

High Pressure Apparatus. Approximately eight hours of operating time have been accumulated with a heat exchanger which cools high-pressure high-temperature water from the high pressure apparatus with raw Columbia River water. The test is being made to determine fouling characteristics of the NPR heat exchanger using raw river water. No scale formation was noted except at the end of the tube which was in a stagnant flow area.

Mechanical Equipment Development

Organic Cooling System Components. The MOTS-1 facility operated for a total of 174 hours at temperatures from 300 to 350 C. Leakage from the mechanical seals being tested on the facility increased to approximately one quart of MIPB per day. The cause of the leakage appears to be shaft damage under the Teflon shaft-sealing rings. This shaft damage has not appeared when the same mechanical seals have been run in water under comparable conditions.

Pressurized fire tests were conducted at 350 C and 350 psi, using an eutectic mixture of ortho-terphenyl, meta-terphenyl, and biphenyl. This eutectic mixture was much less combustible than MIPB.

Shielding Studies

Attenuation Studies. Ferrophosphorus concrete test slabs are being irradiated in the DR test well after baking at 200 C. The test data on ferrophosphorus concrete baked at 100 C are being analyzed. The foils from the test on ordinary concrete baked at 200 C have been counted and the data have been sent to IBM. The ordinary concrete test slabs are now being baked at 300 C. Pure iron test slabs are being fabricated in the shop.

Thermal Shield Studies. During the last C Reactor shutdown, eight 3/4" holes were drilled through the outer 1-7/8" plate of the 36" shield plug. This is the first step in preparing new slots for cooling water tubes and instrument leads.

Document HW-57818, "Detailed Test Procedures, NPR Design Test DT-1037: In-Reactor Test of Borated Mortar Thermal Shield," has been issued. Shop fabrication of the test insert for this design test is approximately 10% complete.

B. WEAPONS - 3000 PROGRAM

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

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C. CUSTOMER WORK

Radiometallurgical Examinations

IP-148-AC Examination of Rupture from 0957-C (RM-247). Examination of the internally and externally cooled, enriched fuel element, which was irradiated as part of IP-148-AC and failed in tube 0957-C, was completed this month.

Examination indicated that the rupture was caused by failure of the uranium. The basis for the conclusions are listed as follows:

1. The cracks in the uranium are radial.
2. The minor amount of uranium corrosion product formation present was insufficient to cause the extensive splitting observed in the uranium.
3. The nature and location of the uranium corrosion product indicate that the corrosion occurred after the uranium had fractured and water had entered through the ruptured can wall, which parted in a tensile failure.
4. Macro and micro examination of the internal can wall showed that no penetration had occurred, no corrosion was evident, and the aluminum quality was good.
5. The area of greatest damage appeared in the central portion of the slug, nearly equidistant from the ends of the slug.

Examination of Depleted Uranium Failure - C (RM-253). The examination of three ruptured and one unruptured 0.2 a/o U-235 I & E slugs from the 105-C Reactor was begun. The failure from 3789-C appeared to have failed by water entry through a pin-hole in the weld at the female end, the water following the aluminum spire to a point 1/2" to 1" from the female end. A football-shaped mass of corrosion product formed to fill the aluminum spire and to crack the uranium. Studies of the other similar kinds of failures are continuing.

I & E Hole Failure - 2582-C (RM-249). The element had failed by internal spire failure. The samples were sectioned longitudinally, and severe corrosion attack was seen on the spire can wall both above and below the failure point. Can wall metallography on a section of the spire is being conducted.

Metallography Laboratories

Samples Processed During the Month:

Total samples processed: 222

Photographs

Micrographs 160
Macrographs 283

Total 443

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-58019 A2.

J.W. Woodfield

For Manager, Reactor and Fuels Research
and Development Operation

FW Woodfield: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
ED Waters	9/29-10/3	GEL, Schenectady Wallensak Optical Co., Rochester, N.Y.	Present paper at GE symposium. Consult on high speed motion picture photography.	DH Brown & JA Mauro	No
JM Batch	10/20-23	Purdue University, Lafayette, Ind.	Recruiting	--	"
JF Fletcher	10/1-2	Portland, Ore.	Present talk to Natl. Assn. of Power Eng.	--	"
PA Scott	10/2-9	Byron-Jackson, Los Angeles, Calif.	Witness pump testing and engineering consultation.	A Bunke	"
JW Finnigan	10/23-24	ORNL, Oak Ridge, Tenn.	Attend Neutron Physics Div. Info. Meeting.	EP Blizard	Yes
HE Hanthorn	10/1-4	Industrial Process Engrs., Newark, N.J.	Consult on design requirements for autoclave and blowdown system.	Mr. Rubin	No
LG Merker	10/27-11/10	Clearing Machine Co., Chicago, Ill.	Engineering consultation.	P Delmar	"
CS Powers		Industrial Process Engrs., Newark, N.J.		IE Rubin	"
		Harper Elec. Furnace, Buffalo, N.Y.		HD Roth	"
		Stokes Mfg., Philadelphia, Pa.		D Garwood	"
		Sargeant & Wilbur, Inc., Pawtucket, R.I.		--	"
SH Bush	10/1-2	AECL, Chalk River, Ontario, Canada	Discuss Sheath Program.	EE Sinclair	Yes
DC Kaulitz	10/5-10	AEC-100 & Phillips Pet. Co., Idaho Falls, Ida.	Install in-reactor section 3x3 loop.	R Neldner	"

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
WL Wyman	10/1	Aeroprojects, Inc., Westchester, Pa.	Discuss ultrasonic welding.	B Jones	No
	10/2	Air Reduction Machine Welding Dept., Union, N.J.	Check on vacuum chamber.	J Berryman	"
HJ Pessl	10/10	Northwest Metal Prod., Kent, Wash. Mech. Prod. Mfg. Co., Seattle, Wash.	Discuss clampholder fixtures for 7-rod cluster fuel element for the NPR.	SF Parker PE Schinman	" "
SH Bush	10/20-22	U. of Michigan, Ann Arbor, Mich. BMI, Columbus, O.	PhD Recruiting	--	"
	10/23		Discuss BMI technical program	FR Shober	Yes
	10/24	National Lead Co., Albany, N.Y.	Discuss casting of U	EB Blasch	"
TT Claudson	10/20-24	American Ceramic Society Los Angeles, Calif.	Present paper.	--	No
DC Kaulitz JE Minor	10/20-22	AEC-100 & Phillips Pet. Co., Idaho Falls, Ida.	Inspect Hanford loop in ETR & consult on use of loop.	S Cohen & S Bartz	Yes
JC Tverberg	10/21	ANL, Lemont, Ill.	Discuss fabrication of direct cast U cores.	K Smith	"
	10/22	Lindberg Eng. Co., Chicago, Ill. GE - Carbology Div., Detroit, Mich.	Discuss furnace for 306 Bldg. expansion. Discuss Zr fabrication.	C Burling JA Yoblin	No No
	10/23	BMI, Columbus, O.	Discuss fabrication of direct cast U cores.	FR Shober	Yes
	10/24	Clevite Res. Center, Cleveland, O.	Discuss casting of U into Zr components.	GW LaPier	No
	10/25-31	ASM Metal Show, Cleveland, O.	Attend Metal Show.	--	"

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
DR Stenquist	10/24	Clevite Res. Center, Cleveland, O.	Consult on ceramic fuel element fabrication.	GW LaPier	No
	10/27-30	AIME Fall Meeting, Cleveland, O.	Present paper.	--	"
JW Goffard	10/25-28	ASM Metal Show, Cleveland, O.	Attend show.	--	"
	10/29	NMI, Concord, Mass.	Discuss coextruded fuel material.	S Isserow	Yes
DC Kaulitz	10/27	National Res. Corp., Cleveland, O.	Discuss specialized fabricating equipment for fuel element fabrication.	D Reese	No
	10/28	High Vacuum Corp., Cleveland, O.	Same as above.	Mr. Williams	"
	10/29	Stokes Mfg. Co., Cleveland, O.	" " "	L Patrick	"
GS Allison	10/27	The Yoder Company, Cleveland, O.	Consult on design of equipment for 306 Bldg.	--	"
HJ Pessl	10/29	Clearing Machine Co., Chicago, Ill.	Same as above.	Mr. TerMeer	"
		Verson Press Co., Chicago, Ill.	" " "	--	"
LJ Chockie	10/27-31	ASM Metal Show, Cleveland, O.	Attend show.	--	"
	10/27	GE - Lamp Wire & Phosphors Dept., Cleveland, O.	Discuss fabrication of wires for electron gun filaments.	RH Humbert	"
JE Minor	10/27-29	ASM Metal Show, Cleveland, O.	Present paper.	--	"
	10/30	KAPL, Schenectady	Consult re fuel performance.	CE Weber	Yes

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
WE Roach	10/27-28 10/29	Northwestern Univ., Evanston, Ill. BMI, Columbus, O.	PhD Recruiting Discuss thermal conductivity measurements.	-- FR Shober	No Yes
AL Bement	10/28 10/29 10/30 10/31	Cook Electric Co., Chicago, Ill. Aero Res. Institute Chicago, Ill. Marshall Products, Columbus, O. Federal Products Corp., Providence, R.I. Metals & Control Corp., Attleboro, Mass.	Discuss procurement of specialized creep capsule components & development & fabrication of such capsules.	WT Welsh M Scadron LA Marshall EA West AR Matheson	No " " " Yes
JA Ayres	10/1-2	AECL, Chalk River, Ontario, Canada	Attend meeting on fuels and corrosion.	EE Sinclair	Yes
RH Todd	10/23-24 10/27-29	ORNL, Oak Ridge, Tenn. ASM Metals Show Cleveland, O.	Discuss vibratory polishing. Attend show.	RJ Gray --	" No
CG McCormack	10/21 10/22-24	Pratt & Whitney Aircraft, Livermore, Calif. AVSS, San Francisco, Calif.	Observe hot cell operation & discuss rare gas collection equipment. Attend American Vacuum Society Symposium.	V Scott --	Yes No
EC Watts	10/27-31	ASM Convention Cleveland, O.	Attend convention.	--	No
LD Turner	10/1-2	ANL, Lemont, Ill.	AEC-sponsored alpha-gamma hot lab conference.	RC Goertz	Yes

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JW Riches	10/20	Wolverine Tube, Allen Park, Mich.	Consult on Zr fabrication.	EA Wright	No
	10/21	Chase Brass & Copper, Waterbury, Conn.	Same as above.	DK Crampton	"
	10/22	Tube Reducing, Wallington, N.J.	" " "	E Fisher	"
	10/24	Harvey Aluminum, Torrance, Calif.	" " "	GA Maudry	"
PJ Pankaskie	10/28	Cook Electric Co., Chicago, Ill.	" " "	--	"
	10/29	BMI, Columbus, O.	" " "	FR Shober	"
	10/30	Federal Products Corp., Providence, R.I.	" " "	EA West	"
RC Aungst	10/28-29 & 31	New Rochelle Tool Co., New Rochelle, N.Y.	" " "	CA Tudbury	"
	10/30	NMI, Cambridge, Mass.	" " "	T Tarpey	"
DE Baker	10/20	Minn. Mining & Mfg., Minneapolis, Minn.	Discuss graphite coatings.	JR Johnson	"
	10/21-22	ORNL, Oak Ridge, Tenn.	Present paper at Info. Mtg. on GCPR.	AJ Miller	"
	10/23	GERL, Schenectady	Discuss graphite coatings	RJ Dirfendorf	"
	10/24	Carborundum Co., Niagara Falls, N.Y.	" " "	DG Sturges	"
C Groot	10/3-6	WAPD, Bettis Field, Pittsburgh, Pa.	Discuss Zr pickling	B Lustman W Hereford	Yes
YB Katayama	10/1-7	Fused Salt Electrodeposition Conference, Ottawa, Canada ANL, Lemont, Ill.	Attend conference, discuss UCRL program & single crystals. Discuss Pu fuel element fabrication.	-- LR Kelman	No Yes

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
ID Thomas	10/10-14	Metals & Controls Co., Attleboro, Mass.	Discuss PRP fuel elements.	Mr. Dunlop	Yes
RW Stewart	10/16-17	Dow Chemical Co., Denver, Colo.	Discuss device fabrication.	IB Venable	"
ED McClanahan	10/22-27	American Vacuum Society, San Francisco, Calif. UCRL, Livermore, Calif.	Attend symposium.	--	No
WB Weihermiller	10/23-31	Monarch Machine & Tool, Dayton, O. Lodge & Shipley Co., Cleveland, O.	Discuss Project Whitney	WJ Ramsey	Yes
			Witness test demonstration on lathes.	--	No
OJ Wick	10/27/31	ASM Metal Show, Cleveland, O.	Attend metal show.	--	No
ID Thomas		ANL, Lemont, Ill.	Discuss Pu fabrication facilities.	AB Shuck	Yes
RD Nelson	10/27-31	ASM Meeting, Cleveland, O.	Present paper.	--	No
		Buehler, Ltd., Evansville, Ind.	Inspect metallographic equipment.	Mr. Buehler	"

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
JE Duncan	10/8	UCRL, Livermore, Calif.	Discuss Project Whitney.	RW Stewart	Yes	200-W, 2704-Z, 231-Z
RL Waldron O'Keefe	10/18	"	"	"	"	"
JB Bryan AJ Hodges	10/21-21	"	"	"	"	"
JO Jepson WJ Ramsey	10/22/23	"	"	" OJ Wick	"	"
MH Wahl	10/23	duPont, Savannah River Plant.	Discuss UO ₂ programs.	FW Woodfield	"	300, 306, 325
L Cuthbert	10/23	National Lead, Cincinnati, O.	Technical discussions	FW Woodfield	"	300, 306, 325
W Cone	10/28	U. of Idaho, Moscow, Ida.	Inspect facilities for research thesis.	LD Perrigo	No	100-K, 1706-KE
ML Jackson	10/28	"	Enrollment in graduate course.	JA Ayres KD Hayden	"	100-K, 1706-KE 1704-K
DD LaRocque	10/6	KAPL, Schenectady	Discuss cathodic etching procedures & hot lab operation.	LD Turner	Yes	300, 327
RA Quadt	10/14	Hunter-Douglas, Riverside, Calif.	Consult on Zr fabrication.	JW Riches	No	300, 306
EF Wilson	10/6	ACF Industries, Washington, DC	Discuss Gas Cooled Reactor Conference.	JM Davidson EM Woodruff RE Nightingale	Yes	300, 326, 328
LJ DiGirola	10/17	"	"	"	No	"
WF Banks	10/28	"	"	"	Yes	"

4000 PROGRAM RESEARCH AND DEVELOPMENTREACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATIONPLUTONIUM RECYCLE PROGRAMPlutonium Fuels Development

Al-Pu Alloy Capsules for MTR Irradiation. The Al-Pu and Al-Si-Pu alloy cores (GEH-3-33 through 40) containing 5 to 25 w/o Pu, were radiographed and sampled for chemical analysis to verify earlier results. A few of the Al-Si-10 w/o Pu alloy cores were non-uniformly dense on the radiograph indicating that some segregation had taken place during the casting operation. Based on the recent findings, the cores for the irradiation test have been selected for final assembly. The cladding components and MTR full-flow capsule holders are fabricated. Heat transfer calculations indicate that the capsules will generate about 38 kw/ft and will have a central core temperature of about 400 C. It is planned to ship the eight irradiation test capsules to the MTR in the near future.

Al-Pu Alloy Dimensional Tolerance Test in MTR. Al - 1.8 w/o Pu alloy capsule cores have been cast, machined, and sampled. Zircaloy cladding components have been completed, and the fabrication of MTR full-flow capsule holders is in progress at the shops. The four capsules are to be irradiation tested to establish whether or not the proposed fuel core diameter and the jacket inside diameter tolerances for the plutonium-bearing PRTR initial fuel element charge are satisfactory. Heat transfer calculations are currently under way for this test. Also, four capsules containing Al - 1.65 w/o Pu and Al - 12 w/o Si - 1.65 w/o Pu canned in Zircaloy with standard gap tolerances are being prepared for irradiation in the MTR to 60-100 percent burnup of the Pu atoms.

Extruded Al-Pu Alloy Capsules for MTR Irradiation. The recently extruded Al - 1.65 w/o Pu alloy rods were examined and some sections selected for capsule irradiation in the MTR. Metallography, sampling, and machining of the test rods are currently being initiated. Present plans are to test four capsules, two to 25 percent burnout of the Pu atoms and two to 50 percent burnout. MTR experiment numbers are being requested.

Al-Pu Alloy Clusters for KER Irradiation. One, 4-rod cluster containing Al - 8 w/o Pu and Al - 12 w/o Si - 8 w/o Pu alloy cores is presently being irradiated in Loop 3 of the KER facility. It is tentatively planned to discharge this element during November 1958. A second fuel element cluster of similar design is waiting to be charged into KER Loop 1 at the next scheduled loading date.

The Al - 1.8 w/o Pu fuel cores for the proposed seven-rod cluster irradiation test in the KER facility have been extruded. The present plans are to use a modified PRTR, Mark I-C, design which will have the assemble-disassemble type fuel rod end caps. The one piece cores will be about 17.7 inches long. Stand-by fuel core material has been cast and machined. The fabrication of the Zircaloy-2 fuel rod cladding components and the stainless steel brackets are in progress at the shops.

Injection Cast Irradiation Specimens. Four injection cast irradiation capsules were fabricated, and the capsule ends were counterbored 1/4 inch to provide space for insertion of end caps. The core lengths were measured to provide pre-irradiation data. One capsule was successfully decontaminated, and the others are being processed.

PuO₂-UO₂ Capsules for MTR Irradiation. Tentative plans are to irradiate four capsules with PuO₂-bearing cores. Two capsules will have high density, sintered PuO₂-UO₂ mixed crystal oxide cores (GEH-3-43,44), and two will have high density, sintered cores composed of a mechanical mixture of PuO₂ and UO₂. Cladding components and MTR full-flow capsule holders are currently under fabrication. The group of eight mixed crystal oxide compacts which will provide core material for four capsules are presently being ground to finish dimensions. Physics calculations have been completed, and heat transfer calculations are under way.

PuO₂ Impregnated Graphite. An experiment has been designed for the irradiation testing of six PuO₂ impregnated graphite capsules. This material is of interest as a potential plutonium-containing fuel for PRTR application. The physics and heat transfer calculations have been completed, and the parts are being fabricated in the shop. The impregnated graphite cores will be about 0.5 inch in diameter and two inches long and will be contained in Zircaloy cladding. The irradiation of the samples will be performed at three different core temperatures of 220 to 345 C, 454 to 525 C, and 685 to 778 C. The range for each core temperature is due to the decrease in thermal conductivity of the graphite with irradiation, and the consequent increase in core temperature. The different core temperatures will be obtained by varying the plutonium concentration and the size of the helium filled heat transfer path between the core and the can wall. The plutonium concentrations will be 0.031 and 0.55 gm of Pu-239 per cc, and the gaps between the core and the can wall will be 0.005 and 0.010 inch. The samples will be placed in an unperturbed flux of about 5.75×10^{13} nv, and the highest specific power of 190 watts/cc will be generated in the samples which contain 0.055 gm of Pu/cc and have a 0.010 inch helium-filled gap. This is comparable to the maximum specific power anticipated in the PRTR. Two samples will be irradiated at each of the three core temperatures, one to about 25 percent burnup of the Pu atoms, and the other to about 50 percent burnup.

Each sample will be supported in the capsule by graphite spiders on either end. This will provide a relatively unrestrained irradiation test. Post-irradiation examination will include dimensional inspection, changes in C₀ spacing, and burnout analysis. The samples will then be submitted to the Chemical Research Operation for separations and re-impregnation investigations.

Plutonium Oxide Fuel Materials. Pellets consisting of a mechanical mixture of UO₂-0.0259 a/o Pu in the form of PuO₂ were pressed to a green density of 63% of theoretical and sintered in hydrogen at 1480 C. At this temperature a sudden current surge was observed, followed by failure of the furnace heating element.

The pellets, after sintering, averaged 76% of theoretical density, while pieces containing the same concentration of Pu in the form of the mixed crystal oxide and receiving a similar thermal treatment increased from 63 to 90 percent of theoretical density. An investigation of this difference in sinterability is planned. The mixed crystal oxide bearing pellets, upon being ground, exhibited

an extremely porous sub-surface. At present there is no explanation for this occurrence.

Diffractometer patterns using $\text{CuK}\alpha$ radiation have been run on a solid solution of $\text{UO}_2\text{-PuO}_2$ (14.7 w/o Pu) obtained by coprecipitation. Patterns have also been run on mechanical mixtures of $\text{UO}_2\text{-PuO}_2$ (14.7 w/o Pu) both before and after sintering of the mixture. An atomic size difference of seven percent and the FCC lattices of both UO_2 and PuO_2 indicate that extensive substitutional solid solubility is possible. That a solid solution did form on sintering was proved by the absence of double peaks on the trace. Because of excessive broadening encountered in the high angle region, low angle reflections were used for lattice parameter calculations, though a greater magnitude of error is introduced. The parameter of the as-received mixed crystal oxide was calculated from the 111, 200, 220, and 311 planes to be $5.431 \pm 0.003 \text{ \AA}$ while the sintered mixture was $5.449 \pm 0.002 \text{ \AA}$. The latter value being between the lattice parameter of UO_2 (5.468 $\text{\AA}$) and the mixed crystal oxide indicates lack of complete plutonium diffusion at 1480 C.

Pyrometallurgical Techniques. The possibility of recycling Pu from Al-Pu alloys into Al-Si-Pu alloys was outlined last month. Briefly, the process is as follows: Pu is extracted from molten Al-Pu alloy into molten Bi; the Pu is then extracted from the molten Bi into a molten Al-Si alloy.

One experiment had previously indicated the latter extraction to be virtually complete. This would allow an appreciable increase in Pu concentration in the Al-Si alloy over the feed Al alloy. The mechanism of the extraction was believed to be the formation of a Pu-Si compound which either floated or dissolved preferentially in the aluminum phase. However, data received this month indicate that possibly an equilibrium is reached between the bismuth and Al-Si with a distribution ratio, K, approximately equal to two (gram Pu/mole Bi: gram Pu/mole Al-Si). Since these results are inconsistent with other observations, the experimental procedure will be re-examined to assure greater contact between the Al-Si and Bi phases at temperatures just above the melting point of eutectic Al-Si where Pu-Si compounds would be most stable.

Extrusion Development. The installation of accessory equipment on the 280-ton extrusion press is continuing. This equipment includes a mobile billet furnace, a hydraulic billet loader, a run-out tube extension and hydraulically operated bolster blocks.

Work is also progressing on improving the quality of the 1100A and U-Al extrusions. A lowering of the extrusion temperature from 400 C to 200 or 300 C has improved the surface finish on the Al and low percent U alloys.

The 50-ton vertical prototype extrusion press utilizing the existing tensile machine has been put into operation, and the testing phase of the program has been completed. Metallography, mechanical testing of extruded rods, and final evaluation of data remain to be completed.

The primary purpose of this program is to obtain a comparison of the extrusion constants of Al-U and Al-Pu alloys. The indication at this time is that both alloys offer approximately the same degree of resistance to deformation.

Tests were conducted on 1.65, 10, and 20 weight percent Al-U and Al-Pu alloys at 300, 400, and 500 C using Oildag as a lubricant on the container wall and the die face. Oildag has a low flash point (300-400 C) and presents a serious fire hazard in a dynamic-type hood. Testing was done in a static argon atmosphere, but the extremely dense smoke generated lowered visibility considerably. Some experiments were conducted using a lubricant of Alemite - 40% graphite, which has a higher flash point. This lubricant appears to be satisfactory, although the smoke problem in a static type hood is still present.

Several extrusions were attempted with the Al - 1.65 w/o Pu alloy with no preheating of the billet and the container at 200 C. This required a pressure of approximately 26.5 tsi, whereas the same alloy with billet and container at 500 C required a pressure of only 6.6 tsi. The required pressure was decreased 20% by lubricating the sides of the billet. The best surface finish has been obtained with the 1.65 w/o alloy extruded at an extremely slow rate, with no preheating, and with the container temperature at 200 C. Lubrication of the billet promotes inclusions of graphite in the surface of the extrusion.

Tubing for PRTR Fuel Element Development. A shipment of 400 feet of stainless steel (304L alloy) tubing with 0.008 inch wall thickness was received and sent to Radio-graphic Testing Operation for examination.

Procurement of the following jacket tubing orders has been initiated:

<u>Material</u>	<u>OD, ID (in.)</u>	<u>Wall (in.)</u>	<u>Amount (ft)</u>
Stainless steel (304L), vacuum-melted stock	0.507 (ID)	0.005	400
Aluminum (8001 alloy with 0.1% Ti addition)	0.505 (ID)	0.030	4800
Stainless steel (17-4 PH or 17-7 PH alloy)	0.563 (OD)	0.005	400
Inconel X	0.700 (OD)	0.020	40
Inconel X	0.700 (OD)	0.015	40
Inconel X	0.563 (OD)	0.010	40

In each of the above cases, the quantities of rod and wire required for assembling fuel elements have also been ordered.

19-Rod Cluster Engineering. The first full size Mark I-B, 19-rod cluster assembly has been fabricated and delivered to 100-KE for thermal cycle and pressure drop tests.

Seventeen of the rods were stainless steel clad and two were Zircaloy-2 clad. All rods used 2S aluminum rod for core material. The two Zircaloy-2 rods were wire wrapped with Zircaloy-2 wire. The wire was fabricated by swaging and drawing 3/4"

rod down to 0.072" diameter. The completed rods were etched and autoclaved at 400 C and 1500 psi steam for 48 hours. After autoclaving one of the end cap welds exhibited white breakaway corrosion. This has been difficult to explain since they were welded two at a time in an inert atmosphere welding box. The wire attachment welds which were made with an argon arc spot-welding gun proved to be satisfactory. A small line of white corrosion product was visible under the wire, which was apparently due to the inability of the nitric acid and aluminum nitrate rinse to remove the etch solution completely.

The cluster, including the bands, was assembled in thirty minutes. Two types of cluster wrap bands will be tested on this cluster. One is a preformed strap clamp which locks under full tension and finishes in one lever movement. A special small clamp was fabricated in order to keep the outermost part of the band within the diameter of the wire wraps of the cluster.

The other was a welded wire ring made from the same wire used for spacing the rods. This ring is kinked in six places around the circumference. The kinking process decreases the length of the band and thereby clamps the rods together. This type of band will be more satisfactory for remote assembly operations.

A seven-rod cluster of the Mark I-C type using quick disconnects has been designed. This cluster is the six-rod ring and center rod from the 19-rod cluster. It will be used in radiation testing where the process tube diameter is limited.

The scoping of the cluster disassembly and reassembly machine is continuing. A prototype banding apparatus using the wire rings is being fabricated in Tech Shops.

Welding Development. Design was started on an extension tube for the vacuum welding box large enough to accommodate 18 fuel elements at one time, thus permitting 18 end closures to be made with one back-filling of inert gas.

The rotating mechanism is being changed to maintain a closer tolerance on arc length. Test elements show that the use of argon rather than helium in the torch produces better arc stability at lower amperages and does not adversely affect corrosion quality.

UO₂ Fuel Development

Capsule Irradiation of Sintered UO₂. The effect of surface grinding on the thermal fracture resistance and the fission gas retention of high (>98%) density, sintered UO₂ during irradiation will be examined. Four capsules for this test have been prepared for irradiation in the MTR.

Irradiation of Swaged UO₂ Capsules. Irradiation exposures of swaged capsules containing enriched UO₂ have reached 2000 MWD/T.

Irradiation of Tubular Fuel Element. Six thermocouple holes 0.032 inch in diameter are being drilled in a total length of three feet of eight percent enriched UO₂ tubular fuel core material for irradiation testing in SRE.

Irradiation of PuO₂-UO₂ Powder. The three-rod Zircaloy clad cluster containing unsintered, PuO₂ enriched UO₂ powder successfully completed one cycle of irradiation in the MTR. One rod of the element was damaged at the MTR during removal from the basket, and the assembly has been returned to HLO for post-irradiation examination.

Irradiation of Swaged UO₂ in VBWR. A fuel element consisting of nine rods, thirty inches in length, is now being irradiated in a vertical position in the Vallecitos Boiling Water Reactor. The rods are 0.560 inch OD, with Zircaloy-2 cladding and UO₂ cores swaged to an average density which is 87.3 percent of the theoretical. Maximum heat flux at full power at the present location in-reactor will be approximately 250,000 Btu/(hr)(sq ft).

Microstructure of UO₂. Pre-post irradiation examination of the microstructure of UO₂ by electron microscopy techniques is a method of studying radiation damage. Three capsules containing a total of eight metallography specimens were prepared for irradiation at HAP0.

Swaged UO₂, Seven-Rod Fuel Assemblies. To study the irradiation behavior of Zircaloy-2 clad, swaged UO₂ fuel, four 7-rod assemblies, 18 inches long, were fabricated and are awaiting irradiation in a high temperature, high pressure recirculation facility. Each fuel assembly consists of one central rod surrounded by six similar rods uniformly distributed on a 1.285-inch diameter circle.

Tube and Rod Test Element Mockup. A 36" long dummy rod and tube element mockup was built to the dimensions of an element proposed for an ETR irradiation for purposes of measuring coolant pressure drop in an ex-reactor facility. Tube dimension is 1.770" OD x 0.938" ID, and the rod is 0.658" in diameter.

Preparation of UO₂ for Swaging. Approximately 75 pounds of 2.42 percent enriched UO₂ was prepared for swaging fuel elements for irradiation in VBWR. Two hundred pounds of natural UO₂ was prepared for swaging of Zircaloy-clad, seven-rod clusters to be irradiated in KER. The UO₂ was prepared by isostatic pressing, sintering, and pulverizing.

UO₂ for Chemical Processing Studies. UO₂ fuel cores of several types have been prepared for studies of UO₂ fuel element processing by the Chemical Development Operation.

