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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT
SEPTEMBER, 1958

Classification Cancelled (Change to) Declassified
By Authority of CG-PR-2
Robert M. Stein 4/23/92
By [illegible] 5/12/92
PM Erick 5-12-92

Compiled by
Operation Managers

D. P. Benson
(by M. Wenke)
5/15/79

October 15, 1958

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

[redacted]

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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 September 30, 1958

FORCE REPORT

	At end of month			At beginning of month			Additions		Separations	
	Exempt	Nonexempt	Total	Exempt	Nonexempt	Total	Exempt	Nonexempt	Exempt	Nonexempt
Chemical Research & Dev.	122	94	216	125	95	220	1	1	4	2
Reactor & Fuels	157	108	265	158	111	269	4	1	5	4
Physics & Instrument	62	25	87	65	25	90	4	0	7	0
Biology	36	42	78	36	41	77	1	1	1	0
Operation Research & Syn.	14	3	17	14	3	17	0	0	0	0
Radiation Protection	34	108	142	37	114	151	0	3	3	9
Laboratory Auxiliaries	45	182	227	44	181	225	1	8	0	7
Financial	16	33	49	16	33	49	0	0	0	0
Employee Relations	60	31	91	73	39	112	1	8	14	16
Programming	15	3	18	15	4	19	0	0	0	1
General	1	2	3	1	2	3	0	0	0	0
Totals	562	631	1193	584	648	1232	12	22	34	39
Totals excluding transfers	562	631	1193	584	648	1232	5	13	26	31

Composite Separation Rate - 6.1190

Separation Rate (based on Separations leaving G.E.- 4.0234

Controllable Separation - .4193

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BUDGETS AND COSTS

Costs for September were $1,597,000 an increase of $141,000 over the month of August. Part of the increase is due to the normal practice at HAPO to include in the final month of the calendar quarter, work order charges for five weeks. Costs for FY 1959 to date are $4,409,000 or 22% of the annual budget.

Cost-budget relationships are satisfactory at this time with perhaps the minor exception of CPD Separations. This imbalance is due to emphasis on the Palmolive program and should be corrected later in the year due to shifts to CPD Separations processes for NPF.

RESEARCH AND DEVELOPMENT

1. Reactor and Fuels

The in-reactor testing of rod cluster fuel elements to date shows excellent radiation characteristics. However, on discharge, some of the elements showed that the precipitation hardening stainless steel supports were badly embrittled during irradiation.

Out-of-reactor loop testing of defected coextruded fuel rod reveals a high degree of resistance to undercutting and a remarkable degree of uniformity in the manner of failure. The failure characteristics of all the specimens tested have been far less drastic than expected.

Electron microscopy techniques lead one to believe with a fair degree of certainty that the voids noted in uranium after modest irradiation are real and are not artifacts formed by the etching process.

Several aluminum clad fuel elements appeared to be in good condition after operation in an ex-reactor organic loop for five months at 370 C.

Two graphites being tested for possible NPR use from Texas Lockport and Sohio Lima cokes were manufactured by Speer Carbon Company using iron oxide to increase density, thus eliminating a time-consuming pitch impregnation step. Purification by a chlorine treatment resulted in a purity nearly as high as that obtained by the F Process.

Experiments simulating the rupture of a C Reactor front hydraulic connector indicate adequate cooling at 900 KW when the rear header pressure is 25 psig or more. Damage is indicated at lower rear header pressures.

Preliminary experiments indicate that critical flow (e.g., velocity of sound) will occur with resulting increased process tube pressurization in the event of a B-D-F Reactor rear pigtail rupture.

One, four-rod cluster of Al-Pu alloy is currently being irradiated in KER Loop 3 and a second cluster is ready to be charged into KER Loop 1.

Aluminum alloy specimens with plutonium contents varying from 5 to 20 w/o are in the final stages of preparation for irradiation testing. Heat

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generation calculations for a series of PuO_2-UO_2 oxide capsules equivalent to the aluminum-plutonium alloys have been completed.

A glove box mounted hydrogen sintering furnace is completed and in use on plutonium-containing oxides. Preliminary results indicate that UO_2 containing mixed PuO_2-UO_2 oxide sinters to higher density than UO_2 alone.

A small scale experiment in which plutonium was extracted from a Pu-Al alloy by bismuth, recovered from the bismuth as an oxide, and reduced and alloyed with aluminum to complete the cycle has been completed. An 87.5 percent yield of the plutonium was recovered in the final alloy.

The irradiation of eight UO_2 swaged cluster assemblies in KER has continued successfully since their charging in early August 1958.

Preliminary thermal conductivity data of high density UO_2 shows that the conductivity is somewhat lower than the commonly accepted values.

An order has been placed with Tube Reducing Corporation for 100 PRTR process tubes. Although the first completed tubes are expected about June 1959, the vendor will receive a premium payment if 25 tubes are delivered by March 1959. Fabrication of the tubing billets is well under way.

PRTR Phase I construction is 24% completed. Phase II construction is 6% completed. The Phase III bid package and Phase II-A invitations to bid were mailed to prospective bidders. The Fuel Element Examination Facility design criteria were completed and approved.

PFPP Phase II construction is 12% completed. Phase III design is 45% completed.

2. Chemical Research and Development

Instantaneous dissolution rates of unirradiated Dingot uranium-silicon alloys in nitric acid are comparable to that of production Ingot uranium provided that about 0.05 weight per cent silicon is present.

In pyrochemical processing studies, vacuum heating of the plutonium-zinc alloy button prepared by reduction of plutonium chloride from a sodium chloride-potassium chloride system reduced the zinc content to less than one part zinc per million parts plutonium. Although the magnesium content was estimated at one-tenth to one per cent by weight, it is believed that it could be eliminated by treatment at higher temperatures (800 C vs. 600 C.)

In the alkali halide-aluminum halide-aluminum system the effects of cations and anions other than potassium chloride were in accord with theory. For example, sodium chloride or potassium bromide increase the yield of uranium metal whereas cesium chloride reduces the yield.

In both laboratory and field tests on the flow of synthetic, high level, Redox wastes in soils, penetration was limited to shallow depths. Sludge plugs pore spaces in the soil and encourages lateral spreading of the wastes. In waste processing studies a proposal for a field test on concentration of coating wastes by submerged combustion was prepared.

Studies on neptunium chemistry continued to give better understanding of the relationships of the various oxidation states of neptunium.

In fission product recovery studies additional work is reported on the development of the $Cs_2ZnFe(CN)_6$ process for cesium recovery. Work has been initiated on a solvent extraction process to recover strontium and on determination of the fate of technetium in Hanford separations processes.

Studies on the reprocessing of Non-Production Fuels continue to show that Hastelloy F is a promising material of construction of wide flexibility, with potential application to the Zirflex, Niflex and Sulfex feed preparation steps. Passivation of stainless steel under Darex dissolving conditions appears to be avoided by the inclusion of copper metal with the stainless steel charge. To obtain stable feed solutions from Darex of Niflex dissolutions, lower pH than current Redox feeds is required. Consequently, distribution data continue to show that fission product separation from these feeds will be lower in the first solvent extraction cycle. Plutonium oxidation to plutonium(VI) with dichromate proceeds smoothly in these solutions.

3. Physics and Instrument Research and Development

Experimental work continued on the nuclear safety of Non-Production Fuels of 3% enrichment both in dissolver situations and in the subsequent solution stages of the process. Tests with smaller diameter fuel elements indicated smaller dissolver critical masses than those previously reported.

Review of a shipping container for 5% enriched uranium slugs was among the nuclear safety consulting work undertaken this month. It was demonstrated that this container would not provide safety under all conditions.

Loadings of I and E slugs in the B, D, and F Reactors will gain more reactivity upon loss of coolant than is the case with solid slugs according to results of exponential experiments which were in line with similar results previously obtained for C and K lattices.

In the Plutonium Recycle Program, studies of the neutron behavior in the PRTR lattice were aided by the completion of analysis of the PCTR measurements made with 19-rod clusters in a 9-inch lattice.

Pilot experiments and testing of prototype equipment for the Air Force-AEC cooperative atmospheric diffusion program was in full swing. Results of previous work were found to be translatable, for planning uses, to situations to be encountered in this program.

Testing of construction materials of the Body Monitor for intrinsic radioactivity continued. In the course of this work commercially available krypton was found to be unsuitable for filling X-ray counters because of its fission product, Kr^{85}, content. Procedures to be used in examining subjects with activity levels near background were explored.

The accuracy of the pulse method for reading pencil ion chambers was determined to be 5% at 1 mr total dose.

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Satisfactory progress was made on the many development projects in the radiation monitoring field; among them was the use of a single detector for alpha, beta, and gamma radiation with electrical sorting of counts obtained.

4. Biology

No important changes in activity densities of wildlife occurred during the month.

Young rats fed Sr^{90} and Ca^{45} with diets of varying total calcium content show a constant ratio of Sr^{90} over calcium deposition. This is in contrast to the rather widely varying ratios obtained at different calcium levels in mature rats.

5. Programming

A study of the process scope and costs for capital facilities necessary for "Palm Olive" processing indicated that the Hot Semiworks could be modified satisfactorily for about $1,000,000. An alternate, new shielded, pit-type facility serviced by a mobile crane, would cost about $2,500,000.

Analysis indicated that the early availability of about 34 kg of high exposure plutonium would shorten by two years the time required for the PRTR to reach near steady-state operation. Twenty-two kg have been requested from current MTR and PWR loadings, and the cheapest way to provide the 12 kg remainder was found to be by irradiation of depleted uranium in Hanford reactors.

At the request of the Division of Reactor Development, normal work on plutonium recycle analysis was postponed in order to permit participation in a "crash" program, jointly with ORNL and ANL, to calculate plutonium values in several current reactors as an aid to the establishment of Commission plutonium pricing policy.

Hazards aspects of the PRTR were reviewed with members of the Hazards Evaluation Branch of the AEC at a meeting in Washington, D.C. on September 15.

Technical and Other Services

No new cases of plutonium deposition were detected.

I^{131} emission from separations facilities averaged 11.4 curies per week - primarily from the Purex plant. Some difficulty with the vessel vent system was suspected as the source of increased emission. The average weekly emission rate for the past 12 months has been 8.1 curies.

Statistical and mathematical assistance on 22 separate problems was given within HLO and to other departments and operations. Of particular interest were mathematical and statistical methods for studying the formation of gas bubbles in irradiated uranium, and a report on the analysis of calibration data for 200 Area vessels which includes a rather complete discussion of the whole calibration problem.

The necessary development work in connection with computational programs for generating input-output response simulation models was completed this month and data preparation is well under way.

There were 20 authorized projects (exclusive of PRTR and PFPP) at month end, with total authorized funds of $4,161,800. The total estimated cost of these projects is $8,487,800. Two projects were completed during the month. One project proposal was submitted during the month and is awaiting AEC authorization. Project proposals for twelve new projects are in preparation.

Installation of the "in-reactor" portion of the 3 x 3 loop in the Engineering Test Reactor at Arco is scheduled for October 5. Design of the 6 x 9 loop has been completed and bid invitations for fabrication have been issued.

The construction contract for the ceramics press enclosure addition to the 325 Building was awarded. Construction will start October 2, 1958.

A new technique has been used for the radiographic analysis of thin sections of Plutonium for the Plutonium Metallurgy Operation. This involved the use of low energy level X-Rays, obtaining considerably improved radiographs. Microstructural details, not previously obtained, were revealed.

Supporting Functions

Preparations are under way for establishing the approved central storage area for HLO equipment and material in the 325 Building basement. An Informal Request to cover a truck access and other work required for the storage is in process.

The physical inventory of uninstalled cataloged equipment in the custody of Laboratory Auxiliaries was completed with satisfactory results.

The amount of underruns on appropriation requests continue to exceed the overruns. Of the 142 completed since July 1957, 74 (52%) have deviated (either over or under) by more than 10% from the original estimate.

Cost of the U-233 plates for MTR during September was $38,000 making a total of $108,000 to date.

At month's end, the staff of the Hanford Laboratories Operation totalled 1193, including 562 exempt and 631 nonexempt employees. There were 478 exempt employees possessing technical degrees, including 269 BS, 106 MS, and 103 PhD.

Placement of excess Radiation Protection personnel is continuing at a satisfactory level with a total of 8 who had not been placed by the end of the month.

Laboratories personnel worked a total of 186,581 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,709,121 man-hours was completed with no disabling injuries. The medical treatment frequency for September was 1.23 as compared with 1.86 during August.

There were 2 security violations during the month, bringing the total for the calendar year to 36.

Regional Monitor negotiations were completed on September 26 with the signing of a contract by the Company and the Union Representatives.

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During September employment offers were extended to eight PhD candidates. Three candidates accepted our offer and one was placed on the roll. One of those accepting employment will be placed in HLO. In addition, employment offers were extended to ten experienced BS/MS candidates with six accepting and four placed on the roll. Of these numbers, five will be placed in HLO. Offer action to Program BS/MS candidates was confined to employees on leave of absence to the military service. In this area, four offers were extended with one acceptance and one employee placed on the roll.

Firm recruiting dates for all schools to be visited by Hanford recruiters during the fall have now been established. PhD recruiting will begin October 16 at Iowa State College. BS/MS recruiting will begin October 6 at Oklahoma State University. Over-all Company requirements for PhD's are down slightly from last year - from 346 to 322, while BS/MS requirements are up substantially from 400 to 600. HAPO's requirements for PhD's are roughly the same as last year while Program BS/MS requirements appear to be up substantially from approximately 20 to approximately 65.

Five employees terminated during the month to attend colleges of their choice under the General Electric Educational Loan Program.

Thirteen suggestions were approved for awards totalling $275 at the September meeting of the HLO Suggestion Board. The average year to date suggestion award for HLO was $24.81 with a ratio of awards to savings of 12.1%.

H M Parker

Manager,
HANFORD LABORATORIES

HM Parker:kss

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REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATION

TECHNICAL ACTIVITIES

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. METALLURGY PROGRAM

Corrosion Studies

Interim Comparison of 360 C Water and 400 C Steam Corrosion Rates of Zircaloy. The corrosion resistance of four lots of Zircaloy is being compared in water at 360 C and in steam at 400 C and 1500 psi in order to learn how reliably corrosion behavior may be predicted from short, high temperature steam tests. The four lots were selected and rated on the basis of earlier 400 C steam tests as "very good" Zr-2, "good" Zr-3, "poor" Zr-3, and "very poor" Zr. The average results are tabulated below, each entry being represented by five or more samples.

	Weight Gains, mg/dm^2							
	400° Steam				360° Water			
Days	1	3	7	14	2.0	6.0	16.0	36.8
"very good" Zr-2 (Code "21")	13.0	18.1	24.9	31.1	12.7	16.4	21.0	25.1
"good" Zr-3 (Code "18")	14.6	20.8	28.5	35.7	11.7	15.6	20.8	25.5
"poor" Zr-3 (Code"13")	25.8	33.4	42.7	50.7	10.7	14.6	19.4	24.5
"very poor" Zr (Code"5")	56	151	363	764	11.1	14.6	19.0	63.2

In the case of Code "5" material, the 400 C steam test accurately predicted an early demise in the 360° water test. Failure was indicated after one day and was visually obvious after three days in the steam test. Accelerated corrosion in the water test was first detected in this material at the 36.8-day inspection. Exposure in 360 C water is continuing with the next inspection scheduled after an additional 70 days. Improved correlation of results from the two tests may come with extended exposures at 360 C.