High Temperature Studies. The melting points of UO₂, UC, and UN were redetermined, respectively, as 2700 C, 2280 C, and 2480 C, all $\pm$ 30 C. The melting point of UO₂ was found to be independent of O/U ratio and UO₂ fabrication method. Preliminary determinations of the emissivity and thermal conductivity of UO₂ between 800 C and 2300 C were made. The values will permit a better understanding of the effective thermal conductivity of ceramic fuel elements operating with extremely high temperatures.

Facilities. The evacuable, inert atmosphere welding box was completed. Evacuation and inert gas backfill rates are excellent. Installation of the continuous sintering furnace was completed. Construction of the 325 Building press enclosure addition is under way, and installation of the 300-ton Kux press is scheduled to begin during November.

Structural Materials Development

Zircaloy Jacket Tubing. A two-foot section of 0.598" ID jacket tubing with three ribs attached by welding was received from New Rochelle Tool Company. A 14" section of this tube will be used by the Ceramic Fuels Development Operation to fabricate a fuel element for irradiation in a test loop.

Each of the three ribs had received a different degree of heat in the welding operation. The lightly welded rib showed no beads of extruded metal at its base. The medium and heavy welds were both marked by quite heavy beads of extruded metal. The lightly welded rib resisted removal quite well but could be torn off in one piece with a pair of pliers. The other two ribs were firmly attached, with attempts to remove the ribs resulting in tearing both the tube wall and the ribs in the process.

Photomicrographs at 6X and 250X of both transverse and longitudinal sections of the welds showed no trace of a crevice under any of the ribs. Corrosion tests were made on sections of the tubing after it had been vapor blasted and etched. Both the tube wall and ribs emerged in shiny black condition with no trace of white corrosion product even at the base of the ribs. On the basis of these tests it has been decided to request the New Rochelle Tool Company to produce full length samples using the light weld. Three full length (9-1/2 ft) tubes in each of the three sizes will be produced, with acceptance of the machine based upon successful completion of this operation.

Detailed inspection of Zircaloy jacket tubing from Wolverine for swaged oxide and Pu-Al fuel elements has revealed that the tubing is of good quality and generally within specifications. A thinning of the wall was noted on several tubes, but since the change in wall thickness was only 0.003 inch, it did not cause rejection of the order from the vendor. Some sorting of the tubing will be made according to the intended end use.

Zircaloy Pressure Tubing. Extrusion billets for the 100 PRTR process tubes are being prepared by Chase Brass and Copper Company. The holes in the first 35 billets were drilled; however, the subsequent billets have been hot pierced with a saving of 35 pounds of zirconium per tube. After overcoming initial difficulties, the hot piercing operation was very successful. Some difficulty with eccentricity was encountered in the first extrusions but was corrected. Chase is maintaining a very tight production schedule. Tooling for all three tube reducing steps has been designed and is being fabricated.

PRTR Steel Shot Corrosion Test

Corrosion tests of a Duriron shot have been in progress for about 10 days, but no conclusions are possible yet. This test is based on the use of hot softened water, passed through the sample section once.

Apparatus has been installed and is ready for use in corrosion tests employing recirculating deoxygenated, deionized water. Purity and oxygen content of the water will be controlled by a feed and bleed system. Iron shot will be used in this test.

Coolant Systems Development Studies

PRTR Testing. The Hammel-Dahl and Powell control valves were removed from ELMO-7 after six weeks operation at 535 F and 1400 psi. No measurable leakage was noted on either of the valves after the packing on the Powell valve was tightened subsequent to the initial startup. Delta-ring and Flexitallic gasket nozzle-process tube seals were cycled 500 times from 400 to 525 F. No leakage was noted on the delta-ring seal, but the Flexitallic gasket leaked after 100 cycles.

Thermal Hydraulics Studies

Thermal Hydraulic Studies Associated with the PRTR. The stainless steel to copper welds of the Mark II-B fuel element mockup test section were found to be faulty. Lead in the commercial grade copper is believed to be the cause of this. The welds are being remade using a high temperature silver braze.

Attempts at calibrating the velocity probe for use in calandria moderator flow tests have been plagued with many problems. Several modifications to the associated electrical components were required. Air bubbles were found to accumulate on the probe surface which caused large errors in the velocity measurement. A means of preventing the air bubble formations has yet to be found.

Mechanical Equipment Development

Design Test PR-20 - Calandria Characteristics. The prototype dump valves and prototype air compressor have been installed on the calandria mockup and tested for proper operation.

Design Test PR-25 - Shroud Tube Bellows. Tests were completed on bellows furnished by the Parts Engineering Company. These failed to meet the leakage requirement of less than one cubic foot of helium per hour. The bellows with brazed aluminum ends were received from the Solar Aircraft Company. Orders were placed with three companies for bellows having cast aluminum ends. All bellows will be tested by December 17.

Design Test PR-32 - Biological Shield Moat Rupture Diaphragm. Testing of the 8-mil thick aluminum diaphragms was completed. The average burst pressure was 6.6 psi. The final report on this design test is now being prepared.

Design Test PR-50 - Reactor Piping Seal Testing. Process Tube Assembly "A" has been equipped with a water collecting shroud on the inlet fitting and a prototype gas seal. This assembly will be installed on ELMO-7 for additional thermocycling tests. Process tube assembly "B" has undergone 850 temperature cycles from 150 to 535 F. However, upon disassembly after 750 cycles, it was discovered that the nozzle-to-process tube seal and the nozzle cap seal had been leaking slightly. New gaskets were installed and testing is continuing.

Preliminary results of the gas seal tests were as follows: inlet "O" ring, using a Zircaloy tube - 0.09 liter per hour; inlet "O" ring, complete with bellows and steel rod - 0.18 liter per hour, and outlet "O" ring and centering flange - 6.0 liters per hour. The high leakage rate of the outlet gas seal appears to be caused

by improper flattening of the "O" ring. Dimensional tolerances of the test assembly and the "O" ring are being checked.

Design Test PR-51 - Reactor Piping Structural Integrity. The jumper flexure testing facility was modified to permit the testing of one of the shortest outlet jumpers. This jumper has been installed and pressure tested. Testing will begin as soon as the necessary strain gauges are installed. Design of the jumper heating equipment was completed and construction started. Fabrication of both the upper and lower face space arrangement mockups continued during the month. The dummy nozzles for the upper face mockup were approximately 90 percent complete.

Design Test PR-63 - Process Channel Leak Detection Facility. The final report will be issued early in November.

Single Tube Prototype Mockup. A hundred-hour hot test of the PRTR prototype pump was run at the Byron Jackson Plant during the first week of October. The test was unsatisfactory and will be rerun due to overheating of the primary mechanical seal faces. Additional testing is in progress at the Byron Jackson seal testing laboratory to determine the proper hydraulic balance on the rotating seal face. The delivery date of the pump is now uncertain. A Bingham centrifugal pump is being repaired and will be installed in the facility. The stainless steel process tube was installed and the fabrication of the prototype nozzle started. Initial loop operation is scheduled for November.

PRTR 14" Gate Valve. Inspection and shipment of this valve is due in early November.

PRTR 8" Single Check Valve. The purchase order alteration has been issued for adding internal counterweights on the disc to permit installation of the valve at a $17-1/2^\circ$ angle.

PRTR 15 GPM Injection Pump. A small pump was installed in the suction line of the Aldrich pump to provide a pressurized suction. Operation of the Aldrich pump was much smoother using a suction pressure of 15 to 20 psi.

PRTR Primary Pumps. The drawings showing changes in nozzle thickness and new mounting pads on the pump cases were approved and returned to the Byron Jackson Company. The pump delivery dates are not affected by the trouble experienced with the main seal of the prototype pump.

PRTR Inlet Valves. Testing of the valves on ELMO-7 was discontinued. The valves are now being installed on the Single Tube Prototype Mockup.

PRTR 3" By-Pass Stop Valve. A requisition was issued to purchase this valve for testing on the Single Tube Prototype Mockup. It is expected that the purchase order will be placed in November.

PRTR Shim Control. Fabrication was begun on a plastic facility for testing the operational clearances of the prototype shim control element. A motor generator set of the proper output voltage was ordered for this facility.

Hood Electrical Connections. Testing of two types of electrical connections for the hoods of the Plutonium Fabrication Laboratory was completed. Both types of connection were leak tight.

Shielding Studies

PRTR Shielding. The review of the PRP shielding was continued. Additional shielding was found to be required for the fuel element examination facility near the access door to the helium gasometer. This was necessitated by removal of part of the inside shielding partition to provide space for the future fuel element disassembly machine.

PRTR Process Instrumentation. Preliminary reports were submitted to Design Development Operation on the results obtained from the testing of prototypical flow transmitters and resistance temperature detectors. The Panellit Company provided the more satisfactory flow transmitter. The Charles Englehard Company supplied a promising clamp-on resistance temperature detector. Testing of the flow transmitters and resistance temperature detectors is continuing.

The final draft of the report on the multi-point power calculator was submitted.

PRTR Design Development Operation

Construction Status. The Phase I PRTR contract is approximately 35 percent complete versus 46 percent scheduled. Difficulty was experienced in holding containment vessel tolerances when penetrations were welded in place. The most critical penetration is the fuel transfer opening, which is approximately 1-1/2" from nominal versus an allowable 1/2".

The Phase II PRTR contract is approximately 15.2 percent complete versus 24 percent scheduled. The contractor has requested permission to supply a commercial carbon steel tank for diesel fuel storage instead of reworking the excess stainless steel tank.

The Phase II-A (River Pump and Condenser Facility) contract was awarded to George A. Grant Inc., of Pasco for \$218,800. The fair cost estimate was \$225,000.

The pre-bid conference for the Phase III PRTR bidders was held on October 22. Addendum No. 2, incorporating pre-bid conference answers to bidders questions, was mailed out to the bidders. Bids will be opened November 5.

Instrumentation and Control. Fabrication of the shim control prototypes continued during the month at APED. A change in drive motor insulation was necessitated when formex-insulated, epoxy-encapsulated stator windings on all five of the motors being procured burned out while under test by the manufacturer, Globe Industries, Inc. To permit delivery of the prototypes on time, it was agreed that the four motors furnished with the two prototypes will have windings insulated with Teflon-filled ceramic and encapsulated in epoxy resin. These motors will suffice for all tests to be performed on the prototype except radiation testing. Within one to two weeks after delivery of the prototypes, a fifth motor plus two replacements stators will be delivered. These will be insulated with unfilled

ceramic, and epoxy encapsulated. The spare motor will be tested for radiation resistance, and the stators will be installed in the drive motors of one prototype assembly prior to radiation testing of the assembly.

Development of the design for the reactor automatic controller showed that increased panel space on the console was required. This space requirement was accentuated by the addition of manual control features to the controller. In order to provide the increased panel space, a second arm was added to the console. The shim rod control switches and remote meters, the manual scram and safety circuit reset buttons, and the annunciator acknowledge and reset buttons were moved to this arm of the console.

Visual and audible alarms were provided in the control room to warn of low crank-case oil pressure in the D₂O injection pumps.

The effect of manual control on PRTR operating safety was considered in detail during the month. Conclusions were that no new nuclear hazards can be introduced by the manual control system since no new mechanism for introducing reactivity is present. However, the possibility that the reactor can be operated in a manner which will result in undesirable thermal stress in some reactor components is increased somewhat. The thermal stress hazard will be reduced to an acceptable level by safeguards built into the equipment and by very strict operating procedures.

Difficulty is being experienced in obtaining high level safety amplifiers for the PRTR. No commercially built equipment presently available is able to meet the specifications. Use of the equipment now available will require relaxing specifications somewhat in the lower ranges and perhaps dropping the lowest ranges completely. The controller vendor has been asked to make recommendations for a solution to this problem during the first week of November.

The possibility that false short period signals may be generated as the moderator level moves past the position of a chamber is being examined. The chamber signal for a given average neutron flux may change by several factors of ten as the moderator passes the chamber, thus creating a false period signal. If the rate of change of chamber signal per unit of average reactor flux proves to be large enough to cause false period trips, the chambers used to generate period signals may have to be moved farther out into the reflector. It is possible to do this without any reactor design changes. The absolute value of the chamber signal would then be smaller for a given flux.

Fueling Vehicle. All tracings for the fueling vehicle design have been received from General Mills, together with the parts list and a general description document. A procurement specification, HWS-6230, was prepared, including an acceptance test procedure, and minor revisions were made to some tracings. The bid assembly was forwarded to the AEC and mailed to prospective bidders on October 24, with bids requested November 24.

Process Piping. A study of process and equipment changes which would be required for operation of the coolant loop at low pressures and temperatures with aluminum process tubes was completed and summarized in letter form. The majority of required changes would be in the steam generation system, with fewer changes required in general instrumentation and the helium system.

A review of process and equipment changes required for use of a heavy water reflector showed that only minor piping revisions will be required provided the side flux chamber cooling system is retained in the reflector loop. Preliminary calculations show that the substitution of D₂O for cooling the flux chambers will have no significant effect on instrument response.

The cost-plus-fixed fee contract with Hunter-Douglas for five process tubes has been signed, and tooling is being fabricated. Fabrication work on the price-renegotiation contract with Tube Reducing is on schedule. Some extrusion billets are complete and waiting extrusion.

PRTR Physics. Calculations of spike requirements for single-annular spike loading configurations in the PRTR have been completed. A report (HW-58016) is being written. Given in the report is the variation of number of tubes in a single spike annulus with radial positioning of the annulus for fixed k_{eff} values of 1.020, 1.010, 1.000, and 0.990. Also presented is an evaluation of the peak-to-average power ratio for any of the above annular loadings. The general loading types considered, each with H₂O and D₂O reflectors, are Mark I UO₂ feed with Mark I Pu-Al spike at an initial 1.65 wt % enrichment, and Mark II-B UO₂ feed with Mark I Pu-Al spike at an initial 1.8 wt % enrichment. Calculations were made for 30% burnout of Pu in the above loadings.

Thermal neutron flux distribution calculations for plutonium impregnated graphite fuel test samples to be irradiated in MTR were completed. Results were obtained for plutonium concentrations of 31 and 55 mg/cm³ in graphite of 70% density.

Core Components. Consolidated Western Steel Division's detail shop drawings for the calandria have been approved and fabrication of this vessel has started.

Helium Gas System. Detail shop drawings of the helium gasholder have been received from General American Transportation Corporation. Comments were made, and the drawings were approved.

Fuel Element Examination Facility. The design criteria for the Fuel Element Examination Facility (HW-48116) was issued.

The detailed design of the concrete shielding was completed, and the drawings were approved for construction. Applicable portions of the work were included as part of the Phase III PRTR Addendum No. 1. The design of the cast iron and steel shielding and the necessary ventilation and services was started.

A procurement specification was prepared for the primary manipulator. Copies of the specifications were sent prospective builders with an inquiry regarding their interest in obtaining a fixed-price design and construct contract for the manipulator.

Design of the prototype combined 5X viewer and profilometer was started.

Plutonium Fabrication Pilot Plant

Construction of the PFPP is 27 percent complete. Project design completion is approximately 75 percent.

Phase II Construction. Construction is progressing at better than the scheduled rate, and some of the status lost at the beginning of the month is being recovered. Mechanical work is well under way with installation of the under-floor exhaust ventilation ducts. Construction is 26 percent complete versus 30 percent scheduled.

Phase III Design. A portion of installation drawings and specifications, including the following equipment items or systems, will be provided by equipment vendors rather than by the Construction Engineering Operation. The estimated cost of the added design work is \$3000 to \$4000 per vendor, for a total of about \$15,000.

1. Hydrogen atmosphere sintering furnaces. Work transferred to Harper Electric Furnace Company, design contractor for the furnaces.
2. Ammonia dissociation system (gas supply for the sintering furnaces). Work transferred to Sargeant and Wilbur, Inc., the equipment vendor.
3. Autoclave and blowdown system. Work transferred to Industrial Process Engineers, the equipment vendor.
4. Oxide line compacting press. Work transferred to Clearing Machine Company, the equipment vendor.

Drawings for the degrease-decontamination facility and the vacuum welding hood were behind schedule at the end of the month. A detail scope specification for procurement of the rolling mill was submitted for comment.

The proposal of F. J. Stokes Corporation for gas-cooling the vacuum melting furnace was rejected because of incompatibility with the project schedule.

Procurement. Nearly all requisitions for the PFPP process equipment have been placed. Two of large dollar value, for the rolling mill and the extrusion press, have not been placed.

Requisitions totaling \$650,000 in estimated cost have been transmitted to Purchasing Operation. Purchase orders totaling \$406,176 have been placed. The actual purchase price for the orders thus far placed has been \$19,000 under the estimates.

PRTR Pressurized Gas-Cooled Loop Facility

The project proposal, which was revised to incorporate changes required to permit irradiation of fissionable materials, is being circulated for approval. The revised cost estimate is \$820,000.

BASIC SWELLING STUDIES (FISSIONABLE MATERIALS)

The diffusion of the inert fission gases, krypton and xenon, and subsequent void formation results in swelling of irradiated fuel materials. This swelling appears to be dependent upon irradiation temperature, restraining pressure, burnup, burnup rate, fuel composition and fuel material parameters such as purity, residual work and grain size.

A report is in preparation which proposes a new theory of diffusion of impurities in relatively pure metals. It is based primarily on results of studies of inert gas diffusion through silver. A proposed application of this theory is the prediction of the mobility of the inert gases in uranium based on observations of self-diffusion rates in uranium.

Swelling of uranium has been produced in a laboratory apparatus using xenon gas in uranium metal. The inert gas was introduced into the uranium by means of an electrical glow discharge at about 700 C. The uranium increased 3.3% in volume in forty-eight hours as determined by a density decrease from 19.0 to 18.4 gm/cm³. Metallographic study with the electron microscope showed large voids formed throughout the 1/8 inch thick uranium disc. The voids were segregated primarily at the grain boundaries and twin boundaries. This segregation gives credence to a theoretical calculation indicating that the energy of nucleus formation will be lowered at such sites. It is therefore expected that heterogeneous nucleation will be the predominant factor in void formation during the swelling of fuel materials.

The possibility that small voids observed on replicas of irradiated uranium were artifacts introduced during etching by ion bombardment or during the replication process was investigated during the month. Replicas of unirradiated uranium specimens were made in Radiometallurgy hot cells under conditions identical to those used in replication of the irradiated uranium. Other replicas were made in the metallurgical laboratory in the same manner. These replicas were examined by high magnification electron microscopy; no voids were detected on specimens etched with a normal time cycle. Etching by ion bombardment for two to three times the normal cycle was found to cause pitting of the uranium that could have been interpreted as voids in the uranium. Etching time for irradiated uranium is to be closely controlled in future preparation of specimens for replication in order to avoid this pitting effect.

Voids, 200 Å in diameter, were observed by means of replicas made of normal uranium irradiated at about 350 C to a burnup of 0.09 a/o. After a two-hour post-irradiation heat treatment at 900 C of the same specimen, the small voids were no longer detectable; in their stead voids with diameters near 2500 Å were observed. Growth of these voids during annealing is conclusive evidence that small detectable voids form even at relatively low irradiation temperatures and increase in size during annealing, and that the voids are not the result of preparation of the specimen for replication. A more extensive study will be made with microscopic void detection to determine the effects of post-irradiation annealing and the relation of these effects to in-reactor fuel swelling behavior.

The controlled temperature irradiation capsule design was modified again this month. The main problem under consideration was the accommodation of the thermal expansion of the liquid metal NaK used as a heat transfer medium. It is essential that the uranium samples be covered with NaK at all times. The void necessary for expansion of the NaK must be contained and controlled. The first design was based on the use of a completely sealed stainless steel collapsible bellows. It was discovered that the required bellows would be at least twelve inches long. An alternate design for an expansion system has been developed and tested in prototype which eliminates the steel bellows, provides an adequate expansion space of 1.55 cubic inches, and adds only four inches to the capsule length.

GAS COOLED POWER REACTOR PROGRAM

Graphite Studies

Recent tests indicate that thick-wall quartz tubing will serve satisfactorily as a container for high-pressure carbon dioxide-graphite reaction studies. It appears that it may be unnecessary to employ stainless steel capsules which would become highly radioactive and impose severe handling problems. Quartz capsules containing graphite and carbon dioxide at 200, 300, 400, and 500 psi have been irradiated in a Hanford reactor at about 500 C without fracture, and the composition and pressure of the reaction products and graphite weight losses have been determined.

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATIONMONTHLY REPORTOCTOBER 1958FISSIONABLE MATERIALS - 2000 PROGRAMMETALLURGY

At the request of CPD a theoretical study was made of the minimum critical mass of plutonium metal as a function of cylinder diameter and equivalent reflector thickness. The study indicates that the minimum critical mass for water reflected cylinders occurs at a cylinder diameter of 2.9 inches.

A study was made for FPD on methods of shipping 2000 uranium fuel elements enriched to 1.44 percent in U²³⁵. The result was a close packed linear array not to exceed 16 inches wide and 8 inches high.

REACTORSTUDIES RELATED TO PRESENT PRODUCTION REACTORS

Lattice neutron temperature experiments began in the TTR thermal column with two foil irradiations at room temperature. No results are available on this work as yet.

Progress has been made on the analytic solution of the neutron thermalization problem in the vicinity of a temperature discontinuity. By means of an Euler Transformation, a previously existing divergent solution has been eliminated. Flux values have been calculated with this new solution using the IBM-650. Analysis continues on the PCTR experimental work connected with this problem.

The diffusion equations for a two-temperature system were obtained in a form which permits use of present methods for computing the lattice constants and makes feasible the application to practical problems.

Instrumentation

A special underwater telescope to be used with the 105-C optical profilometer was designed and is now being fabricated.

Development continued on the circuitry for the magnetic core storage elements. Printed circuit transistorized plug-in components are being used in order to provide flexibility in the use of the storage elements for the various possible applications.

A monitoring system was proposed, for use on the H reactor elevator, which includes five independent scintillation-type detecting stations--four of which are beta-gamma sensitive and one which is neutron sensitive. Using a Rustak recorder, the cost of each channel was estimated at \$875.

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STUDIES RELATED TO FUTURE PRODUCTION REACTORS

Calculations were completed to obtain material bucklings from exponential pile data previously taken on 0.5-inch-diameter rods in graphite moderator. In connection with this program horizontal traverses were taken on a pile stacked near another pile to determine the change in extrapolation length caused by the resulting neutron reflection. The reflection caused an increase in extrapolation length of 0.15 inch.

Exponential pile measurements commenced on 1.92-inch-diameter natural uranium fuel elements.

Fabrication has been completed of a PCTR core for an experiment on a cluster of 0.926-inch natural uranium rods.

Analysis of old exponential pile data has begun in the Theoretical Physics group as part of an effort to promote a cooperative long range experimental-theoretical program.

A cooperative planning effort is being conducted with IPD physicists to decide on the best approach to try on firming up reactor physics data for the NPR.

Background material was collected from our reactor physicists from which specifications for the full size PCTR will be prepared.

STUDIES RELATED TO SEPARATIONS PLANTS

Subcritical multiplication measurements were made on a second water-moderated lattice fueled with 0.600-inch three percent enriched uranium rods. From this it was determined that for an H_2O/U volume ratio of 2.71, the critical mass is 368 pounds. This critical mass is 20 percent smaller than given by curves for 0.900 inch rods.

Another subcritical multiplication measurement was begun on a lattice fueled with 0.900-inch, three percent enriched uranium rods. This is an extra measurement, which is needed to fix the minimum critical mass for these elements.

PCTR measurements continued to determine k_{∞} for homogeneous systems of three percent UO_3-H_2O with an H/U of 6. This month the work consisted of (1) measuring the effective absorption cross section of borated polyethylene, and (2) studying the effect of changes in incident neutron spectrum on the spectrum in the test cell. The results of the latter work indicate that the test cell spectrum becomes less dependent upon the PCTR spectrum as the H/U ratio is increased as would be expected. Present work is being done on both water-moderated and polyethylene-moderated core tanks.

A preliminary hazards report was completed for the new Plutonium Critical Mass Facility.

The last scheduled experimental run on the neutron age experiment was completed this month. An IBM-650 program for data reduction has been debugged.

Several measurements of foil weight must be made before starting final data reduction.

Trouble in the source vacuum lock on the new mass spectrometer is believed to have originated with a small amount of abrasive material left in the analyzer during fabrication. This instrument is still being shaken down to catch wiring mistakes.

REACTOR DEVELOPMENT - 4000 PROGRAM

Plutonium Recycle Program

Design of an experiment to measure the effective resonance integrals of plutonium bearing rods was worked on. Current work is aimed at determining the amount and isotopic distribution of plutonium to be used in the rods. Rods of several isotopic compositions will be used in the experiments.

Calculations of k_{∞} and f were continued. The results for the seven-inch lattice did not agree well with experiment. The value of p for the eight-inch D_2O cooled lattice was calculated to be 0.886 as compared to the experimentally determined value of 0.865.

Hanford PCTR results on k_{∞} for D_2O moderated 19-rod UO_2 clusters have been compared with Chalk River values deduced from exponential experiments. There appears to be good agreement. A detailed comparison has not been made.

Instrumentation

Detail design work is continuing on the prototypes of the Wide-Angle Viewer and the combination Profilometer and 5X Viewer.

Gas Cooled Reactor Program

A cost and time estimate was made by shop personnel for fabrication of the test core components. Based on this estimate it appears that the earliest date for starting PCTR experiments would be February 1, 1959. Shop work will be held up until new fuel assembly drawings are received from ACF because we understand that the fuel element spacing has been changed. Delays caused by this change may push back the February 1 date.

A theoretical analysis of the scheduled PCTR measurement of the worth of a control rod in the GCR lattice is in progress. The planned method of solution involves formulating criticality conditions in terms of the small source parameters for the cases of the control rod both in and out.

CROSS SECTION PROGRAM

Mr. G. C. Hanna of AECL spent three days at Hanford reviewing our absolute fission cross section measurements on U^{235} . This review is being done at the request of the Tripartite Nuclear Cross Section Committee. A result of the review has been the withdrawal by Harwell of their value. Regarding the Hanford work, Mr. Hanna pointed out a few instances where a more refined analysis might lead to changes in the order of 0.1 to 0.2 percent in the final value. It

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seems unlikely that the final Hanford value will change by more than 0.5 percent aside from considerations of fission foil weight.

The new three-crystal neutron spectrometer was used to start studies on elastic scattering of neutrons by carbon, and both elastic and inelastic scattering from water. An attempt was made to see the 0.20 ev molecular vibration state in water by observing the inelastic scattering of 0.24 ev incident neutrons. The effect was not seen. This work is being hampered by intensity problems. The highest net counting rates from neutrons scattered by water have been about five counts per minute.

BIOLOGY AND MEDICINE - 6000 PROGRAM

ENVIRONMENTAL STUDIES

Atmospheric Physics

Final design limits for the stable atmosphere diffusion experiments to be run in 1959 were completed. The spacing of samplers, flow rates for air sampling, and generation rates for the tracer material were designed for compatibility and for maximum statistical significance. Similar design criteria were established for vertical sampling, also.

The final experimental design was discussed with Air Force personnel to insure adequate measurements for the ANP problems. All design features were agreed to with some flexibility remaining in the sampler spacing on the 16-mile arc.

A special climatological survey of wind patterns over the experimental area during meteorological conditions favorable for these diffusion experiments was completed. This study showed that, on the average, 23 occasions in June were suitable for an experiment, 27 in July, and 29 in August. The average wind flow patterns showed the tracer material will generally remain within the experimental course, but occasional strong curvature of the tracer trajectories must be expected.

Analyses of the diffusion measurements made at Friday Harbor in July were carried to the limit of significance. The vertical profiles of the integrated cross-wind concentration provided valuable guides to the design of proposed deposition experiments, but were not themselves sufficiently precise to permit quantitative evaluation of the vertical flux of tracer material to the water surface. These measurements did show, semi-quantitatively, the eradication of an initially strong positive gradient of the tracer material within the first 10 feet above the water. The point of maximum concentration, which was initially at about 10-12 feet elevation, was found very near the water surface at 1200 feet downwind from the source. These data suggest high values of vertical flux (and deposition) near the source, but much smaller values at quite modest distances from the source.

DOSIMETRY

Construction forces completed the assembly of the iron room for the body monitor. We observed the assembly to insure proper cleaning of the iron.

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The Bureau of Mines was contacted to see if krypton, free from Kr^{85} , was available from helium wells; they had no knowledge of its availability. Such radioactivity-free krypton is desired for use in counters. A circuit developed by two Russians, Ovchinnikov and Semenov, for increasing the pulse height from counters by electronic feedback was tried. The initial results on one counter were very promising.

A case of plutonium deposition in a wound was studied by X-ray counting. The first count showed 0.348 ± 0.017 μ c of plutonium in the wound. Surgery was performed. Fifty-four percent of the plutonium was found in the excised tissue; 4.3% was left in the wound. The difference is unexplained; surgery was performed within an hour so transport from the wound site is improbable; very likely the extra plutonium was lost in the bandages. Surgery was repeated and the wound washed with EDTA. Two and four tenths percent of the original burden was left in the wound. There was 360 times as much plutonium in the swabs from the washing as in the excised tissue; the EDTA was the effective agent in the second treatment. There still exists about 1.7% discrepancy between the results of alpha counting and X-ray counting of these samples where both can be performed.

The positive ion Van de Graaff operated satisfactorily till late in the month when replacement of the charging belt became necessary. Available operating time was equally divided between experiments by Nuclear Physics Operation to determine if they could measure the C-H ratio in kerosene by a time-of-flight method, an experiment by Radiological Development Operation to determine the characteristics of slow-neutron pencils in paraffin moderators, an experiment to improve energy control by regulating charging current, and maintenance on the charging belt.

A design was completed for a long counter that is expected to be reproducible enough to be duplicated in other laboratories.

Maintenance was completed and experimental work resumed at the electron Van de Graaff. The calibration of the condenser-divider voltage measuring system was repeated. It had changed by only two parts in 18000. This is a much smaller change than we expected. Linearity of the calorimetric system and the condenser-divider plus beam current integrator system was checked by making beam power measurements at 0.9 Mev by both methods. The agreement was well within the experimental uncertainty.