Etch Facility for Zr-2 Fuel Elements. Four stainless steel tanks were fabricated and installed outside 314 Building. Etching and rinsing procedures were set up, and two batches of fuel elements have been etched. The last batch of fuel elements has been etched and autoclaved twice. After the first etch and autoclave cycle, all the welds turned white indicating the surfaces of the electron gun welds were contaminated. The ends of the fuel elements were vapor blasted clean, and the elements were re-etched and autoclaved again. After this cycle the welds were a uniform black, but the area where the vapor blasting stopped turned

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white. It is concluded that if any portion of a fuel element is to be vapor blasted, the entire element should be vapor blasted to assure that contaminated areas of the element do not remain.

Radiometallurgy Laboratory Studies

Annealing and hardness testing of specimens of uranium that were given a short-time, low-temperature irradiation under HAPO 173 were completed. Initial x-ray diffraction studies were performed on two uranium samples that were irradiated at low temperatures and shipped to the Radiometallurgy Laboratory in a refrigerated cask. The results and conclusions are reported in detail in connection with the respective development programs involved.

Basic Metallurgy Studies

Electron and Optical Microscopy. The study of the microstructure of cladding and fuel materials is a direct way of detecting radiation damage in these materials. Two techniques are being used: (1) metallographic examination of polished and etched surfaces, and (2) fractographic studies.

Negative replicas of uranium irradiated to a burnup of 0.2 a/o at a temperature of 200 C have disclosed voids 200 to 400 Å in diameter. In order to determine whether these voids originated during the etching process, a sample of non-irradiated uranium was etched for 1.0, 2.5, and 4 hours. Negative replicas of this sample were studied in the electron microscope at high magnification. No voids were found after 1.0 hour of etching; after 2.5 hours etching, some voids were found; and after four hours etching, an increased number of voids were noted on the surface. Since the average etching time for non-irradiated and irradiated uranium is one-half to one hour, the origin of the voids noted on irradiated uranium is believed not to be due to the etching process.

Negative replicas of uranium irradiated to a burnup of 0.012 a/o and 0.015 a/o at approximately 200 C also discloses a number of voids, the population of which is much less than that noted on uranium with higher burnup values. Examination of uranium irradiated to other burnup values is continuing.

Replicas of a fractured surface of alpha phase cast plutonium fractured at liquid nitrogen temperature, have been studied with the electron microscope. The surface shows a typical intergranular cleavage pattern with an average grain size of three microns.

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

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There has been a reversal in the downward trend of the leakage resistance between thermocouple lead wires being exposed at KW Reactor. After additional exposure of 192 hours, for a total of 1828 hours, all of the thermocouple lead wires, with the exception of the asbestos insulated chromel-alumel pair, were showing resistance measurements above the upper limit of the bridge (10^7 ohms). The chromel-alumel pair was reading 1.62×10^6 ohms, as compared to 5.3×10^5 ohms as reported last month. No explanation of these excursions can be made at this time.

Components for the 300 C stability test capsule have been assembled at KW, and the capsule is now being bench-tested prior to insertion into the test hole.

Effects of Low Temperature Irradiation on the Properties of Uranium. The purpose of this test is to find the threshold of detectable neutron damage to uranium through a series of low temperature and short exposure irradiations. The specimens were irradiated in the snout facility at 105-KW to exposures ranging from 10^{15} to 10^{18} nvt or from 5×10^{-7} to 5×10^{-4} total atom percent burnup. Post-irradiation tensile, hardness, and annealing tests are being performed to determine the amount of damage induced and the ease of removal.

Hardness tests were performed during the month on specimens representing 2×10^{17} and 7×10^{17} nvt exposures. These data revealed that vacuum annealing treatments at 400 C for 25 hours affected only from 50 to 60 percent recovery of radiation-induced damage. In general, the recovery per unit time at temperature decreased exponentially with increasing time.

In-Reactor Testing. Engineering data concerning the instantaneous effects of neutron radiation on structural material properties, primarily creep, are required for determining reactor design limits. Research and development work is being done to provide remotely controlled, in-reactor creep capsules. By means of the in-reactor and duplicate ex-reactor capsules, the net effects of the neutron radiation on creep rate will be determined.

A creep capsule which maintains a constant loading by differential thermal expansion and indicates strain by temperature measurement was tested out-of-reactor during the month. The Zircaloy-2 specimen was maintained at 300 C and 20,000 psi over a period of 120 hours. Secondary creep was observed after 30 hours, and a creep rate of 5.8×10^{-6} in/in/hr was measured. This rate appears reasonable compared with creep tests conducted on Zircaloy-2 by conventional creep test techniques at BMI.

Diffusion Studies. A knowledge of the interdiffusion 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. For this reason, penetration of uranium into the X-8001 cladding in AlSi bonded, depleted uranium slugs is being studied. Fifty depleted uranium slugs especially canned for this study are being furnished by FPD; twenty-five with ribs for the ELMO #6 and #7 pressurized water loops, and twenty-

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five without ribs. The twenty-five slugs without ribs have been received, and eleven of these are now being annealed in water autoclaves at 300 C and 360 C. Ten slugs were cross sectioned and metallographically polished to provide data on the initial condition of the bond. Brittle bonds were found in sections approximately one inch from the cap ends. In order to complete the study in as short a time as possible, the remainder of the slugs in the present batch will be used in spite of brittle bonds in the cap ends. Two slugs have been annealed in a water autoclave 14 days at 360 C and are now awaiting cross sectioning by the Metallography Laboratory.

Irradiation Damage and Recovery of Molybdenum. The kinetics of damage recovery in irradiated molybdenum have been studied by x-ray diffraction. Defect trapping apparently has occurred at impurities and/or dislocations. The trapping process is complex and in this case apparently occurs during irradiation as well as during post-irradiation annealing. The fact that interstitials can be retained at temperatures at least 400 C to 800 C above their equilibrium temperature by interaction with impurities, vacancies, and dislocations is one which could explain radiation hardening and other effects observed in fissionable and non-fissionable materials at temperatures above which point defects are considered to be stable.

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 atmosphere have been selected as the independent variables.

Recovery of 50 percent cold worked zirconium heat treated in helium at six temperatures from 300 to 800 C for 10 and 100 minutes was investigated by measuring x-ray line broadening. Recovery curves using width at half-height versus temperature delineate the recrystallization temperature clearly as 600 C and 650 C, respectively, for the 100 minute and 10 minute heat treatments.

In addition to defining the recrystallization temperature, measurements of line width indicate that recovery of a type not affecting hardness to a great degree is occurring below 400 C. Fifty percent recovery of half-width occurs at 400 C in 10 minutes, and at 340 C in 100 minutes, while no hardness change is noted at 400 C for either annealing time.

New Fuel Element Development

Rod Cluster Fuel Elements. Rod cluster fuel elements with uranium cores and stainless steel jackets have been tested to exposures up to 3000 MWD/T in high temperature water. In the latest test at the Hanford KER loop, twenty (20), eight-inch long, four-rod fuel elements were irradiated to an average exposure of 2250 MWD/T in 240 C maximum water. The fuel element supports were cold worked stainless steel "pencil clip" springs oriented longitudinally on each rod end cap. The supports were satisfactory for charge, operation, and discharge. No permanent deflection of the supports was observed after the test. The internal ring used to

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connect the four rods in a rigid assembly was machined from 17-4 PH stainless steel and precipitation hardened. Severe embrittlement of these rings occurred during irradiation, and all but two were fractured when the discharged fuel fell into the basin. The intact rod cluster fuel element assembly has no visually obvious warp or fuel rod swelling.

Upon completion of KER tests of stainless steel clad elements, two tests of Zircaloy-2 clad uranium rod cluster fuel elements were charged. KER Loop 1 contains two seven-rod natural uranium cluster elements with 0.050-inch inter-rod spacing. The exposure of these elements is now 450 MWD/T, and the coolant temperature has remained at 268 C.

KER Loop 3 contains two three-rod cluster fuel elements of 24 and 36-inch length. The object of the test is to measure the amount of bowing in long fuel rod Zircaloy-2 clad uranium. The exposure of these elements is now 500 MWD/T with coolant water at 180 C.

A fuel basket assembly containing three seven-rod cluster fuel elements and one cluster of seven Zircaloy-2 tensile specimens was shipped to the ETR. This is the first fissionable fuel loading to be irradiated in the new 3x3 high temperature loop facility. These fuel elements will be irradiated in 200-290 C water to a goal exposure of at least 1000 MWD/T as part of a program to develop a nuclear fuel element capable of satisfactorily performing at NPR operating conditions. Each fuel element consists of seven Zircaloy-2 clad, natural uranium coextruded rods, 0.593-inch OD and with 0.030-inch cladding thickness. The maximum specific power of this fuel is expected to be 80-90 kw/ft, and suitable inlet and exit thermocouples have been provided in the basket assembly to monitor its specific power.

At present it is unknown what effect an integral end closure will have on the performance of such a fuel rod during irradiation. Designs have been completed, and components are now being fabricated for a three-foot, three-rod fuel element made from 1.6 percent enriched uranium Zircaloy-2 clad integral end closed rod. This fuel element is to be irradiated in a Hanford KER loop facility. In addition, a seven-rod cluster fuel element is being fabricated from identical rod for irradiation in the ETR 3x3 loop facility. This fuel element will be 18 inches in length and formed by cutting 36-inch integral end closed rods in half and placing the integral end closed portion of the rods on the same end of the fuel element. The cut ends will be closed by welding appropriate end plugs in place. The integral end-closed end of the fuel will be positioned in the ETR such that this end will produce maximum power. Rods for this fuel were chosen to give a maximum rod distortion if any exists, and it is hoped that the fuel can be discharged and examined at the end of each ETR cycle.

To compare the operating characteristics of 30-mil and 20-mil cladding on coextruded fuel rod, eight 7-rod cluster fuel elements, four with 20-mil clad rods and four with 30-mil clad rods, are to be irradiated in a Hanford KER loop facility. Components for these fuel elements have

been completed and will be assembled ready for irradiation during the next month.

An electrically-heated, seven-rod cluster fuel element is being fabricated for rupture testing. One defected rod operating at 10 kw/ft will be allowed to fail adjacent to an intact Zircaloy-2 clad rod also generating 10 kw/ft. The test assembly components are complete, but braze assembly is still necessary before the fuel is tested.

Coaxial Fuel Element. The third irradiation test of the coaxial fuel element at the MTR has been discharged after operating during four MTR cycles and after attaining about 850 MWD/T exposure. There were two fuel elements irradiated during this test with one being temperature monitored. Good temperature stability of the coaxial concept element has been indicated by the thermocouple during the course of its exposure. At initial startup an equilibrium maximum temperature of 670 C at about 88 kw/ft was attained. During subsequent exposure to about 300 MWD/T the maximum temperature gradually increased to 750 C and has maintained that temperature when at 88 kw/ft to its discharge exposure. The increase in temperature from 670 to 750 C is not surprising and probably reflects slightly dimensional changes of the inner coaxial tube resulting from creep or stress relaxation in the inner uranium tube during operation. Cyclic operation from high to low and back to high power did not affect the operating behavior of the fuel element.

The temperature monitored element will be returned to HAPO for post-irradiation examination, and its unmonitored companion piece will continue to be irradiated at the MTR, as opportunity permits, to a goal exposure of 1500 MWD/T.

Rod and Tube Fuel Element. Tubular fuel elements can combine the extended surface advantage of rod cluster fuel elements with symmetrical coolant channels and irradiation stability. Nuclear Metals has produced coextruded Zircaloy-2 clad uranium tubes.

Five rod and tube elements have been built from NMI coextrusions. They are complete with exception of external supports still to be welded in place. Three elements have electron beam welded end plugs. Two elements are integrally end closed by the extrusion of end plugs coincidentally with the coextrusion of core and cladding. One welded element will be used for ETR 6x9 criticality measurements. Four elements will be charged into KER Loop 2 in October.

Aluminum Clad Rod and Tube Fuel Elements. One sample of the three 20-inch long gas pressure bonded tubular elements failed in a 200 C ELMO loop test in a manner characteristic of poorly bonded cladding. The failure started at an intentional defect. Sections of the other pieces were prepared for testing to determine if poor undercutting resistance is characteristic of the cladding technique used.

Restraint of Uranium Swelling by Zirconium Cladding. To date, no swelling data are available for unalloyed clad uranium with a 250-350 C cladding surface temperature and a 450-600 C maximum fuel temperature. Two experiments were designed for irradiation in the MTR to provide initial swelling data on unalloyed uranium fuel rods coextruded with Zircaloy-2 operating at the above temperature conditions. One fuel rod, GEH-3-31, which operated an average maximum uranium temperature of 400 C and has an estimated exposure of 2100 MWD/T has been returned to Hanford for examination. Rough measurements indicate that no diameter change or warpage of the rod has occurred. The other fuel rod, GEH-3-32, which is presently undergoing irradiation, has an estimated exposure of 900 MWD/T at a maximum uranium temperature of 375 C. Neither fuel rod has operated in the desired maximum uranium temperature range of 450-600 C. Two additional experimental assemblies, GEH-3-57 and 3-58, identical to GEH-3-31, were shipped to Arco, Idaho, for irradiation in the ETR.

The assembly of a series of capsules designed for irradiation in a Hanford reactor is proceeding. These experiments should determine the dependence of fuel element swelling upon cladding and uranium temperatures, cladding thickness, and exposure. A capsule was delivered to Irradiation Testing Operation for irradiation. Results from the irradiation of this capsule will be used to evaluate the accuracy of the physics and heat transfer calculations used to design the capsules. Final assembly of the remaining capsules must await the results of this test.

Self-Supported Aluminum Jacketed Fuel Elements. Self-supported fuel elements with collapsible rails attached to the jacket of the element are designed to accurately position the fuel element in smooth bore process tubes. The collapsible feature prevents tube damage in event of a fuel element failure. It also facilitates discharge of the element. A production test, IP-84-A, is now being irradiated in 105-B. This test has been expanded to include 13 tubes of I & E elements irradiated to 900 MWD/T.

A jig has been put into operation which prevents the weld current from penetrating the AlSi layer making it possible to attach supports with no disturbance of the AlSi beneath the weld area. This also insures no damage to the compound layer. Using this method, resistance spot welding is suitable for production attachment of supports to aluminum jacketed fuel elements.

Closure of Coextruded Rod Fuel Element by Brazed End Caps. A uranium machining and pickling operation could be eliminated from the preparation of coextruded rod fuel elements if the end caps could be attached by brazing. For this reason various brazing alloys are being studied in an effort to find one suitable for production assembly of these elements. A clamping jig which permits making linear brazed joints for simple, uniform evaluation of physical characteristics of different braze alloys has been designed and put into operation in the electron beam vacuum

system. The close proximity of the melting points of uranium and the braze alloys used to date makes temperature control a very critical factor. The search for a suitable braze with a lower melting point continues. Very limited observation indicates that a diffusion weld might be obtained by silver brazing and holding at temperature until the silver has diffused into the Zircaloy. The physical and chemical properties of such a joint have not been evaluated.