Studies aimed at improving low-dose pencil ion chamber techniques shifted to the pencils themselves. It was found that certain pencils gave readings reproducible to 1% at 1 mr. After being dropped accidentally, one such pencil lost its reproducibility. Tightening the retaining ring holding the center electrode assembly caused more harm than good; apparently the ring became charged by friction. Tightening followed by exposure to about 100 r from Co^{60} gamma rays improved the reproducibility of a set of pencils.

INSTRUMENTATION

The work on detection techniques for use in radiation protection instrumentation continued. Laboratory testing is in progress on components for the prototype hand and shoe counter which employs a single scintillation detector

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for each hand surface capable of detecting the alpha and beta-gamma components of contamination. Fabrication was started on equipment for demonstrating the use of scintillation detectors on portable surveying instruments. Further investigations were started on techniques of detecting the zinc sulfide particles on a filter in order to reduce the effects of filter thickness variations. Investigations of high-level detection techniques were started with plans for experimental and evaluation work on the HM chamber-Beckman system and on an argon-filled ionization chamber.

Effort on sensitivity improvement techniques continued with the design of equipment for investigating inertial separation of airborne particles for use with our medium-level alpha air monitors. Balancing and adjustment techniques are being developed and evaluated for the Purex alpha air monitor which employs two high-level monitors with a differential alarm.

Work on automatic techniques continued with an investigation of possible devices for use in portable dose-rate integrators. A mechanical integrator which was ordered for this investigation also has possible application for the pyrheliometer integrator. Another concept in automation is being investigated for possible use in the radioanalysis laboratory. Development was started on a demonstration passive analog computing-type network which can be used to solve for the quantities of five radioisotopes in a radioactive sample when the readings from the pertinent channels of the multichannel analyzer are available.

Other developments included the fabrication of an underwater probe for use by the Radioecology Operation and the design of an optical and radioactive pinhole camera for demonstration at Hanford.

Three prototype scintillation, portable gamma-beta dose-rate meters were fabricated and delivered to us for final evaluation. These instruments incorporate all of the modifications deemed necessary from previous evaluation work with the first models. They were fabricated with ease of maintenance in mind. At the request of the Field and the Calibrations Operation, the ranges employed are 0-5.0 mr/hr, 0-50 mr/hr, 0-500 mr/hr and 0-5.0 r/hr. The instruments read correctly and accurately to $\pm 10\%$ of full scale for any gamma energy above 90 Kev with readability, but greater error, down to 15-Kev gammas.

In an attempt to reduce background readings from large neutron sources in the 234 Building placed adjacent to the room containing the four alpha, scintillation fixed-filter counters as used for routine air sample analyses, it was proposed to shield the counters with a cadmium shield covered by five to six inches of paraffine blocks. The general operation of this type of counter has been good unless large neutron sources are brought near. A simpler solution would be to remove the sources from the room adjacent to the counting room; this adjacent room was used for a source storage area. Other than the neutron interference, the counters appear to be operating satisfactorily.

WASHINGTON DESIGNATED PROGRAM

Previous measurements of the resolution of the mass spectrometer for this program have indicated that the collector slit may not be properly aligned with the image of the source slit. A modification was made to the adjustable

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collector slit assembly to facilitate examination of this alignment.

The components of the ion pulse counting instrumentation were operated successfully except for the electron multiplier which has not been installed.

CUSTOMER WORK

Analog Computing

A few additional runs were attempted on the Two Group Flux calculation but were not satisfactorily completed because of faulty equipment. There were too many loose connections to the patch bay to obtain a reliable answer.

The Glove Hood Control problem has been completed and satisfactory results obtained for the customer.

A series of computer runs were made in the NPR Pressurizer problem to evaluate two different types of control. It was determined that some changes had to be made in the equations and approximations to obtain valid results. Faulty components in the computer were a major difficulty in attempting to solve the problem. When the computer is repaired, this problem will be re-scheduled to go on.

The analog computer was out of service during the last two weeks of October for maintenance purposes. The work done consisted principally of replacement of patch cord receptacles in the patch bay. The patch bay of the GEDA A-14 is, in our opinion, of inferior quality in its design.

One member of the group spent three days at the Computer Manufacturing Section of Litton Industries in Culver City, Calif. This trip was made for the purpose of obtaining information necessary to clarify and extend operating and maintenance procedures pertaining to the Litton Digital Differential Analyzer.

The DDA was out of order for a few days, due to the identical difficulty for which it was returned to the factory earlier this year. The trouble was located and found to be a poor soldered connection. It has been repaired and is now back in operating condition.

Weather Forecasting and Meteorology Service

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	62	88.0
24-Hour General	93	86.1
Special	125	96.8

October was the sixth straight month with above-normal temperature and the fourth straight with below normal precipitation. The average temperature was 54.4. The departure of +1.2 degrees was due mostly to unseasonable warmth during the first 5 days. The total precipitation of 0.19 inch was less than 30 percent of normal.

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Instrumentation

Testing continued on the dual alpha air monitoring system for use at Purex. The system utilizes two high-level alpha air monitors which act independently and a differential alarm and recording system which provides a means of reducing background effects. With about 20% detection efficiency, the filtering is such that an alarm setting of 200 d/m would result in about a 20% probability of a false alarm due to natural background in any one year.

The sensitive gamma scintillation transistorized monitor was modified to provide higher ranges and to provide better linearity. The ranges were changed to 0-10,000, 0-100,000, and 0-1,000,000 c/m corresponding approximately to 0-0.1, 0-1.0 and 0-10 mr/hr from a radium source. The accuracies available are approximately $\pm 5\%$ of full scale on any range using the radium source. The instrument is completely transistorized, employs a 5" x 5" terphenyl in polyvinyltoluene crystal detector, and will drive a 0-1.0 ma chart recorder. It will be used for on and offsite routine monitoring from the air, on the river, and on the land.

The experimental medium-level scintillation alpha air monitor was used at the Biology Operation for one month with excellent results including satisfactory daily tests with a known value (400 d/m) Pu²³⁹ alpha source. The equipment is installed in the inhalation laboratory where animals are caused to breathe in a Pu²³⁹ particulate contaminated controlled atmosphere. The instrument is set to alarm if the "clean air" atmosphere exceeds 60 mpc of air-borne Pu²³⁹ in 20 minutes with no radon-thoron false alarms.

On the zinc sulfide particle counter, tests indicate different counting rates are obtained from different filters with the same deposition of Pu on them because of actual imbedding of the particles within the filter rather than deposition on the surface. This can be corrected by using uniform Millipore filters and uniform flow rates for all samplers. The instrument sensitivity requirements have been reduced and now, the minimum number of particles they wish to detect is approximately 1000--before the amount was only 100.

The dog counter, to be used for in vivo monitoring of dogs for radioisotopes Pu²³⁹, Sr⁹⁰-Y⁹⁰, Ru¹⁰³, Ru¹⁰⁶, and Cs¹³⁷, was thoroughly tested. Two new phototubes and 1.0-mm NaI crystals were installed for Pu²³⁹, 17-Kev X-ray counting to provide better resolution and hence, better sensitivity. The lead collimators were also modified to enhance the sensitivity. It is hoped to be able to locate and determine the magnitude of Pu²³⁹ sources, in vivo, in the order of 1.0 to 5.0 μ c to permit satisfactory low-level analysis. There does remain some background difficulty when the wind blows from the 100-F settling basin toward the counting room.

Evaluation was completed on a sensitive gamma detector for portable use, and the evaluation of the Rustrak recorder was almost completed.

Two Victoreen remote area monitoring systems were given acceptance tests but only about 50% of the channels were acceptable. About half of the failures were due to electrical or mechanical troubles and the remaining failures were due to channels that would not meet calibration limits. The river monitor with the large crystal was calibrated. The response of the scintillation

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alpha air filter monitors to neutrons was investigated and wax and cadmium shielding recommended to lower this response. Evaluation was started on the all-purpose scintillation alpha-beta-gamma detector for portable use.

Customer Work

A work authorization was reviewed to design, engineer, and fabricate a prototype of the combination 5X viewer and profilometer for the PRTR fuel element examination facility. Design drawings of the profilometer are being prepared.

Fabrication of the photoelectric controller for the R&U Electrical Operation is 99% complete. The only problem remaining is to find a transformer of adequate current rating for the calibrated lamp. The first transformers which were installed proved inadequate.

The installation of the seven Purex crane periscopes was completed.

Modifications of the existing underwater borescope for I&E fuel elements are being designed, fabricated, and tested. The probe was originally of a 3/8-inch diameter air-filled, water-tight construction but after limited use, this probe leaked water. A water-filled probe 3/8-inch in diameter was next used, although air bubbles and stray light made it less effective than desired. The probe now being fabricated is glass-filled with only a small volume of water included. Air bubbles have little chance to form in the small volume of water admitted in the line of sight.

The routine optical shop work included the fabrication of a right-angle eyepiece for a transit and two camera mounts. Fabrication started on a new borescope probe for 105-C and on a special profilometer telescope for 105-C. Repair work was completed on two 105-F portable periscopes and was started on four sections of a process tube borescope. The installation of the optics in the periscopes at the Purex addition was completed, and several radiation measuring pencils were coated with gold by evaporation.

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 and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
C. J. Weichel L. Van Vleck	10/1	General Electric Co. Idaho Falls, Idaho	Discuss instrumentation.	RA Harvey	No	300: 329
J. I. Sweeney L. D. Test	10/6	General Electric Co. San Jose, Calif.	Discuss instrumentation.	RA Harvey	No	300: 329
P. E. Church	10/17	Univ. of Washington Seattle, Wash.	Consultation on meteorological problems.	GR Hilst PF Gast HM Parker	No	300: 329 3760 200-W: 622
J. W. Corbett	10/20	G-E Research Lab. Schenectady, N. Y.	Discuss radiation damage.	JL Carter JE Faulkner PF Gast IT Myers WC Roesch	No	300: 326
G. C. Hanna	10/21-23	AEC of Canada, Ltd. Chalk River, Canada	Review Hanford U ²³⁵ fission cross section measurements for Tripartite Neutron Cross Section Committee.	BR Leonard WJ Friesen	No	300: 326
J. L. Powell	10/27-31	Univ. of Oregon Eugene, Oregon	Consultation.	JE Faulkner	Yes	300: 326
R. A. McCormick	10/30-31	U. S. Weather Bureau U. S. Public Health Service Cincinnati, Ohio	Discuss atmospheric diffusion measurements.	GR Hilst JJ Fuquay	No	200-W: 622

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
G. R. Hilst	10/8-9	Air Force, Cambridge Research Center Boston, Mass.	Planning session with AF Personnel for 1959 experiments.	M. L. Barad	No
P. F. Gast	10/11	Nevada Test Site Las Vegas, Nev.	Witness nuclear test.	Ward Miller	Yes
J. DePangher	10/13	Mass. Inst. of Tech. Cambridge, Mass.	Discuss neutron measurements.	Hans Mark	No
	10/14-17	High Voltage Engr. Corp. Burlington, Mass.	Attend accelerator conference.	Chet Ellison	No
	10/20	Nat'l Bur. of Stds. Washington, D. C.	Discuss neutron measurements.	Randall Caswell	No
J. L. Carter J. E. Faulkner	10/21-24 10/22-24	Oak Ridge Nat'l Lab. Oak Ridge, Tenn.	Attend Information Meeting of Neutron Physics Division.	E. P. Blizzard	Yes
J. E. Faulkner	10/21	Nazarene College Nampa, Idaho	Recruiting.	G. C. Ford	No
G. R. Taylor J. L. Stringer	10/27-29	Litton Industries Culver City, Calif.	Obtain information relative to operation of Litton Digital Differential Analyzer.	Warren Shepard	No
J. J. Fuquay	10/27-28	Meteorology Research Inc. Pasadena, Calif.	Confer on meteorological instrumentation problems.	P. B. MacCready	No

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
M. F. Scoggins	10/27	Gast Mfg. Corp. Benton Harbor, Mich.	Obtain engineering data on vacuum systems.	Chas. Baker W. Gast	No
	10/28	Motor Wheel Corp. Lansing, Mich.	Obtain engineering data on motors and power plants.	L. C. Vandertill	No
	10/29-30	Leiman Bros. Newark, N. J.	Obtain engineering data on vacuum systems.	Mr. Whip	No

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Chemical Research and Development

ORGANIZATION AND PERSONNEL

R. G. Warner, Chemist II, transferred in from Irradiation Processing Department and was assigned to Analytical Laboratories Operation.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIAL - 2000 PROGRAM

IRRADIATION PROCESSES

Automatic Analyzing Monitor

Reproducibility of the analyzer detector response was measured by permitting the monitor to "see" fixed sources over a period during which only the counting and sequencing circuits were in operation. For twenty-four hour's operation a standard deviation ranging from 1 per cent to 6 per cent was obtained for detectors and energy channels for P^{32} , Si^{31} , Np^{239} , Cu^{64} , and As^{76} , and the gross beta measurement. For Mn^{56} the standard deviation was 18 per cent. With the exception of the high standard deviation for the Mn^{56} channel, these results were satisfactory and indicate the degree to which stability of detector response has been achieved. This test was performed to examine the reproducibility of response to fixed sources and does not measure reproducibility of total sample preparation and counting steps.

Transistorized amplifier-pulse height analyzer circuits were further tested for possible application to waste stream monitors in which long term stability is essential. Necessity for extremely stable voltage supply prompted design of an accurate voltage potentiometer for these transistor circuits and the selection of power supplies which meet the rigorous long term stability requirements.

Reactor Decontamination

Results from laboratory soil column tests supported previous work which indicated that spent decontaminating solution, Turco 4306-B, can be disposed of safely in the existing 100 Area trenches. Decontamination of greater than 99 per cent was achieved for the 5 isotopes of concern. The indicated increase in decontamination over previous experimental results is attributed to soil ion exchange mechanisms. In addition leaching of rupture debris was investigated. While analysis of the data has not been completed, preliminary calculations indicate that leaching will not be of consequence.

Uranium Oxidation and Fission Product Volatilization

Correlation of experimental data on uranium oxidation in air at high temperatures was accomplished by using the average oxidation rate for the time period required to completely oxidize a uranium specimen. The average rate was found to correlate as a function of the original specific area and furnace temperature. Extrapolation of the data to a uranium specimen the size of a normal Hanford reactor slug has been made. No mathematical expression has been found to calculate instantaneous oxidation rates as a function of time. However, they can be estimated from the experimental data.

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Analytical Services

Free fluoride in Zircaloy etch solution may be determined by titrating, near boiling, with cerous nitrate. As soon as all free fluoride (that is, fluoride not already in $\text{ZrF}_6^{=}$) is complexed, bromocresol green undergoes a color change. The method will assist operating people doing large-scale etching. They will know when to butt with hydrofluoric acid the $\text{HNO}_3\text{-H}_2\text{F}_2\text{-H}_2\text{O}$ etch solution.

SEPARATION PROCESSES

Anion Exchange Processes

Decontamination of Purex LBP. The feasibility of producing adequately decontaminated plutonium product by one cycle of anion exchange applied to Purex LBP was again demonstrated. The feed for this run was prepared by adjusting fresh Purex plant LBP to 7.2 M nitric acid by addition of concentrated nitric acid. This feed contained zirconium-niobium activity at a level ten-fold higher than the feeds used in earlier work.

Processing this feed through a single cycle of anion exchange employing a wash cycle consisting of 15 column volumes of 7.2 M nitric acid followed by 18 column volumes of 7.2 M nitric acid, 0.01 M hydrofluoric acid produced a 46 g/l plutonium product in which zirconium-niobium activity amounted to only 0.4×10^{-11} microcuries gamma per alpha d/m. This corresponds to a zirconium-niobium decontamination factor of at least 6×10^4 in the anion exchange step.

From these data it is apparent that a single Purex partition cycle followed by a single cycle of anion exchange is sufficient to produce adequately decontaminated plutonium product.

Plutonium Processes

Chlorination Gas Scrubber. The prescope studies made to provide design information for the 234-5 chlorinator off-gas absorber have been completed. From the studies sufficient data have been obtained using the 1-1/2 inch diameter, 3 foot long glass column packed with Raschig rings to permit specification of either a batch or a continuous absorption unit for plant application. At anticipated plant gas loads, for an 8-hour absorption cycle, the batch absorber would be sized for a minimum holdup of 70 liters of 6 M NaOH. In designing to provide the absorption volume of caustic, the gas should be required to pass through at least a 32-inch high packed section of 1/4-inch Raschig rings.

Plutonium Oxide Chlorinator. Gold, platinum, Baker 413, Hastelloy B and C, Haynes 25, and 304L stainless steel were exposed at 500 C to CCl_4 vapor carried in an air stream. Corrosion rates observed (0.7, 0.9, 4.1, 0.8, 1.2, 2.0, and 29 mils/mo. in the order given) were, as expected, somewhat lower than those previously reported at 600 C except for platinum. The value obtained for platinum at 600 C was 0.1 mil/mo. This discrepancy is as yet unresolved. Attempts to expose these same materials to CCl_4 vapor at 400 C were not successful due to plugging of outlet

lines by decomposition products. This data point will be omitted from the study. From a corrosion standpoint, Hastelloy B or C remains the best choice for a chlorinator which could be used with all three proposed reductants - COCl_2 , CCl_4 , and $\text{H}_2\text{-HCl}$.

Flurex Development

Tirrelloy B (platinized tantalum) was evaluated as a candidate Flurex anode material in both alkaline ammonium nitrate and nitric acid (1.0 M). In both solutions the Tirrelloy B had a very short (about 80 ampere hours) life and it was concluded that this material is not suitable as an anode in nitrate media.

Analytical Services

Basic analytical requirements are being met for pyrochemical studies with plutonium. A DU flame photometer was altered to provide alkali data. Aluminum is being measured with oxine, and thorium-234, by gamma energy analysis after fluoride precipitation. Uranium and plutonium are being measured by controlled potential coulometric titration.

Plutonium was measured at the micro microgram level in soil stream influent and effluent. Dowex 1, X-8, Cl^- form, 100 - 200 mesh was used to separate plutonium from Am-Cm. The method, including three precipitations, gave 75 ± 15 per cent recovery.

Many isotopes determined by beta proportional counters may be calculated with a single correction factor. It combines such items as self-absorption, back-scattering, air path, etc. The single factor will simplify both manual and IBM calculations and programming. The single factor would not apply to low energy beta emitters like Ru^{103} (0.2 Mev).

WASTE TREATMENT

Nitrate Destruction

Initial experimental runs in the pilot scale formaldehyde-nitric acid reactor have proved that the reaction proceeds smoothly and is easily controlled.

A series of exploratory tests to define the hazards of off-standard operating conditions affirmed the stability of the system. In these tests, cold formaldehyde and nitric acid were mixed in the reactor and after a half an hour delay period the reactor was heated. The maximum pressure generated was 1.7 psig with an initial mixture of 4.6 M HNO_3 and 1.4 M HCHO . Reactant concentrations above or below these values resulted in a lower maximum pressurization.

Six additional semicontinuous electrolyses of a synthetic Purex 1WW solution have been completed under high temperature conditions using a stainless steel cathode and platinum anode. In three runs, glass or stainless steel diaphragms were used to separate the anode and cathode.

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Operation at 90 C, or above, particularly with a diaphragm in the cell, proved to be much more efficient than operation at lower temperatures unless an ion-exchange membrane was used. Anode corrosion rates were within an acceptable range (0.01-0.06 mg/amp-hr) even considering the high cost of platinum.

Calcination of Purex Waste

A study of the melting temperatures of the glasses formed by adding phosphate and borate to Purex 1WW to form phosphate-borate glasses (predominately AlPO_4 , FePO_4 , NaBO_2 mixtures) is in progress. The object is to determine the composition range which will yield glasses that can be handled in mild steel equipment. This will require melting points less than about 900 C if a protective atmosphere is used and less than about 750 C in air. It has been found that a fairly wide composition range exists that will melt in this temperature range. One mixture: 13.7 per cent AlPO_4 ; 10 per cent FePO_4 ; and 76.3 per cent NaBO_2 , gave evidence (from differential thermal analysis measurements) of melting at the abnormally low temperature of only 450 C. A special illuminated furnace is being constructed so the melting can be observed visually in order to confirm these results.

In other experiments, the hydrothermal formation of feldspar type "minerals" through addition of silica to 1WW salts followed by high temperature autoclaving was studied. By analogy to the cesium mineral pollucite, such materials should retain fission product cesium well. The experiments were only partially successful, the products showing disappointingly high water solubility. This appears to be due, in part at least, to the presence of sulfate in the waste. Because of this factor and the inherent drawbacks of pressurized operation on highly radioactive waste, this approach does not appear attractive.

Spray Calcination

Construction and installation of the experimental spray calcination reactor is essentially complete except for electrical circuitry and instrumentation. The electrical work is estimated to be complete by November 5.

A mathematical study has been made of the effect of an absorbing gas (steam) on the radiant heat transfer from the wall of the calciner to a central droplet. The results indicate that such absorption should not be a serious factor in the scale up of the radiant heat spray calciner. A paper is being written presenting the details of this development as well as the earlier calculations of the angle factor.

Observation Wells

The concentration of radioactive material in samples of ground water from monitoring wells near the 216-A-24 crib continued an increasing trend, while those from monitoring wells near the 216-A-8 crib showed decreasing concentrations. The maximum concentration of gross beta reported to date for samples from 216-A-24 monitoring wells is 1.8×10^{-4} uc/cc. Two monitoring wells in the 216-BX trench area indicate increasing concentrations of radioactive contaminants in the ground

water beneath this site. From June to September the concentration of radioactive material in samples from well 299-E33-8 increased from 2.2×10^{-6} to 6.0×10^{-4} uc/cc. The source of this material is not certain. The possibility of its representing drainage from the BX specific retention trenches will be investigated.

Disposal to the Ground

The Purex 216-A-24 tank farm condensate crib is not operating as planned in that waste does not cascade from one section to another. The first section of the crib has received essentially all the waste since the crib was activated, May 1, 1958. This volume is almost equal to the predicted Sr⁹⁰ breakthrough volume. In order to utilize the full capacity and to avoid Sr⁹⁰ contamination of the ground water, it was recommended that piping be installed to by-pass the first section as soon as possible.

Research was performed to evaluate the removal of radiostrontium by soil from unneutralized UO₃-Plant condensate. The degree of removal was immeasurably small at the very low pH (<1.0) of this solution before neutralization. The Sr⁹⁰ concentration of this stream is normally just over its MPC. It is estimated that the waste contains a total of about 3 mc/year. The primary concern in disposing of this stream is apparently to avoid leaching of fission products already adsorbed by soils. It was recommended that this 224-U Building condensate be neutralized with sodium hydroxide prior to being discharged to the 216-WR replacement crib.

Columns of Amberlite IRA 400 anion exchange resin were tested to evaluate the ability of this material to remove alpha emitters (Pu and Am) from acid CAW (Recuplex) waste. At a flow rate of 5 gal/ft²/hr, 89 per cent of the alpha emitters was removed by a 4-cm resin column. This degree of removal was maintained during the passage of 68 column volumes.

High Level Wastes

Laboratory data indicated that high-level Redox waste released from a tank would have its sludge physically filtered from the solution in the first few centimeters of soil. Subsequently, the solution would have to pass through this filtered sludge before being released into the soil. The filter cake formed by the sludge was found to have a permeability of about 2×10^{-6} cc/cm²/sec per cm of sludge thickness. This is about 10^{-4} of the permeability of soil and would thus be the controlling resistance to the flow of such waste.

Studies of the permeability of soil for filtered synthetic Redox waste (D-8) in heated columns indicated that movement of unconcentrated waste would not be appreciably affected by precipitation of salts during cooling. However, such wastes concentrated to half their volume by evaporation were slowed to flow rates less than 10 per cent of that of water as the temperature was decreased. This tends to indicate some precipitation of salts in the soil pores but in no test was there complete plugging.

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Special Geological Studies

The Midland Drilling Company using a drive barrel for churn drilling wells rather than a rock bit and bailer, averaged 19 feet per drilling day in the first three wells drilled. The overall average of all previous drillers at Hanford is 15 feet per drilling day. The higher rate probably will continue at greater depths as the drillers become more used to this technique and the Hanford sediments. The drive barrel technique utilizes a core tube several feet long and small enough to enter the well casing. It is driven into the sediments in the well bottom, then raised with the core to the ground surface. This one-step operation eliminates the dual operation of drilling with a rock bit and bailing of the cuttings. No water is used thus permitting the accurate determination of soil moisture in samples. Fracturing of the sediment grains is avoided thus the samples show actual grain size.

TRANSURANIC ELEMENT AND FISSION PRODUCT RECOVERY

Neptunium Recovery

Recovery of Neptunium in Purex. Two miniature mixer settler runs were made to explore the feasibility of extracting neptunium in the Purex HA column by addition of dichromate to the 3WB (backcycled waste concentrate). The flowsheets used in these runs closely approximated the present Purex HA column flowsheet with the exceptions that sodium dichromate was added to the 3WB to a concentration of 0.01 M in Run 3 and 0.08 M in Run 4 and because of malfunction of feed metering equipment the solvent/feed ratios were high, 480/75 in Run 3 and 440/75 in Run 4. In both runs the 3WB and IBSU streams were synthetic feeds, containing no fission products. The HAF, prepared from Purex dissolver solution, contained fission products at ten per cent of full Purex feed level.

In both runs, near-quantitative extraction of neptunium was effected in the extraction section. In Run 3, however, substantial internal reflux of neptunium occurred, the neptunium concentration in the organic product (HAP) being only one-fifth that in the organic phase two stages below the feed point. In Run 4, employing the higher concentration of dichromate in the 3WB, internal reflux of neptunium was minor. The concentration of neptunium in the organic phase two stages below the feed point was only about 1.5 times greater than that in the organic product. The material balance indicated that steady-state operation had been achieved in Run 4 but not in Run 3. At the time Run 3 was terminated, the concentration of neptunium in the organic product corresponded to recovery of only 87 per cent of the neptunium in the feed.

Since dichromate was added only to the extraction section in these runs and the organic phase residence time in the Mini scrub section was approximately 30 minutes, the fact that neptunium was recovered in Run 4 offers some basis for optimism that neptunium recovery could be effected in the Purex plant without addition of dichromate to either the HAS or the HSS, provided the processing rate is maintained at a capacity factor of one or higher. It is, of course, desirable to effect neptunium recovery without addition of dichromate to the HSS in order to avoid carry-over of dichromate into the LBX column where a reducing potential must be maintained.

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Measured plutonium waste losses were 0.1 per cent in Run 3 and 1.2 per cent Run 4. The high apparent loss in Run 4 is not considered significant in view of the fact that the aqueous waste sampler failed in Run 4 and it was necessary to use an improvised sampling technique employing equipment which had been previously contaminated with plutonium.

The effect of dichromate on fission product decontamination requires further study. Fission product decontamination in Runs 3 and 4 was clearly unsatisfactory, decontamination factors from HAF to HAP being only 60 for zirconium-niobium, 130 for ruthenium, and 90 for cerium in Run 3 and 100 for zirconium-niobium, 80 for ruthenium, and 600 for cerium in Run 4. On the basis of previous experience, the high organic/aqueous flow ratio in these runs would not completely account for these low decontamination factors.

Addition of dichromate to the HA column extraction section will apparently result in substantial internal reflux of radiocerium. In Run 4, with 0.08 M dichromate added to the 3WB, the cerium concentration in the organic phase seven stages below the feed point attained a value 100 times the cerium concentration in the feed. A substantial loss of cerium decontamination in the HA column could probably be tolerated since the necessary cerium decontamination could probably be obtained in the second cycles. However, cerium reflux of this magnitude, if it persisted into the scrub section, could possibly lead to significant beta radiation damage to the linear polyethylene sieve plates in the HA column scrub section.

Use of MnO_2 as Oxidant for Neptunium. The use of C.P. manganese dioxide as an oxidant to effect extraction of neptunium has been briefly explored in batch experiments. Addition of MnO_2 to a concentration of 0.01 M resulted in conversion to extractable neptunium, the distribution ratio for neptunium under HA column feed point conditions increasing from 0.02 in the absence of MnO_2 , to 1.63 and 1.73, respectively, after 20 and 30 minutes in 0.01 M MnO_2 at room temperature, and increasing to 1.95 after 30 minutes at 40 to 50 C in 0.01 M MnO_2 .

No change in plutonium distribution was noted in the room temperature MnO_2 oxidations and less than 0.009 per cent of the plutonium was retained by the solid MnO_2 .

An attempt to determine the rate of reduction of neptunium(VI) in the absence of a holding oxidant gave results in sharp contrast to the behavior observed in the previously described Mini runs. Whereas neptunium apparently survived in an extractable state through a 0.5 hour residence time in the Mini scrub section in the absence of dichromate, the distribution ratio for neptunium which had been rendered extractable by oxidation with MnO_2 decreased from 1.95 to 0.02 within five minutes after the manganese dioxide-containing aqueous phase was removed and replaced by an aqueous phase of supposedly identical composition except that it contained no MnO_2 . The reason for this behavior is not known, but it is possible that the second aqueous phase may have contained a reductant such as nitrous acid. The same behavior was observed when the solvent used was one which had been previously exposed to acid dichromate.

Neptunium Recovery from Purex 3WB. Three runs have been made on the recovery of neptunium from Purex 3WB on 30 - 50 mesh Permutit SK resin in support of the CPD proposal to install a critically safe column for this purpose. Conditions were

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chosen to give the same residence times as would obtain in the six inch by ten foot plant column. Three runs were made, two with synthetic 3WB and one with 3WB prepared from evaporated plant 2DW. Neptunium concentration in the first (7.3 mg/l) corresponded to continuous processing of 3WB and in the second (47 mg/l) to intermittent recovery (with reflux in the plant between recovery cycles). For the former, loading was about 0.9 gm/l resin at 20 per cent instantaneous breakthrough (ten per cent integrated loss) and 1.8 gm/l at 50 per cent breakthrough (25 per cent loss). The corresponding loadings in the second run were 4.7 and 9 gm/l. In both cases, over 96 per cent was easily eluted in one column volume. Data are not yet available for the run with feed prepared from 2DW, however, it is noteworthy that there was much less gassing than with the synthetic feeds.