AlSi Bond Quality Studies. As a pre-requisite to investigations of causes and effects in bond quality, it has been agreed that the development of objective methods for determining bond frangibility should receive first consideration. Three approaches are being tried:

1. Modification of the Frost Test to permit extremely rapid heating of the slug jacket, whereby the jacket will be expanded away from the core in spots where the adhesive strength of the bond is less than the yield strength of the aluminum jacket ($\sim$4500 psi for 1245 Al at 100 C).

2. Chilling slugs in suitable refrigerant, followed by dipping them in boiling water. Rapid expansion of the jacket away from the core, as described above, is expected to cause fracture of weak bonds, detected by the accompanying snapping sound.

3. Use of a microcharacter hardness tester to scratch a groove across a polished specimen of the compound layer to be tested. The load necessary to cause spalling along the scratch groove would be a measure of the frangibility of the bond.

Of these, the first two would be destructive only of those slugs which should be rejected. The last, although completely destructive, should give a more revealing analysis of the bond structure, to aid in relating causes and effects.

Coextruded Zircaloy-2 Clad Uranium Fuel. The fuel element parameters which affect the failure behavior of defected coextruded Zircaloy-2 clad NPR uranium fuel are being investigated. Some of these parameters are: clad-core bond strength and ductility, clad thickness, diffusion zone thickness (bond zone), and nature of the defect.

No definite conclusions have been made as yet based upon the limited work to date, but it appears that:

1. The "as-extruded" bond is tenacious and may be embrittled by improper beta heat treatment of the uranium core.

2. The tenacity of the bond affects the manner in which defected elements behave; a tenacious bond tends to confine the uranium corrosion; an embrittled bond permits bond fracture and sporadic corrosion of the uranium core.

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3. The effect of clad thickness on defect behavior is affected by the bond strength. A strong ductile bond is desirable at all times. If the bond becomes embrittled, increased cladding thickness appears to decrease the harmful effect of this embrittlement.

4. Uniformly side-defected as-extruded fuel rods behave consistently in 300 C water in both the dynamic ELMO loop and a static autoclave. Failure appears more rapid under the dynamic conditions.

Mechanical Model for Void Growth During Swelling. A mechanical model was developed which can be used to analyze swelling data from constant temperature irradiations. The model assumes that swelling is caused by the growth of spherical voids. The rate of growth of the voids is assumed to be controlled by gas pressure inside the voids, relative dimensions of the voids and surrounding material, and creep resistance of the material. In order to evaluate the effective creep resistance of the material, the following data must be obtained:

1. Calculated gas pressures.
2. Experimentally measured number of voids per unit volume.
3. Change of density of the irradiated specimens.

If the number of voids remains constant, only the gas pressure and change in density need be known. The analysis is developed in such a manner as to evaluate the creep parameters of the material from the actual swelling data as functions of irradiation intensity, temperature, and material structure. A rough draft report of the method of analysis and data needed for its evaluation has been circulated for comments.

Volumetric distributions of void shapes in irradiated specimens need to be determined in order to evaluate the mechanisms of swelling. Only plane or linear distributions of areas or line segments can be determined experimentally, thus, an investigation of effects of various sphere distributions on linear and areal analyses was started. A method for determining sphere size distributions with a linear analysis of line segment lengths from uniformly random distributions of spheres was found in the literature. Since the actual distribution of voids in swelling specimens may not be uniformly random, more general methods of areal and linear analysis are being sought.

Evaluation of Cast I & E Elements. A shipment of 1000 I & E fuel elements prepared by American Bearing Company by static casting were sampled for examination of general quality and metallurgical properties at this stage of development. Examination of the material included chemistry, density, micro and macrostructure, mechanical properties, preferred orientation, and results of additional heat treatment. These examinations have been completed, and a report is being written concerning the results.

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Thermal Contact Conductance. The value of ex-reactor contact conductance measurements on fuel element materials will be increased provided a more accurate method can be developed for applying the results to in-reactor conditions. The 3x3 ETR loop facility makes it possible to measure the pressure dependence of contact conductance of materials under irradiation and as a function of burnup. A prototype element of a four-rod cluster designed to measure aluminum-uranium contact conductance in-reactor passed an autoclave exposure. These elements are made with ellipsoidal ends to avoid thermal ratcheting effects. A practical and easily fabricated spider for this type of four-rod cluster was made and tested.

Continuing the ex-reactor measurements, contact conductance of joints between sintered UO_2, stainless steel, and Zircaloy-2 were measured. Improved accuracy in the results was obtained on the systems involving uranium, stainless steel, and aluminum in contact. Use of one inch diameter instead of one-half inch diameter specimens accounts for the improved accuracy in contact conductance values.

Direct Casting of Uranium into Zircaloy Cans. Economics of casting uranium metal directly into Zircaloy cans show a substantial saving over coextrusion. Preliminary work has indicated that bonding can be attained in this manner. Zircaloy-2 I & E cans were fabricated from 1-1/2" and 1/2" tubing. These cans were bright HF etched and assembled into a graphite mold. Thermocouples were inserted at the top, center and bottom of the mold to record cooling temperatures. Three mold preheat temperatures of 675 C, 785 C, and 820 C were investigated, while the uranium was cast at 1475 C. Shrinkage of 0.015" per inch of length and 0.030" per inch of diameter was noted in each casting. Metallography has not been completed, but preliminary examination revealed a uniform bond. Carbides appear to precipitate along the grain boundaries, especially on the upper end of each element, which could account for the weaker bonds at that position.

Aluminum Clad Fuel Elements for High Temperature Exposure. Six aluminum clad fuel elements exposed 3500 hours to 370 C organic coolant by Coolant Testing Operation personnel were examined. Three, eight-inch long, AlSi bonded pieces displayed external evidence of diffusion in the forms of bumps and slight bulging of the end caps. Two I & E hot-pressed Ni bonded pieces showed no external change except the dark coloration characteristic of X-8001 alloy exposed to MTPB. All five of these pieces gave a good bond response to ultrasonic tests. The sixth piece was uranium, knurled to increase contact area and canned in aluminum by sizing and welding of the cap. A colloidal graphite layer effectively prevented diffusion between the uranium and aluminum.

ETR Recirculating Loop Facilities. Installation of the ETR 3x3 in-reactor tube is now scheduled for the week of October 5. A gamma heating experiment will be installed in the facility at the same time and gamma heat generation determined during the period in which loop operation is checked out. If no difficulties develop in the loop, the first fuel experiment will be loaded on or about October 15.

Placement of ex-reactor components for the 6x9 facility is essentially complete. The in-reactor portion of the facility had to be redesigned when Hanford obtained full-time use of the C-69 location to replace half-time use of the C-99 location. This redesign is now complete, and the in-reactor tube is out on bid. Beneficial use of the facility by January 1959 is still planned.

Mockups of the central portion of the 6x9 process tube are being fabricated for use in both the ETR critical facility and in the ETR proper. The critical facility will provide comparative flux measurements showing both the flux levels present during operation with this facility loaded and other experimental holes empty, and the perturbation of those flux levels as adjacent experiments are loaded in the reactor. The mockup placed in the ETR proper will be used to check the critical facility flux values and to determine the rate at which activity levels build up in the process tube. The latter information will be necessary in evaluating problems which will be encountered when the in-reactor tube is removed from the ETR.

2. REACTOR PROGRAM

Coolant Systems Development

Thermocouple Slug. The Doe alloy thermocouple slug in the high flux region of KER Loop 4 continues to show a slight increase in temperature of the surface with time. More data are needed at this loop operating temperature to show the temperature trend more clearly. Preliminary plans have been made to run a special thermocouple slug test in which the specific power of the slug will be measured. A KER nozzle cap using a Flexitallic type gasket torqued to 40 ft-lbs has successfully operated one week at 535 F and 1300 psi on ELMO-7 with no leakage. If such gaskets continue to operate satisfactorily, they will be recommended as replacements for the O-ring seals presently used on the KER nozzle caps for the thermocouple slug tests.

Prototype Equipment for Heated Slug Rupture Tests. A successful test run of 90 minutes was made with a solid rod producing 46.5 kw (8500 amps at 5.5 volts) to determine the compatibility of the generators with the low voltage requirements. This power requirement of 46.5 kw is close to that which will be required in testing two coextruded rods of a seven-rod cluster element with a rod diameter of 0.630 inch and Zircaloy-2 thickness of 30 mils. Such a test will produce a surface heat flux equivalent to an NPR fuel element operating at 200 kw/ft. Although some difficulty is being experienced in the fabrication of electrical insulating pieces for the fuel element, it is expected the initial test will be completed during the first week of October.

Rupture Testing of Fuel Elements. A KER size, aluminum clad, rod-in-tube fuel element, defected on the outside of the tube with a 25-mil hole through the jacket, was exposed to 300 C water for one hour in a water flow of 60 gpm. The fuel element was bonded to the aluminum jacket

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by the gas-pressure bonding technique. However, examination of the fuel element after exposure showed that it had ruptured in a pattern similar to unbonded elements. The whole uranium surface had been attacked, and the aluminum can swelled to a maximum of 2.5 inches. Rod-in-tube fuel elements using coextruded uranium and Zircaloy-2 will be tested soon.

Raw Water Heat Exchanger Studies. The heat exchangers in the Dowtherm Loop have run for a total of 79 days using raw water as the coolant. Water conditions are 7 fps velocity, inlet temperature 68 F, outlet temperature 212 F, and a maximum pipe wall temperature of 310 F. During this period a reduction of about five percent in the heat transfer coefficient was noted after 20 days. The coefficient has been quite constant since that time.

The raw water cooled heat exchanger test (ELMO-1) has been shut down after one year's operation. A ten-mil rust-colored scale formed on the stainless steel tubes, and a 1/8-inch (average) barnacle type scale formed on the carbon steel baffles after this time. Equipment will now be installed to permit chemical addition to study methods of removing the scale formed.

Radiation Effects on Aluminum Corrosion. Corrosion rates in 110 C, pH 7.0 process water for dummy fuel elements in the extreme downstream portion of the test channel (2943-KE) are estimated to be greater than rates on upstream pieces by a factor of 2.2. This increase indicates that some change is produced in the process water during passage through the reactor which affects aluminum corrosion. The extreme downstream and upstream samples were exposed to equivalent and relatively minor radiation flux. The increase factor of 2.2 was determined by statistical analysis based on industrial control chart principles. "Scatter" in the individual corrosion rate measurements was sufficient to prevent quantitative estimate of this factor without statistical analysis, although a graph of the corrosion rates versus sample position did indicate a difference in rates at the two ends of the test channel.

High Temperature Testing of Aluminum Clad Fuel Elements. Several aluminum-clad fuel elements were exposed in an out-of-reactor organic loop (ORA-1) at 370 C for a period of five months. One was an unbonded element clad in 1245 aluminum; the uranium was mechanically keyed to the aluminum and utilized graphite as a diffusion barrier; two elements were nickel plated, hot pressed, and clad in X-8001 aluminum (e.g., M-388); three elements were standard lead dip pieces and also clad in X-8001. All six elements looked good after the five-month exposure. The aluminum had only an extremely thin oxide film. The unbonded piece appeared to exhibit no racheting although the organic loop had been temperature cycled about 10 times during the test. The nickel plated pieces showed no bumps or pits and appeared to be in perfect shape. The AlSi pieces had some very small bumps. All pieces will be transmitted to Fuels Development Operation for detailed examinations and for metallographic inspections.

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Nonmetallic Materials Development

X-Ray Diffraction of Irradiated Graphite. A thorough analysis of x-ray diffraction lines of polycrystalline materials has indicated the types of information which can be derived by the Fourier analysis of the line shapes. By the use of the IBM 650 computer, the Fourier coefficients of x-ray diffraction lines have been obtained for a series of TSGBF graphite samples irradiated to varying neutron exposures at 30 C and 500 C. From a consideration of the variation of the Fourier coefficients with order of reflection, data were obtained on the crystallite size. In the C_o direction, the values decrease rapidly from an unirradiated value of 190 Å to 30 Å at 1000 MWD/AT, and then slowly decrease to 20 Å at 2400 MWD/AT. When two or more orders of reflection can be resolved, it is feasible to obtain data indicating the relative inhomogeneous distortion in the lattice. In addition, from a consideration of the phase angles of the complex Fourier coefficients, it is possible to obtain the mean lattice spacing in an unambiguous manner. Two reports will be issued soon on the theory and method employed and results of the peak shape analyses.

With the x-ray diffraction equipment now available irradiated graphite exhibits a very low peak to background intensity ratio, preventing the accurate determination of line shapes; hence, it has not been possible completely to utilize the theoretical techniques which have been developed for the analysis of x-ray data. Improved equipment is being obtained which will result in a more accurate determination of line shapes of irradiated samples.

Graphite Development. Samples of new types of graphite and of single crystal natural graphite supplied by the National Carbon Company have been prepared for short exposures in a cold test hole. Four series of samples are included in this test, and the irradiations are to be for 5, 10, 25, and 100 MD/AT. Included with the test samples are standard samples of CSF graphite to permit correlation of irradiation effects in the newer graphites with effects in CSF. It is the purpose of the experiments to clarify the nature of radiation damage in perfect crystals at low neutron exposures where the damage centers produced are simple. It is hoped that changes in dimensions of the crystals can be measured. These will be compared with changes observed in the crystal lattice parameters.

Testing of graphites for possible use in the NPR continued with receipt of samples from the Speer Carbon Company. The new graphites were manufactored from coke from Texas Lockport and Sohio Lima. Iron oxide was added at the time of mixing to increase the density without a second pitch impregnation. The physical properties of the resulting material were similar to those resulting from the standard AGOT process. Purification was accomplished by a chlorine treatment and resulted in a purity nearly as high as that obtained by the F process. Purity measurements in the 305 Test Pile indicated a d.i.h. value of +0.950 and +1.022 for the Texas and Sohio coke materials, respectively. F processed material usually has a d.i.h. of about 0.96 to 1.10. The

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irradiation behavior of these promising materials will be studied in the cooled and uncooled test holes.

Resistance of Elastomers to Immersion in Water Up To 175 C. A report is being prepared under the above title. Although all the data obtained in the program have not been thoroughly analyzed some of the important conclusions are now clear. The best materials on the basis of tests run up to 175 C in water (in the absence of radiation) in sealed systems for 1000 hours are the nitriles (Hycar 1002 is best), the silicones (Silastics S2096 and S2097 appear best), and the fluoroelastomers (Viton A polymer compounded properly appears best). It should be noted that because Hycar 1002 is only moderately resistant to heat aging in air, any seal made of this material should not come in contact with hot air for optimum performance. The silicones on the other hand are deteriorated more than the Hycar in hot water but are superior in air aging tests. They therefore should be used, if possible, in contact with air. The Vitons on the other hand are about equally resistant to air and water attack, but more work is required on compounding techniques to produce a Viton with the hot water resistance of the Hycar 1002.

Radiation Induced Oxidation to Plastics. A report, HW-57067, "Analysis of Oxygen Diffusion and Reaction in Polyethylene," has been issued. Work is currently under way to determine the effect of dose rate changes on the reaction. The theory indicates that as dose rates decrease, more oxidation will occur for a given gamma dose, and the oxidation will be distributed further into the sample.

Samples of irradiated Lexan have been sent to General Electric's New Product Development Laboratory, Pittsfield, to determine the intrinsic viscosity. This will help clarify the damage mechanism to this material. It is quite apparent from vacuum radiation studies that oxidation is not an important factor in the degradation.