These runs show that the proposed plant conditions result in marginal absorption cycle behavior, the loadings being only about a fourth what would be expected from equilibrium data. This is due to the high flow rates dictated by imposing critically safe geometry and to high uranium concentrations resulting from the current five per cent recycle. Runs at lower uranium concentrations are in progress.

Concurrent with the laboratory tests, a pilot scale (6-inch diameter by 6-foot packed height) fixed bed ion-exchange unit has been fabricated and installed to explore the engineering problems associated with neptunium recovery. Preliminary results indicate the pressure drops across a free-settled Permutit SK 20-50 mesh resin bed with 3 M nitric acid at 22 C to be 0.17 psi/ft bed per gal/min-sq. ft. of flow, up to flow rates of 6 gal/min-sq.ft.

Anion Exchange Prototype - 222-S Building. The major portion of the profile pulse column equipment has been removed from the I-F Multicurie Cubicle. Assistance has been given to CPD personnel in the design of an anion exchange facility which will be installed in the I-F Cubicle and which will serve as a prototype for the neptunium purification facility to be constructed in the Purex plant.

Recovery of Neptunium in Redox. Experimental studies have been initiated to determine the feasibility of recovering neptunium in Redox. The extractability of neptunium by hexone is similar to that by tri-butyl phosphate, neptunium(IV) and (VI) being extractable, neptunium(V) being virtually inextractable.

The fact that neptunium is currently lost to the aqueous waste in the first Redox extraction column is consistent with the hydrogen ion dependence in the oxidation reaction.

Preliminary experiments yielded data which are approximately fitted by an equilibrium constant of about 60 for this reaction. The ratio of neptunium(VI) to neptunium(V) can then be expressed approximately as

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$$\log \frac{[\text{NpO}_2^{++}]}{[\text{NpO}_2^+]} = 1.78 + 0.33 \log \frac{[\text{Cr}_2\text{O}_7^{=}]^{0.5}}{[\text{Cr}^{+++}]} - 2.33 \text{ pH}$$

and it is apparent that increasing the pH by one unit will decrease the Np(VI)/Np(V) ratio by a factor of 220 while increasing the dichromate concentration by a factor of 10 will increase the Np(VI)/Np(V) ratio by a factor of only about 1.5.

Experimentally it was found that neptunium(VI) in hexone reverted rapidly to the equilibrium Np(VI)/Np(V) ratio when contacted with acid-deficient ANN-dichromate aqueous solutions. The equilibrium ratio was generally established in less than five minutes. In addition, contact beyond this time was found to result in continued slow re-extraction of neptunium into the aqueous phase, at a rate of about 15 per cent per hour, presumably due to reduction of neptunium(VI) by hexone.

The neptunium(VI) distribution coefficient into hexone has been determined as a function of pH. At constant total nitrate the neptunium distribution data are correlated by the expression

$$\log \text{Np(VI)} E_a^0 = \text{constant} - 0.14 \text{ pH.}$$

Neptunium Reduction. Two five-gram batches of neptunium metal and approximately 150 grams of aluminum-10 w/o neptunium alloy were prepared starting with neptunium nitrate solution.

Neptunium(IV) oxalate was precipitated from 125 milliliters of solution containing ten grams of neptunium (0.04 moles) as the nitrate by reduction with 0.02 moles of semicarbazide followed by the slow addition of one molar oxalic acid at room temperature. After standing overnight, the supernate analyzed 3.8 molar nitric acid, 0.11 molar oxalic acid and 3.4 milligrams of neptunium per liter. The neptunium loss was thus very low, corresponding to 0.01 per cent of the neptunium involved in the precipitation. The oxalate was transferred to a platinum boat, dried at 115 C for an hour and converted to the fluoride by heating for four hours in a stream of hydrogen fluoride while the temperature was raised from 150 to 550 C. The resulting fluoride was very voluminous, having a bulk density of only 0.7 g/cm³. The two reductions utilized NpF₄:Ca:I₂ mole ratios of 1:3.15:0.5 and 1:3.3:1.0. Yields were respectively 84 and 95 per cent, very satisfactory considering the scale of the operation.

Neptunium oxide for the preparation of aluminum alloy was prepared by calcining the oxalate on a pyrex filter for one hour at 550 C. The oxide was tan in color and had a bulk density of 2.4 g/cm³. It was reduced with aluminum using cryolite as a flux. The resulting alloy was recast into 0.5 inch diameter rods using graphite molds. The scrap from the above Metallurgical operations was treated by the cryolite process to recover waste values as dilute aluminum (1 w/o) neptunium alloy.

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Plutonium-238 Production

The potential production of plutonium-238 at HAP0 has resulted in evaluation of production schemes for this material employing more-or-less conventional processes for neptunium-237 recovery, solid element fabrication, irradiation, and reprocessing for plutonium-238 recovery and neptunium-237 recycle. Alternately, the desired product could be manufactured by employing neutron irradiation of a solution of neptunium followed by recovery in a close coupled separations plant.

A brief survey of this alternate has been made and a study flowsheet is being issued. Preliminary and tentative evaluation of process indicates that the scheme may have the following advantages:

- a) Minimizing the dilution of the plutonium-238 product with higher isotopes.
- b) Reducing the cost of the product.
- c) Maximizing the fraction of available neptunium undergoing irradiation.
- d) Allowing irradiation conditions conducive to high product yields.

Further process study evaluations have been recommended.

Plutonium Recovery

Incomplete analyses indicate that at least 75 per cent of the plutonium was recovered from a liter of filtered, but otherwise untreated, LWV by passage through a Permutit SK column.

Further study of the solids filtered from plant LWV shows that this material is not solely silicic acid but rather a multi-component mixture consisting of a highly radioactive fraction, a caustic soluble fraction, a caustic tartrate soluble fraction, and insoluble fraction (two to three per cent).

Strontium Recovery

Work on the fuming nitric acid process for recovery of strontium from Purex LWV was completed, and a terminal report has been prepared. It was found that strontium could be recovered from synthetic LWV in satisfactory yield provided barium carrier was added and sulfate was absent. Efforts to remove the interfering sulfate by prior precipitation of barium or lead sulfate was unsatisfactory. Excessive strontium was lost to these precipitates; however, the carrying was not sufficiently quantitative to be made the basis of an alternate process.

Di(2-ethyl hexyl) phosphoric acid (abbreviated D2EHP) has been found at ORNL to extract strontium from sodium nitrate solutions. Experiments with this reagent confirmed this behavior. Maximum extraction occurred at pH 5-6 and fell off to negligible values at high acidity. Thus, an extraction coefficient, E_a^0 , of ten was obtained at the optimum pH with 0.1 M D2EHP - 3 per cent TBP-Amsco. Experiments will be performed with partially neutralized LWV to determine the behavior of other fission products, trace impurities, etc., and to evaluate possible process application.

Cesium Recovery

Plant scale demonstration of the wet chemistry portion of the cesium recovery process has continued with synthetic Purex 1WW. In the iron-aluminum precipitation strike, the smallest volume of solids produced to date was secured by a two-step neutralization process at 90 C using ammonia to precipitate iron and sodium hydroxide to precipitate aluminum. A total of 1350 gallons of the resultant slurry was processed at 10 gpm in the 40-inch centrifuge at 870 rpm before solid carryover occurred.

Additional findings include:

- a) Verification that the ammonia addition endpoint for precipitation is readily detectable by a sudden increase in the rate of pH change.
- b) Any inadvertent over-addition of sodium hydroxide during aluminum precipitation is strongly buffered by ammonia volatilization.
- c) Slow speed centrifugation (870 rpm) is adequate for the iron-aluminum solids removal step and can produce an iron decontamination factor of 10^4 .
- d) No effective mechanical removal procedure for the iron-aluminum solid has been developed and acid dissolution is currently being used.

Drafting for the cesium isolation and packaging prototype is approximately 96 per cent complete. Detailed drawings are essentially complete and in the checking stage.

Drawings for about 50 per cent of the shop fabrication work have been submitted to the shops. The fabrication of these components is about 30 per cent complete.

Preliminary data derived from a test work coil and various pipe materials have demonstrated the feasibility and practicability of the inductively heated ball mill for the hydrolyzer. Low carbon Shelby tubing, mild steel, cast iron and type 430 stainless steel pipe have been tested as container materials. It appears entirely feasible to achieve 20 KW input at a power factor greater than 0.8 in a 30-inch length of 6-inch pipe. A 6-inch diameter mild steel pipe covered with a 0.030-inch thick layer of sprayed copper yielded a power factor greater than 0.95 at 10 KW. The nominal design input is 220 volts 60 cycles.

A paper entitled, "Design Concepts for a Radiocesium Packaging Facility," was prepared for presentation at next spring's AIChE annual meeting at Atlantic City.

Ion chambers for measurement of cesium-137 using lavite and polystyrene insulators have been tested in a radiation field of 8×10^4 r/hr (at 8-inch spacing). The negative ion accelerator in the 3745A Building was used to obtain the desired radiation field. Either type insulator is satisfactory, but polystyrene is recommended because of its ease in machining and resulting lower cost. At the 8×10^4 r/hr radiation level complete ion collection (saturation) is achieved with a chamber voltage of 600 volts.

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ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Determination of Acidity of Stainless Steel Solutions

The usual methods employed at Hanford for free acid determination were found to give erratic results when applied to Darex process feed solutions which contain stainless steel, aluminum, and uranium as principal constituents. High results by the potentiometric titration method with oxalate complexing are caused by chromium III and in some cases by high aluminum nitrate plus sodium nitrate.

A review of other methods was made and the modified oxalate complexing method developed at the Idaho Chemical Processing Plant (IDO-14316) appeared to be the most satisfactory one. The results by this method on Darex type dissolver solutions were reproducible within an apparent standard deviation of $\pm 0.05 N$ and agreed within at least $0.1 N$ of both the known values where available and the results of conductimetric titration. The principal features of the method are: (1) pre-adjustment of the oxalate solution to a selected pH, (2) titration back to the same pH after sample addition, and (3) a two-hour waiting period when chromium III is present to permit the desired chromium-oxalate complex to form.

Neptunium Titration

The neptunium titration method described in the previous Progress Report (September, 1958) was tested further to establish the precision limits and the limits of interference by several common ions. The coulometric titration method consists of pre-oxidation with cerium IV, coulometric reduction of the excess oxidant including reduction of neptunium to the V state, and coulometric titration of the neptunium (Np(V) to Np(VI)) in $1 N H_2SO_4$. The estimated standard deviation under ideal titration conditions ranges from 1.1 per cent at about 20 micrograms to less than 0.1 per cent at 900 micrograms. Theoretically, less than 20 micrograms could be accurately titrated but from a knowledge of the variations of the titration blank under some conditions, the precision may deteriorate to as poor as ± 25 per cent at ten micrograms.

X-Ray Spectrography

In the usual X-ray spectrographic methods, it is customary to analyze the X-ray fluorescence by use of an analyzing crystal, collimator and goniometer mounted detector. For specific applications a simpler procedure might involve analysis of the energy spectrum of the fluorescence by use of pulse height discrimination. Scintillation and proportional counters were both examined with respect to this application and it was found that with a pulse height analyzer having a "window" width equal to the voltage range of the distribution curve at ten per cent of the peak intensity, the scintillation detector was capable of discriminating between elements four to five atomic numbers apart and the proportional counter elements two atomic numbers apart. This technique is particularly suited to elements of low atomic number, i.e., from aluminum to iron. This is because of the greater separation of the fluorescent energy peaks associated with the lighter elements.

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EQUIPMENT AND MATERIALSPump Development

The Randolph Squee-Gee pump, a peristaltic pump under evaluation for possible 234-5 Building metering service failed after 984 hours of operation. The 1/2-inch diameter tygon tubing ruptured, allowing 5 M HNO_3 to leak into the pump casing. The ball-type rollers were badly corroded and the aluminum casing was deeply pitted. Since the pump has demonstrated ability to meet process metering requirements, it was being tested to destruction.

A modified Johnston deepwell turbine pump has been received from CPD Facilities Engineering Operation for evaluation. This pump incorporates a new discharge head which locates the liquid throttle bushing near the mid-point of the shaft. With this position, appreciable throttle bushing wear and leakage can be tolerated in most plant applications. The unit is prototypical of a new design which will later employ a splined shaft assembly and is representative of a design considered attractive for general separations plant application.

Valve Development

234-5 Powder Lock. The initial 234-5 calciner and/or chlorinator powder lock was tested using corn-starch, mercuric nitrate, sand and lead oxide powder as substitutes for plutonium powders. The first three powders were fed smoothly but the lead oxide packed between the discs and the body plates causing jamming. The unit has been re-designed to more completely seal the powder into scraped channels to provide more rigidity and to provide a shorter powder path. The new unit is also being made smaller to permit its use on a 234-5 test calciner.

Carbon Filter Rotary Valve. A carbon filter supplied by CPD Facilities Engineering and designed for possible use in filtering plutonium fluoride dust from fluoride converter gases has been tested. The carbon filter is attached to a rotary powder valve ("banjo" valve) and is designed such that the rotary valve blades scrape the carbon filter to clean off the filter surface. In studies to date, using cerium fluoride as a plutonium fluoride substitute, the carbon filter has plugged quickly. A pressure drop of 20 inches of mercury was obtained after two to six hours operation at gas flow rates roughly 70 per cent those anticipated for plant application. Variations in scraper speed, scraper blade to filter distance, and dust loading did not appreciably increase the filter life.

Corrosion of Haynes Stellite #1 in Nitric Acid

The corrosion rate of Haynes Stellite #1, which is under consideration as a hard-facing material for process solution lubricated pump bearings, was < 0.1 mil/mo in 60 per cent HNO_3 at room temperature. However, in boiling 60 per cent HNO_3 the rate was about 200 mils/mo.

Corrosion of 304L SS and A-55 Ti in HNO_3 Containing KMnO_4 , MnO_2 , or $\text{Na}_2\text{Cr}_2\text{O}_7$:

In connection with proposed modifications to the Purex process to accommodate the neptunium recovery, the effect of potassium permanganate, manganese dioxide and sodium dichromate on the corrosion of 304-L stainless steel and A-55 titanium by

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boiling 6 M HNO_3 is being evaluated. Concentration range studied for these three additives was from 0.01 to 0.2 M. Neither potassium permanganate nor manganese dioxide appears to accelerate the corrosion; all rates measured were less than one mil/mo. Dichromate does accelerate the corrosion of 304-L markedly; rates increased from 20 to 600 mils/mo as dichromate concentration was increased from 0.01 to 0.2 M. Titanium (A-55) showed good corrosion resistance in the presence of all three additives in the concentration range studied.

Bearing Materials

Pyroceram* did not prove to be a satisfactory bearing material when run submerged in water against either Coors Al_2O_3 or stainless steel journals at 2700 rpm and at loads in excess of 20 psi.

Coors porcelain bearings and journals have been found to freeze when suspended in nitric acid vapors. A mated pair of Linde flame plated alumina bearing-journals froze similarly. Inspection shows the alumina to be attacked by the vapors, creating large crystals of aluminum nitrate which solidify at the line of junction. Impregnation with high melting wax is being investigated as a possible method of minimizing this crystal growth.

Non-Metallic Materials

Samples of six different types of currently marketed Marlex 50 polyethylene were tested to evaluate the radiation tolerance of these various types. Melt index is the primary criterion for the classification. The various types tested are:

<u>Type</u>	<u>Melt Index</u>	<u>Type</u>	<u>Melt Index</u>
2	0.2	15	1.5
4	0.4	35	3.5
9	0.9	50	5.0

None of the types of Marlex 50 polyethylene now marketed is the equivalent in radiation stability of the Marlex 50 previously offered before the separation by melt index. There is a variation in radiation tolerance among the different types. The lower numbered are superior. All types exhibited a low point in flex life in the vicinity of 10^7 to 10^8 r gamma total dose. A more detailed report is currently being issued under the title "The Effects of Melt Index on the Radiation Tolerance of Marlex 50 Polyethylene."

* Corning Glass Works trademark for a crystalline glass.

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PROCESS CONTROL DEVELOPMENTAssistance to Chemical Processing Department on Process Control Instrumentation

The gamma monitor on the Redox 3BP stream was placed in beneficial use this month. This is a pulse type instrument which allows discrimination of plutonium gamma activities below 0.45 mev. The two gamma monitors at Redox which have been in service for the longest time are now inoperative because of plugged sample jets. Scale and corrosion products in the inert gas system are the cause of this malfunction. Redox technology plans to install additional filters and driers to alleviate this condition.

A simplified design of a gamma monitor cell was conceived and a prototype fabricated. The design uses a replaceable section of standard size tubing for the sample cell.

An ultrasonic level detector for use on the Purex 1WW ion exchange column has been under laboratory test and has not yet performed satisfactorily. Most of the time the "echo" from the resin surface is too small to reliably operate the circuitry. Tests are continuing to determine the cause of the poor performance as occasionally the unit performs well.

A mock-up of the Redox IAFS two jet sample system, designed by FEO is being tested for its effectiveness in delivering an air free sample at an acceptable flow rate, without salt crystallization. It appears that the size of the sample pot can be reduced. It is necessary to baffle the inlet stream to prevent aeration of the solution in the sample pot. An alternate method of venting the sample pot is being tested to prevent salt crystallization in the vent line.

Calciner Control Instrumentation

The Foxboro magnetic flowmeter performed satisfactorily during 12 days of continuous operation metering 100 per cent UNH solution. Flow rates of 0.12, 0.24, and 0.36 gpm were controlled satisfactorily. On the 13th day of operation, the meter developed an electrical short. Inspection revealed fluid leakage into the electrical windings. The leak occurred at a point where a Dow silastic #50 "O"-ring had been used as a pressure seal. The "O"-ring softened into a putty-like mass. The Fischer-Porter magnetic meter was reinstalled in the test loop and has performed satisfactorily since October 13. Four Fischer-Porter meters are now on site for test on a plant calciner.

Electrical Conductivity

An in-line conductivity cell was constructed and calibrated for use in the prototype formaldehyde nitric acid destruction reactor. It is designed for measuring acid concentrations ranging from 0.0 to 4.5 M with up to 4 M concentration of other salts.

Pipeline Plutonium Monitor

The use of a commercial preamplifier (Victoreen model 205-B) in a multitube (four), BF₃ tube-type neutron monitor system was successfully demonstrated in laboratory

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and plant experiments during the month. This neutron monitor system, combined with a lucite moderating block, was installed on a 2-inch plutonium transfer line in the Redox plant. It was intended to use this prototype installation to determine optimum moderator and shielding configurations for a pipeline plutonium monitor, however, the physical aspects of the immediate area and the excessively high neutron background indicate that another site is desirable.

Computer and Simulation Work

Simulation of controllers and various transfer functions has proven to be somewhat more difficult than originally anticipated on the Litton DDA. However, it can be done, and it is anticipated that a great number of control problems involving no more than two controllers and two measuring instruments can be set up on the computer and optimum controller settings determined rather quickly. Larger problems will have to be set up on the Goodyear computer.

NON-PRODUCTION FUELS REPROCESSING

Mechanical Processing

Chopping studies with a 40-ton hydraulic shear equipped with type 420 stainless steel "V" shear blades and cutting both simulated fuel elements and stainless rod and bar showed that (a) shear power requirements nearly doubled, but shear operation is smoother for V-blades as compared to straight blades, and (b) the expected life of a 420 stainless steel would be approximately half that of a hardened high carbon steel blade.

Future work includes modifications to the shear for closed system cutting, and continued studies with blades and simulated fuel elements of various geometry and materials.

Feed Preparation

Niflex Process. Preparatory to conducting a Niflex dissolution of irradiated uranium metal, studies were conducted with "cold" uranium. Acid consumption on dissolving 304-L stainless steel in 1 M HNO_3 , 2 M HF , and in 3 M HNO_3 , 2 M HF was, respectively, 3.7 and 3.1 moles acid consumed per mole of stainless steel dissolved.

Satisfactory uranium dissolution rates of the order of 0.5 g/hr, cm² were obtained on dissolution of uranium in solutions containing 0.16 M stainless steel, 0.8 M F^- , 0.8 M ANN , and 1.6 to 3.1 M total acid. Acid consumptions ranged from 3.5 to 3.9 moles acid consumed per mole of uranium dissolved.

The "hot" Niflex solution was prepared under conditions which yielded a terminal acidity of 0.2 M in cold experiments. A small amount of reddish-brown residue was present at the end of the dissolution but proved to be readily soluble in 5 M nitric acid.

Niflex Dissolver Fabrication. Fabrication of a vacuum melted Hastelloy F dissolver has been started. Penetration, undercutting, and some cracking of welds have been experienced.

Zirflex. Zircaloy sheets (30 mil thick, oxidized 336 hours at 400 C) and sintered UO_2 were used in three consecutive Zirflex pilot plant decladding runs with subsequent UO_2 dissolution in nitric acid. Weight ratios of Zircaloy to UO_2 were 0.17, 0.17, and 0.16. Zirflex solutions were charged to leave a ten per cent Zircaloy metal heel in the dissolver through the UO_2 dissolution step. Dissolution of the Zircaloy inventory was 89, 92, and 92 per cent in 3.7, 5.8, and 5 hours for the respective runs with an air sparged, refluxing system. Uranium in the decladding solutions after centrifugation was 0.30, 1.1, and 1.9 grams per liter. Waste losses to the centrifuged solution were 0.1, 0.4, and 0.5 per cent of the uranium charged.

Darex. Studies of metallic uranium dissolution in a dilute aqua regia solution were initiated and the dissolution of stainless steel was further investigated. Previously reported (August report) laboratory studies have shown that some metals, such as copper, aluminum, iron, and uranium, in contact with the stainless steel charge will preclude passivation. Two stainless steel test dissolutions were made in the Darex pilot plant unit to demonstrate the depassivating effect of copper. In both runs, a piece of copper was placed upon the stainless steel charge. The dissolution step was then interrupted - a procedure that previously has caused passivation. Upon reheating with sufficient excess chloride present in solution, the remaining stainless steel in contact with the copper dissolved. In one run, a piece of stainless steel tubing suspended in the solution above the copper and the rest of the charge was only partially dissolved.

Subsequent to the stainless steel dissolution, two consecutive chargings of solid 8-inch uranium slugs were dissolved. The uranium dissolution rates were 180 mils per hour for the first charges and 25 to 30 mils per hour for the second charges. Cursory laboratory studies performed to determine the reason for the widely different dissolution rates between the two chargings have indicated that the nitrate-to-chloride mol ratio must be below about four in order to obtain the high dissolution rate. The nitrate-to-chloride mol ratios were 2.4 and 5.2 for the first and second uranium dissolutions respectively in the two pilot plant runs.

Sulfex Process. A major uncertainty in applying the Sulfex process to declad power reactor fuels clad in stainless steel is the rate at which irradiated uranium dioxide is dissolved by dilute sulfuric acid. While awaiting delivery of appropriate samples of irradiated uranium dioxide, preliminary experiments have been conducted with irradiated uranium dioxide which had been used in earlier Zirflex experiments. This material had been irradiated to 500 g/T and had cooled for about 20 months. The sample used in these experiments was estimated to be about five to ten grams. Measurements with a ferrous sulfate dosimeter indicated a rate of energy absorption by the solutions used in these experiments of 2.5×10^{16} ev/ml, hr, corresponding to formation of hydrogen peroxide at a rate of 4×10^{-7} mole/liter, hr.

This uranium dioxide has been exposed to boiling 4 M sulfuric acid in two experiments to a boiling solution 4 M in sulfuric acid and 1.4 "molar" in stainless steel, and to boiling 4 M sulfuric acid in which 304-L stainless steel was simultaneously being dissolved.

Only fragmentary analytical data are available at present. In the two experiments with boiling 4 M sulfuric acid, the rate of appearance of plutonium in the solution corresponded to dissolution of 0.1 per cent of the plutonium per hour for the first

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four to five hours. After this period the plutonium dissolved more rapidly, at a rate corresponding to about 0.6 per cent per hour. No analytical data are available for the other two experiments but comparison of CP survey meter readings taken on samples of the supernatant indicate qualitatively similar behavior on exposure of the irradiated UO_2 to a boiling 1.4 "molar" stainless steel solution in 4 M sulfuric acid. In this case the initial dissolution rate persisted for about six to seven hours after which time the UO_2 dissolved at an increased rate. In both regions, however, the rate appeared to be lower by a factor of about two than the rate in boiling 4 M sulfuric acid. CP survey meter readings taken during exposure of the irradiated UO_2 to a boiling 4 M sulfuric acid solution in which 304-L stainless steel was being dissolved indicate a very slow rate of dissolution of UO_2 until some two hours after dissolution of the stainless steel was completed. After this point, however, dissolution of the UO_2 apparently proceeded at the same rate as in the absence of stainless steel.

Both uranium metal and uranium dioxide were found to dissolve much more rapidly in 4 M sulfuric acid when iron(III) was present. In the case of UO_2 , the accelerated dissolution persisted until a mole ratio of iron to uranium in solution of about two had been established. With uranium metal the increased rate persisted until the iron to uranium mole ratio had reached about six. These observations suggest that the iron(III) functions as an oxidant, not as a catalyst, in the dissolution of uranium or uranium dioxide.

The dissolution of metallic uranium in boiling 4 M sulfuric acid containing initially 0.1 or 0.2 M Fe(III) was found to be first order in Fe(III), following the equation

$$R = 10 \frac{M}{\text{Fe(III)}}$$

where R is the dissolution rate in mg/min, cm².

Dissolution of Uranium-Molybdenum Alloy. Uranium-molybdenum alloys are readily attacked by boiling nitric acid forming a slurry containing a yellow solid. When a nine weight per cent molybdenum alloy was dissolved to produce a 0.5 M UNH solution the volume of the settled solid was about 20 volume per cent. The composition of the solid is not yet known; X-ray diffraction lines for H_2MoO_4 and $\text{MoO}_3 \cdot 2\text{H}_2\text{O}$ were not found. It does contain some uranium. The solid can be solubilized in acid solution by chromic acid or cerium(IV) nitrate. Solutions of sodium carbonate readily dissolve the solid. The alloy can be dissolved in nitric acid - hydrofluoric acid - aluminum nitrate solutions without formation of appreciable solids. Experiments are in progress to determine the optimum dissolvent composition from the standpoint of both subsequent processing and corrosion of dissolver materials.

Materials of Construction. Corrosion rates for vacuum melted Hastelloy F, Carpenter 20, and Ni-O-Nel in solutions encountered in stainless steel decladding with sulfuric acid have been determined. Rates for Hastelloy F are high in sulfuric acid only (16-30 mils/mo in 3-4 M H_2SO_4) but decrease markedly (to less than 10 mils/mo) as the stainless steel concentration increases. The reverse is true for Carpenter 20 and Ni-O-Nel. The attack was general for Carpenter 20 and Ni-O-Nel in all solutions studied. Some intergranular attack of Hastelloy F occurred at low stainless steel concentrations. The Carpenter 20 used was non-stabilized. Stabilized material will soon be available for test.

Corrosion of Carpenter 20, 304-L, and Hastelloy F in nitric acid-hydrofluoric acid-aluminum nitrate solutions typical of those proposed for dissolution of alloyed cores was studied. All showed good resistance (2 mils/mo or less) when the aluminum-fluoride mole ratio was one or more. Corrosion of 304-L increases markedly as this ratio is reduced to less than one; the other two materials are less sensitive to this ratio.

Volumetric Calibration of a Process Vessel. Anticipated accountability procedures in the NPFR program, indicate a need for accurate and reliable measurements of the total quantity of dissolved fuel elements in any batch. Concentrations of individual constituents will be determined by laboratory analysis of representative samples. The approach to the problem of total quantity dissolved most consistent with present plant practices appears to be the measurement of liquid level in an accurately calibrated vessel. Operations research personnel are presently studying calibration procedures which will provide statistically significant vessel calibration data.

Tank T-4 (4000 gallons) in the 321 tank farm is to be used to test and verify the validity of the calibration procedure. A fifty gallon drum has been calibrated for adding increments of water to tank T-4. A "standard" secondary weight of $423.5 \pm .05$ lb. has been prepared. Instrument systems to measure and record the liquid level in a vessel with an accuracy ± 1 per cent are presently under study.

Solvent Extraction

Stability of Darex and Niflex Feeds. A study of the stability (towards solids formation) of simulated Redox LAF, LAFS, and LAW solutions prepared from Darex-type dissolver solution has been completed. The stability can be correlated with total nitrate concentration; plots of this variable versus either pH or acid deficiency for solutions nearly unstable with respect to hydroxide formation are straight lines. The curves can be used to predict pH and acid deficiency of stable solutions for uranium to stainless steel ratios in the range 1.0 to 5.0. A similar study based on Niflex dissolver solutions is nearly complete.

Oxidation of Plutonium in Darex and Niflex Solutions. Studies of the oxidation of plutonium in simulated Darex and Niflex dissolver solutions were continued. Although analytical data are not yet complete, there are still no indications of unusual difficulty in the oxidation of plutonium in these solutions. Essentially complete oxidation was obtained for both types of solutions (at 0.1 M HNO_3 and 0.1 M $\text{Na}_2\text{Cr}_2\text{O}_7$) in one-half hour at 95 C. Studies on a dissolver solution prepared by Niflex dissolution of irradiated U metal are in progress.

Solvent Extraction of Darex and Niflex prepared Feeds. Continued laboratory batch Redox-type extraction and scrub studies on simulated Darex feed solutions confirm previously reported conclusions as to fission product behavior. Studies to determine decontamination during second cycle treatment of Darex feeds are in progress. Batch contact studies simulating Redox first cycle extraction and scrubbing of Niflex feeds have been made but can not be summarized yet because analytical data are not complete. Several mini mixer-settler first cycle extraction and scrub runs were made using simulated Niflex feeds. In all of these, entrainment of aqueous by

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organic occurred and decontamination values observed are questionable. Considerable loss of first cycle decontamination (factors of 10 or greater) is still indicated due to the necessarily high acidity of the feeds.

Semiworks Testing of the Redox Process on NPT Feeds. Semiworks scale experiments on this subject have been initiated at ORNL. Two HLO professional personnel are at ORNL in support of the program.

Packed TBP Solvent Extraction Columns. Packed C-column efficiency studies utilizing a dilute feed in a 3-inch diameter by 20-foot-high Raschig ring packed column have verified previously reported (see August report this series) indications that the efficiencies of graded and "zebra" packings were comparable with those of uniform packings.

Alternate Redox Solvents. A number of organic solvents have been examined as possible replacements for hexone in the Redox plant. The incentive for this study is to enable feeds of higher acidity to be safely processed in the existing Redox plant.

Of the compounds which have been examined to date, straight chain polyethers appear to be the most attractive, in particular polyethers in which the spacing between oxygen atoms is sufficient to prevent inductive interaction between the oxygens. The properties of several of these compounds are compared with those of hexone in the accompanying table. In addition to physical properties which should make these compounds usable in packed towers, and uranium extraction capacities approximately equivalent to hexone, these compounds are much more resistant to attack by nitric acid. For example, the effect of exposing dimethoxy hexane to 5 M HNO_3 , 0.01 M NO_2^- for 30 minutes at 80 C was only to develop a slight coloration in the solvent. Under these conditions hexone reacts vigorously in a period of a few minutes.

Although not presently commercially available, these compounds can be prepared by simple and direct synthesis methods and could perhaps be procured in large-scale lots on a custom basis. The decontamination potential of these compounds has not yet been studied. However, they offer promise of greater versatility than hexone in that the first Redox cycle could perhaps be operated with an acidic feed, the subsequent cycles presumably with acid-deficient feeds. Such operation would be more compatible with non-production fuels and also for recovery of neptunium in the Redox plant.

COMPARISON OF PROPERTIES OF STRAIGHT CHAIN POLYETHERS WITH HEXONE

	Boiling Point at 50 mm Hg	Solubility in H ₂ O (g/l)	Density (g/cc at 25 C)	Viscosity (millipoise, at 25 C)	$E_a(U)^*$
Hexone	43	20	0.796	5.46	0.012
Dimethoxyhexane	102	22	0.852	11.1	0.034
Diethoxybutane	84	10	0.833	9.2	0.011
Methoxypropoxybutane	87	7.5	0.840	9.7	0.0095
Diethoxypentane	106	5	0.840	11.8	0.0067
Methoxybutoxybutane	107	5	0.841	16.8	0.0052

* $E_a(U)$ = Distribution coefficient for U (organic/aqueous) when aqueous phase containing initially 0.3 M uranyl nitrate contacted with equal volume of solvent.

REACTOR DEVELOPMENT - 4000 PROGRAMSeparation of Thorium-228 from Uranium-232

In the preparation of MTR type fuel plates containing uranium-233, a serious radiation hazard arises from the presence of small quantities of the 74 year uranium-232 isotope which is formed by an (n, 2n) reaction of uranium-233. The thorium daughter of uranium-232 has a half-life of only 1.9 years and heads a decay chain of elements having half-lives ranging from 0.16 seconds to 10.6 hours. Since there are several energetic beta and gamma emitters in the chain, the specific activity due to it is appreciable. It has been estimated that a single MTR type fuel plate fabricated from 14.7 w/o uranium-aluminum alloy containing 50 parts of uranium-232 per million parts of uranium will have a surface exposure dose rate of 33 mr/hr from the gamma emission and 1000 mrad/hr from the beta emission twenty days after the uranium daughters have been separated from the parent. Since the gamma is hard, the accumulation of 18 fuel plates in a single assembly will represent a considerable radiation field, perhaps as much as 300 mr/hr in the vicinity of the assembly. Since the radiation dose rate varies linearly with time from separation, it is essential that the separation be made as close in time as possible to the onset of the fabrication job.

Recent experiments using thorium-234 (UX₁) tracer were conducted to determine the feasibility of separating the thorium daughters from aluminum-uranium alloy by extraction into molten potassium aluminum chloride at 700 to 800 C. Qualitatively, results were similar to that of uranium and plutonium, as a maximum was observed in the distribution coefficient, defined as

$$K_M = \frac{\text{gm/g metal phase}}{\text{gm/g salt phase}},$$

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at an AlCl_3/KCl ratio of about one. Quantitatively, K_{Th} values of about 0.02 were determined in the range of AlCl_3/KCl ratios of 0.8 to 0.9. This is to say that only two per cent of the thorium remained in the metal phase under these conditions, conditions under which K_{U} ranges from 3.5 to 4 and the uranium reduction from 75 to 80 per cent. K_{Th} values of 0.11, 0.12, and 0.30 were found for higher values of the AlCl_3/KCl ratio; however, the sharpness of the dependence and the difficulty of obtaining quantitative aluminum and potassium analyses have made accurate delineation of the dependence difficult.

The effectiveness of this procedure for removing thorium was demonstrated in an experiment in which 55 grams of uranium (as UO_2) was reacted with 200 grams of KAlCl_4 and then contacted with 200 grams of aluminum. The resulting alloy contained 14.2 w/o uranium (vs. 14.5 w/o goal) and gave no dose rate reading when checked with a CP meter. The salt phase, on the other hand, read 500 mrad/hr when checked under identical conditions (UX_1 analyses are incomplete). The decontamination indicated is more than adequate for interrupting the daughter activity of uranium-232. The activity associated with the 10.6 hour lead-212 will, of course, not be removed by this method but since the parent has been removed will decay in 50 hours to 0.04 of that present at separation. Thus, by this potassium aluminum chloride technique, a simple contacting of the alloy with the salt phase, satisfactory removal of uranium-232 daughter activity prior to fabrication can be expected.

Pyrochemical Processes

Current consideration of the tentative pyrochemical process for the extraction of plutonium from irradiated uranium dioxide and conversion to aluminum-plutonium fuel material points up the high probability that rare earth fission products will be the principal contaminants of the final product. Scouting experiments have, therefore, been initiated to determine the utility of magnesium oxide drossing for removing these materials. A sample of aluminum-1.5 w/o plutonium alloy spiked with cerium-144 tracer was held at 1300 C for two hours under an argon blanket. Whereas the activity of the original sample was 4.5×10^5 gamma/min, g, no cerium activity was detectable in the resulting alloy. The question of possible simultaneous oxidation of plutonium has not been completely resolved since nearly half of the alloy had disappeared because of volatilization or spattering. The plutonium recovered in the residual button comprised 59 per cent of the original and was enriched with respect to the aluminum by 13 per cent, thus indicating the possibility of little plutonium oxidation during the course of the reaction.

Amine Extraction of PRP Fuels

The use of the aromatic compound xylene as a diluent for triaurylamine has been previously shown to allow much higher plutonium loadings than a kerosene type diluent with equally good performance otherwise. A high boiling aromatic Amsco diluent (Amsco D-95) has been found to perform similarly. Batch extraction scrub studies were made on feed prepared from Purex dissolver solution with ten per cent triaurylamine Amsco-95. Plutonium extraction and stripping were normal, and the ruthenium and zirconium-niobium decontamination factors were 1.6×10^{-4} and 1.1×10^{-4} , respectively. These compare favorably with those previously obtained.

Zirflex Decladding of PRTR Pu-Al Fuels

Aluminum-uranium alloy rods (1/2-inch in diameter, 6 inches long, 2.25 w/o uranium) were subjected to a Zirflex decladding step for four hours. Uranium in the decladding solution was 0.0036 gram per liter and waste losses of the uranium from the rods were 0.25 per cent. The Zircaloy to Al-U alloy weight ratio was 0.78. The rods were bare and clean when removed from the decladding solution.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Geology and Hydrology

The difficulty in tracing sinuous geologic structures by well drilling was emphasized by observations in the recently completed well 699-2-33. This well, located on the buried projection of the Yakima Ridge, encountered basalt nearly 300 feet deeper than expected from limited local data. Magnetometric surveys, made when drilling began, suggested a double ridge with well 699-2-33 in the valley between the ridges, but provided no depth data. A well scheduled for N 7000, W 38,000 was moved to N 14,000, W 40,000 and drilling begun to intercept the ridge evidently lying north of well 699-2-33. Direct and positive evidence of the double ridge in this area and of the exact location of each of the ridges is still lacking.

An attempt to pump well 699-9-E2 resulted in the pump becoming lodged in the well. The trouble was apparently caused by a break in the casing which permitted gravel to enter the well above the pump and effectively wedge the pump in the casing. Efforts of a well drilling firm hired to attempt recovery of the pump were unsuccessful.

The definition of such descriptive terms as "gravel," "cobbles," and "boulders" is not uniform among those concerned with preparing and interpreting well logs. Partly in order to aid in contract matters, it is proposed to standardize these descriptions at Hanford according to definitions advanced by the National Research Council.

A laboratory model design was tested that appears to solve the problem of obtaining uniform flow distribution. The model incorporates a pattern of inlet and outlet ports and porous steel plates to smooth the flow. It was found that in an open channel a density variation of 0.013 per cent had an observable influence on the velocity distribution.

Field Apparatus Development

The in-well permeability measuring packer was reconditioned and tested in a well driven in a region of relatively low permeability. Sealing and other mechanical functions were satisfactory as judged by performance in an unperforated section of the well. When the packer was tested in the perforated section, unexpected high flow rate through the packer and out through the formation was observed. The performance of the packer suggested either that channels were present outside the casing leading to lower sections of the well or that water was by-passing the seal rings. Further tests must be made to establish the limitations of this method for in-well permeability measurement.

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One of two geophysical exploration firms asked to bid on quantitative analysis of magnetometer survey data declined, indicating that more intensive data would be required. The other firm submitted a bid believed to be excessive for the potential gain. Magnetometric methods to give more intensive data rapidly will be explored before additional attempts are made to obtain quantitative analysis.

Soil Chemistry and Geochemistry

Experiments were performed to study the removal of phosphate from solution by a calcite bed as a function of flow rate and temperature. While the removal of radio-strontium from a phosphate solution by calcite is improved several orders of magnitude by raising the temperature from 25 to 60 C, phosphate removal is increased just two-to six-fold. The results showed no direct relationship between strontium removal and phosphate removal. This indicates no direct relationship between the rate of apatite formation and the rate of strontium removal from solution.

Columns of crushed calcite of various lengths were studied to evaluate the influence of bed depth on strontium removal. It was found that the improvement in removal efficiency for longer columns was far greater than the proportionate increase in bed depth. Doubling the column length increased the strontium uptake more than ten times for the solutions studied.

Preliminary results from tests of calcite columns receiving phosphate-treated coating waste indicate strontium removal comparable to that from distilled water solutions.

A technique is being developed to prepare uniform and representative soil samples for laboratory studies such as crib capacity evaluation. The method developed includes wet screening of mixed samples of soil from various horizons properly distributed through the profile. The procedure involves a number of mixing, screening, and washing steps to prepare a uniform, fine sample that can be split for multiple testing without bias.

Analytical Development

Analytical procedures were developed for Mo^{99} , Sb^{122} , and Sb^{124} in reactor effluent water based on selective sulfide precipitation and gamma spectrometric analysis. Decay periods of five days and three weeks after separation are used to simplify the measurements. Application of the procedures to all reactors showed the Sb^{122} and Mo^{99} to be present in activity densities of about one-half and one-sixth that of P^{32} . Sb^{124} was also observed and measured in Turco purge material.

Reactor Radioisotopes

Another study was made, October 8 and 9, of the depletion of radioactive materials by natural processes from the Columbia River water between the reactor outfalls and the Pasco-Kennewick water intake plants. The results are tabulated below together with the averaged values from six previous determinations for comparison.

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RADIOISOTOPES REACHING PASCO (Percent)

Isotope	<u>Na²⁴</u>	<u>P³²</u>	<u>Sc⁴⁶</u>	<u>Cr⁵¹</u>	<u>Cu⁶⁴</u>	<u>Zn⁶⁵</u>	<u>As⁷⁶</u>	<u>Ba¹⁴⁰</u>	<u>La¹⁴⁰</u>	<u>Ce¹⁴³</u>	<u>Sm¹⁵³</u>	<u>Np²³⁹</u>
Previous Studies	50	69	52	81	44	54	60	65	--	--	--	72
Present Study	49	63	31	92	41	72	75	(100)	66	35	39	71

All of the previous studies were made during low temperature, low water flow conditions while this study was made during a relatively high water temperature and high metabolic activity period. The results show no marked dependence on the water temperature and metabolic rate conditions. The association of the various radioisotopes with the particulate matter suspended in the water was also studied.

Dosimetry

The protective action of erioglaucine in preventing the death of mice from 800 r of X-radiation is currently being tested by the Biology Operation. This represents the first phase of testing of compounds determined to have high protective potential by the dye dosimeter technique.

Manager,
Chemical Research & Development

LP Bupp:bp

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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
K. S. Watson	10/1/	General Electric Co. Schenectady, N.Y.	Discuss water resources problems.	LP Bupp CE Linderoth LC Schwendiman JF Honstead	No
E. M. Shanks	10/1/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Discuss separations technology.	MT Walling, Jr. EE Voiland LL Burger	Yes
M. K. Twichell	10/1/	Union Carbide Nuclear Company Pittsburgh, Pa.	Discuss separations technology.	MT Walling, Jr. EE Voiland LL Burger AM Platt	Yes
C. C. Thomas, Jr.	10/1/	Westinghouse Pittsburgh, Pa.	Discuss instrumentation.	GJ Alkire	Yes
H. Eyring	10/2/	University of Utah Salt Lake City, Utah	To visit laboratory facilities.	LP Bupp	No
G. Saunders W. C. Philloon	10/14/ 10/15/	Mallinckrodt Chemical Works St. Louis, Mo.	Discuss calcination technology. Discuss extraction technology.	EM Johnson, Jr. AM Platt GJ Alkire	No Yes
R. Scheid	10/20/	U.S. Intelligence Washington, D.C.	Discuss Geneva Conference.	RL Moore RJ Brouns AS Wilson	No
U. P. Lang N. Berry	10/22-23/	Mallinckrodt Chemical Works St. Louis, Mo.	Discuss d ingot dissolution problems.	LP Bupp RE Burns	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
P. Vermeulen	10/24/	University of California Berkeley, California	Solvent extraction separations and ion exchange.	RE Burns	Yes
J. Hughes	10/23-24/	Commonwealth Edison Chicago, Illinois	Radiochemical environmental analysis discussions.	FE Holt	No
A. E. Peckman	10/24/	USGS Radiohydrology Section Washington, D.C.	Discuss ground water studies pertinent to waste disposal.	DW Pearce RE Brown JF Honstead WH Bierschenk	No
F. P. Baranowski	10/27/	Division of Production Washington, D.C.	Power Reactor Fuels Reprocessing.	LP Bupp OF Hill	Yes
M. H. Wahl	10/22-23/	Savannah River Lab. Aiken, South Carolina	Separations technology.	LP Bupp	Yes

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
E. W. Christopherson	10/1/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Serve on Remote Control Techniques Panel for Second Conference on Analytical Chemistry.	RC Shank	No
	10/2/	Gatlinburg, Tennessee	Participate in Fuel Burn-up Task Force Meeting, American Society for Testing Materials.	DN Sunderman	No
H. J. Anderson	10/1/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Attend Second Conference on Analytical Chemistry		No

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
H. J. Anderson	10/2/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Discuss mass spectrometry problems.	MT Kelley AE Cameron	No
H. J. Anderson E. W. Christopherson	10/3/	Savannah River Lab. Aiken, South Carolina	Observe analytical facilities.	CH Ice	Yes
H. G. Rieck	10/2/	duPont Company Aiken, South Carolina	Discuss instrument problems.	JD Ross CH Ice	Yes
	10/3/	Oak Ridge National Lab. Oak Ridge, Tennessee	Discuss instrument problems.	CJ Borkowski GW Parker	No
L. P. Bupp	10/6-10/	Union Carbide Nuclear Company Oak Ridge National Lab. Oak Ridge, Tennessee	Attend Chemistry and Chemical Technology Program Reviews.	AM Weinberg	Yes
W. H. Bierschenk	10/13-17/	American Society of Civil Engineers New York, New York	Attend meetings and present paper.		No
J. E. Mendel K. J. Schneider	10/13-31/	Oak Ridge National Lab. Oak Ridge, Tennessee	Consultation on reproces- sing of NPF fuels.	FL Culler	Yes
W. L. Walker	10/14/	Battelle Memorial Inst. Columbus, Ohio	Discuss corrosion work, specifically areas in molten salt.	EM Simmons CL Peterson	Yes
	10/15-17/	National Association of Corrosion Engineers Cincinnati, Ohio	Attend meeting and present paper.		No

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
R. E. Burns	10/15-17/	Iowa State College Ames, Iowa	PhD Recruiting Trip		No
O. F. Hill	10/22-24/	University of Illinois Urbana, Illinois	PhD Recruiting Trip		No
P. O. Jackson	10/20-31/	Argonne National Lab. Lemont, Illinois	Discuss Washington Designated Programs.	MH Studier	Yes
D. R. Kalkwarf	10/20-24/	Varian Associates Palo Alto, Calif.	Consultation re. specifications and components necessary for instrument to be purchased.	EH Rogers	No
J. L. Daniel	10/28-29/	Washington State College Pullman, Washington	Recruiting of PhD Candidates.		No
E. E. Voiland	10/30-31/	University of Alberta Edmonton, Alberta, Canada	Discuss mercury isotope separation methods.	HE Gunning	No

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BIOLOGY OPERATION

A. There were no significant personnel or organization changes during the month of October 1958.

B. TECHNICAL ACTIVITIESFISSIONABLE MATERIALS - 2000 PROGRAMBIOLOGICAL MONITORINGAtmospheric Contamination

Concentrations of I^{131} in thyroid glands of jack rabbits were about 20 times less than a year ago. Values were as follow:

<u>Collection Site</u>	<u>$\mu\text{c/g}$ thyroid</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Wahluke Slope	2×10^{-4}	2×10^{-4}	- 4
Prosser Barricade	4×10^{-4}	7×10^{-4}	-
4 Miles SW of Redox	1×10^{-4}	3×10^{-4}	- 3

Fission products were present in rabbit tissues in the following amounts which were below those of last year by a factor of 2:

<u>Sample Type</u>	<u>$\mu\text{c/g}$ wet wt.</u>	<u>Trend Factor</u>
	<u>average</u>	
Bone	4×10^{-5}	-
Feces	4×10^{-5}	-
Liver	8×10^{-6}	-
Muscle	8×10^{-6}	-

Columbia River Contamination

Contamination levels for beta emitters in fish from Hanford and Ringold were about the same as one year ago. Levels in whitefish from Priest Rapids were 10 times higher this year. Values were as follow:

<u>Sample Type</u>	<u>Location</u>	<u>$\mu\text{c/g}$ wet wt.</u>		<u>Trend Factor</u>
		<u>Average</u>	<u>Maximum</u>	
Minnows (entire)	Hanford	2×10^{-2}	3×10^{-2}	-
Whitefish Flesh	Priest Rapids	8×10^{-5}	3×10^{-4}	+ 9
Whitefish Flesh	F-1	2×10^{-3}	4×10^{-3}	-
Whitefish Flesh	Ringold	1×10^{-3}	2×10^{-3}	-

Effect of Reactor Effluent on Aquatic Organisms

Reactor effluent water at a strength of 3 per cent did not significantly increase mortality among young rainbow trout after an exposure of 20 weeks. Growth was markedly reduced, however. Trout held in well water have had excellent survival and growth during the past two months.

Equipment was made ready for a test to measure the increase in contamination which results in Columbia River fish following a purge of a reactor with diatomaceous earth. Difficulty was encountered in scheduling a special purge for the test, however, and the program has been postponed until next year when water temperatures will again be favorable.

Aerial surveys of salmon spawning activity in the Columbia are in progress. Preliminary results indicate the total number of nests in the environs of HAPO this year will surpass all previous counts.

BIOLOGY AND MEDICINE - 6000 PROGRAMMETABOLISM, TOXICITY, AND TRANSFER OF RADIOACTIVE MATERIALSPhosphorus

A test to measure the turnover rate of P^{32} in trout held at temperatures of 7° C, 11° C, and 15° C was started on October 20. The isotope is being administered orally each day for a four week's period.

Zinc

Herbivorous fish were introduced into simulated streams that contained established populations of food plants that had reached a concentration of Zn^{65} in equilibrium with the water which contained a constant amount of 0.1 $\mu\text{C}/\text{ml}$. The Zn^{65} content in the entire fish, minus gut, approached equilibrium within two days.

Uptake of Zn^{65} by bean plants was evaluated in a series of tests with the radioelement placed at varying depths within the soil. Gallon cans were used as soil containers and the Zn^{65} was placed on the surface, $1\frac{1}{2}$ " deep, 3" deep, and uniformly mixed throughout the 1,800 grams of soil. The lowest concentration was observed in the plants grown on soil uniformly contaminated with Zn^{65} . Greatest uptake occurred from pots containing the radioelement at the $1\frac{1}{2}$ " level. It seems possible that the increased uptake from near surface contamination may be the result of a high surface root concentration. This possibility will be examined following the second croppings which are currently in progress.

Strontium

As a first approximation it appears that trout assimilated about 30 per cent of Sr^{90} administered orally and that the biological half-life is about 5 days.

Animals chronically fed with diets containing 0.03, 0.1 and 0.5 per cent calcium show continuing decreases in OR values at the 100-day time interval. Animals on a 2 per cent calcium diet continue to exhibit constant OR values.

In the experiment designed to study the effects of added dietary calcium on the uptake, retention and transfer of Sr^{90} and Ca^{45} in ewes with suckling lambs, it was found that a 50 per cent increase in dietary calcium (using calcium gluconate) caused a 50 per cent reduction in both Sr^{90} and Ca^{45} in these ewes. In the suckling lambs nursing these ewes, a 75 per cent decrease in Sr^{90} and Ca^{45} burden was evidenced.

Study of the daily blood and milk radioactivity values showed that added dietary calcium had a greater diluting effect on Ca^{45} than on Sr^{90} by a factor of 6 in blood and a factor of 2 in milk.

Comparison of the blood level and urinary excretion curves for Sr^{90} following a single oral dose in miniature pigs shows that the slopes of the two curves are very similar. Urinary and fecal excretion curves after the sixth day are also similar. This indicates that all Sr^{90} excreted in the feces after day six was endogenous, and that both fecal and urinary Sr^{90} activities are probably dependent upon the concentration of Sr^{90} in the blood.

The urinary excretion curves for young and adult pigs are similar. The curve for young pigs is higher, indicating a greater concentration of Sr^{90} in their blood and retention of a greater percentage of the administered dose in their bone.

A mathematical model explaining the behavior of bone-seeking radioisotopes upon entry into the circulatory system has been established. Proportionality constants for various isotopes are being investigated.

In plants, differential action of Ca^{45} and Sr^{90} was tested in two ways. First, plants were grown in nutrient solutions containing equal concentrations of these two isotopes. Following a growth period the root systems were immersed in a variety of washing solutions including distilled water, 0.1 N HCL, 10 meq Ca/L , and 10 meq Sr/L . The amount of each isotope removed was quite similar in each test with the exception of that using calcium in the washing solution. In this test the amount of Ca^{45} removed into the washing solution was about double the amount of Sr^{90} removed into the washing solution. There seemed to be little, if any, effect of the calcium on removal of Sr^{90} , and there seemed to be no effect of strontium on removal of either Ca^{45} or Sr^{90} . The second test is in a preliminary state, and comparative values are not yet available. This test involves the determination of dissociation constants for Ca^{45} phosphate and for Sr^{90} phosphate. At present, only values for Ca^{45} are available, but they check very well with literature values for the same dissociation constant. Additional tests with phytate are underway.

Iodine

Most levels show an increase in Q/D this month, due to cooler weather and weaning of lambs. The new 5 μc level (1958 offspring) started their I^{131} dosing regimen September 29, 1958. These animals will be held for thyroid tumor development observation.

The group of 13 ewe lambs given 3 mc I^{131} orally, as reported last month, showed an effective half-life in the thyroid gland of 5 days, and a biological half-life of 14 days. The delivered dose was estimated as approximately 40,000 rads to a 3-gram thyroid gland and 30,000 rads to a 4-gram thyroid. These animals are being held for possible thyroid tumor development.

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Tungsten

Preliminary results indicate that insoluble $W^{185}O_3 \cdot nH_2O$ and soluble $W^{185}O_4$ solutions deposit in bone in similar amounts whether administered intragastrically or intratracheally.

Plutonium

Preliminary data suggests that median survival time is less in animals administered 800 r of x-radiation following intravenous plutonium than in animals receiving 800 r of x-radiation alone. Excretion of injected plutonium by rats did not vary significantly with dose level of $CaNa_3DTPA$ administered one hour later.

Radioactive Particles

Approximately 150 mice were killed for histological examination of lungs and other tissues 500 days after exposure to non-radioactive aerosols. These are control animals for another group exposed to radioactive particles.

Twelve beagle dogs were exposed to $Pu^{239}O_2$ dust as an aerosol for deposition, translocation, and excretion studies.

Gastrointestinal Radiation Injury

Experimental evidence suggests that in rats the lethal amount of radiation from chronically ingested radioyttrium may be about 3 times that which is acutely toxic.

Relative Biological Effectiveness

Studies with S^{35} and tritium in resting cultures of haploid yeast gave an RBE value of 1.5 for S^{35} as compared with tritium, using viability as a criterion of biological damage. Since there could have been little opportunity for the S^{35} to penetrate into key metabolic sites within the cell, it seems unlikely that transmutation is causing the high damage from S^{35} . That the RBE for S^{35} betas should be greater than that for H^3 betas is difficult to believe. Efforts are, therefore, being made to again check the adsorbed radiation dose.

A new dosimeter was tested to determine if it could be used in the presence of finely divided platinum particles. The dosimeter, erioglaucine in 0.1M H_2SO_4 , appears to be satisfactory in that the platinum does not affect the degree of decoloration of the dye during exposure to radiation. This test utilized X-rays, and a similar experiment will be conducted with alphas from Po^{210} to be sure that the dye can be used for dosimetry of Po^{210} alphas in the presence of platinum carrier particles.

Changes in yeast permeability were measured following radiation under aerobic and anaerobic conditions. Greater loss of potassium occurred under anoxic conditions than in the presence of oxygen. However, a similar relation was noted in unirradiated cells maintained in similar atmospheres. This suggests that the permeability is associated with metabolic state of the cell and that the degree of radiation damage is similar under conditions of anoxia and with oxygen present. Further work is underway to clarify this problem.

C. OFF-SITE VISITS AND HAPO VISITORS

Name	Dates of Visits	Company or Organization Represented/Visited	Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
VISITS TO HANFORD WORKS						
Dr. Eyring	10/2	U. of Utah, Salt Lake	Present HLO seminar	RC Thompson	No	100-F, 141-M 108-F, 146-FR
Dr. A.B. Everett	10/22	U. of Wash., Seattle	Present seminar	LA George	No	" " "
Dr. W.O. Rieke	10/22	U. of Wash., Seattle	Tour facilities	"	No	" " "
W.J. Fiddymont,	10/24	Bresden Power, Chicago	Tour facilities	WJ Clarke	No	" " "
O.W. Dodd, Jr.				RF Foster	No	" " "
D.E. Woodman						
Charles Hamilton	10/24	General Electric, APED	Tour facilities	Clarke, Foster	No	100-F, 141-M, 146-FR
Berton C. Macbain & Frederic Cramer	10/28	U.S. Army Corps of Engineers, McNary Dam	Tour Aquatic Biol.	RF Foster	No	100-F, 146-FR
Dr. A. Carsten	10/28	Brookhaven Nat'l. Lab.	Present seminar	WJ Bair	No	100-F, Biology
Dr. C. Conzak	10/29	WSC, Pullman	Attend seminar	FP Hungate	No	100-F, Biology
Dr. Sidney M. Beck,	10/31	U. of Idaho, Moscow	Visit facilities	RT O'Brien	No	" "
Dr. Owen B. Weeks						

VISITS TO OTHER INSTALLATIONS

R.F. Foster	10/6-10	Mich. State U., East Lansing; Detroit; Cincinnati -USPHS	Discuss research Attend Mtg. Fed. Sewage & Ind. Wastes Assoc.	RC Ball JM Smith	No No	
P.L. Hackett	10/9-10	U. of Wash., Seattle	Discuss research	Tarzwel, Henderson	No	
L.A. George	10/9-10	U. of Wash., Seattle	Discuss research	Bustad, Carlson	No	
A.C. Case	10/14-17	Rad. Counter Labs, Chicago	Training school	"	No	
H.A. Kornberg	10/16-30	New York; Wash. D.C.; Cincinnati; Philadelphia	Attend NAS Mtg. Discuss research Attend AEC BMD Mtg. Discussion w/GE	S. Warren Dunham & Zelle Cowles	No No	
R.C. Thompson	10/17-19	Linfield College, McMinnville, Oregon	Address ACS Mtg.	F.J. Reithal	No	
W.J. Clarke	10/22-23	Oregon State College, Corvallis, Oregon	Address Am. Soc. Agric. Engr.	Swamer	No	
R.C. Thompson	10/27-11/9	Philadelphia and Oak Ridge	Attend bone conference; attend Information Mtgs.		No	
W.C. Hanson and R.C. Pendleton	10/9-10	Twin Lakes and Rock Lake, Wash.	Collect samples.		-	

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D. Lectures

a. Papers presented at meetings

R.C. Thompson, "Hanford Research on the Biological Hazards of the Atomic Age," October 18, 1958, Oregon Section of the American Chemical Society, McMinnville, Oregon.

W. J. Clarke, "Peacetime Accomplishments of Atomic Energy as it Affects Agriculture," October 22, 1958, Pacific Northwest Section of American Society of Agricultural Engineers, Oregon State College, Corvallis, Oregon.

b. Seminars

A. Wiggins, "Multi-Compartment Flow Model with Chronic Feeding," Oct. 8, 1958.

Dr. Everett, Univ. of Washington, "Studies on Lymphocyte Formation in the Guinea Pig using Tritiated Thymidine," October 22, 1958.