Structural Materials Development

NPR and KER Tubing. Three of the four NPR process tubes received from Chase Brass and Copper Company have been cut in half and the six pieces sent to Tube Reducing Corporation for reduction to KER size. These tubes have been received and inspected by Tube Reducing Corporation and sent by them to Allegheny Ludlum Steel Company for vacuum annealing. Delivery of at least four tubes is scheduled for December 1, 1958.

Of the five NPR process tubes to have been produced by Mallory Sharon on DDR-28, only two were considered as possible candidates for acceptance under the contract specifications. These two were inspected at the plant of Tube Reducing Corporation on September 22-24. Neither tube passed this inspection, the principal defects being thin spots in the tube wall from excessive localized OD grinding, and several internal defects that appeared to be caused by lack of control in the sand blasting operation. The inside and outside surfaces, the ID, and the straightness of the tubes were all within the specified tolerances.

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Thermal Hydraulics Studies

Reactor Flow Hazard Studies. Experimental studies were continued to evaluate the seriousness of events following a rupture of a front hydraulic connector to a process tube at C Reactor. The full scale heat transfer apparatus was used to simulate an instantaneous rupture of a connector where the only flow then available to cool the fuel elements was that coming back through the process tube from the rear header. Tentative results to date are summarized by the following:

1. Adequate cooling of the simulated fuel elements was demonstrated for the case of a tube operating initially at 900 kw and 125 C outlet water temperature when the rear header pressure was 25 psig or greater. For rear header pressures below 20 psig the surface temperature of the simulated fuel elements was 450 C and still rising when the runs were terminated because of the probability of damaging the test section. In these runs the heat generation was decayed after scram according to a typical reactor decay curve to a value of about 80 kw. At this point the heat generation was held constant for the remainder of the run.

2. One run was attempted at a heat generation rate of 1250 kw and a rear header pressure of 20 psig. This run was terminated at six minutes after scram when the test section melted due to excessive temperatures.

It was thought probable that the experiments were unduly conservative and that conditions at the reactor might not be as severe as those experienced in the laboratory. Plans were made to modify the equipment for a closer simulation of actual reactor conditions in an effort to determine at what power levels and rear header pressure damage could be expected should a front connector fail on a reactor process tube.

Hydraulics Studies. IPD Operations at DR Reactor found a normal uranium I & E element on which a piece of masking tape had been placed over the female end of the hole channel. The plugged element was brought to the hydraulics laboratory for evaluation of the seriousness of possible flow blockage. It was found that the masking tape would have been removed by the water pressure during reactor startup and would have been undetectable to operations.

Experiments were conducted to determine the extent of process tube pressurization due to critical flow (e.g., velocity of sound) in the outlet fittings in the event of a rear pigtail rupture at the B-D-F type reactors. The experiments did indicate the existence of critical flow pressurization, but limitations of the hydraulics equipment prevented an evaluation of Pannellit protection for a process tube operating with a missing rear pigtail. Plans were made for further experimentation using the electrically heated apparatus.

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Calibration curves were determined for eight K venturis which had been reamed to larger than standard throat diameters. IPD will choose the size which they wish to use as the venturi for K Reactor I & E fuel element loadings.

Experiments indicated that use of a new slip joint pigtail would result in a 0.3 gpm flow increase through a B-D-F type process tube. Otherwise, the flow characteristics are almost identical to the normal helical shaped pigtail.

High Pressure Heat Transfer Apparatus. Construction was nearly completed on the heat exchanger test section. This test section was designed to evaluate the feasibility of operating a heat exchanger with a 500 F carbon steel surface in contact with cold Columbia River water.

Miscellaneous. Initial equipment was received on plant as part of the project to increase the DC heat generating capacity of the heat transfer laboratory to a nominal 2700 kw. Two rectifier transformers and the 13.8 KV switch gear were received.

Calculations were made to determine the heat transfer characteristics of a proposed uranium swelling test capsule. Required insulation to maintain specimen temperatures over a range from 300 C to 800 C was specified. Electrical heat requirements were also estimated to maintain near constant specimen temperatures during power fluctuations and reactor shutdowns.

Design was continued on a test section to be used for determining heater rod surface and cooling water temperatures when the rod is eccentrically located within the tube. This test section was designed to fit in a short heat transfer facility being provided for by a minor modification to the low pressure heat transfer apparatus.

Mechanical Equipment Development

Organic Cooling System Components. The MOTS-1 facility operated for 105 hours during the month. All down time was for inspection and reinstallation of the mechanical pump seals. Leakage through the Sealol seal could not be stopped, and the seal was removed. A small leak has developed in the John Crane seal and may necessitate removal of the seal in the near future.

Shielding Studies

Attenuation Studies. The results obtained in testing ordinary concrete baked at 100 C are reported in "Neutron Attenuation in Ordinary Concrete Baked at 100 C," (HW-57575, E. G. Peterson). The ferrophosphorus concrete test slabs are being baked at 200 C. The foils from the test on ferrophosphorus concrete baked at 100 C have been counted, and the data have been sent to IBM for processing.

Fast Neutron Spectrometer. The unit is operating continuously. Minor changes in the electronic equipment are still required and are being made as needed.

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Thermal Shield Studies. Partial disassembly of the C Reactor shield plug was again attempted. The cast iron nose piece was successfully removed and placed in its cask. Dose rates through the cask are low enough to present no problems in disposal of the nose piece. In attempting to remove the cooling panel, only one-half of the retaining screws could be removed.

Preparatory work has begun for NPR design test DT-1037: In-Reactor Test of Borated Mortar Thermal Shield. A rough draft of a detailed test procedure has been issued for comments and approval by IPD customer personnel.

Eighteen ion chambers for measuring shield gamma ray attenuation have been built, nine with two-wire cables and nine with three-wire cables. These instruments have been checked for fluctuations, quiescent current, and response to cable flexing, and appear to be satisfactory.

B. WEAPONS - 3000 PROGRAM

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

C. CUSTOMER WORK

Radiometallurgical Examinations

IP-148-AC Examination of Rupture From 0957-C (RM-247). The internally and externally cooled, enriched, fuel element, which failed in tube 0957-C, and was classified as a "split" type rupture, was sectioned. A wafer was removed two inches from the female end of the piece, and a section one and one-fourth inches long was removed adjacent to the wafer toward the male end of the slug. The bond between the AlSi and uranium had parted completely around the internal can wall in both of the removed sections. Reaction of the coolant with the uranium was noted on the internal surface in two locations in the central portion of the slug. The build-up of corrosion product as a result of the reaction caused the internal can wall to be displaced approximately 0.10 inch into the coolant annulus. The one and one-fourth-inch long section was broken apart along the uranium cleavage lines, and the internal can wall was easily removed from the section. Although the can wall was deformed by the reaction between the coolant and the uranium, no penetration of the can wall was observed.

Metallography Laboratories

X-ray diffraction analyses on samples of the bonding layers from Hanford fuel elements have made possible the identification of the compound USi_3. By means of special techniques and a precision back reflection goniometer developed by the x-ray laboratory, four checks were made on a small area of the compound formation which confirm the identity of the layer originally suspected to be

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USi_3 on a metallographic section. The identity of the other compounds formed during the canning process is still being confirmed.

Work recently completed on a series of compound layer samples indicates that the presence of silicon inhibits to some extent the growth of the layer formed between uranium and aluminum. Too great a concentration of silicon will cause the formation of a compound which is quite brittle. The optimum concentration of silicon in the AlSi portion of the duplex bath appears to be near nine percent silicon. The temperature of the duplex bath also has a decided effect. Temperatures below 605 C seem to promote formation of the brittle compound while temperatures above 610 C form the tougher UAl_3 type compound. However, too high a temperature will cause growth of the compound layers until they become brittle by virtue of their excessive thickness.

Samples Processed During the Month

Total samples processed	266
Photographs	
Macrographs	93
Micrographs	283
Total	376

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-57636 A2.

F. 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
NG Wittenbrock	9/14-18	US-AEC, Washington, DC	PRTR Safeguards Analysis.	CW McLaughlin	Yes
PA Scott	9/8-10 9/18-19	Byron Jackson Pump Co., Los Angeles, Calif.	Witness pump test.	A Bunke, E Dovidio	No
HK Nelson	9/18-19	Minneapolis-Honeywell, Philadelphia, Pa.	Technical liaison on PRTR controller contract.	BE Dahlin	No
DJ Foley	9/15-19	Consolidated Western Steel Div., Maywood, Calif.	Approval of vendor detail calandria drawings.	DJ Bentley	No
WA Burns	9/9-10	Yuba Heat Transfer Div., Honesdale, Pa.	Technical assistance on PRTR steam-generator design.	WD Comley	No
	9/11	Struthers-Wells Corp., Warren, Pa.	Technical assistance on PRTR small heat exchangers.	HA Backstrom	No
JC Fox	9/7-14	Tube Reducing Corp., Linden, N.J.	Purchase of PRTR process	EH Fisher RA Quadt	No
		Hunter-Douglas Aluminum Corp., Riverside, Calif.			
	9/29-30	General Mills Corp., Minneapolis, Minn.	Technical liaison on PRTR fueling vehicle design contract.	GC Kelly	No
RM Fryar	9/6-17	Tube Reducing Corp., Wallington, N.J.	Negotiation of a contract for fabrication of Zr & technical consultations.	SN Randall	No
		Hunter-Douglas, Riverside, Calif.		RA Quadt	No
		GE-APED, San Jose, Calif.		RD Bennett	No
ED Waters	9/27-10/3	GEL, Schenectady	Present paper at symposia	ND Fitzroy	No
		Wollensak Optical Co., Rochester, N.Y.		F Emens	No

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VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
PA Scott	9/29-10/3	Byron Jackson Co., Los Angeles, Calif.	Witness pump testing & engineering consultation.	A Bunke S Winstein	No
TK Bierlein	9/1-15	Intn'l Conf. on the Peaceful Uses of Atomic Energy, Geneva, Switzerland.	Present paper.	--	Yes
DC Kaulitz	9/8	Thermo Electric Co., Saddle Brook, N.J.	Discuss thermoelectric thermometry.	Mr. Gilliad	No
	9/9	Air Reduction Co., Union, N.J.		Mr. Thornquist	No
	9/9	E. C. Smith Co., Conshohocken, Pa.		EC Smith	No
	9/11	GE-ANP, Idaho Falls, Ida.	ETR high pressure loop installations.	Mr. Provost	Yes
JE Minor	9/11-12	GE-ANP, Phillips Pet. Co., Idaho Falls, Ida.	ETR high pressure loops & irradiation programs of GE in ETR & MTR.	R Neidner-GE Mr. Provost	Yes
MK Millhollen WE Roake	9/12-13	GE-APED, San Jose, Calif.	HAPO irradiation test in VBWR.	EW O'Rorke	No
WV Cummings	9/18-19	Mallinckrodt Chem. Wks., St. Charles, Mo.	Discuss preferred orientation in uranium.	JW Starbuck	Yes
KR Wheeler	9/22	Northrup Aircraft, Hawthorne, Calif.	Discuss electrolysis & electrolytic deposition of nickel on aluminum.	J Seymour	No
	9/22	Chem Plate, Los Angeles, Calif.		B Sherwood	No
	9/23	N. American Aircraft, Downey, Calif.		--	No
	9/23	General American Transp., Los Anglees, Calif.		Mr. Thompson	No
	9/24	Atomics Int'l.(NAA) Canoga Park, Calif.		GV Alm	No
	9/25	GE-APED, San Jose, Calif.		EW O'Rorke	No

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
KR Wheeler	9/26	Industrial Plating Seattle, Wn.	Discuss electrolysis & electrolytic deposition of nickel on aluminum.	W Fowley	No
	9/26	United Control Corp., Seattle, Wn.		RD Sollars	No
WL Wyman	9/29-30	Electrochemical Society, Ottawa, Canada	Present paper.	--	No
JM Skarpelos RW Stewart ID Thomas	9/2-3 9/2-4 9/2	UCRL, Livermore, Calif.	Project Whitney	WJ Ramsey	Yes
RK Koler TD Chikalla	9/7-8 9/8	Kux Machine Co., Chicago, Ill.	Design problems on fuel elements.	JJ Kux	No
JH Rector	9/24-30	Gorton Co., Racine, Wisc.	Discuss various types of	Mr. Gunderson	No
		American Tool Works, Cincinnati, O.		Mr. Hussey	No
		WJ & John Barns Co., Rockford, Ill.		R Binningham	No
YB Katayama	9/28-30	Ottawa, Canada	Attend Fused Salt Electrodeposition Conference	--	No
		ANL, Lemont, Ill.	Discuss UCRL Prog., single crystals & Pu fuel element fabrication.	LR Kelman	Yes
LD Turner	9/29-30	WAPD, Bettis Field, Pittsburgh, Pa.	Hot Laboratory operational problems.	RR Fouse	Yes
B Griggs	9/15	Kaiser Aluminum & Chemical Corp., Spokane, Wn.	Nickel plating aluminum.	DW Smith, GH Kissin HJ Wittrock	No

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VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
C Groot	9/29-10/3	Ottawa, Canada WAPD, Bettis Field, Pittsburgh, Pa.	Electrochem. Soc. Natl. Mtg. Discuss Zr pickling.	-- B Lustman W Hereford	No Yes
JW Riches	9/8-9	Tube Reducing Corp., Wallington, N.J.	Negotiation of contract. for fabrication of Zr.	SN Randall	No
	9/11-12	Hunter Douglas, Riverside, Calif.		RA Quadt	No
HP Oakes	9/9	Allegheny Ludlum, Watervliet, N.Y.	Consultation on fabrication of Zr.	RE Rohrabaugh	No
	9/11	Wolvertine Tube Co., Detroit, Mich.		EA Wright	No

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
MJ Sinnott	9/8-12	U. of Michigan, Ann Arbor, Mich.	Consultant Agreement 169	SH Bush JJ Cadwell OJ Wick	Yes	300, 326, 306 200-W, 231, 234-5
Carl Alexander Alex Lemmon	9/23	BMI, Columbus, O.	Critical & two-phase flow equipment.	TW Ambrose	No	100-D, 189
HD Hage EP Myers	9/25	Bechtel, Pac. Gas & Elec., San Francisco	Observe PRTR testing apparatus	JM Batch	No	100-D, 189
EC Fiss WN Thomas	9/19	CVNPA, Charlotte, N.C.	Observe PRTR facilities.	JM Batch	No	100-D, 189
DL Burman CW McLaughlin Sheldon Meyers	9/19	AEC, Washington, DC AEC, New York, N.Y.	" " "	"	"	"

VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
AR Del Campo HW Granes, Jr. RF Sterling HG Thorp, II RK McGeary RG McGrath	9/19	WAPD, Pittsburgh, Pa.	Observe PRTR facilities.	RH Purcell H Harty RM Fryar JM Batch	No	300, 325 100-D, 189
EW O'Rorke D Eldred	9/15	APED, San Jose	Fuel element discussions	JJ Cadwell EA Evans SH Bush	Access Permittees	300, 325, 326
JD Rogers	9/17-18	Philips Elec. San Francisco	Service electron microscope.	B Mastel	No	300, 326
HR Holmes	9/19	Sandia Corp., Albuquerque, N.M.	Discuss cathode vacuum etching.	B Mastel	No	300, 326
JP Darginis HR Johnson	9/19	Sandia Corp., Livermore, Calif.	"	"	"	"
P Berner	9/24	Star Machinery Co., Seattle, Wn.	Discuss belt centerless grinding equipment	WE Roake RJ Anicetti	No	300, 325
AV Lislin S Nakazato	9/10	Aerojet-General Nucleonics, San Ramon, Calif.	Radiometallurgical examination of prototype fuel.	LD Turner	No	300, 327
J Whealdon	9/2	Air Supply Co.,	Engineering discussions	R Harrington	No	300, 326
LM Doney	9/25	ORNL, Oak Ridge	Discuss coatings for graphite	EA Evans DE Baker, TJ Clark, JM Davidson	No	300, 326
WE Ruther NR Grant G Panter MJ Whitman	9/9-10	ANL, Lemont, Ill. Allis Chalmers, Minneapolis, Minn. AEC - DRD, Washington, DC	Aluminum Alloy Task Force & consult on aluminum	JA Ayres RJ Lobsinger RL Dillon VR Troutner C Groot FW Woodfield JW Riches	Yes	100-K, 1706-KE, 1704 300, 314, 328, 325 700, 703

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VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
WE Traggert G Oxx	9/15	GERL, Schenectady	Discuss corrosion tests	JA Ayres RJ Lobsinger GE Neibaur C Groot FW Woodfield JW Riches FW Albaugh	Yes	100-K, 1704, 1706-KE 300, 328
EW O'Rorke D Eldred WE Traggert G Oxx	9/16	APED, San Jose GERL, Schenectady	Discuss aluminum cermets	JA Ayres C Groot RL Dillon JW Riches FW Woodfield	Yes	300, 328, 326

4000 PROGRAM RESEARCH AND DEVELOPMENT

REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATION

PLUTONIUM RECYCLE PROGRAM

Plutonium Fuels Development

Irradiation Testing. The alloy cores with nominal compositions of Al - 5, 10, 15 and 20 w/o Pu and Al - 12 w/o Si - 5, 10, 15 and 20 w/o Pu which are to be irradiated in the MTR under tests GEH-3-33 through 40 have been prepared for final assembly. The chemical analyses received to date indicate that the actual alloy compositions are approximately Al - 5, 12, 14 and 20 w/o Pu and Al - 12 w/o Si - 5, 9, 19, 22 w/o Pu. Two analytical results were obtained from each end of every capsule. Considerable variation between determined values was noted. Additional samples are being submitted to verify earlier results.

Calculations have been completed for the PuO_2-UO_2 mixed crystal oxide capsules which are to have the concentration of plutonium adjusted so that the capsules are equivalent from a heat generation viewpoint to similar size capsules of Al - 1.8, 5, 10, 15 and 20 w/o Pu alloy. The Al - 5 w/o Pu alloy case is going to be rerun since there appears to be a discrepancy in the data. It was found that the macroscopic fission cross sections for the mixed crystal oxide capsules were 0.0933, 0.2592, 0.5185, 0.7777, and 1.0370 cm^{-1} for the equivalent alloys of Al - 1.8, 5, 10, 15 and 20 w/o Pu, respectively.

Al - 1.8 w/o Pu irradiation capsules are being fabricated by injection casting techniques. These capsules will be irradiated in the MTR and will provide data on the effect of imperfections (gas voids, microshrinkage) and microstructure on the radiation stability of the cores. One capsule has been fabricated, and another capsule is planned. After casting the next capsule, the ends of both samples will be prepared and end closures will be made.

One, four-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. A second cluster of similar design which has been fabricated and delivered to the reactor is to be charged in Loop 1 at the next scheduled loading date.

Plutonium Oxide Fuel Materials. Hydrogen atmosphere sintering facilities have been completed and put into use. A sixty-four-hour helium pressure test at 15 psig indicated the system was leak free. The furnace was dried out slowly under vacuum at temperatures up to 900 C. Pellets of UO_2 and UO_2-PuO_2 mixed crystal (14.8 w/o Pu) were sintered for one hour at 1000 C in de-oxidized helium. A large difference in sinterability was observed, the mixed crystal oxide exhibiting a 20% greater increase in density. To simulate the proposed Al - 1.8 w/o Pu alloy from a heat generation standpoint, the mixed crystal oxide was diluted with UO_2 to produce a mixture containing 0.0259 a/o Pu. Although it was planned to hold the pressed pellets in hydrogen at 1700 C for six hours,

the molybdenum heating element failed at 1480 C. Upon examination it was again noted that the Pu-containing pieces were of higher density than UO_2, the difference being roughly three percent.

Injection Casting Development. The prototype air pressure injection casting equipment recently installed in 231-Z Building is being evaluated. Some difficulty has been experienced with making vacuum tight seals around the silicon carbide dip tube on this equipment. There are many imperfect threads on this ceramic part, and it is not possible to use conventional sealing materials because of the high temperatures involved. When this problem is solved, the development work on this equipment will continue.

The Kux Machine Company has completed the design engineering on the fuel element containment block which will fit their 400-ton cold chamber die casting machine. Fabrication of all components has been started and is expected to be complete by October 6, 1958. Kux will then begin prototype casting experiments under the direction of HAPO engineering personnel. These experiments are expected to take approximately five days.

Extrusion Development. A number of 1100 aluminum, 6063 aluminum, and U-Al alloy billets were extruded to 0.500 nominal diameter rod. The 1100 and 6063 billets were wrought, and the U-Al billets were cast from melts containing 1.8, 6, 10, 15 and 20 w/o uranium. All billets were extruded through a ratio of 27 to 1 (98 percent reduction in area) using oil dag as a lubricant for the container and flat face shear dies. Billet temperatures ranged from 300 to 500 C, and die temperatures ranged from room temperature to 200 C. Extrusion constants as a function of billet temperature were determined; however, results were not of sufficient precision to give a good correlation.

The average maximum diameter variation from one end of the extrusion to the other was 0.0008 and 0.001 inch for the 1100 and U-Al alloy billets, respectively. In all cases the smaller end of the extrusion was the first end through the die. One very interesting item was discovered. The diameter variation appeared to be dependent upon the throat radius of the die as illustrated in Table I. This variation in diameter could not be correlated with composition or extrusion temperature. The average maximum diameter variation was the same whether the extrusion was 10 feet or 21 feet long. This phenomenon was attributed to the cooling effect of the container. All of the rod extrusions were round within an indicated reading of 0.0005 inch or less.

TABLE I

Die Throat Radius	Avg. Max. Dia. Var. From end to end
0.005 inch	0.0006 inch
0.010	0.001
0.015	0.001 (two extrusions)
0.025	0.0019

The ratio of the die throat diameter and extrusion diameter proved to be slightly affected by extrusion temperature. On an average, extrusions made through the same die increased in diameter 0.0003-0.0005 inch when the extrusion temperature was decreased from 500 to 400 C. This effect is attributed to the change in springback. These experiments show that the 280-ton extrusion press can extrude PRTR fuel element cores to size without any further sizing operation. The extrusion constant data indicate a capacity of three to four rods per extrusion.

Prototype extrusion equipment was designed and fabricated for use in the 443,000# Baldwin Universal testing machine. This equipment will provide initial data on Al-Pu and core material for irradiation test specimens. Initial cold testing proved very satisfactory, and the extrusion fixture was installed in the portable testing hood. Tests will resume when a broken part has been replaced.

Ten 1100 aluminum alloy extrusions were straightened in the Sutton rod straightener. Proper operation of the machine was found to be an art. All ten rods were straightened enough to roll on a flat surface. These rods had excellent surfaces. The straightener did not take out end-to-end diameter variations as might be expected. The quality of the extrusion determines the quality of the core.

Pyrometallurgical Techniques. A process for the recovery of Pu from irradiated Al-Pu alloys was previously described. Briefly, molten bismuth is used to extract the Pu from the Al alloy; results indicate no minimum limit to which the Pu concentration may be reduced in the Al alloy. Pu concentration was reduced to 0.1% Pu in one experiment, but no attempt was made to reduce this concentration further. Chalk River (CRC-639) reported the partition coefficient (mole fraction Pu in Bi/mole fraction Pu in Al) varied from approximately six to eight, depending upon temperature. Comparable results from the recent Hanford work have indicated a slightly lower number, varying from three to six. The Pu is extracted from the Bi with molten caustic soda. This extraction is virtually quantitative with a 10 w/o caustic addition. The Pu concentration in the Bi may be reduced to 0.001 w/o. The Pu is then recovered by leaching the caustic with hot water and acid. The residue, containing Pu in an oxidized state, is dried and added to an aluminum melt which is mixed with cryolite. The Al reduces the Pu, and the aluminum oxide which is formed is dissolved in the cryolite flux. In a small scale experiment in which 8.8 g of Pu was extracted by Bi from a 2 w/o Pu-Al alloy, 7.7 g was recovered in a 5.5 w/o Pu-Al alloy using this process, or a recovery of 87.5 percent of the Pu extracted by the Bi in this experiment.

Although Pu is successfully extracted from an Al-Pu alloy by Bi, the reverse occurs when Si is added to the system. Molten Bi does not extract Pu from an Al - 11 w/o Si alloy, and indeed the converse is true. Al - 11 w/o Si extracts essentially all of the Pu from a Bi-Pu alloy. Also, although the chemical analyses are not complete, the preliminary data indicate that Si metal alone will extract Pu from molten Bi. Granular Si metal was dispersed in a molten Pu-Bi alloy. The Pu apparently formed an intermetallic compound on the Si surface which oxidized, glowing brightly, when the silicon particles floated to the surface. The Pu-Si was removed from the Bi by skimming. The Pu-Si may be alloyed directly with Al, or the Pu may be separated by dissolution and precipitation.

A rather simple one shot reprocessing scheme would be the extraction of Pu from an Al-Pu alloy into Bi followed by the extraction of Pu from the Bi by an AlSi alloy.

Experiments are being made to determine whether the Pu concentration in the resulting AlSi alloy can be made appreciably higher than the Pu concentration in the starting Al alloy. Since in the Pu-Si compound, Pu_xSi_y, which is formed, the ratio of y:x is probably 2:1 or less, a relatively small amount of Si would be required to extract the Pu from the Bi alloy. Thus, it should be possible to make an AlSi alloy with a Pu concentration substantially higher than the Pu concentration of the initial Al alloy. Of course, to reprocess the Pu-Al-Si alloy other pyrometallurgical processes would be employed.

Fuel Element Rod Loading. The feasibility of loading a full length extruded aluminum core into a closed end Zircaloy tube had not been previously demonstrated. Preliminary insertion tests were run with makeshift equipment to obtain data on clearances required. The results of these tests are shown in Table II. All rods and tubes used in these experiments were vapor and swab degreased with trichlorethylene but were not etched or pickled other than that treatment done by the tube fabricator. All rods were extruded from type 1100 aluminum alloy wrought billets and straightened. Rods were seven feet, four inches or longer, and the closed-end tubes were seven feet, five and one-half inches or longer. Tube diameters were checked by air gage, and the rods were measured every six inches using a micrometer. Each reinsertion became more difficult due to aluminum pickup on the tube wall.

TABLE II

Rod* Dia.	Jacket Material	Tube Min.Dia.	Tube Max.Dia.	Tube Avg.Dia.	Results
0.503 ± 0.0005	Zircaloy	0.5055	0.507	0.506	Rod was inserted and withdrawn several times.
0.504 ± 0.0005	"	0.5065	0.507	0.5068	Rod was inserted halfway in. A dent prevented any further insertion.[1]
0.504 ± 0.0005	S. Steel	0.5055	0.5065	0.506	Rod slipped in easily.
0.501 ± 0.005	Zircaloy	0.5025	0.507	Unknown[2]	Rod slipped in except last eight inches.

*Rods and tubes were dry and unlubricated.

1. Rod was honed out from 0.5055-0.507 to 0.5065-0.507 using an aluminum rod and grinding compound. Tube was unknowingly dented before an insertion test could be made.

2. Due to the maximum diameter of the probehead (0.504") an air gage reading could be made of the first half of the tube only. After the test the welded end of the tube was sawed off and measured 0.5025" at a distance eight inches inside the tube.

Plutonium Fuels Welding Development. An extension tube has been installed on the vacuum welding box, which will permit two rods to be placed in it at one time. The tube is in the form of an air lock to make it possible to remove the rods without losing the inert atmosphere in the main part of the box.

The welding chamber for PFPP is being designed to accommodate 19 oxide rods in a vertical position in case it is necessary to make a head closure on the oxide elements.

UO_2 Fuel Development

Swaged UO_2 Fuel Elements. The irradiation of eight, four-rod cluster fuel element assemblies in KER Loops 1 and 3 has continued successfully since charging of the material on August 4, 1958. The fuel elements contain natural and 1.6 w/o enriched UO_2 swaged in either Zircaloy-2 or stainless steel jackets to UO_2 core densities which are 81 to 89 percent of the theoretical. Six of the elements are 18 inches long, and two are 12 inches in length; the individual rods are 0.625 inch OD.

In another production reactor, a three-foot long, stainless steel clad, swaged fuel element charged in May is still under irradiation.

Under irradiation in the MTR and ETR are seven swaged capsules of natural and 2.44 w/o enriched UO_2. These capsules are to be irradiated to exposures of more than 10,000 MWD/T, with maximum core temperatures at approximately the melting point of UO_2.

Fabrication of nine swaged UO_2 (2.42 percent U-235) fuel rods 27.8 inches long by 0.558 inch OD was completed, and the material has been delivered to the VBWR for irradiation testing.

Irradiation of Tubular Fuel Elements. Uranium dioxide (eight percent U-235) rings, 2.3-inch OD x 1.8-inch ID x 1/2-inch long, are being fabricated for the second six-foot tubular assembly to be irradiated in the SRE as part of a joint HAPO-AI program. Three feet of the rings are being drilled with six 0.033-inch thermocouple holes. Approximately 15 pounds of eight percent enriched uranium in grinding sludge was reclaimed by chemical dissolution and solvent extraction.

Irradiation of Unsintered Fuel. A plutonium-enriched fuel assembly has completed one irradiation cycle in the MTR, generating a power of approximately 30 kw/ft. The three-rod, Zircaloy-clad cluster is 11.4 inches long, and consists of one rod of 2.47 w/o U-235 enriched UO_2 and two rods containing UO_2 with 0.88 w/o plutonium oxide. The plutonium-bearing rods were prepared by diluting PuO_2-UO_2 mixed crystals with natural UO_2; this phase of the work was performed by the Chemical Research and Development Operation.

High Temperature UO_2 Irradiation Studies. The in-reactor, and ex-reactor, behavior of ceramic fuel materials at extreme temperatures is being studied, Four elements containing loose, unsintered, enriched UO_2 in Zircaloy-3 cans six inches long and one inch OD were irradiated, and post-irradiation examination is being continued. The following additional information has been obtained.

1. The cladding failure in the second irradiation test was caused by insufficient cooling at the end cap of one of the two elements. Coolant water was unable to reach the area between the two elements.

2. A heat flux in excess of 700,000 BTU/hr/ft^2 was generated in the region where the UO_2 had concentrated after sintering. No reaction was observed between the Zircaloy-3 thin-walled tube and the UO_2.