Dr. A. Carsten, Brookhaven National Laboratory, "Investigation of the Lethal Mechanisms Associated with Partial Body X-Irradiation in the Rat," October 28, 1958.

R. F. Foster, "Temperature Problems in the Columbia River Fishery," October 29, 1958.

R. Borasky, "Electronoscopic Analysis of Aerosol Particles," October 29, 1958.

E. Publications

a. HW Publications

None

b. Open Literature

Bustad, L.K., D.B. Warner, and H.A. Kornberg, "Effect of Stable Iodine on Uptake of Radioiodine in Sheep," Am. J. Vet. Research 19, 893-4 (1958).

Manager
BIOLOGY OPERATION

HA Kornberg:es

OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

October, 1958

ORGANIZATION AND PERSONNEL

There were no changes in personnel during October.

OPERATIONS RESEARCH ACTIVITIES

Economic Studies

A rough draft report of the task force for evaluation of capital expenditures was completed and will be issued for comment early in November.

An oral report was presented on the econometric investigation of the effect of R & D expenditures on CEO activity.

Work on the input-output response simulation model was continued as outlined in the previous monthly reports.

CPD Control Study

A rough draft summary of the analysis of control data from the currently established material balance areas of the 234-5 operation was submitted to accountability and production personnel. This report recommended 1) the use of a strict LIFO policy on by-product recovery, 2) the retention of the by-products in the generating control area, 3) the use of item, batch, and lot internal control and 4) the segregation of materials from other operations along with scrap material into a separate control area.

A complete historical study is being made of the plutonium B-PID's throughout CPD. This study will complete the compilation of basic data and the remaining time will be used in the compilation and issuance of a summary report.

Effort during the month on the Z Plant information study was directed toward obtaining the necessary analytical tools. Due to other commitments, considerable difficulty was experienced in obtaining the participation on the part of all team members.

Further study of the proposed method of estimating B-PID's presented in HW-56535, "B-PID and Inventory Estimates," indicates that the negative correlation existing between successive B-PID's in the present method tends to be eliminated using the proposed method.

Other

A study of the recommendations on spare part inventory control by the Standard Engineering Operation of IPD has resulted in the adoption of these methods for use. Personnel in CPD and FPD have also become interested in the recommendations and they are presently being considered for use.

Work continued on the program to establish a practical model for NPR spare equipment and spare part procurement.

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STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Metallurgy

A regression analysis of uranium hardness on log irradiation time was completed. Further work on data for the annealed material remains to be done.

2000 Program - Reactor

An interim report was issued on the analysis of NPR design experiments to investigate the physical properties of zirconium alloys as a function of temperature, stress and time. Suggestions were made concerning temperature and stress test levels for test data yet to be obtained and analyzed.

Discussions were held with interested personnel concerning optimum counting schedules for short lived materials, in order to estimate strength of source in the presence of appreciable background.

2000 Program - Separations

Assistance was given in deriving and partially evaluating a mathematical model for the radiant heat transfer to a cloud of particles in a spray calcinator. For special positions with respect to the geometry involved, results have already been reported. Work is now in progress on a complete analysis of the process.

4000 Program - Uranium Swelling

Analysis and consultation was continued on the construction of a mathematical model for the formation and size distribution of bubbles in irradiated samples of uranium. Several alternative methods have been proposed for the determination of the three-dimensional spatial and size distribution of voids within the metal based upon observations made by means of planer and lineal cross-cuts of the specimens.

6000 Program - Biology

Work continued on the further development of a mathematical model of migration with chronic feeding. A seminar on this work was presented to interested personnel of the Biology Operation on October 8, 1958.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

Process Control (FPD)

In order to determine a standard setting for the penetration tester, it is necessary to know the relationship between voltage and can wall thickness and the variation of voltage values associated with fuel elements having known thicknesses. An experiment was designed in order to determine the slope of the regression line and the uncertainty associated with a given reading. Results were compared with similar data gathered prior to the most recent calibration.

Process Experimentation (FPD)

An experiment was designed to determine the differences in measured reactivity between slugs with both solid and I and E geometries and the ingots and rods from which they were derived. A preliminary analysis was made of some production data in order to evaluate the effect of sleeve size on residual can wall thickness, the idea being that more objective criteria for sleeve replacement might result. As is usually the case when attempting analyses of production data, results were obscured by the existence of other known and unknown variables affecting the yield variable. Suggestions were made for using designed experimentation in a further investigation of this problem.

Fuel Element Performance (FPD and IPD)

In connection with the general problem of obtaining better ways to describe outgoing quality of fuel elements, considerable attention has been given to problems associated with using total bond count to describe the porosity of a given lot of metal. Other variables measurements are also being considered. An investigation of what constitutes a lot is also being planned with the objective of assuring a balance between a fair degree of homogeneity and a reasonable inspection cost.

Production Tests (IPD and FPD)

The analysis of data from production test IP-60-A was completed. An interesting interaction between hydrogen content and the effect of recrystallization was uncovered.

All of the data from production test IP-120-A dealing with an evaluation of low hydrogen dingot fuel elements have now been submitted. The analysis has been completed, and a report summarizing these results will be issued soon. The relative contributions of the two types of growth, diameter increase and warp, to tube filling capacity were sorted out, and the differences in the ways in which the dingot and ingot fuel elements changed dimensionally were noted.

Rupture Analyses (IPD)

Rupture data for the depleted uranium fuel elements were analyzed to assess the possibility that enough of the original tubes would reach goal to result in a successful completion of the program.

An investigation is being made of available rupture data to determine whether or not the rupture model can be adjusted to allow for the existence of "oddball" low exposure ruptures, if indeed such "oddballs" exist. Since there are not enough ruptures in any given power temperature class to permit such a study, an adjusted exposure figure is being used, where each exposure at discharge is adjusted to some base power-temperature condition.

Final Product Specifications (CPD)

Tolerance statements to demonstrate conformity to specifications of final parts shipped during the third quarter of calendar year 1958 were prepared. This resulted in revised estimates of current process and measurement parameters which can be used to establish criteria for accepting each part on the basis of measurements associated with it. Preliminary data from the 4th quarter were also analyzed.

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General

The first two of a series of statistical training sessions have been presented to FPD personnel engaged in process control, process experimentation, and process instrumentation. One problem is being considered throughout the course, namely, an investigation of the variables affecting porosity and residual can wall thickness in a fuel element.

A document was issued giving in some detail the methods recommended for use in future tank calibrations. Comparisons were made of the uncertainties and biases associated with different proposals.

An approximate mathematical expression was derived to predict the quantity of radiation received at the surface of a large slab of radioactive material as a function of the thickness of the slab, given that the material has certain attenuation characteristics.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

Consulting services were provided as requested in connection with certain salary administration, industrial medical and communications problems.

Consulting services were provided on the general subject of determining quantitative relationships between a large number of apparently related variables by means of dimensional analysis. The problem is one of determining the characteristics and time behavior of class of chemical filters. Further work on this problem will be undertaken.

Further efforts were made to solve a second order quasi-linear partial differential equation which is implied by a proposed mathematical model of a soil column breakthrough phenomenon.

The course on statistical methodology for personnel of the Theoretical Nuclear Physics Operation is being continued.

Work continued on a rough draft of a formal report presenting a mathematical method of resolving a multi-source count among a known set of isotopes in the presence of appreciable background.

Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
Charles C. Thomas	10-1	Westinghouse Elec. Co.	Consultation on Inspection Program	CA Bennett	Yes
Major W.E. Scott	10-1,2	Dept. of Air Force Wash., D. C.	Consultation on Wash. Desig. Proj.	CA Bennett JL Jaech RY Dean	Yes

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
Carl A. Bennett	10-15,16,17	Argonne Nat. Lab. Chicago, Illinois	Consultation on Wash. Designated Projects.	F. Hagemann	Yes
"	10-20	U. of Michigan Ann Arbor, Mich.	Recruiting Ph.D.s	CC Craig	No
"	10-21,22	Oper. Res. & Syn. Cons. Ser. Chicago, Illinois	Oper. Res. Mtg. Experimental Sect.	WH Bloodworth	No
"	10-23,24	AEC Wash., D.C. Div. of Nuc. Mat'l Mgmt.	Consult. on statistical manual	DF Musser MH Hudson	No
Robert L. Basmann	10-23,24	U. of Wash. Seattle, Wash.	Invited speaker	Arnold Zellner	No

PROGRAMMING OPERATION
OCTOBER 1958

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. Palmolive Processing

The comment issue of the final report on palmolive processing was released.

Extensions of related studies covering the in-reactor close-coupled processing, evaluation of stored wastes as potential sources, and combined operation involvements to provide more desirable fuel were initiated.

2. Nonproduction Fuel Processing

In support of intensified CPD efforts, study of facilities for the dissolution step of nonproduction fuel processing was continued. In view of the problems of critical mass, materials of construction, scheduling and research and development required for attractive alternate processes, such as Niflex and Sulfex, the possibilities of a process based on fuel cutting and core leaching were explored. The equipment scope for the latter process was completed for estimating.

B. REACTOR DEVELOPMENT - 4000 PROGRAM

1. Plutonium Recycle Program

Plutonium Evaluation

At the request of the Division of Reactor Development calculations of the fuel exposure characteristics of four plutonium fuels of specific isotopic composition in each of three types of reactors have been made. The data developed are in line with previously reported results. Concurrently ANL is investigating the use of the same plutonium fuels in fast reactors. Also ORNL is studying the use of three plutonium fuel compositions in several thermal reactors. It is planned to compare results of the three studies during November.

Development of RBU Computer Code

The current draft of the report on the RBU code (ASAE-34: Calculation of Reactor History Including the Details of Isotopic Concentration, Part I: Method) was reviewed in detail. Two significant modifications were recommended, both relating to the calculation and application of the Doppler-broadened Breit-Wigner single-level resonance expressions. Formulation of the computer program is now complete, except for such

modifications as will inevitably be made from time to time as long as the program is being used. Coding for the 704 computer is mostly complete but debugging has been delayed to some extent. Completion of the component 704 codes by December 1 and of the 709 unified code by February 28 are called for by the present schedule. Part I of the report should also be issued by December 1.

Facilities for Cut-Off, Sectioning and Inspection of PRTR Elements

The comment issue of the final report on the study of alternate cut-off, sectioning and inspection facilities for examination of PRTR fuels was released.

Annual Report

A draft of the PRP FY-1958 Annual Report has been written.

2. Other Studies

Nonrigid Fuels

A study was initiated to determine the economics of paste-type fuels. Such fuels may consist of a suitable low melting metal such as the lead-bismuth eutectic (m.p. 125 C) intimately mixed with uranium and/or plutonium oxide in such ratios to yield a thick slurry or paste which could be poured or squeezed into the simplest fuel element jacket without need for any final machining. Preliminary results indicate a fuel element cost about one-half that of the cluster element.

C. RADIOLOGICAL CONSULTATION

Additional work was carried out on the critical mass laboratory hazards report concerning the quantity of fuel possibly released during an incident. The maximum permissible limits for plutonium resulting from high irradiation levels were reviewed. It was found that the maximum permissible body burden for plutonium from high irradiation levels was on the order of one-tenth of that for Pu-239 when expressed as mass of material or as quantity of alpha emitters.

Material was prepared for the discussion of site characteristics with the Site Evaluation Committee for the Gas Cooled Power Reactor and a meeting was attended with the group. Additional consultation was held on the advisability of a uranium melting program to determine fission product release. Papers on maximum permissible limits, behavior of phosphorous in the body, and iodine monitoring methods were reviewed with comments to the authors. A project proposal for monitoring stations on the Columbia River was also reviewed. Details of the calculation of effective energy release from thorium isotopes in the body were forwarded to Oak Ridge in response to a query.

The destructive incident in the Borax I reactor was reviewed with the general conclusion that the quantity of material released and readings downwind were about as would be expected from present assumptions. Since there was no large fission product inventory in the reactor before the incident, the release of the short-lived products did not produce the same impact that the release from a reactor operated at a significant power level would produce. These conclusions were presented to the General Electric Reactor Safeguards Council meeting on October 13-14.

Discussions on the maximum permissible limits for P^{32} based on Hanford work and on the use of total body as a critical organ were submitted to the Subcommittee on Internal Dose of the NCRP. A maximum permissible body burden of ten micro-curies was derived as based on the estimate that 30% of the phosphorous was in the bone and the localization factor of one-fifth for bone seekers was included. Using a fraction absorbed to the bone from the GI tract of 0.14, an MPC in water of 5×10^{-5} uc/cc was proposed.

Comments on the ASA Standard for Evaluating Film for Measuring X-Rays or Gamma Rays were prepared and circulated to the Committee members for comment.

The quarterly report of research and development activities in the fields of radiological sciences was assembled and submitted for final typing. Material from the Radiological Sciences program was submitted for the 25th Semiannual Report of the Atomic Energy Commission. A review of the Radiological Sciences programs was completed in draft form. A start was made on the organization of a Task Force to study the needs of Radiological Evaluation and the methods of performing these evaluations. Members were tentatively chosen and a proposed program started.

D. OTHER ACTIVITIES

Security Memorandum

A memorandum "Information Control in the Atomic Energy Program" was prepared and transmitted to the General Manager of APD by A. B. Greninger.

Science Colloquium

The third session of the colloquium was held on Thursday, October 2 at the Village Theatre. Dr. Henry Eyring, Professor of Chemistry and Metallurgy and Dean of the Graduate School, University of Utah, spoke on "Thermodynamics of Liquids." About 100 persons attended.

Summer Institute on Nuclear Energy

The AEC advises that the ASEE-AEC Summer Institute programs will be reduced from nine this year to five programs for next year. The ASEE has recommended that the HAPO-Chemical Processing Institute be one of the five for 1959.

LH McEwen:dl

Chas. A. Rohmann for
Manager, Programming

VISITS TO HANFORD:

Name	Date of Visit	Company or Organization Represented and Address	Reason for Visit	HAPQ Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
Mr. Van Vleck and Mr. Weichel (ACCESS PERMIT)	9/30/58 10/1/58	GE - ANP Idaho Falls, Idaho	To discuss reactor accident calculations and the meteorological concepts involved.	J.W. Healy	No	300 - 328
W. F. Banks	10/28/58	ACF Industries, Inc. Washington, D.C.	To discuss gas cooled reactor work.	M. Lewis	No	300 - 326

VISITS TO OTHER INSTALLATIONS:

Name	Dates of Visit	Company Visited & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
J. W. Healy	10/13-14	GE Reactor Safeguards Council, Chicago, Ill.	Attend meeting of the GE Reactor Safeguards Council.	Dr. K. Cohen	No
J. W. Healy	10/26-28	AEC - Div. of Biology & Medicine (Taft Sanitary Engineering Center, US Public Health Service) Cincinnati, Ohio	Attend Biology and Medicine Program Directors' meeting.	Dr. C. Dunham Dr. V. Beard	No
J. R. Triplett	10/20-21	American-Standard Atomic Energy Division Mountain View, Calif.	RBU computer code discussions.	E. J. Leshan	No
M. Lewis	10/20	Minn. Mining & Manuf. Minneapolis, Minn.	Discuss graphite coatings technology.	J. R. Johnson	No
	10/21-22	ORNL - Oak Ridge, Tenn.	Gas cooled reactor meeting.	U. M. Staebler J. M. Atwood	No
	10/23	GE Research Lab, Schenectady	Discuss graphite	W.J. Diefendorfer	No
	10/24	Carborundum, Niagara Falls, New York	coatings technology.	D. G. Sturges	No

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RADIATION PROTECTION OPERATION
MONTHLY REPORT -- OCTOBER 1958

A. ORGANIZATION AND PERSONNEL

Two beneficial transfers of exempt personnel within RPO were initiated. Janis G. Campbell terminated on October 24, 1958. M. L. Brinkerhoff was placed on military leave October 31, 1958. Four RPO employees were transferred to new assignments, namely, R. C. Crawford to Biology on October 6, 1958; Patricia A. Wodarz and Elma S. Liddell to Chemical Research & Development on October 13, 1958; and R. M. Campbell to Chemical Research & Development on October 20, 1958. Four employees--Marie S. Berndt, Darlene H. Hunter, Ethel H. Jaseck, and Margaret F. Peterson, were terminated on October 31, 1958, due to reduction of force.

B. ACTIVITIES

There was one case of plutonium deposition confirmed through bioassay analyses in October. The plutonium deposition resulted from a minor injury to a CPD employee when the sharp edge of a piece of plutonium metal cut his right thumb. Excision of a small amount of tissue and subsequent cleaning of the wound area reduced the plutonium in the wound from approximately 0.35 μc to approximately 0.008 μc , about one-fifth of the MPL.

Three employees in the Plutonium Metallurgy Operation have been removed from radiation zone work because of their accumulated whole-body exposure for the calendar year.

Excavation along the west wall of the 327 Building revealed contaminated dirt, which later led to the discovery of a hole, caused by corrosion in the underground waste line. The dosage rate at the hole was as high as 5 r/hour.

Construction of the Shielded Personnel Monitoring Station is progressing at a satisfactory rate. Assembly of the cell proper is now complete and painting and finish work continues in the remainder of the building. A preliminary background check was made in the cell after it was assembled and temporary equipment determined that the background was comparable to the present temporary cell utilized by Radiological Physics. A 256-channel analyzer has been ordered for the facility.

The annual average weekly emission of I^{131} for the twelve-month period ending in October was 8.3 curies. The twelve-month average for the period ending in September was 8.1 curies per week. The emission rate of I^{131} returned to normal during October. Immediate action by CPD to decrease the amount of emission was responsible for the improvement.

Fallout of nuclear bomb test debris in Eastern Washington, including the Hanford reservation, increased the fission product activity on vegetation to levels of two to four times those measured in September. The extensive testing at the Nevada Proving Grounds was reflected in fallout concentrations which increased by several orders of magnitude during the last two weeks of October. The maximum fallout was at Boise, Idaho, on October 31 when a concentration of 360 d/m/m³ was observed in contrast to background concentrations of 1 to 2 d/m/m³. The highest local concentration was 35 d/m/m³ on October 30.

The average values of gamma measurements on crops collected from Southeastern Washington reported for the month of September did not differ significantly from

previously reported data. The radioisotopic concentrations in crops from the Walla Walla area were similar to those obtained locally.

The routine third quarter report of mineral constituents in Columbia River water was transmitted to the Washington State Pollution Control Commission and the Portland, Oregon, office of the U. S. Public Service. The Columbia River Advisory Group was informed of initial more sensitive analytical results, obtained by emission spectrography and neutron activation, for arsenic, phosphorus, zinc, and uranium in river water from four sampling locations between Grand Coulee Dam and Hanford. In August, phosphorus concentrations increased downstream by a factor of ten, to about twenty parts per billion at Hanford. Farm fertilizers are suspected to be the source.

The study for measuring high-level gamma dose with Eastman Type 2 film yielded favorable results. The accuracy in the range of 40 r to 2000 r is indicated by a tolerance interval of about $\pm 10\%$, increasing to $\pm 15\%$ at the 200 r level. This tolerance interval computed on a rather small number of observations is based on a 95% confidence that 99% of all film exposed within that dose region would be included within the tolerance interval. The technique used involves bleaching the sensitive emulsion, and reading the film with a conventional densitometer. At radiation levels of less than 40 r, removal of sensitive emulsion is not required. These results are for 1 Mev gamma.

The use of the pulse pencils was extended to measure the radiation levels in and around the various kinds of houses in the Tri-City area in an effort to determine normal radiation levels. The scatter in the pencil data obtained in the environmental monitoring program decreased during the last two months, presumably because of the reduced thermal cycling.

Earlier indications that meter orientation was an important factor in beta-gamma calibration correlation were substantiated by additional data collected. A tentative calibration procedure was established and will be used for the collection of additional information to support the correlation of beta and gamma response. Upon completion of the evaluation, the calibration procedure will be revised as indicated. Hopefully, the frequency of the beta calibration will be greatly reduced.

The Charleston Rubber Company is fabricating hood glove molds of lead-loaded gloves and materials resistant to organic solvents. On the leaded glove, the lead-bearing layer is between thicknesses of conventional glove material which minimizes the possible problem of secondary radiations. Their standard Neosol glove has substantially better resistance to organics than other types of Neoprene gloves. The improved resistance was found on tests with pertinent solutions encountered at HAPO. The Neosol gloves are currently being procured for plant use.

C. EMPLOYEE RELATIONS

The personnel attitude survey, conducted through individual personal contacts initiated some time ago in Calibrations, has been continuing in the Exposure Evaluation and Records Operation. The planned reduction of Exposure Evaluation and Records personnel to thirty-five nonexempt and six exempt was completed on October 31 with all but four employees, who were given ROF's, being placed in other positions.

A meeting was held with Union Relations and Radiation Monitoring representatives of all HAPO departments to determine the methods of training Regional Monitoring

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personnel to qualify as radiation monitors. It was decided to utilize the normal HAPO transfer procedure, placing volunteers from Regional Monitoring in Radiation Monitoring groups and vice versa.

There were two medical treatment injuries for a frequency of 0.81. No security violations occurred during the month.

Four suggestions were submitted by RPO personnel. One evaluation was completed. Two additional suggestions were received in RPO for evaluation. No awards were made made to RPO employees.

D. SIGNIFICANT REPORTS

HW-57644 "Regional Monitoring Activities, September, 1958" by B. V. Andersen.

HW-57649 "Radioactive Contamination in Liquid Wastes Discharged to Ground at Separations Facilities Through June, 1958" by K. F. Baldrige.

HW-58054 "Monthly Report - October 1958, Radiation Monitoring Operation" by A. J. Stevens.

"Experience of a Plant-Operated Laundry" by E. C. Watson and K. R. Heid, "The Hanford Uranium Bioassay Program" by R. H. Wilson, and "A Review of Significant Hanford Deposition Cases" by R. H. Wilson were prepared for presentation offsite.

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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 Buildings	Areas and Buildings
Charles C Thomas, Jr.	10/1/58	Westinghouse Special Products Atomic Power Department Pittsburgh, Pennsylvania.	Discuss doorway monitors and U-235, U-234, and Pu detection methods.	FH Sanders	No	300:3706
Dr. Kenneth S. Watson	10/1/58	General Electric Co., Schenectady, New York	Discuss publication of Radiation Protection information.	HV Clukey	No	300:325
Roger Koon Mr. Sweetzer	10/9/58	Aircraft Nuclear Propulsion Dep't. Evandale, Ohio	Discuss organization structure of health physics at ANPD.	AR Keene	No	300:3702
John Hughes	10/13-31-58	Commonwealth Edison Company, Chicago, Illinois	Job training.	AR Keene and Staff	Yes	300:3746, 3706, 329, 325, 327, 3705, 3745. 700:747.
Professor Hindel	10/28/58	Univ. of Idaho Moscow, Idaho	Inspect RDO project.	RL Jenkins LF Kocher	No	300:3706

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Location	Activity	Attendees	Access to Restricted Buildings	Areas and Buildings
A. J. Stevens A. R. Keene	10/6/58	Portland, Oregon	Arbitration Hearings - Maki Case	--	No	
E. C. Watson	10/15-17/58	Uranium Symposium New York, New York	Present a paper	Attendees	No	
A. R. Keene	10/27/58	Aircraft Nuclear Prop. Dep't. Evandale, Ohio	Discuss radiation protection	R.F. Hoffer	Yes	
A. R. Keene	10/28-29/58	Bio-Medical Directors Meeting, Cincinnati, Ohio	Gain information useful to HAPO	Attendees	Yes	

REGIONAL MONITORING - RESULTS (September 21 - October 26, 1958)

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Monthly Average</u>	<u>Units*</u>	<u>Trend** Factor</u>
<u>Drinking Water</u>				
100-F Area	Isotopic	0.7	% MPC _{GI}	--
Separations Areas	Total Beta	1.7×10^{-6}	μc/cc	+2
Pasco	Isotopic	0.2	% MPC _{GI}	--
Kennewick	Isotopic	0.1	% MPC _{GI}	--
Richland	Total Beta	$< 3.0 \times 10^{-8}$	μc/cc	--
<u>Columbia River Water</u>				
Above 100-B Area	Total Beta	$< 3.0 \times 10^{-8}$	μc/cc	--
100-F Area	Isotopic	3.8	% MPC _{GI}	--
Hanford Ferry	Total Beta	4.1×10^{-5}	μc/cc	--
Pasco	Isotopic	1.0	% MPC _{GI}	--
McNary Dam	Total Beta	8.9×10^{-7}	μc/cc	--
Vancouver, Washington	Total Beta	1.7×10^{-7}	μc/cc	--
<u>Waste Water</u>				
Outlying Test Wells	Total Beta	6.9×10^{-6} (max)	μc/cc	+3
Reactor Effluent Retention Basins to River	Total Beta	24,000	curies/day	--
<u>Atmosphere</u>				
Gross Dose Rate -				
Separations Areas	Beta-gamma	0.6	mrad/day	--
Residential Areas	Beta-gamma	0.5	mrad/day	--
I-131 Separations Areas	I-131	4.1×10^{-13}	μc/cc	-2
I-131 Separations Stacks	I-131	5.7	curies/week	-2
Active Particles - Project	--	4.2	ptle/100 m ³	--
Active Particles - Environs	--	4.7	ptle/100 m ³	--
<u>Vegetation</u>				
Separations	I-131	3.5×10^{-6}	μc/gm	+2
Residential	I-131	$< 1.5 \times 10^{-6}$	μc/gm	--
Eastern Washington and Oregon	I-131	2.4×10^{-6}	μc/gm	+2
Fission Products less I-131 - Wash. and Ore.	Beta	9.2×10^{-5}	μc/gm	+3

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

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

EXPOSURE EVALUATION AND RECORDSExposure Incidents Above Permissible Limits

	<u>Whole Body</u>	<u>Localized</u>
October	1	2
1958 to Date	5	12

Gamma Pencils

	<u>Pencils Processed</u>	<u>Paired Readings 100-280 mr</u>	<u>Paired Readings Over 280 mr</u>	<u>Lost Readings</u>
October	33,938	89	23	1
1958 to Date	419,450	422	70	21

Beta-Gamma Film Badges

	<u>Badges Processed</u>	<u>Readings 100-300 mrad</u>	<u>Readings 300-500 mrad</u>	<u>Readings Over 500 mrad</u>	<u>Lost Readings</u>	<u>Average Dose Per Film Packet</u>	
						<u>mrad(ow)</u>	<u>mr(s)</u>
October	10,381	1,033	71	14	25	2.99	16.72
1958 to Date	180,358	7,729	343	88	392	14.18	79.33

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	0	0	0	0
1958 to Date	25,880	297	94	8

Neutron Film Badges

	<u>Film Processed</u>	<u>Readings 50-100 mrem</u>	<u>Readings 100-300 mrem</u>	<u>Readings Over 300 mrem</u>	<u>Lost Readings</u>
<u>Slow Neutron</u>					
October	1,564	134	22	0	2
1958 to Date	2,590	139	22	0	2
<u>Fast Neutron</u>					
October	1,022	0	0	0	2
1958 to Date	10,321	10	1	0	9

Bioassay

		<u>October</u>	<u>1958 to Date</u>
Plutonium: Samples Assayed		808	11,414
	Results above 2.2×10^{-8} $\mu\text{c/sample}$	24	381
Fission Product: Samples Assayed		783	11,747
	Results above 3.1×10^{-5} $\mu\text{c FP/sample}$	1	24
Uranium: Samples Assayed		253	3,006
Confirmed Plutonium Deposition Cases		1	16*

*Bringing all-time HAPO total to 228.

Uranium Analyses

<u>Sample Description</u>	<u>Following Exposure</u> <u>Units of 10⁻⁹ μc U/cc</u>			<u>Following Period of No Exposure</u> <u>Units of 10⁻⁹ μc U/cc</u>		
	<u>Maximum</u>	<u>Average</u>	<u>Number</u> <u>Samples</u>	<u>Maximum</u>	<u>Average</u>	<u>Number</u> <u>Samples</u>
Fuels Preparation	30	4.3	30	3.9	2.4	19
Hanford Laboratories	43	6.6	27	16	3.5	21
Chemical Processing	44	5.2	65	43	4.4	59
Chemical Processing*	14	9.1	2	14	4.8	4
Special Incidents	0	0	0	0	0	0
Random	11	1.3	25	0	0	0

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

Thyroid Checks

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

Hand Checks

Checks Taken - Alpha	33,809	424,543
- Beta-Gamma	21,798	337,566

Skin Contamination

Plutonium	23	288
Uranium	6	68
Fission Product	28	521

CALIBRATIONS

<u>Portable Instruments</u>	<u>Number of Units Calibrated</u>	
	<u>October</u>	<u>1958 to Date</u>
CP Meter	963	9,567
Juno	346	3,264
GM	1,323	13,218
Other	199	2,182
Total	2,831	28,231

Personnel Meters

Badge Film	1,632	11,959
Pencils	970	31,510
Other	420	3,879
Total	3,022	47,348

Miscellaneous Special Services

	629	7,345
--	-----	-------

Total Number of Calibrations

	6,482	82,924
--	-------	--------

for A. J. Stevens
Manager
RADIATION PROTECTION

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - OCTOBER, 1958

GENERAL

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 3.30 per cent, which is considered about average experience.

The absenteeism rate was 3.55 per cent, which is about average experience.

There were no security violations charged to the Operation.

TECHNICAL SHOPS OPERATION

Total productive time for the month was 13,515 hours. The total shop work backlog is 18,386 hours of which 50% is required in the current month, with the remainder distributed over a three month period. Overtime worked during the month was 2.1% (399 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
Fuels Preparation Department	1430	10.5
Irradiation Processing Department	1538	11.4
Chemical Processing Department	916	6.7
Hanford Laboratories Operation	9460	70.1
Construction Engineering Operation	29	.2
Miscellaneous	142	1.1

The number of requests from customers for emergency service declined somewhat from the previous month's experience, resulting in a reduction in overtime hours. The work backlog increased approximately 15% during the month and currently stands at 6 crew weeks. Optimum backlog for the shops is considered to be 3 to 5 crew weeks.

Security performance was considered satisfactory with no violations. Safety performance was fair with no major injuries and 11 medical treatment injuries.