3. The composition of the gases removed from the two test elements from each of the two irradiations differed greatly. A large percentage of the gas from the first test was hydrogen, whereas carbon dioxide was the primary component of the gas from the second test. Identical UO_2 powder was used in both tests, except that the UO_2 used in the second irradiation had been exposed to the air for four months. The quantity of fission gases released was approximately the same in both irradiation tests.

Thermal Conductivity of UO_2. Preliminary data from the joint test program with BMI indicate that 94.3 percent dense, unirradiated UO_2 has a lower thermal conductivity than expected. Similar UO_2 specimens have now been irradiated and are awaiting shipment to BMI.

High Temperature UO_2 Studies. The utilization of high temperature generating equipment for ex-reactor thermal studies is part of a program for conceiving and evaluating improved ceramic fuel cores for the PRTR. The carbon-arc image furnace was operated at a power level of approximately 12 kw. A total of fifty samples of UO_2, UO_2 containing additives, UC, and UN were heated in a flowing helium atmosphere. In addition, samples of stoichiometric and non-stoichiometric UO_2, UC, and UN were heated in a steam atmosphere. A high temperature microscope was used for visual studies and motion picture studies of the high temperature phenomena. Temperatures were determined with a recording multicolor pyrometer designed and constructed for use with the image furnace. Reports describing this pyrometer and its operating characteristics have been prepared.

Corrosion Studies

PRTR Shot Corrosion Test. Corrosion tests of steel shot in inhibited, softened water have been completed. Tests with filming amine type inhibitors showed some improvement over untreated water as shown in the table below, but not nearly enough to be considered for PRTR use. The addition of caustic to increase the water to a pH of 10 to 11 also showed some improvement over uninhibited water, but the equipment was susceptible to plugging by precipitation of calcium carbonate if the quality of the softened water was not constantly maintained. It appears that some other means will be needed to minimize corrosion of the shot. Possible alternatives are a corrosion resistant shot made from a material such as duriron or stainless steel. An inhibited recirculating system, which can be deoxygenated, would also be satisfactory from a corrosion standpoint.

Starting Wt. (lb)	Wt. Loss (lb)	Testing Time (days)	Inhibitor	Percent Flow Capacity Remaining at End of Test
15.57	0.45	48	None	92%
15.57	0.35	30	Caustic added-pH 10 to 11	30% (after acid treatment to remove some $CaCO_3$-flow increased to 84%)
15.57	0.31	30	12 ppm diethylenetriamine	92%
15.57	0.18	48	12 ppm Cronox 192	96%

Use of Ammonium Fluoride as a Pre-Treatment Etch for Zircaloy-2. Zirconium alloys are subject to corrosion from surface contamination. It is necessary to remove contaminants by a surface etch before meaningful corrosion testing can be performed. A mixture of nitric and hydrofluoric acids is commonly used but is difficult to handle and evolves noxious fumes. Other etchants are being sought which would eliminate these disadvantages. An ammonium fluoride-hydrogen peroxide-acetic acid solution at pH 5 is currently being evaluated. The following facts have been established:

1. The rate of dissolution of zirconium increases with temperature and with ammonium fluoride concentration. Hydrogen is evolved. Ammonium fluoride solutions at room temperature have difficulty breaking through the ZrO_2 film on the metal. This results in a slow uneven etch.

2. While zirconium reacts with ammonium fluoride, the alloying ingredients of Zr-2 (mostly tin) do not. These alloying ingredients deposit on the Zr-2 surfaces as a black sludge. This sludge interferes with the etching operation and results in an uneven etch.

3. If the etching is done at about room temperature, this sludge dissolves readily in concentrated HNO_3. If the etching is done in a hot solution, the sludge dissolves slowly in concentrated HNO_3.

4. Since the etching rate is governed by the unionized HF concentration, the addition of a weak acid such as acetic acid increases the etching rate. This solution will etch Zircaloy at room temperature, but the sludge problem remains.

5. Since the sludge is predominantly metallic tin, the addition of an oxidizing agent should oxidize the tin to a soluble form. This is one function of the HNO_3 in the standard HNO_3-HF etch. Sodium nitrate, sodium dichromate, and potassium permanganate were added to

the ammonium fluoride-acetic acid bath. All reduced the etch rate and were all unsatisfactory. However, hydrogen peroxide was found to prevent sludge formation. Hydrogen evolution was reduced but not stopped.

This new etch solution would have the following potential advantages:

1. No noxious fumes are given off during the etch operation (hydrogen is evolved, however, and small amounts of HF would be given off.)

2. The solution is a weak acid of pH 5 and could be handled more safely than the standard HNO_3-HF etch.

3. It is possible that the solution can be used in stainless steel equipment. Although no corrosion rates have yet been measured, all work has been done in stainless steel beakers with no visible signs of attack over an eight-hour period.

4. The solution can be used at room temperature and could be buffered to provide a constant HF concentration.

The solution would have the following disadvantages:

1. The solution is not as effective in removing zirconium oxide, fingerprints, marks, etc., as the HNO_3-HF etch and does not produce as bright an etch.

2. Evolution of hydrogen raises the question of hydriding Zr during etching.

3. Hydrogen peroxide is unstable and would slowly decompose on standing.

4. As with the HNO_3-HF etch, accelerated etching occurs at the contact points.

It may be concluded that although the solution is not as effective an etchant as the HNO_3-HF standard etch, it is easier to handle and work with. It is possible the solution may be effective enough for use on a production basis. Further work will evaluate what degree of effectiveness is required.

PRTR Process Tubes. An order was placed with Tube Reducing Corporation for 100 PRTR process tubes. Chase Brass is to produce the extrusions from billets forged by Heppenstall Company. Forging of the last of the ingots was witnessed at the Heppenstall plant in Bridgeport on the morning of September 24, and the forgings from the previous day's production were inspected. On the afternoon of September 24, this latter group of forgings was in the shop of Chase Brass being cut to billet size.

Sample lengths of tubing manufactured by a process similar to that to be used for the 100 PRTR process tubes were tested to failure at 300 C. The calculated

ultimate stress averaged 45,000 psi for the annealed tubing. This value is approximately 50% greater than results from tensile specimens cut from rolled and annealed strip. Fabrication and annealing history are the most likely causes for this difference. Analysis of subsequent tests on tubing having varied fabrication and annealing histories will determine the cause and reproducibility of this phenomenon.

PRTR Jacket Tubing. On September 26, final modifications were made in the atmosphere chamber on the rib-to-tube welding machine at New Rochelle Tool Company. The first weld produced in this chamber looked good but was removed from the chamber before it was adequately cooled. The weld was bright on removal from the machine but colored rapidly when exposed to air. A malfunction of the machine ruined the second weld and necessitated replacement of a part before additional welds could be made.

In the effort by Nuclear Metals to produce ribbed jacket tubing by extrusion, a revision has been found necessary in the method contemplated for final sizing. This was to have been done by extruding the tubing slightly undersize and expanding to final dimension. Efforts have been unsuccessful thus far in expanding this tubing by the necessary amount while maintaining it round. It is now believed that the proper method would be to extrude oversize and draw down to final dimensions. An attempt will be made to prove this method on the remaining extrusions. The tubes thus formed will be below our specifications by 30 mils or so but will indicate the feasibility of the process. An attempt is being made to produce one set of tubes to our dimensions. This has been accomplished on the smallest tube, but it appears that the two larger sizes will be about five mils undersize.

The initial shipment of Zircaloy-2 tubing for the plutonium-bearing, 19-rod fuel element was received from Wolverine Tube Company within nine weeks after delivery of ingots to the vendor.

Radiometallurgy Laboratory Studies

Examination has continued on the ruptured UO_2 powder element (GEH-4-30). The Zircaloy-3 cap, which was the water entry side, has been etched successfully, and metallography is in progress. The results and conclusions are reported in connection with the respective development program.

Thermal Hydraulics Studies

Thermal Hydraulic Studies Associated With the PRTR. Fabrication of the electrically heated mockup of the Mark II B element was 98 percent complete. It became necessary to bore out the process tube to remove the shrinkage that occurred when the pressure tap connections were welded on.

Purchase requisitions were issued for materials to construct a full size electrically heated mokcup of the Mark I fuel element.

Equipment was designed to determine local heat transfer coefficients along each rod of a 19-rod cluster fuel element. A special sensing probe was designed to

be used to replace any of six rods and will be movable along the length of the fuel rods. The sensing probe consists of resistance ribbon wrapped around a plastic rod. The ribbon will be heated by a small amount of DC power and the ribbon temperature measured by thermocouples placed under the ribbon. The power supplied to the ribbon, the ribbon temperature, and the bulk water temperature permit local heat transfer coefficients to be calculated.

Plans were made to run selected experiments designed to investigate certain air cooling characteristics of PRTR type fuel elements. As planned, the experiments will consist of the following:

1. A short test section of an electrically heated outer Mark II B element with associated duct work to simulate air cooling in the fuel examination cell.

2. A short test section of the Mark I element with the same duct work as in (1).

3. The use of a full scale Mark I electrically heated mockup for determination of surface temperature in free air.

Response times were determined for prototype models of the 0 to 10 psi differential pressure monitors proposed for use on the PRTR. The response times for both instruments (Panellit and Bristol) were between 0.75 and 0.90 second for trip set at 75 percent of full scale while imposing a flow reduction from 100 percent to 60 percent of full scale. This is 3-1/2 to 4 times the response time of the 0 to 25 psi monitors but is not unexpected since the bellows displacement of the 0 to 10 psi monitors is about five times that of the faster 0 to 25 psi gauges.

Mechanical Equipment Development

Design Test PR-20 - Calandria Characteristics. The conversion of the calandria mockup flow system to recirculation is 90 percent completed. Flow monitoring instruments are being calibrated by the Thermal Hydraulics Operation.

Design Test PR-25 - Shroud Tube Bellows. Testing of bellows submitted by various manufacturers continued. The new design by the Parts Engineering Company is currently being flex tested. The leak rate is approximately two cubic feet of air per hour at a pressure of two psi.

Aluminum ends were cast on two bellows that had previously failed the cycling test. The bellows were flex tested successfully; however, the leak rate was excessive due to the short embedded length of the bellow's ends.

Design Test PR-25 - Shroud Tube Collapsing Pressures and Installation. The final report, HW-57089, has been issued.

Design Test PR-50 - Reactor Piping Seal Testing. Nozzle cap assembly "A", using two restrained flesitallic gaskets, was thermocycled 1100 times with an average

leakage of 0.2 cc/cycle. Testing was discontinued due to a 180° fracture of the housing near the base of the seal surface. A large stress concentration existed at this point. The reactor nozzles are being redesigned by Construction Engineering Operation to eliminate this stress concentration point.

Process tube assembly "A" is being prepared for installation on ELMO-7. A prototype gas seal, inlet fitting shroud, and nozzle cap flexitallic gasket will be included on the assembly. Process tube assembly "B" has been thermocycled 460 times without noticeable leakage.

The process tube outlet packing tests were completed. The successful packing was an aluminum ring with a tear drop cross-section.

Design Test PR-51 - Reactor Piping Structural Integrity. Fabrication of the jumpers and jumper piping for the outlet face mockup is 60 percent complete. The dummy nozzles for the same mockup are approximately 15 percent complete. Flexure testing of outlet jumpers will begin in October.

Design Test PR-63 - Process Channel Leak Detection Facility. The final report is being prepared.

Single Tube Prototype Mockup. The operating manual for Phase I has been issued. Construction of this phase except for lagging and minor pipe work was essentially complete. The remainder of the work will be done at the time of the installation of the primary pump.

The hot test of this pump at the Byron Jackson Pump Company plant was stopped after 48 hours due to excessive vibration at speeds about 2500 rpm. The pump will be rebalanced and the hot test repeated. The mechanical seals performed well at speeds to 2700 rpm, suction pressures to 1600 psi, and temperatures to 550 F.

PRTR Inlet Valves. Testing of the 1-1/2" valves continued on ELMO-7 during the month. The leakage is below measurable amounts with the present hooding and collecting arrangements.

PRTR Eight-Inch Check Valve. The vendor has proposed internal counterweights to maintain the required 10° opening when the valve is installed downward at an angle of 17-1/2°. A drawing and the estimated cost of the change will be received shortly.

Shielding Studies

PRTR Shielding. The review of the PRTR shielding was continued. The thickness of the top shield for the fuel element examination facility and dose rates through the fuel element cask shielding were calculated.

PRTR Process Instrumentation. Several tests on the flow monitors are being repeated before issuing a preliminary report. One vendor requested the return of an instrument for further modification. Accelerated life tests on the units are awaiting final assembly of test equipment.

The Engelhard clamp-on resistance temperature detectors are continuing on the thermal cycling life tests. One of these units appears to have changed its characteristics after cycling. Another unit was found to be shorted to its case on arrival, and the instrument is being replaced by the vendor. Two wrap-around prototypes were received from Aero Research, Inc. The connector to the sensor of both units melted at 500 F during the first calibration check. These instruments are being returned to the vendor for repair.

A composite purchase specification was prepared which combined three specifications previously written for a temperature alarm system, a data reduction system and a power calculator. The composite specification was limited to combining the three individual specifications without change in design. A comparison of costs between this limited systems approach and the individual specification method may be possible. The final draft of the power calculator report will be submitted as soon as the vendors complete their estimates.

PRTR Design Development

Construction Status. The Phase I PRTR contract is approximately 24 percent completed versus 37 percent scheduled. Difficulty was experienced in affixing the hydromat membrane to the containment vessel shell. Additional problems were encountered in the use of an automatic welding machine and in the repairing of defective welds.

The Phase II PRTR contract is approximately on schedule with about six percent completed versus eight percent scheduled. Permission was given to the contractor to accelerate the structural part of his work by completing the service building in two parts. The pouring of concrete during the winter months will also be avoided by this change.

Design Status. A critical review of the Phase III bid assembly was conducted during the month and a majority of necessary revisions and corrections to drawings and specifications were completed. The bid assembly was mailed to interested contractors and building associations on September 17. Bids will be opened on October 29.

Invitations to bid on Phase II-A (River Pump and Condenser Facility) were mailed during the month, with bids scheduled for opening on October 23.

Fueling vehicle design was essentially completed during the month except for final review and comment.

Fuel Element Examination Facility. The design criteria for the Fuel Element Examination Facility (HW-48116) was completed and approved, and is being prepared for issuance at month's end. Funds were authorized for the design of shielding and services to be performed by Construction Engineering Operation.

Instrumentation and Control. The Minneapolis-Honeywell analysis of the automatic controller for moderator level was essentially completed. Optimum ranges and values for proportional band, reset rate, and derivative action have been established for all expected PRTR operating conditions. The installation of

manual control features to supplement the automatic controller and eliminate feedback effects during reactivity tests was considered in detail.

Several changes in the shim control assembly were made to achieve a more positive seal and attachment to the top shield, simplified external wiring, and reduced loading error in the position transmitting system. Assembly prototype parts are being fabricated by APED, and delivery for on-site environmental testing is expected in mid-November.

PRTR Physics. Reactivity calculations were extended to include various loadings of the Mark I, 19-rod cluster UO_2 fuel assemblies (the most probable startup charge) with 1.65 percent Pu-Al spike fuel. Preliminary results indicate approximately the same number of spike columns will be required for the Mark I loading as for Mark II B in most cases. This is due primarily to the fact that the lower plutonium concentration used in the Pu-Al assembly (1.65 percent instead of 1.8 percent) is offset by the lower negative fuel reactivity coefficient of the Mark I UO_2 fuel compared with the Mark II B UO_2 fuel.

Pressurized Gas-Cooled Loop Facility. Revision of the project proposal for this facility was undertaken to incorporate changes required to permit irradiation of fissionable materials. The revisions will increase the project cost to approximately $800 thousand.

Shielding requirements are currently being studied. Preliminary calculations of radiation levels at the surface of a typical portion of unshielded loop piping show an expected dose rate of about 1.7×10^5 R/(hr)(loop fuel MW). The calculations were based on an activity-weighted gamma energy of 0.55 Mev associated with an equilibrium concentration of fission-produced gases. Mainly, activities associated with Xe-138, Kr-87, Kr-88, and Ba-140 and La-140 from the Xe-140 chain were used. For calculation purposes it was assumed that fission gases were instantaneously released from the fuel and that no filtration of solid elements in the Xe-140 decay chain occurred.

Core Components and Shielding. The first special pour of high silicon iron shot for use in the top and bottom primary shields was attempted during the month without success. The shot was contaminated with nickel from the melting furnace, and excessive pouring temperatures caused the shot to be deformed. Shot from a good pour will receive an environmental corrosion test.

Plutonium Fabrication Pilot Plant

Phase II Construction. Construction has progressed to the point that most work is at or above ground level. A total of 800 yards of concrete are now placed, of the 2500-yard total. Work is progressing in exact accordance with the contractor's approved schedule and is 12% complete.

Phase III Design. Phase III design is approximately 45% complete. Group 1 mechanical design was essentially completed during the month. All oxide line process hood drawings were completed, leaving Group 2 complete except for the sintering furnaces. Comment drawings were received for the degrease-decontamination system. Scope requirements for the rolling mill were transmitted to CEO for use in drawing up the detail scope requirements. Hood ventilation control tests using a domestic gas reducer valve were conducted during the month. Under the rapid response conditions required for control it was found that the mass of

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moving parts is so great as to cause oscillation of the valve plug and stem.

A proposal for gas cooling of the 30 kw furnace was received from the F. J. Stokes Corporation. Design bases were under review by Scope Engineering and Plutonium Metallurgy Operation at the end of the month.

The design development contract for the horizontal sintering furnace was mailed to Harper Electric Furnace Corporation, and negotiations for a design-development contract for a vertical sintering furnace were cancelled.

A general alarm system was added to the building scope. Alarms are provided for the following: sump high level, building ventilation air supply temperature (high-low alarm), autoclave system off-standard, ammonia dissociating system off-standard, main process water low pressure, main steam low pressure, and a push-button personnel alarm in the radiography room.

A listing of maintenance shop equipment to be located on the second floor of the building was prepared.

Procurement. Requisitions were written for the following items: radiographic unit and carriage dark room developing tanks, oxide finishing line, process hoods, ammonia dissociating equipment, and the following oxide line process equipment pieces; blenders, ovens, jar mill, cut-off machine, platen grinder, oxide handling trays, and air gage dimensional inspection units.

Summary. Project construction completion is 12% and project design is approximately 61% complete.

GAS COOLED POWER REACTOR PROGRAM

Gas-Graphite Reaction Studies

The characteristics of the surface of graphite play an important role in graphite-gas reaction kinetics. An apparatus previously constructed for surface studies was modified to measure surface area and pore size distribution of samples for gas cooled reactor studies. Nitrogen adsorption isotherms were obtained according to the method of Brunauer, Emmett and Teller, and the surface area was computed from these data. The surface area of an unirradiated sample of CSF graphite which had been oxidized to 1.8% was found to be 0.70 m^2/g. The surface areas of two samples cut from adjacent positions in a graphite bar are being measured. One sample will be irradiated in a helium atmosphere, and the other sample will be irradiated in an oxidizing atmosphere to determine the effect of oxidation on surface area. This information will be useful in the interpretation of the kinetics of the CO_2-graphite reaction.

Four quartz capsules containing graphite and CO_2 at pressures of 200, 300, 400, and 500 psi were recently discharged after an exposure of 160 MD/AT at about 525 C. The purpose of this test was to determine whether quartz would serve as a satisfactory container. If no leaks have developed, the gas pressure and composition will be determined, and changes in the graphite weight and structure will be measured.

Several items of interest to the U.S.G.C.P.R. program were discussed with British representatives from Windscale, Harwell, and Hawker-Siddeley Nuclear Power Co., Ltd., during the Geneva Conference. Some optimism was expressed concerning the possibility of reducing the CO_2-graphite oxidation rate with gas phase inhibitors. One of the more promising candidates is carbon monoxide. Several questions concerning the use of high concentrations of carbon monoxide for this purpose need to be answered. These include the extent of inhibition achieved and the question of deposition of carbon or other materials in cooler parts of the coolant circuit. Experiments are being planned at Hanford to study gas phase inhibitors.

The Hawker-Siddeley Nuclear Power Co., Ltd., had on display an interesting graphite fuel can assembly. A graphite impregnation process resulted in a material with high density (2 g/cc), high thermal conductivity, low porosity, and high strength. It was stated that in the latest material the permeability was too low to measure. They are now devising a system using a radioactive gas to measure permeability. The possibility of obtaining samples of this material for testing at Hanford is being pursued.

The U.K. - A.E.A. had on display a similar fuel can at the official government exhibits in the Palais de Nation. In this case part of the can was cut away showing the fuel elements. These were small disks of fuel in graphite and assembled on a graphite spline. Helium will pass through a small annulus of about 1/32-inch between the fuel and graphite can to remove fission products. The fuel cans in the form of hexagons will be assembled into clusters of seven. Fuel elements of this type will be among the first tested in the High Temperature Gas Cooled Reactor which was described in a paper at the Geneva Conference.

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.

In order to determine the effect of purity on swelling behavior, it is considered necessary to obtain high purity uranium as a base material for the swelling experiments. Electrolytic high purity uranium is available at Argonne National Laboratory. The enrichment required for the swelling studies (3%) can be achieved by adding 90% enriched uranium in the proper ratio. Results of this technique indicate that the impurities introduced are of a very low concentration. Procurement of 48 pounds of high purity enriched uranium of normal isotopic concentration has been initiated on the basis of expressed willingness on the part of ANL to supply the material. Enrichment will be performed on site.

A small electrolytic cell has been modified by the replacement of a stainless steel electrode by one made of Zircaloy-2. The electrolyte composition is being changed to allow 3% enriched uranium to be purified. It is anticipated that the product of this cell will be of equal or superior purity to the ANL material enriched by remelting.

Design modifications have been made on the controlled temperature swelling capsule on the basis of heat transfer calculations. The capsule will contain four, 1 cm spherical uranium specimens. Capsule construction will provide heating elements to maintain the specimens at a selected temperature between 300 C and 800 C during the entire irradiation. Specifications for temperature control instruments have been prepared. Either chromel-alumel or platinum-platinum rhodium thermocouples will be used for monitoring specimen temperatures in this capsule. A decision as to final thermocouple type will be made on the basis of in-reactor tests. Arrangements have been made to irradiate the capsules in front-to-rear "through holes" of KE and KW reactors. The instrumentation will be situated in the X-0 level rooms of these reactors.

The measurement of the pores visible in irradiated uranium continued this month. A test was devised to determine if the pores which are observed by electron microscopy in the irradiated uranium are present in unirradiated uranium or perhaps introduced by the etching procedure. Unirradiated uranium was found to contain no pores when etched by krypton ion bombardment for one-half hour. At one and one-half hours of etching a few pores are discernible. After four hours, many pores can be seen in the uranium. Since the usual time of etch for the irradiated samples is 30-40 minutes, the pores observed in the irradiated uranium are probably caused by inert gas bubbles in the metal unless irradiation changes the etching reaction of the metal.

Volumetric distributions of void shapes in irradiated specimens need to be determined in order to evaluate the mechanisms of swelling. Only plane or linear distributions of areas or line segments can be determined experimentally, thus, an investigation of effects of various sphere distributions on linear and areal analyses was started. A method for determining sphere size distributions with a linear analysis of line segment lengths from uniformly random distributions of spheres was found in the literature. Since the actual distribution of voids in swelling specimens may not be uniformly random, more general methods of areal and linear analysis are being sought.

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PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATION

MONTHLY REPORT

SEPTEMBER 1958

FISSIONABLE MATERIALS - 2000 PROGRAM

METALLURGY

A prototype shipping container for 0.95 percent U^{235} uranium fuel elements was approved. This container surrounds each fuel element with 1/8 inch of iron. Approval was also given for making future containers with 0.109-inch iron tubing.

Drawings of a Fernald designed shipping container were reviewed for nuclear safety. These are cadmium-lined boxes which Fernald hopes to use for shipping in unrestricted quantities uranium metal pieces enriched to 5 percent U^{235}. The conclusions of the review are that these containers are not suitable for shipment of enriched uranium as proposed. Indeed trouble might be encountered in using these containers for unrestricted shipment of 0.95 percent enriched uranium.

Comments were received from Livermore on our empirical method of estimating critical masses for oralloy and plutonium shells. One existing piece of experimental data could be used as a check. This check gave good agreement between the critical mass predicted by the empirical method and the observed data. Livermore plans to do more experimental critical mass work on spherical shells. The applicability of this method to water-reflected hemispherical shells remains in doubt because no experimental data are available for this geometry.

REACTOR

STUDIES RELATED TO PRESENT PRODUCTION REACTORS

Theoretical studies of neutron thermalization progressed with the programming of a calculation to check the second ten universal constants occurring in the analytical solution of this problem. In addition, a recursion scheme for computing values of Laguerre polynomials was tested and found to be sufficiently precise for use in calculating flux from the previously mentioned analytical solution.

The experimental portion of this problem continued with the measurement of bare and cadmium covered gold activities as a function of distance from a hot-cold boundary. The purpose of these measurements was to determine how to correct the activities of $\frac{1}{v}$ detectors for fast activation with room temperature and hot moderators. To date, six PCTR irradiations have been made with a temperature discontinuity present.

Pu and U^{235} foils were also irradiated in the above experiment to determine the neutron temperature as a function of position by this technique. These

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are the foils which will be used in a lattice in the TTR thermal column to measure the shift in neutron temperature on loss of water. This is the first "hot" irradiation of these foils. Radiation Monitoring personnel followed this irradiation closely and found no evidence of loss of Pu from the foils.

Buckling measurements were completed on solid and I and E elements in the B, D, F type graphite lattice. The results show that the gain in reactivity upon loss of water is greater for the I and E slug than for the solid slug by 6.7 ± 3 microbucks. These results agree with a similar measurement previously made on a lattice typical of C-pile.

Instrumentation

The investigation of data storing devices continued. Design work was started on a system for utilizing the magnetic-core storage elements on an experimental radioisotope analyzer. The techniques involved will be considered for possible use in reactor stack effluent monitors.

Consultation was provided on a possible monitoring system for the H reactor elevator. Further work on this is expected to result in information suitable as a basis for design so that the system can be included as part of a project proposal concerned with charging while the reactor is operating.

Assistance was given to the stuck rupture removal task force in reviewing and commenting on proposals for borescope design and lighting. A test of the feasibility of using a closed circuit TV system with the borescope was attended. The tests indicated that TV could be coupled to the borescope although less detail is observed than with direct visual observation through the borescope. Several problems are apparent from the test, and it is proposed that we investigate further the techniques involved.

STUDIES RELATED TO FUTURE PRODUCTION REACTORS

Work is continuing on the fabrication of lattice components to be used in a PCTR measurement of k_{∞} for clusters of 0.925-inch rods in a 10.5-inch graphite lattice. Some of the special fuel elements for the test cell have been assembled.

An investigation has begun to obtain better correlation of existing exponential pile data with lattice theory. At present, the natural uranium-graphite data for solid fuel rods are being re-examined with the aim of developing improved methods of analysis and presentation while simultaneously acquiring background information.

Conclusions have been reached on the scale of effort required for an investigation of the fuel temperature coefficient of the surface-to-mass term in the resonance integral of natural uranium. Nine measurements of k_{∞} and $\frac{1}{k_{\infty}} \frac{dk_{\infty}}{dT}$ are required using three different rod sizes. The level of PCTR effort required will be six shift weeks. Preliminary laboratory work is being carried on now on a low priority basis.

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Eight bars of graphite were tested in 305-pile. These bars will be shipped to France as a portion of an international exchange of graphite aimed at cross checking graphite standards.

The experimental radiation damage program has been suspended following the termination of the one exempt man working on this program at the G. E. Research Laboratory.

STUDIES RELATED TO SEPARATIONS PLANTS

Experimental work continued for determining the minimum critical mass and maximum buckling of a heterogeneous system of three percent enriched uranium rods in light water. The diameters of the rods used were 0.925-inch and 0.600 inch. One subcritical multiplication measurement was done with the 0.600-inch rods (at a H_2O/U ratio of 3.41). It gave a predicted critical mass of 328 pounds, which is about 20 percent less than the predicted critical mass for 0.925-inch rods at the same water-to-uranium ratio.

With reference to the k_∞ measurements on homogeneous systems of three percent UO_3-H_2O mixtures, experiments were begun in the PCTR for determining k_∞ at the H/U ratio of six. Previous measurements were taken at an H/U ratio of 3.4. Detailed analysis of the latter data has not been completed.

Five more tons of 0.95 percent I and E fuel elements were shipped to the ORNL Critical Mass Laboratory for use in extending their criticality measurements on random arrays to loadings closer to critical. Preliminary data was received from ORNL on a uniform loading of these elements in water giving a critical mass of about six tons. This number compares well with predicted critical masses from exponential experiments on uniform arrays.

Nuclear safety considerations or consultations were made on

(a) Plutonium solution handling systems
(b) Plutonium metal pickling tanks
(c) Storage of arrays of plutonium metal and powders
(d) A cadmium-lined shipping container for uranium enriched to 5 percent U^{235}
(e) Chemical processing of uranium enriched to 5 percent U^{235}.

An empirical formula has been developed giving the volume ratio of water-to-uranium for a random array of identical cylindrical fuel elements immersed in water in terms of the dimensions of the elements.

One run was made on the monoenergetic neutron age measurement. A 3/8-inch-diameter source was used in kerosene moderator. A second run was postponed because of a reactor outage.

Difficulties were encountered in the operation of the source vacuum lock on the first new mass spectrometer. Work on this instrument has been suspended while efforts are concentrated on the start-up of the second mass spectrometer.

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REACTOR DEVELOPMENT - 4000 PROGRAM

Plutonium Recycle Program

Values of k_∞ and f have been calculated from the experimental PCTR data taken with 19-rod UO_2 clusters in a 9-inch D_2O lattice. The results are as follows:

Lattice	Coolant	$\frac{V_{mod.}}{V_{UO_2}}$	$\frac{V_{coolant}}{V_{mod.}}$	$\frac{V_{AL}}{V_{UO_2}}$	$\frac{V_{Pu-Al}}{V_{UO_2}}$	f	k_∞
9"	Air	15.188	--	1.003	--	0.903	1.117
9"	D_2O	15.188	0.062	1.003	--	0.897	1.096
9"	Air	18.038	--	1.191	0.1875	0.901	1.170
9"	D_2O	18.038	0.062	1.191	0.1875	0.898	1.153

Work at present is directed toward an experimental evaluation of the systematic errors in k_∞ caused by the presence of the moderator-containing cans.