Specifications for a jig boring machine were prepared and forwarded to the Purchasing Operation to obtain vendor quotations.

RADIOGRAPHIC TESTING OPERATION

General activity for the Radiographic Testing Operation was reduced somewhat this month due to a reduction in available man-hours resulting from scheduled vacations. A total of 4,971 tests were made, of which 1,312 were radiographic exposures (including X-ray and gamma ray), and 3,659 were supplementary tests. The supplementary test work included dimensional measurements (micrometric and radiographic layout), eddy current, leak detection, magnetic particle, penetrant, and ultrasonic (thickness measurements and flaw detection).

The reduced number of tests was also reflected in the feet of material examined, which amounted to 10,393 feet - roughly 2,000 feet under last month's figure. The reduction in the number of pieces examined was not as great, totalling 1100 as compared to last month's 1200 pieces. Work was done for 13 different organizational components, representing most of the operating departments and service organizations. A total of 26 reports were issued, detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on 22 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in Part II.

A new ultrasonic testing facility for the examination of tubular products up to 60 feet in length will be available for use shortly in the Radiographic Testing Operation. The tank and travelling bridge components of the unit were accepted at the vendor's plant at the end of the month and shipped immediately. The facility will permit immersed ultrasonic testing for flaw location by providing longitudinal scanning and rotational translation of the work piece. The equipment features a travelling bridge, carrying the ultrasonic equipment and the operator. Automatic flaw alarm and recording features are incorporated in the instrumentation.

At the request of the Atomic Energy Commission, a reject analysis of the radiographic examination of the welding on the PRTR containment vessel was made. Over-all reject rate of 6.3% has been experienced in the welding done to date. The principal difficulties experienced were in slag and lack of penetration and/or fusion at percentages of 4.8% and 1.5%, respectively. The remaining 0.1% of rejects consisted of gas cavities (porosity) and cracks. While the reject rate is somewhat high for good quality, economical weld construction, it is not significantly out of line for this type of fabrication.

Testing Statistics

Component	No. of Tests	Ft. of Weld or Material	No. of Pieces	Description
A. CPD	28	20 1/2	8	2" sch. 40 and .375" SS welds.
B. CEO	998 176	1316 1/2 528	36 5	160-gas loop. PRTR containment vessel. Pressure weld X-ray & leak detection.
C. HLO	256 352 1344 621 198 944	2646 1/2 2955 1/2 177 1230 393 1054 1/2	376 315 7 145 25 146	Hastalloy weld coupons, Zr. & SS clad UO ₂ KER fuel elements, 30 mil wall.505", .599", .750" I.D. Zr. tubes. 8 mill 1/2" SS tubes. BDF ribbed Zr. process tubes. .140" wall tubing. 15.4% U-Al fuel plates and cores. 1.8, 2, 5, 7.4, 10, 13, 15 & 20% cast Pu-Al rods and wafers. 1.8, 6, 10, 15, 20% cast U-Al rods and wafers.

<u>Component</u>	<u>No. of Tests</u>	<u>Ft. of Weld or Material</u>	<u>No. of Pieces</u>	<u>Description</u>
D. IPD	11 9	16 4	2 9	4' x 12' CS air receiver tank.
E. RUO	34	51 1/2	29	3", 6", 10", 16", sch. 10 SS long welds on 45° and 90° L's.
TOTALS	<u>4971</u>	<u>10393</u>	<u>1103</u>	

FACILITIES ENGINEERING OPERATIONProject Activity

There were 18 authorized projects at month end, with total authorized funds of \$3,952,000. The total estimated cost of these projects is \$8,473,400. Two projects were completed during the month. One project proposal is awaiting AEC authorization. Project proposals for nine new projects are in preparation.

The attached project report covers the individual project activity.

Engineering Services

<u>Title</u>	<u>Status</u>
Modification of Elevator, 327 Bldg.	Security Fire Door Company drawings have been approved. Preparatory work has started on elevator.
Installation of New Hood, Lab. 14-A, 329 Building	Hood fabrication and installation work is complete. Induction generator is being installed.
Fabricate and Install XY Manipulator in Metallographic Cell	Work is 90% complete.
Extend Annunciator System - 1706-KE Building	Work complete.
Provide Operating & Safety Improvements - 340 Building Tank Pit	Work complete.
Revisions to Room 108, 3706 Bldg.	Work essentially complete. Room occupied 10-17-58.
Improvements to Process Pump House - 147-F Building	Design work is progressing.
Additional Pasture - 100-F Area	Work is 80% complete.
Provide Procurement Assistance for Die Casting Machine	Experimental work to be complete about 11-15-58. Based on this analysis, selection of equipment will be made.

UNCLASSIFIED

H-4

HW-58019

Title

Status

Removable Floor Grating - 3745-B Building

Engineering work is complete. Fabrication work remains to be performed.

Improvements to Traveling Crane - 314 Building

Required equipment is being purchased.

Removal of Obsolete Equipment - 231-Z Building

Work complete except for removal of contaminated duct.

Minimize Vacuum Pump Oil Spray - 325 Building

Entrainment material is being installed in present equipment and tests will be made in November.

Additions to Room 123, 146-FR Building

Design work was started 10-28-58.

Correct Ventilation Deficiency 326 Building Mezzanine

Design complete. Installation to start in November

Provide Additional Hoods in Room 7-2A - 325 Building

Work is progressing.

Expansion of Electrical Shop 306 Building

Plans and estimates are being made.

Instrument Boom Support - 3745-B Building

Design and specifications are being prepared.

Scope Consolidation of Operation in 231-Z Building

A drawing has been made of proposed layout of Army mess hall buildings located in the vicinity of 231-Z. An equipment layout is being prepared. An analysis of utility requirements is underway.

Replace Roofing on 146-FR & 222-U Buildings

Bids opened on 10-28-58. Work to start 5 calendar days after receipt of award by contractor. 146-FR Building will have priority and is to be completed within 20 calendar days. Bids: low bid \$8,750.

306 Building - Air Conditioning Units Condensate Revisions

Work is nearing completion on the last 5 units to be equipped with double traps. Reworking of remaining traps is in progress.

UNCLASSIFIED

Title

306 Building Water Filter

Status

Filter arrived on plant 10-15-58. Actual tie-in to building services was made Saturday, October 25. It was placed in operation October 27, and a mechanical failure was noted during test. The Vendor has consented to disassemble for analysis of failure. Vendor will furnish necessary material. Resolution of cost will be determined and resolved with vendor.

Design and Drafting ServicesTitle

Cesium Recovery

Status & Description

Based on present scope of work job is approximately 95% complete.

Pit Cover - 3745-B Building

Work complete.

Prototype Swelling Capsule

Scope design complete.

Fuel Element X-ray Densitometer

Work 85% complete. Further information required before proceeding.

ETR Critical Facility

Work complete.

Gatling Gun Type Cask

Work complete.

Fuel Element Assembly Patterns

Work complete.

Non-Production Fuels Processing

Three concepts were developed. After test of selected prototype design changes are anticipated.

Transfer Mechanism - CA-749

The mechanism to transfer sampler through passage ways imbedded in walls consists of: a) sample transfer carriage, b) right angle crank, and c) straight crank. Eight drawings (details, assemblies, and installation) completed and checked. "For Comment" drawings issued. 100% complete.

Wet Storage Transfer - CA-749

This job involves transferring samples from a water storage tank through a 20 foot rectangular tube at an angle of 42° to cell at higher level. Detail drawings of tube plates 50% complete. Cranking mechanism 70% complete. Overall job 55% complete.

TitleStatus & Description

Tray and Tray Dolly - CA-749

The cell tray is 4' x 6' to support 1,000 pounds per square foot. The dolly for tray removal is designed to be electrically motorized. Design work 35% complete.

Rod Support

Work sheet drawings of an adjustable rod support. 100% complete.

In-Reactor Tools for ETR Loops

Specialized tools for installation and removal of pressure cap and sealing of thermocouple leads in a 3x3 and 9x9 process tube by remote operation. Design and Drafting 30% complete.

Electron Beam Vacuum Welding
Box - 306 Building

Design and drafting 100% complete. Box fabrication 85% complete. The design for electrical and instrument panel-push button operation of all valves, motors, controllers, welding and related equipment 50% complete.

Maintenance and Building Engineering - Landlord Functions

The following tabulation analyzes costs of the latest financial report. The current month reports are not available for analysis. Therefore, the status reflects data of last month's billing.

	<u>September</u>	<u>August</u>	<u>July</u>
Building Maintenance	\$ 11,570	\$ 7,990	\$ 12,302
Machinery Maintenance	6,916	4,850	6,037
Unusual Maintenance	8,087	19,517	2,772
Janitor Service	12,731	11,015	10,142
Power Operators	9,984	8,845	8,488
Utilities - Steam	12,028	7,325	8,292
Elect.	5,381	5,387	5,077
Other	8,663	8,887	8,673
Engineering Service & "As Builts"	4,501	3,765	2,142
General	3,683	5,162	4,334
Administrative	3,450	3,600	3,600
	<u>\$ 86,997</u>	<u>\$ 86,343</u>	<u>\$ 71,256</u>

YTD Total: \$257,595 - 20% of Budget
Planned Forecast of Expenditures - 20%

August maintenance was less than July because of other commitments for available manpower. Janitor and Power operator costs rose in September in accordance with five week fiscal month. "Other Utilities" include water, sewage, compressed air and emergency power systems. "Engineering Services" include ER costs and \$2,000 per month for a CEO as-built review. "General" includes grounds maintenance, evacuation bus maintenance, load lugger disposal, fire alarm system maintenance, and similar area-wide services. "Administrative" includes \$3,000 for the three regularly assigned employees. The additional \$600 and \$450 charges represent a rotational trainee.

Unusual Maintenance Items (Planned):

<u>Item</u>	<u>Month of Activity</u>	<u>FYTD</u>
Enclosing 326 Building Staircase	7/58	\$ 674
Programming Rearrangement	7,8,9/58	1,359
Renovation Room 313, 3706 Building	7,8,9/58	5,417
Shade Screens & Stor Windows	8/58	10,735
Floor Tile	8,9/58	3,973
Exterior Painting	8,9/58	6,482
Revision 306 H. & V.	9/58	269
Heating System 3707-C Building	9/58	668
Roofing 146-FR Building	9/58	801
		<u>\$30,378</u>

(\$30,378 is approximately 16% of budgeted funds for Unusual Maintenance).

Effective October 27, the authorized amounts of the maintenance routine work orders in the 300 Area have been decreased. This revision continues a program initiated in HLO's outer area buildings. The program is designed to stimulate use of individual work orders for better cost control and maintenance histories.

Major Facility Acquisition - 231-Z Building - This structure is being transferred to HLO books and effective November 1, 1958, the landlord responsibilities will be performed by Facilities Engineering Operation. Book value of the structure including installed capital equipment and uninstalled cataloged equipment is \$1,669,868.

A third party inspection was conducted on the elevator in 622 Building, and two pressure vessels in the 314 Building. No corrective measures were required.

TECHNICAL INFORMATION OPERATION

A proposal has also been made that the control of code designations, at the present time a responsibility of Technical Information, be assigned to Security and Patrol Operation. Technical Information would still continue to maintain a central cross-reference file of all security codes, since such a file is important to an understanding of the technical reports. But the primary responsibility for servicing the needs of the plant for code words, and securing AEC approval of these, would be a Security function.

A revised edition of "Facts Are Tools" was published during the month and distributed to all exempt personnel on the plant. The brochure, originally issued in 1956 describes the reference resources and services of Technical Information Operation. An extra three hundred and fifty copies were printed for Professional Personnel Placement Operation, who have found it an effective aid in recruiting.

The distribution list for "TIS Briefs" was updated after review by all Departments. The new lists are longer and additional copies of the "Briefs" have been ordered. As indicated earlier the distribution lists for all the announcement bulletins distributed plant-wide by Technical Information are being updated.

General Information about office-type construction projects at HAPO was compiled for the publishers of Sweets Architectural File. This valuable vendor's catalog file is free but distribution is limited to select architectural and engineering firms concerned with specific types of buildings -- commercial, educational, religious, institutional, public, social, recreational, and residential. Despite the great local need for this file, we have been unable to get copies in recent years because our justifications were considered inadequate. It is hoped that the new information supplied will enable us to receive at least one set for the site.

A report was prepared comparing the organization of HAPO standards with those of General Electric Company and several professional societies. This report will serve as the basis for a brochure on standards and specifications to be published in the near future.

Files has been given permission by GE Security to reproduce classified material by the Thermofax process since we have our own machine, and the local AEC uses this method extensively. This procedure will reduce the time required to obtain copies to fill local and offsite requests. The procedure will be particularly helpful when we get into the microfilming program and use the Thermofax Microfilm Reader-Printer.

Two additional memoranda containing comments on Topic 102 and its sub-topics in the Proposed Hanford Classification Guide were received from the AEC Division of Classification in Washington. This makes a total of five memoranda containing comments on Topic 102 and completes the initial review of this Topic by the Division of Classification.

The HAPO members of the HOO Classification Committee have concluded that the benefits to be gained by re-working the proposed Hanford Classification Guide to meet Division of Classification requirements would not justify the amount of time necessary to do the job. Accordingly, we will request that further efforts to secure Division of Classification approval of the proposed Hanford Classification Guide be temporarily suspended.

Several topic changes were received from the Division of Classification for inclusion in the approved Hanford Guide. Among these changes were two new topics permitting unclassified handling of photographs of the PRTR and the Plutonium Fabrication Pilot Plant. In addition, two NPR topics have been declassified. They are:

1. Number control rods and procurement of control rod components, and
2. Number process tubes in the NPR.

HOO has requested Division of Classification approval on two supplemental topics on photographs. The topics submitted were patterned after topics contained in the Savannah River Classification Guide. They provide considerable latitude for local interpretation and represent a more acceptable approach to the classification of photographs.

A letter justifying HAPO's need for reports in category C-88 "Technology Idaho Processes - Separations Process Technology" of the Standard Distribution List has been mailed to Technical Information Service Extension, AEC, Oak Ridge. No reply has yet been received.

The following rough draft bibliographies prepared by the reference staff were transmitted to the Technical Information Service Extension, AEC, Oak Ridge:

HW-37211 RD "Physical Behavior of Uranium"

HW-52736 RD "Hanford Contribution to the Plutonium Notebook COC 555".

Selected portions of these reports will be used by the TISE staff in preparation of bibliographies on the metallurgy of uranium and plutonium. The TISE bibliographies will be given wide distribution within the AEC, its contractors, and access permittees.

The Fuel Element Design Handbook, HW-51000 was published. Three copies were sent to TISE, Oak Ridge for release to the AEC, its contractors and the Civilian Application Program.

Working Volume Statistics

Document Distribution and Files

	<u>September</u>	<u>October</u>
Documents routed and discharged (copies)	16,645	17,592
Documents issued (copies)	10,735	11,545
Documents sent offsite (copies)	4,949	4,614
Document reserves filled (copies)	785	910
Documents picked up and delivered	21,985	22,525

Document Accountability

Holders of classified documents whose files were inventoried	446	563
Documents inventoried in Files (copies)	20,484	1,948
Documents destroyed or retired (copies)	6,134	3,690

Document Accountability (Cont'd.)

	<u>September</u>	<u>October</u>
Documents revised (copies)	792	1,286
Documents pulled and documents filed (copies)	15,040	11,387
Documents reclassified	682	627
Accountable copies of SECRET and DOCUMENTED CONFIDENTIAL documents on site	204,370	202,671

Reference and Publication

Books cataloged (new titles)	59	168
Books added to the collection (volumes)	137	338
Ready reference questions answered by professional staff	133	131
Literature searches by professional staff	94	119
Reports abstracted (titles)	188	264
Formal reports prepared (titles)	14	6
Offsite requests for HAPO reports (copies)	242	291
Reports released to CAP (titles)	32	45

Library Acquisitions and Circulation

Books ordered (volumes)	322	448
Periodicals ordered	114	166
Books circulated (volumes)	1,667	1,834
Periodicals circulated (issues)	3,451	1,268
Inter-library loans	55	89
Films borrowed or rented	20	28
Industrial film showings	95	55
Bound periodicals added to the collection	14	86

Library collection:

	<u>Main Library</u>	<u>W-10 Library</u>	<u>108-F Library</u>	<u>Ind. Med.</u>	<u>Totals</u>
No. of books	24,466	8,110	1,362	1,908	35,846
No. of bound periodicals	11,264	1	1,426	96	12,787
	<u>35,730</u>	<u>8,111</u>	<u>2,788</u>	<u>2,004</u>	<u>48,633</u>

Classification and Declassification

	<u>September</u>	<u>October</u>
Documents, including drawings and photographs, reviewed for downgrading or declassification	81	9
Documents submitted to Declassification Branch, Oak Ridge	12	78
Documents and papers (intended for oral presentation or publication) reviewed for appropriate classi- fication	92	26

LABORATORIES ADMINISTRATION

Manual Authorization and Performance of Work (September 22, 1958) was distributed.

Timely revisions were issued on six Organization and Policy Guides. As a result of these revisions and the issuance of the Manual, Authorization and Performance of Work, sixteen OPG's have been retired. (The titles and numbers of these OPG's are attached).

A draft of a manual bringing together 53 OPG's on personnel matters has been presented to Employee Relations Operation for review and comment.

Manual, Health and Safety was being duplicated at the end of the month. Distribution will be made early in November.

Three new contracts were signed:

No. MRO-20, RCA Service Company, Inc., for service to an RCA electron microscope;

No. MRO-21, Philips Electronics, Inc., for service to a Philips electron microscope;

No. SA-53, Future Farmers of America, Inc., for care of sheep.

Contract No. DDR-29, for ribbed jacket tubing, was amended to extend the period of performance.

Assistance to Hanford, ATH-HLO-1-59-C, for consultation services of William R. Smith, of Atomic Power Equipment Department, was authorized.

Assistance to Hanford authorization, ATH-HLO-2-59, to Atomic Power Equipment Department for an engineering review of the Plutonium Recycle Test Reactor has been sent to Hanford Operations Office for approval.

Assistance to Hanford, ATH-HLO-1-59-B, for research assistance and facilities for Dr. T. I. Moran by Research Services was terminated as of October 1, 1958.

The property management was closed out on Assistance to Hanford, ATH-HLO-1-58-D, Fuel Element Failure Detection, and ATH-HLO-1-59-B, Research Assistance and Facilities by Research Services.

Manager
LABORATORY AUXILIARIES

JL Boyd:jcw

UNCLASSIFIED

H-12

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 58019	
General Plant Projects - FY 1957 - AEC-23-57-n-2		HANFORD LABORATORIES OPERATION		PROJECT PROGRESS IN PER CENT				STARTING DATE		DIRECTIVE COMP. DATE		ESTIMATED COMP. DATE	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION	DESIGN SCHED.	ACTUAL	DESIGN SCHED.	ACTUAL	DATE	DESIGN	CONST.	DESIGN	CONST.	DATE
CA-658	Shielded Personnel Monitoring Station - 747 Building	\$140,000	\$150,000	100	93	100	93	2-18-57	-	-	-	-	12-19-57
			2-4-57	100	80			3-11-58	12-31-58				12-15-58
		USING COMPONENT						FED ENGINEER					
			Radiation Protection					D. S. Jackson					
REMARKS:	The steel cell was assembled and painted. The contractor experienced difficulty from the curvature of the 3 inch base plate. Corrective measures took approximately 2 weeks. Finish work inside the building addition proceeded at a slow pace. It appears the contractor will take essentially the full contract period to complete his work. Work Authority Number CA-658(4) dated October 17, 1958, authorizing \$1,700 additional money to the General Electric Company, was received from the AEC. A Work Release Authorization dated October 28, 1958 was written to Construction Operation authorizing performance of the additional work.												
General Plant Projects - FY 1958 - AEC-2-23-58-L													
CA-765	Additions to the 314 Building	\$40,000	\$46,000	100	98	100	98	10-14-57	-	-	-	-	3-7-58**
			11-15-57	100	98			3-27-58*	11-15-58				11-15-58
		USING COMPONENT						FED ENGINEER					
			Reactor & Fuels R & D					A. W. Hervin					
REMARKS:	The contractor has essentially completed his portion of the work. A revised Work Authority was received from the Commission. This authorized the General Electric Company \$2,500 more for furniture procurement. Total funds authorized to the General Electric Company are now \$8,640. Bids on office furniture are now being requested.												
* The CPFF Construction Contractor started work on 3-27-58 and the FP Contractor started on 5-14-58.													
** Actual date.													
CA-778	Expansion of the 305-B Building	\$55,000	\$55,000	100	100*	100	100*	4-4-58	5-15-58				5-7-58**
			12-11-57	100	87*			6-7-58	10-15-58				11-15-58
		USING COMPONENT						FED ENGINEER					
			Physics & Instruments R & D					R. C. Ingersoll					
REMARKS:	Roofing is complete. The sheet rock is in place and surface is ready for painting. Electrical work has been roughed-in. Roll-up door and monorail are in place. Cable reel for the monorail has not yet arrived on site.												
* Includes work performed by GE Plant Forces and CPFF Construction Contractor.													
** Actual date.													

HAM-7309-819 (5-56)

UNCLASSIFIED

UNCLASSIFIED

H-13

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				HW - 58019		MONTH		October, 1958		
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION		PROJECT PROGRESS IN PERCENT		STARTING DATE		DIRECTIVE		ESTIMATED COMP. DATE		
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		DESIGN		CONST.		DESIGN		CONST.	
			AMOUNT	DATE	SCHED.	ACTUAL	ACTUAL	ACTUAL	DESIGN	CONST.	DESIGN	CONST.
CG-779	Additions to Separations Development Facilities - 321 Building	\$ 27,900	\$ 27,900	5-22-58	100	95	5-26-58	-	-	-	9-26-58	
		USING COMPONENT	5-22-58	100	97	6-19-58	1-31-59				12-1-58	
REMARKS:		J. T. Lloyd										
		Chemical Research & Development										
<p>All work is complete except fabrication of the HF manifold and installation of the explosion-proof roof exhaustor. The rectifier is scheduled for delivery here early in November. There has been considerable difficulty in procuring proper parts for HF manifold. Construction Operation is still short two monel valves.</p>												
CAH-794	Geological and Hydrological Wells - FY 1958	\$ 49,000	\$ 49,000	4-16-58	100	88	4-7-58	-	-	-	5-15-58 *	
		USING COMPONENT	4-16-58	100	40	7-8-58	12-31-58				1-31-59	
REMARKS:		H. E. Ralph										
		Chemical Research & Development										
<p>Wells completed are: No. 1 (699-24-46), 682 feet; No. 3 (699-2-33), 482 feet. Currently drilling is on wells 2, 7, and 10. To date 1610 feet of hole has been completed. It appears contractor will not bring fourth rig on site. Also, he will not complete project as scheduled. Our present estimate for completion is January 31, 1959.</p>												
* Actual date.												
CGH-796	Facilities for Isotope Study on Animals	\$ 49,800	\$ 49,800	5-22-58	100	100	5-22-58	7-27-58			7-25-58*	
		USING COMPONENT	5-22-58	100	100	6-12-58	11-1-58				10-30-58	
REMARKS:		J. T. Lloyd										
		Biology										
<p>The facilities have been accepted and the project closed out with the tile sewer as an exception. As Built work has been started.</p>												
* Actual date.												

AM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-14

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW -	
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION		PROJECT PROGRESS IN PER CENT				STARTING DATE		DIRECTIVE COMP. DATE		October, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		DESIGN SCHED.		CONST. SCHED.		DESIGN	CONST.	DESIGN	CONST.	ESTIMATED COMP. DATE
			AMOUNT	DATE	ACTUAL	SCHED.	ACTUAL	SCHED.					
IR-240	Removal of Obsolete Melt Plant Equipment - 314 Building	\$ 19,000	\$ 19,000	6-24-58	None	None	99	99	None	6-27-58	11-11-58	11-11-58	11-11-58
REMARKS:		Reactor & Fuels R & D A. W. Hervin											
The main floor checkered plate has been painted. Only a few minor items remain to be completed.													
Equipment Not Included in Construction Projects - Program Class 2900													
CG-661	Additional Heat Generating Facility - 139-D Building	\$475,000	\$664,000	9-18-57	100	100	0	0	12-6-56	12-1-58	8-31-59	11-1-58	8-31-59
REMARKS:		Reactor & Fuels R & D A. W. Hervin											
The Lump Sum bid opening has been postponed until November 14, 1958. The postponement was due to the lack of interest by prospective bidders who are concentrating their efforts on bidding Phase III of PRTR. All items have been shipped from the General Electric Company.													
CA-631	Hanford Equipment in the ETR	\$1,200,000	\$1,200,000	8-12-57	100	100	**	93 *	9-17-56	12-1-58	12-15-58	9-2-58	5-1-59
REMARKS:		Reactor & Fuels R & D H. Radow											
The 3 x 3 insertion was completed without incident and the operation has been very satisfactory. Inadvertent stopping of the circulating pumps during a special test caused over heating of a test specimen. Subsequent examination showed no damage to the tube. The order for the 6 x 9 fabrication has been placed by negotiation with the Rohr Company. The cost for two units is \$13,000, which does not include the cost of Hanford furnished material. Promised delivery is 10 weeks after receipt of material. Based on operating experience with the 3 x 3, a number of additional safety modifications have been requested. Authorization to proceed has been given on most of these.													
*Beneficial use date for the 3 x 3 Loop was October 10, 1958. ** No schedule exists for this project.													

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BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 58019	
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION										MONTH October, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	DESIGN	DESIGN	CONST.
			AMOUNT	DATE	DESIGNED	SCHED.	ACTUAL						
CGH-803	Alterations - Building 231-Z	\$ 49,600	\$ 49,600	6-2-58	None	None	100	None	-	-	-	-	-
		USING COMPONENT			None	None	100	7-7-58	11-15-58	10-21-58			
		Reactor & Fuels R & D	FEO ENGINEER										
			J. T. Lloyd										
REMARKS: The original specified construction work was completed on October 21, 1958. All cells are being used by Plutonium Metallurgy. A design change was approved on October 29, 1958 for installation of a buss duct. The project was closed out with the duct as an exception.													
CGH-804	Ceramic Fuels Press Enclosure - 325 Building	\$ 41,000	\$ 41,000	6-2-58	100	100	18	6-19-58	-	-	-	-	8-1-58 *
		USING COMPONENT			100	100	25	10-1-58 *	1-15-59	12-24-58**			
		Reactor & Fuels R & D	FEO ENGINEER										
			R. C. Ingersoll										
REMARKS: Footings and walls have been poured. The grounding grid is being reinstalled. The sewer line damaged during excavation is being repaired. The caisson is expected to be sunk during the week ending November 9, 1958													
* Actual date. ** Contract completion date.													
CGH-809	Electrical Modifications - 328 Building	\$ 40,000	\$ 40,000	6-30-58	85	0	0	7-30-58	-	-	-	-	11-30-58
		USING COMPONENT			70	0	0	12-1-58	3-1-59	3-1-59			
		Laboratory Auxiliaries	FEO ENGINEER										
			R. C. Ingersoll										
REMARKS: Work Order A-95620 was issued to Construction Operation on October 17, 1958 for purchase and installation of main switch gear and redistribution of power circuits. The order for the switch gear was placed with the General Electric Company on October 20, 1958. Delivery is expected before December 15, 1958. Design on redistribution of lighting and receptacle circuits started on October 14, 1958.													

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BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 58019 MONTH October, 1958	
Equipment Not Included in Construction Projects - Program Class 2900		HANFORD LABORATORIES OPERATION											
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION			PROJECT PROGRESS IN PERCENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE		
			AMOUNT	DATE		DESIGN SCHED.	CONST. ACTUAL	DESIGN CONST.				DESIGN CONST.	
CG-682	High Level Cut-Off and Examination Cell - 327 Building	\$415,275	\$430,000	8-20-57		100	100		7-18-56	- - -	6-28-57*		
		USING COMPONENT	8-20-57			100	100		3-27-58	10-1-58	9-30-58*		
REMARKS:		Reactor & Fuels R & D A. W. Hervin FEO ENGINEER											
<p>The cut-off saw and manipulators are being re-worked. The work on the manipulators has been temporarily curtailed as bearings from Boston Gear have not been received and that company is presently on strike. The Physical Completion Notice, dated September 30, 1958, has been issued. This project will not again be carried in this report.</p>													
CA-695	Radio Telemetering Network	\$105,500	\$105,500	9-23-58		100	35		2-22-57	4-15-57*	5-27-57**		
		USING COMPONENT	9-23-58			100	50		7-25-57	2-1-59	2-1-59		
REMARKS:		Physics & Instruments R & D J. T. Lloyd FEO ENGINEER											
<p>Instrument Laboratories have been instructed to proceed with fabrication of data stations including revised circuits. Duke Electric has been directed to modify supports of all fourteen (14) wind generators and repair any damage due to tower failures. Motorola has completed installation of repeater station on Rattlesnake Mountain.</p>													
<p>* Scheduled date. ** Actual date.</p>													
CG-785	In-Reactor Studies Equipment - 105-KW Building	\$276,000	\$15,000*	2-12-58		100**	0		3-10-58	- - -	10-15-58		
		USING COMPONENT	2-12-58			99**	0		None	- - -	- - -		
REMARKS:		Reactor & Fuels R & D H. Radow FEO ENGINEER											
<p>Approval signatures have been obtained on Revision 1 of the Project Proposal. Submission to the Commission by early November is expected.</p>													
<p>* For preliminary design and services for project proposal preparation. ** Preliminary design only.</p>													

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BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 58019	
Equipment Not Included in Construction Projects - Program Class 2900		HANFORD LABORATORIES OPERATION										MONTH October, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	DESIGN	CONST.	
			AMOUNT	DATE	DESIGN SCHED.	CONST. SCHED.	ACTUAL						
CGH-801	X-Ray Diffraction Cell - 327 Building	\$170,000	\$10,000	6-7-58	N.S.*	0	0	6-10-58	-	-	12-24-58		
		USING COMPONENT	6-7-58	40	0	0						7-30-59	
REMARKS:		Reactor & Fuels R & D											
		A revised project proposal has been prepared and is circulating within HLO for approval signatures.											
* Not officially scheduled because of only partial design, but design is behind target schedule. Design work has stopped as authorized funds have been expended; 8 drawings are approximately 70% complete, 5 drawings are 60% complete and at least 4 drawings have not yet been started.													
CGH-805	High Temperature Tensile Testing Cell	\$150,000	\$10,000	8-4-58	N.S.*	0	0	8-26-58	4-1-59	4-1-59			
		USING COMPONENT	8-4-58	42	0	0						10-1-59	
REMARKS:		Reactor & Fuels R & D											
		A revised project proposal has been prepared and is circulating within HLO for approval signatures.											
* Not officially scheduled because of only partial design, but design is on target schedule. Design work has stopped as authorized funds have been expended; 15 drawings are approximately 50% complete, 2 are 30% complete and at least 6 drawings have not yet been started.													
Equipment Not Included in Construction Projects - Program Class 4900													
CG-758	Ceramic Fuels Development Press and Furnace Additions	\$172,000	\$172,000	7-16-58	100	100	100	8-22-57	2-1-58	2-1-58			
		USING COMPONENT	7-16-58	100	100	100						9-26-58	
REMARKS:		Reactor & Fuels R & D											
		R. C. Ingersoll											
This project was completed with exceptions on September 26, 1958. Installation of the hydraulic press will be performed under contract No. AT(45-1)-1407 which includes the press enclosure (Project CGH-804). Progress on this contract will be reported in Project CGH-804 and this project (CG-758) will no longer be carried in this report.													

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BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 58019	
New Construction - FY 1958		HANFORD LABORATORIES OPERATION										MONTH	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	October, 1958		
			AMOUNT	DATE	DESIGN SCHED.	DESIGN ACTUAL	CONST. SCHED.				CONST. ACTUAL	DESIGN	CONST.
CG-731	Critical Mass Laboratory	\$1,800,000	\$175,000	5-12-58	48	0	0	5-22-58	-	-	2-1-59		
					47	0	0	3-1-59	-	-	10-31-59		
		USING COMPONENT		FEO ENGINEER									
REMARKS:		Physics & Instruments R & D											
Design of Stage I continued at an accelerated pace. The preliminary cost estimates for Stages I and II were submitted to the Commission.													
CA-744	Metallurgical Development Facilities	\$2,600,000	\$60,000	4-28-58	47	0	0	6-30-58	-	-	9-1-59		
					43	0	0	N.S.	-	-	9-1-60		
		USING COMPONENT		FEO ENGINEER									
REMARKS:		Reactor & Fuels R & D											
A letter of justification requested by the Commission was transmitted on October 20, 1958. It was transmitted to the AEC-Washington on October 24, 1958. The Chemical Processing Area design has been suspended pending resolution of processing equipment criteria. Architectural and Mechanical design is progressing satisfactorily.													
CA-749	High Level Radiochemistry Facility	\$960,000	\$960,000	4-21-58	91*	10*	10	6-15-58	11-21-58	11-21-58	11-21-58*		
					88	10	10	8-14-58	6-30-59	6-30-59	7-15-59*		
		USING COMPONENT		FEO ENGINEER									
REMARKS:		Chemical Research & Development											
Wall and column footings, cell walls below main floor level, and north and south basement wall concrete has been poured. Re-steel and formwork for outside walls and columns has been placed. The structural steel and approximately 9,000 linear feet of stainless steel pipe, fittings and transfer ducts have been delivered to the job site. A 7' x 9' hole is being punched through the existing 325 Building basement wall for a double doorway and pipe chase. Directive AEC-112, Modification No. 3, dated October 28, 1958, reducing total project funds to \$960,000, has been received.													
* Schedule recently revised by Bohna Company and approved by the AEC. Extension due to trucker's strike and design changes. Contractor has requested extension of completion date by 31 days due to requests for design changes.													

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BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				MONTH			
New Construction FY - 1958		HANFORD LABORATORIES OPERATION				October, 1958			
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DATE	DESIGN	SCHED.			
CGH-790	High Level Radioactive Receiving and Storage Addition - 327 Building	\$325,000	\$325,000	6-25-58	74*	0	6-23-58	-	12-15-58
					74	1	10-9-58	2-1-60	2-1-60
		USING COMPONENT				PEO ENGINEER			
		Reactor & Fuels R & D				A. W. Hervin			
REMARKS: The crane bids were reviewed and the bid awarded to Ederer Engineering Company on October 20, 1958. Excavating, for the crib waste line and the canal connecting the existing wet storage basin with the new basin, has been started by Construction Operation. During the excavation work, it was found that the waste crib line had been leaking and severely contaminated the ground. As a result of this contamination, a revised project proposal was prepared and forwarded to the Commission. In general it requests that all work to the top of the main floor level be performed by the CPFF Construction Contractor. The CPFF Contractor is using a jack-hammer to remove the concrete from the existing wet storage basin for the new canal. The door for the east end of the canyon has been ordered and work has started on removing the metal panels. Fabrication of the crib waste line has been started.									
* A revised design schedule has been submitted to the Commission.									
CGH-819	Increased Laboratory Waste Facilities - 300 Area	\$300,000	None		0	0	1*	-	7*
			None		0	0	9*	21*	21*
		USING COMPONENT				PEO ENGINEER			
		Chemical Research & Development				A. W. Hervin			
REMARKS: The Commission took exception to the source of funds listed in the project proposal. As a result, the Commission was informed that funds for the trailer would be taken from the equipment budget and the design funds from other sources available to the ABC. The project proposal has been forwarded to the ABC-Washington for approval.									
* Months after authorization.									
		USING COMPONENT				PEO ENGINEER			
REMARKS:									

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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
L.E. Clover and H.P. Ransom	10-21 & 10-24	General Electric Co. Schenectady, N.Y.	Discuss shop problems and visit HLO Facilities Engr. & review mutual subjects.	L.J. Lucas O.W. Priebe P.F.X. Dunigan J.L. Boyd	No	300 - 328
H.V. Ross & C. Szymko	10-15	Argonne National Lab. Lemont, Ill.	Discuss shop problems.	L.J. Lucas	No	300 - 328
Wilbur Fiddiman, Orville Dodd, Don Woodman, & John Hughes	10-29	Dresden Plant Grundy County, Ill.	Discuss shop and maintenance problems.	L.J. Lucas	No	300 - 328 & 321
Hugh Vinyard	10-9	Hugh Vinyard Company Spokane, Wash.	Demonstration of Rol-Dex Office Equipment.	M.F. Puckett A.F. McConiga	No	300 - 3760
Frank R. Johnson	10-9	Watson Manufacturing Co. Seattle, Wash.	Demonstration of Rol-Dex Office Equipment.	M.F. Puckett A.F. McConiga	No	300 - 3760
Vice Principals, Administrators, and Special Education People	10-11	Richland Schools Richland, Washington	Learn about Technical Information Operation.	C.G. Stevenson	No	300 - 3760
Professors	10-24	Univ. of Washington Seattle, Washington	Learn about Technical Information Operation.	C.G. Stevenson	No	300 - 3760

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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
A.F. McConiga M.F. Puckett M.F. McHale	10-17	Thermofax Sales Co. Chinook Hotel Yakima, Wash.	Learn about micro-film Reader - Printer Equipment.	Mr. Zook	No
A.W. Fraser R.B. Socky	10-10 & 10-11	Seattle, Wash.	Attend meeting, Pac. NW Sec., SNT	None	No
R.B. Socky	10-22 - 10-31	GE Co. APED San Jose	Consult re radio-graphic testing ceramic fuel elements.	Mr. Spolaris	No
		Aetna Engr. Co. Van Nuys, Calif.	To observe performance & qualifications on specialized ultrasonic testing equip.	D.M. Fretwell	No
		National Metals Trade Show, Cleveland, Ohio	To obtain information on new NDT equipment.		No
		Republic Steel Corp. Cleveland, Ohio	(Chairman, Pac. NW Sec.) SNT annual meeting.	FA Meunier	No
		Wallingford Steel Co. Cleveland, Ohio	Test tubing program	Don Wiese	No
		ASTM Committee E-7 Cleveland, Ohio	HAPO representative Committee Meeting		No
J.W. Sadler	10-17, 18, & 10-19	Recruiting was done in Los Angeles, Calif.	Recruiting		No

EMPLOYEE RELATIONS OPERATION MONTHLY REPORTGENERAL

At month's end, the staff of the Hanford Laboratories Operation totalled 1188, including 563 exempt and 625 nonexempt employees. Of the total exempt employees, there were 500 with college degrees, including 479 technical degrees as follows: B.S. - 270, M.S. - 106, Ph.D. - 103. There were 31 nonexempt employees with college degrees.

EMPLOYEE RELATIONS

Interviews with Chemical Research and Development Operation employees to obtain their reactions to ideas for attitude survey questions were completed and the report is being prepared.

PERSONNEL DEVELOPMENT

The Manager - Personnel Development participated in a symposium "Education and Training for Health Physics" held at the National Reactor Testing Station on October 30 and 31. This was one of two regional symposia sponsored by the Oak Ridge Institute of Nuclear Studies to stimulate interest in the field of health physics and in the Radiological Physics Fellowship Program. Invitees to the symposium included approximately 45 representatives from four-year colleges in the northwestern part of the United States.

Arrangements were made for eight professors of the University of Washington Electrical Engineering Department to visit within HLO. The professors met some of the research and development personnel and reviewed some of the laboratory facilities.

Ten employees began the 10-week, 20-hour "Interviewing Course," while the same number started "P.M.S.&L."

<u>Req. Received</u>	<u>Req. Filled*</u>	<u>Req. Cancelled</u>	<u>Employment</u>		<u>Candid. in Process</u>	<u>Trans. Pend.</u>	<u>Adtl. Candid. Req.</u>
			<u>Req. Open at Mo. End</u>	<u>Req. Open at Mo. End</u>			
26	13	1	26	26	15	7	3

*Eleven of the requisitions were filled from Plant forces.

Two Bioassay Analysts and two Personnel Meters Clerks were laid off on October 31, 1958. Notice of force reduction has been rescinded for the most senior Personnel Meters Clerk scheduled for force reduction. This employee has been placed on a temporary assignment with the Reactor Engineering Development Operation for approximately one to two months.

One Field Inspector was placed this month in addition to the three previously placed, thus eliminating any necessity for reduction in force in the Regional Monitoring Operation for the foreseeable future.

COMMUNICATIONS

A study was initiated to determine methods for recognition of accomplishments of HLO employees.

A special Saturday tour requested by a group of Tri-Cities school administration people was conducted by HLO technical people active in local school affairs. Thirty Marsing, Idaho senior science students also visited the Laboratories.

HEALTH, SAFETY AND SECURITY

Laboratories personnel worked a total of 205,345 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,914,467 man-hours have been completed with no disabling injuries. The medical treatment frequency for October was 1.61 as compared with 1.23 during September.

There were 6 security violations during the month, bringing the total for the calendar year to 42.

UNION RELATIONS

The HAMTC has notified the Company that they wish to proceed to arbitration in the Wonacott case (radiation monitoring jurisdiction) and have requested that the Federal Mediation & Conciliation Service appoint an arbitrator.

The negotiations with the Regional Monitors reached a conclusion on September 26, 1958. Procedures and problems encountered by the merger of the two groups are now being worked out.

In the Maki arbitration case briefs have been submitted to the arbitrator by Legal and the HAMTC and we are now awaiting the arbitrator's decision.

Two grievances were received during the month of October. One pertained to alleged unauthorized shifts and demanded time and one-half for time worked until such shifts were negotiated through and approved by the HAMTC. The Step I answer was satisfactory. The second grievance pertained to work claimed by the Teamsters. The Step I answer was unsatisfactory and the grievance scheduled for Step II discussion on Nov. 7.

PROFESSIONAL PERSONNEL PLACEMENT

During October, employment offers were extended to two Ph.D. candidates. No HAPO offers were accepted while four candidates rejected. In addition, employment offers were extended to eight experienced BS/MS candidates, eight accepted and five were placed on the roll. HLO accounted for three offers, four acceptances and three placed on the roll, bringing the total HLO experienced BS/MS acceptances for the recruiting year to date (9-1-58 to date) to nine. Of this number, three are Company transfers from departments outside of HAPO, including a welding engineer. One BS/MS Program candidate accepted employment.

During the month, HAPO recruiters visited ten colleges and universities as members of the Company Ph.D. recruiting team. Results of these recruiting trips indicate a tight market in areas of interest to Hanford. Eleven universities and colleges were visited by HAPO recruiters for BS/MS recruiting. Again there are strong indications that this will be an extremely competitive year for all technical talents of interest to HAPO.

Technical Graduate placement activity has increased recently. Nineteen men have accepted off-program positions in the last three months versus eight men in the three months preceding. There are now 37 participants on the Technical Graduate Program with five scheduled for placement on November 1, 1958. Shortages have developed in the areas of physics and mechanical engineering particularly.

A list of technical papers suitable for presentation at colleges and universities within our recruiting region has been compiled. The list is being sent to selected individuals on campuses to further our university relations program.

EMPLOYEE COMPENSATION

Seven information meetings were attended at the request of HLO managers to discuss the philosophy and practices of salary administration for exempt personnel.

Compensation specialists from Aircraft Nuclear Propulsion Department from Evendale, Ohio visited HLO Employee Compensation on October 9 for mutual salary administration discussions.

Work is continuing on the Nonexempt Compensation Study. Present emphasis is being directed toward validating the point score evaluation system for clerical-functional positions.

Ten suggestions were approved for awards of \$155 at the October meeting of the HLO Suggestion Board. The average year-to-date award is \$23.50 and the ratio of awards to savings is 12.7%.

At month's end, Hanford Laboratories' participation in the Savings and Security Program was 96.7% of the eligible employees.

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

<u>Year</u> <u>1958</u>	<u>Insurance</u>	<u>Pension Plan</u>	<u>Savings</u> <u>Stock Bonus</u>	<u>Savings Plan</u>
Sept.	99.7	98.8	61.6	6.5
Oct.	99.8	98.7	60.8	6.6

Manager,
Employee Relations

T.G. Marshall:tr

VISITORS TO HAPO

Name	Date of Visit	Company Represented	Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
Roger Coon E.R. Sweetser	10/9	Aircraft Nuclear Propulsion Dept.	Discuss organizational problems of mutual interest & reconciliation of positions.	H.A. Paulsen R.D. Tillson W.E. Foust A.R. Keene D.P. Schively	None	300 Area 3702 Bldg.

VISITS TO OTHER INSTALLATIONS

Name	Date of Visit	Company Visited	Reason for Visit	Personnel Contacted	Access to Restricted Data
D.C. Fleckenstein	10/8-9	Knolls Atomic Power Laboratory, Schenectady	Personnel Development & Training Discussions	J.D. Leslie J.P. Simpelaar G.L. Smallwood J.J. Forth	None
D.C. Fleckenstein	10/8-9	G.E., Schenectady Specialized Technical Education	Personnel Development & Training Discussions	R.B. Hook J.B. Hendricks E.C. Wanner	None
D.C. Fleckenstein	10/10	G.E., New York Eng'g. Personnel Service	EPR contacts and professional relations discussions	C.F. Savage	None
D.C. Fleckenstein	10/27-10/28	Brookhaven Natl. Laboratory	Discussions related to AEC Radiological Physics Fellowships Program.	Arlend Carsten	None
D.C. Fleckenstein	10/30-10/31	None - Idaho Falls	To participate in ORINS symposium	L.K. Akers	None

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VISITS TO OTHER INSTALLATIONS

Name	Date of Visit	Company Visted	Reason for Visit	Personnel Contacted	Access to Restricted Data
T.G. Marshall	10/20-21	G.E., New York Public & Empl. Relations Serv.	Employee benefits. Placement of ER personnel. Nonexempt wage study.	I.H. Dearnley E.D. Rebucci W.R. Jacobson	None
T.G. Marshall	10/20-21	G.E., New York Engineering Serv.	Engineering Register and placement and recruitment of technical personnel.	T.K. Koerner T.W. Zebley	None
T.G. Marshall	10/16-17	None - Pittsburgh, Pa.	To attend AEC Contractors Personnel Conference.		None
T.G. Marshall	10/23	None - Lemont, Ill.	To attend AEC University Relations Committee.		None
E.P. Galbraith	10/27	G.E., New York Emp. Comp. Serv.	Starting and program rates for college graduates.	H.D. Maeder	None
E.P. Galbraith	10/27	G.E., New York	Starting and program rates for college graduates and determine policies and procedures effecting the employment of tech. grads. from the univ.	W.S. Hill M.W. Sims	None

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TABLE II. NONEXEMPT EMPLOYMENT

<u>Nonexempt Employment Status</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nonexempt Transfer Requests</u>	<u>Sept.</u>	<u>Oct.</u>
Requisitions			Transfer Requests		
At end of month	15	26	Active cases at end of mo.	57	62
Cancelled	1	1	Cancelled	6	1
Received during month	25	25	New	10	7
Filled during month	14	13	Transfers effected	1	1
Candidates Considered					
Total applications	48	54			
Total transfer requests from other at HAPO	8	9			

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

Total processed 27 (includes 3 non-unit grievances)

Step I

Answered satisfactorily* 16

Step II

Pending Step II discussion 3

Answered

Satisfactorily** 8

Pending time limit 0

Pending arbitration decision 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.

TABLE IV. PROFESSIONAL PERSONNEL PLACEMENT

A - Technical Recruiting Activity - HAPO - September 1, 1958 to Date

<u>Visits to Richland</u>					<u>Offers*</u>		<u>On the Roll</u>
<u>Cases Considered</u>	<u>Invited</u>	<u>Visited</u>	<u>To Visit</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	
Ph.D. 125	24	8	4	10	3	2	1
Exp. BS/MS 96	9	8	1	18	14	1	9
Program BS/MS 16	-	-	-	4	2	1	1

*Offer totals include offers open on Sept. 1, 1958

Ph.D. 3
 Exp. BS/MS 3
 Program BS/MS 3

B - Technical Recruiting Activity - HLO - September 1, 1958 to Date

<u>Visits to Richland</u>					<u>Offers**</u>		<u>On the Roll</u>
<u>Cases Considered</u>	<u>Invited</u>	<u>Visited</u>	<u>To Visit</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	
Ph.D. 125	24	8	4	5	1	1	1
Exp. BS/MS 83	7	6	1	11	9	1	6
Program BS/MS (Off Program Placement)				6	6	0	6

**Offer totals include offers open on Sept. 1, 1958

Ph.D. 2
 Exp. BS/MS 2

/ In addition to the above, three exempt employees have transferred into HLO from other HAPO departments.

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

	<u>TG Program</u>	<u>TT Program</u>
Number personnel on assignment	37	14
(HAPO TG Program 35)		
(West. District E.P. 2)		
Distribution of assignments by Depts.		
HLO	14	9
CEO	1	0
R&UO	0	0
FPD	2	0
IPD	17	5
CPD	3	0
Distribution of assignments by functions		
R&D or Engineering	33	14
Other	4	0

FINANCIAL OPERATION MONTHLY REPORTPersonnel

One non-exempt employee was transferred to another HLO component making a total force of 48 at the end of October.

General Accounting Operation

In conjunction with transmitting revised pages of the Prime Contract to known holders within HLO, a registry of copies assigned to specific individuals has been established. This will facilitate maintaining these copies on a current basis. Management was asked to return to the Manager - General Accounting any copies not registered.

A notification was received from the Commission advising of a change in the accounting treatment for transferred capital property and expense portions of construction projects.

1. Transferred capital property will be included in the directive amount and be funded from the project, with a salvage credit applied to the operating appropriation.
2. Expense portions of construction projects (with exceptions outlined below) will be charged to the appropriate operating account.

Transferred capital property has previously been considered an added benefit to the project, with no charge against the budget item. However, this practice has recently been subject to the criticism of avoiding Congressional intent, as it may be possible to overrun legal percentages by transferring to a project capital equipment which it would have been impossible to purchase within the legal limitation.

Expense portion of construction projects has been allowed where it appeared that the capital value of the project would be greatly distorted by including such charges which were then funded, but not unitized, as part of the project.

These charges will now be absorbed in the operating budget except where it appears to be unreasonable, in which case a request for an exception should be submitted along with the project.

The computation of composite depreciation rates and reserve adjustments based on AEC standard service lives has been completed. The computation indicated that the composite rates currently being applied to 14 of the 36 accounts were inadequate by a net of 5 1/4%. This monthly increase of \$2,911 will be reflected in current fiscal year's depreciation beginning with January 1959 depreciation accrual. An adjustment to the depreciation reserve accounts reflecting an increase of \$445,395 was made during the month of October due primarily to the following:

1. Reclassification of Portable Health Instruments 10%, as Special Irradiation Instruments 20%.

2. Reclassification of the 326 and 327 Buildings from 2% to 2 1/2% to conform more closely with the rate indicated in the appendix to the AEC Manual regarding unit depreciation rates.
3. Reclassification of items received from other HAPO components to a more realistic rate than that indicated on the transfer documents.
4. Reclassification and transfer of equipment from an installed account to an uninstalled account.
5. Early retirement of 5 and 10 percent items purchased in 1952 for the Hot Semiworks.

Preparations were completed and a procedure distributed for the physical inventory of uninstalled cataloged equipment in the custody of Biology Operation. The inventory will begin November 3, 1958 with an anticipated completion date of November 14, 1958 for all field work.

Revisions to the Property Management Manual were prepared and distributed to registered holders. Revisions were made to reflect (1) current Property Representative assignments, (2) recent organizational changes in the Purchasing and Stores Operation and (3) to change the scope from equipment to property for items on loan or temporary use offsite.

In connection with establishing the approved central storage area for HLO, an inventory is currently being taken of all existing storage areas. The inventory of storage areas in the 231-Z and 272-Z Buildings has been completed and a list of the equipment found in these areas is being prepared for use by custodial personnel in determining the disposition for each piece of equipment. We are restricted in our operations by the delay in obtaining a central storage area. Laboratory Auxiliaries Operation is working on obtaining a suitable building or location, however, we have received nothing definite as to when such a storage area will be available.

In response to a request of SS Accountability Operation, material custodians were requested to submit inside quota material forecasts to this office. Upon receipt, this information was consolidated into a report and forwarded to SS Accountability.

In connection with the FY 1959 midyear budget review for inventory materials, a new forecast is being prepared of zirconium requirements.

The physical inventory of special materials and precious metals was conducted on September 29 and 30, 1958. The report of results, which will be distributed in November, was held up pending a review of recommendations by Custodial personnel. Total value of the physical inventory was \$716,089 compared to a reconciled book balance of \$716,404 resulting in a physical inventory adjustment of \$315.

Cost Accounting

FY 1959 Midyear Budget Review instructions were received on October 16, 1958. The Review is due to Contract Accounting on November 15, 1958. A budget instruction letter was issued to HLO management on October 22, 1958. Inasmuch as the Review is a summary type budget and submitted on a level two basis, it is being

accomplished through a series of "budget discussion meetings" with the level three managers. These meetings are in process at this time. Information obtained in these meetings will be used to prepare a Consolidated HLO Budget. After submission of the Review to Contract Accounting, budgets for level four and five components (where applicable) will be prepared.

A revised Financial Plan was received October 3, 1958 from HOO-AEC which deviated from previous funding arrangements in the 4000 and 6000 Programs. This information was disseminated to HLO management who agreed that the Revised Financial Plan would be used for control purposes until the Midyear Budget Review preparation, at which time current estimates will be submitted to HOO-AEC. Information was transmitted to Contract Accounting indicating that our Midyear Review would include amounts in excess of the Revised Financial Plan for both the 4000 and 6000 Programs.

The cost detail for Level 5 cost centers was issued on a 5-piece carbon form for the first time covering September costs. Use of the carbon forms rather than duplimats will save approximately \$2,500 a year within HLO Cost Accounting.

In response to a request from Contract Accounting, a quarterly report was issued for the first time showing individual commitments over \$5,000 against research and development funds through purchase orders, off-site contracts, etc. Hereafter, this information is to be provided at the end of each calendar quarter.

Personnel Accounting

A request was received from Consolidated Reports and Statistics, Schenectady, for certain salary administration statistics. The following shows a comparison between the salary administration statistics furnished as of October 1, 1957 vs. October 1, 1958:

<u>October 1, 1958</u>		<u>October 1, 1957</u>	
<u>No. Employees</u>		<u>No. Employees</u>	
Exempt	559	Exempt	494
Non-Exempt	<u>32</u>	Non-Exempt	<u>37</u>
Total	<u>591</u>	Total	<u>531</u>
PhD	104	PhD	95
M.S.	105	M.S.	103
B.S.	*313	B.S.	**254
Other	<u>69</u>	Other	<u>79</u>
	<u>591</u>		<u>531</u>

*Includes 32 non-exempt

**Includes 37 non-exempt

Preliminary listings of transfers in and transfers out of our pension unit for the period January 1, 1958 through August 31, 1958 were received from Schenectady. These listings were checked with our records to verify their accuracy.

Envelopes containing transmittal form TD374 were delivered to those employees on October 31 who have on deposit under the General Electric Savings and Stock Bonus Plan, U.S. Savings Bonds purchased in 1953 as shown on the transmittal form. Employees receiving such transmittal notices are requested to return the

form, plus custody receipts for all bonds purchased in 1953, to Personnel Accounting not later than December 19, 1958.

State Income Tax reports were filed with Idaho, Oregon and Montana. Checks were issued to the states for amounts withheld.

We have been informed that Washington employers will not receive an unemployment compensation experience rating credit for 1958.

Listings of exempt and non-exempt employees who had not taken their 1958 vacation were prepared and submitted to Level 3 Managers on October 15. The listing included exempt employees who had not taken their vacation as of September 30 and non-exempt employees as of October 26.

Auditing

Audit activities during the period included:

- (1) Count and reconciliation of the HLO cash fund.
- (2) Investigation of additions to the "Central Slide File" maintained by Technical Information.
- (3) Test observation of the physical inventory of Precious Metals and Special Materials.
- (4) A brief audit of HLO Good Neighbor Fund deductions during the year ended September 30, 1958.
- (5) Preparation of a memorandum on the tax aspects of the new Savings and Security Program.
- (6) Continued work on the audit of Materials Furnished AEC Contractors.

Measurements

Assembly of the 1958 Business Review of Hanford Laboratories components is nearly complete. Members of FPD management have been contacted and considerable study has been made to get a better understanding of the possible application of ratio delay studies to Hanford Laboratories activities. Schedules for reporting of HLO goals and measurements during the next two months were prepared.

Procedures

The possibility of discontinuing the distribution of financial copy of store orders was pursued in other HAPO operations by the respective procedures specialists. The initial response could be considered favorable.

A package has been developed concerning the combination of records and files applicable to personnel. Detailed flow charts have not been prepared but can be quickly accomplished when needed.

A study has been started to determine when and how we can obtain mechanized cost commitments. Preliminary investigation has not turned up as bleak a picture as expected. Data Processing has a program which matches purchase orders, payment vouchers and receiving reports for inventory accounting. Secondly, some machine time may be available for this purpose prior to March 1, 1959.

Classified Files has agreed to do some key punching for Cost Accounting if a permanent work order card file is deemed desirable. The purpose of such a file would be to obtain, at any date in the future, information concerning historical work order expenditures. The cards would be punched in a printing key punch for ease of reading and could be run through a sorter to pull necessary information (Classified Files would also provide sorter service). Information contained in the cards would probably include:

1. Actual Cost
2. Cost Codes
3. Work Order Number
4. Building Number
5. Brief Description of Work

General Accounting has requested a study of the procedure used for one-trip material passes. No work has been started on this to date.

Preliminary work has been performed with Library Operation concerning the feasibility of designing and implementing a procedure for utilization of a single order form rather than a variety of forms.

Payroll Statistics

<u>Number of HLO Employees</u> <u>Changes During Month</u>	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on Payroll at Beginning of Month	1 193	562	631
Additions and Transfers In	13	7	6
Removals and Transfers Out	<u>(18)</u>	<u>(5)</u>	<u>(13)</u>
Employees on Payroll at End of Month	<u>1 188</u>	<u>564</u>	<u>624</u>

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Overtime Payments During Month

	<u>October</u>	<u>September</u>
Exempt	\$1 572	\$ 5 838
Non-Exempt	4 787	5 411
	<u>\$6 359</u>	<u>\$11 249</u>

Gross Payroll Paid During Month

Exempt	\$440 833	\$454 617
Non-Exempt	335 462	272 558
	<u>\$776 295</u>	<u>\$727 175</u>

Participation in Employee Benefit Plans at Month End

	<u>No. Participating</u>		<u>Percent Participating</u>	
	<u>October</u>	<u>September</u>	<u>October</u>	<u>September</u>
Pension Plan	1 171	1 170	98.7	98.8
Insurance Plan				
Personal Coverage	1 223	1 228	99.8	99.7
Dependent Coverage	804	797	-	-
U.S. Savings Bonds				
Stock Bonus Plan	722	735	60.8	61.6
Savings Plan	78	77	6.6	6.5

Insurance Claims

	<u>October</u>		<u>September</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee Benefits				
Life Insurance	0	\$ 0	0	\$ 0
Weekly Sickness & Accident	11	1 064	7	807
Comprehensive Medical	39	5 584	37	2 630
Dependent Benefits				
Comprehensive Medical	81	6 377	96	11 322
Total	<u>131</u>	<u>\$13 025</u>	<u>140</u>	<u>\$14 759</u>

Good Neighbor Fund

	<u>October</u>	<u>September</u>
Number Participating	813	763
Percent Participating	68.1	64.0

W. Sale
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INVENTORIES OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief no inventions or discoveries were made in the course of their work during the period covered by this report except as listed below. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

INVENTOR

T. F. Evans

B. B. Brenden

H. W. Newkirk, Jr.

TITLE OF INVENTION OR DISCOVERYThe Destruction of Nitric Acid by
ElectrolysisPyrometry Instruments - High Temperature
MeasurementT. F. Evans for H. W. Newkirk, Jr.

END

**DATE
FILMED**

9 / 1 / 92