Five values for the buckling of 19-rod UO_2 clusters in various D_2O lattices have been collected from Chalk River documents for comparison with the PCTR-PRP measurements.

A program for computing fuel isotope concentrations as a function of exposure on the Litton computer has been completed. As now programmed, the machine plots U^{235}, U^{238}, Pu^{239}, Pu^{240}, Pu^{241}, and Pu^{242} concentrations up to a local exposure of 5000 MWD/T.

A method for computing the transmission and reflection coefficients required for the generalized lattice diffusion constants has been developed based upon a variational principle.

Instrumentation

Work is continuing on the design of a combination wide-angle and 5X viewer and of the profilometer.

Gas Cooled Reactor Program

Delivery dates have been established for the various components to be used in the PCTR experiments. The UO_2 fuel pellets are scheduled to arrive in January 1959. By this time the other components needed should be on hand for the first experiment. A few questions still must be answered before detailed fabrication drawings can be made for the PCTR core.

CROSS SECTION PROGRAM

The instrumentation for the KE three-crystal neutron spectrometer has been completely installed and is operating routinely.

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Most of the operating time has been spent in studying monochromating crystals, resolution, and intensity. The neutron intensity through the first beam defining collimators is only one-third of that calculated from the assumed neutron density in the source block in the KE Reactor. The assumed neutron density has been verified by Irradiation Testing (IPD) personnel, so the reason for this loss of intensity is not known at present.

A high resolution run was made through the 0.58 ev fission resonance in Am^{241} and the 0.49 ev fission resonance in Np^{237}.

BIOLOGY AND MEDICINE - 6000 PROGRAM

ENVIRONMENTAL STUDIES

Atmospheric Physics

Testing of prototype air sampling equipment for the AF-AEC diffusion experiments continued and neared completion. At the same time, final design of the diffusion experiments neared completion. Final agreement with Air Force personnel regarding the over-all experimental design is being sought.

Three field tests were conducted in order to scope the requirements for measurements of the vertical distribution of concentration during these experiments. During two of these experiments, the vertical distribution of concentration was successfully measured on the Meteorology Tower when the source was at ground level and one and two miles upwind from the Tower. A third attempt to measure this distribution at eight miles from the source failed when the tracer material failed to hit the Tower.

The measured vertical distributions showed two interesting features: First, the effective variance of the distributions agreed very well with similar variances measured for sources 200 feet above the ground. This fact lends considerable credence to our untested assumption that these variances from previous experiments could be translated to the region near the ground. The second significant observation was that the maximum concentration occurred at 40-50 feet above ground level. This feature could be due to erosion of the underside of the plume by deposition or it could be caused by a buoyant force inherent in our generation methods. More detailed experiments are required before these effects can be separated. Finally, it was found that a 200-foot tower will permit adequate vertical measurements at distances up to two miles from the source. The observed concentrations at 150-200 feet were less than one-tenth the peak concentration.

The confirmation of the lack of a significant difference in the vertical distribution of concentration between the cases when the source is at ground level and when it is at the 200-foot level permits a much extended use of our earlier observations for hazards analyses until the more definitive experiments are completed next summer.

DOSIMETRY

Paint, lacquer, lead wool, lead foil, tile, bolts, and threshold plates for the body monitor were tested for radioactivity. The paint and tile were found unsatisfactory; lacquer and vinyl tile will be substituted. Contami-

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nation was found on the threshold plates; sandblasting and washing removed it satisfactorily.

A krypton-methane mixture was tried in the X-ray proportional counters. Operation was satisfactory, but the background from Kr^{85} was too high. Freon 13B1 ($CBrF_3$) was tried but gave very small pulse heights probably due to being electronegative.

Development was started of an optimum procedure for body monitor measurements for subjects expected to be at background levels. After study of five subjects, the first procedure was judged unsatisfactory. Counting statistics were poor and backgrounds taken without a phantom were too high. A second procedure is now being tested.

Installation of a new analyzing chamber and magnet pole pieces on the positive ion Van de Graaff was completed at mid-month. The machine has operated satisfactorily since then.

Two graduate students of the University of Washington began an experiment with our Van de Graaff machine that they will use for their MS thesis. Purpose of the experiment is to measure the stopping power of 1 to 2-Mev protons in gases. The Al (p,γ) reaction is being used in the experiment to determine the proton energy loss. A preliminary study of this reaction lead to important new information about it.

The electron Van de Graaff was shut down for annual maintenance, thus suspending the calorimetry work there. The beam current integrator was modified to accept currents of both polarities and to activate or deactivate other equipment at the end of an integration. A new cover was designed for the gamma-ray calorimeter that will permit changing sources without disassembling the submarine jacket.

The pulse method of reading pencil ion chambers has achieved an accuracy in a single reading of about 5% at 1 mr total dose. Accuracy of 1% or better would make possible many valuable laboratory experiments. Studies aimed at improving the accuracy to this level were begun. A method of using a vibrating-reed electrometer gave equal, but no better results than the pulse method.

A study was made of the correction to the energy-absorption coefficient that is necessary to account for the absorption of secondary gamma rays (fluorescence X-rays, Compton scattered rays, annihilation photons, etc.) in cavity ion chamber measurements. The corrections had been thought to be negligible but turned out to be important enough for some of our work to require further evaluation.

INSTRUMENTATION

The investigation of detection techniques for use in radiation protection instrumentation continued. Fabrication is in progress on a prototype hand and shoe counter which employs a single scintillation detector for each hand surface capable of detecting the alpha and beta-gamma components of contamination. The alpha-caused pulses are separated electrically to provide

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separate alpha and beta-gamma indications. A tentative program for a study of the use of light pipes for use with scintillation detectors was prepared.

Concepts in sensitivity improvement were incorporated in two alpha air monitors on which fabrication was completed this month. The alpha air monitor for the Biology Operation incorporates two count-rate meters with the same sensitivity but with different time constants in order to indicate bursts of alpha activity. A monitor for the Purex Operation utilizes two high-level alpha air systems and a differential alarm circuit with special filtering to provide improved sensitivity. In both cases, the sensitivity was improved over the high-level alpha air monitor by more than an order of magnitude.

A prototype transistorized scintillation alpha A-C operated poppy was fabricated and tested for possible use at Hanford. The background counting rate is less than one count per minute and the instrument can easily detect a 50 to 100 d/m Pu^{239} source, either as a point source or a distributed source over a 2-1/2 inch by 3 inch area. Both count-rate meter and loudspeaker outputs are incorporated. The instrument weighs 17 pounds and the cost is estimated at about $750. The Calibrations Operation is having plant drawings made.

WASHINGTON DESIGNATED PROGRAM

The vacuum system for this mass spectrometer was completed and is in satisfactory operation.

A positive ion beam was obtained from a uranium source. The observed mass resolution was poorer than expected by a factor of two.

CUSTOMER WORK

Analog Computing

Several flux traverses (two group theory) showing the characteristics of various loading configurations have been completed by IPD personnel. These runs required approximately 3 weeks of this month's machine time.

Frequency response curves have been completed for the D_2O-He Dynamics of the PRTR and for the kinetics of high power levels, power levels slightly above critical, and subcritical power levels. Curves have been obtained for Pu enrichments of 15% and 50%. These response curves compare favorably with those obtained by the potential controls system contractor. Frequency response curves for the combined, dynamics-kinetics, system are now being obtained and should be completed in early October.

The first Litton Digital Differential Analyzer has been repaired at the factory and is now back in service. The machine which was loaned to us while ours was being repaired has been returned to Litton.

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Weather Forecasting and Meteorology Service

Type of Forecast	Number Made	% Reliability
8-Hour Production	90	85.6
24-Hour General	60	85.2
Special	127	89.8

September became the fifth consecutive month and the seventh of the year to average warmer than normal. However, the departure was only 0.9 degree as compared to an average 5.0 degrees during the May-August period.

Precipitation totaling 0.05 inch was less than 15% of normal. This established September as the third consecutive dry month after the first six months of the year had all been wetter than normal.

Instrumentation

The sensitive, gamma, scintillation transistorized monitor was completed and tested satisfactorily. This instrument, designed for the Regional Monitoring Operation, employs a 5 inch by 5 inch terphenyl in polyvinyltoluene organic crystal, a 5 inch phototube, two transistorized high-voltage power supplies, a transistorized amplifier and a three-decade count-rate meter chart recorder circuit. Full-scale first-range sensitivity is 0.01 mr/hr for Co^{60} or Cs^{137}. The instrument will be used for on-plant and offsite routine sensitive monitoring from the air, on the river, and on the land.

The experimental medium-level alpha air monitor was completed, tested, and delivered to the Biology Operation. It will alarm on a 60 mpc level of airborne Pu^{239} in about 20 minutes with no false radon-thoron background alarms.

Fabrication was completed on the dual alpha air monitoring system for use at Purex and testing was started. The system utilizes two complete high-level alpha air monitors which act independently as two separate instruments. Chart recordings of the alpha activity for each monitor are provided and each can sound an alarm if the activity is high enough. A differential alarm and recording system provides a means of reducing background effects so that an alarm is sounded if the activities of the two systems differ by more than a predetermined amount. The system is now being tested.

The zinc sulfide particle counter is still undergoing field testing at the Atmospheric Physics Operation. Operation of the instrument has, thus far, been satisfactory. The instrument employs a phototube detector and a Pu^{239} activating source with a particle linear detection range of 100 to 19,000 particles per filter. The instrument is used in conjunction with airborne particle movement studies.

The dog counter, for the Biology Operation, has now been in successful operation for several months at Biology. The scintillation system is used for the determination of the radioisotope present in the dog via photopeak pulse height analysis. Both the amount and location of the radioisotope, in vivo, can be determined. Results are chart-recorded. Radioisotopes of interest include Pu^{239}, Sr^{90}-Y^{90}, Ru^{103}, Ru^{106}, and Cs^{137}.

Evaluation was completed on a commercial air ionization dose-rate meter. (Nuclear-Chicago Chalk River Circuit CP) Circuit changes, calibration, and evaluation were completed on a scintillation dose-rate meter belonging to Frank Sanders.

Set-up procedures for scintillation alpha, beta, and gamma air filter sample counters were devised and documented.

One suggestion on meter unitization was evaluated for the suggestion system.

Preliminary steps towards evaluation of a commercial (Victoreen) remote-area monitoring system were instituted.

Optical

Supervision and engineering assistance was given during the installation of the optical elements in the seven periscopes on the second remote crane at Purex.

At the request of members of the 105-C Fuel Examination Facilities, the problem of lighting the bore of an I & E slug is being investigated. Three types of lighting and viewing heads were suggested. Work on two of the heads will begin soon.

At the request of the CEO Field Surveys Operation, a right angle eyepiece was designed for a transit. The eyepiece permits the use of the transit in positions where there would not otherwise be head room. The right angle attachment in no way alters the accuracy of the instrument. These units are used to check the straightness of process tubes in the reactors. This unit is being fabricated.

A right-angle eyepiece was designed for an underwater telescope used in conjunction with the 105-C profilometer.

An estimate was made for the Technical Shops of the cost of fabricating an optical scratch depth gage capable of measuring to 0.00005 inch. Parts for this instrument were ordered and the necessary fabrication sketches are being prepared.

Assistance was given to members of the HLO Ceramic Fuels Development Operation in completing work on the arc image furnace and color pyrometers.

The routine optical shop work included the installation of the optics in the periscopes at the Purex addition, the fabrication of three pyroceram bearings, and the preparation of a dozen aluminum accelerator targets.

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
H. Bichsel	9/4-9	Univ. of Washington Seattle, Wash.	To arrange MS thesis experiment.	WC Roesch	No	300: 329 3745-B
B. N. Brockhouse	9/8	Atomic Energy Commission of Canada, Ltd. Chalk River, Canada	Discuss cross section measurements.	BR Leonard	No	300: 326
A. L. Babb Bill Wilson	9/15	Univ. of Washington Dept. of Chem. Eng'g Seattle, Wash.	Discuss exponential pile experiments.	ED Clayton	Yes No	300: 326
Dr. Crompton	9/17	National Lead of Ohio Cincinnati, Ohio	Discuss nuclear safety in shipment of enriched uranium.	ED Clayton JE Faulkner N Ketzlach	No	300: 326
B. T. Subbotin	9/19	Mass. Institute of Tech., boston, Mass.	Candidate for employment.	RA Harvey PF Gast	No	300: 329 326
J. B. Polwarth D. A. Hicks	9/18	Applied Physics Staff Boeing Aircraft Seattle, Wash.	Discuss instrumentation.	RA Harvey	No	300: 329
W. A. Horning	9/24-25	Atomics International Canoga Park, Calif.	Discuss reactor physics experiments and theory.	JE Faulkner PF Gast RE Heineman	Yes	300: 326 303,305-B 100: 105-KE 105-DR
Mr. Van Vleck C. Weichle	9/30-10/1	ANP, General Electric Idaho Falls, Idaho	Discuss atmospheric dispersion of stack gases.	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
J. J. Fuquay	9/8-11	Univ. of Michigan Ann Arbor, Mich.	Attend AMS National Meeting; confer with U. of Mich. Dept. of Meteorology Staff	A. N. Dingle E. W. Hewson G. C. Gill G. H. Whipple	No
G. R. Hilst	9/9-11	Univ. of Michigan Ann Arbor, Mich.	Attend AMS National Meeting; confer with G. C. Gill	G. C. Gill E. W. Hewson	No
	9/12	G-E Research Lab. General Eng'g Lab. Schenectady, N. Y.	Discuss instrumentation problems.	G. W. Hazzard Mr. Van Luik	No
J. J. Fuquay	9/12	Argonne Nat'l Lab. Lemont, Ill.	Discuss micrometeorology and diffusion studies.	H. Moses P. E. Wasko	No
	9/15-16	Oak Ridge Nat'l Lab. Oak Ridge, Tenn.	Discuss diffusion and atmospheric pollution problems.	F. A. Gifford, Jr. W. M. Culkowski	No
W. C. Roesch	9/15-18	Nat'l Res. Council Conference on Penetration of Radiation Through Matter Gatlinburg, Tenn.	Attend Conference.	--	No
	9/22	Dow Chemical Rocky Flats Denver, Colo.	Discuss Pu dosimetry problems.	T. S. Chapman	Yes

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Chemical Research and Development

ORGANIZATION AND PERSONNEL

J. L. Daniel, Senior Scientist, transferred in from Employee Relations Operation and was assigned to Chemical Research Operation.

L. J. Kirby, Chemist I, transferred to Employee Relations Operation from Chemical Research Operation.

H. Freund, Senior Scientist, terminated.

R. M. Peekema, Chemist I, terminated.

H. D. Warren, Engineer II, terminated.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIAL - 2000 PROGRAM

IRRADIATION PROCESSES

Automatic Analyzing Monitor

A paper discussing the Analyzing Monitor was presented at the Second Conference on Analytical Chemistry in Nuclear Reactor Technology, Gatlinburg, Tennessee, on September 29, 1958.

A provision was incorporated into the instrument to permit backgrounds to be automatically recorded once each 12 hours. Improvements were incorporated into the printer circuit that resulted in more consistent operation. A transistorized linear amplifier circuit was designed and assembled which showed desirable non-overloading characteristics, and reasonable freedom from temperature fluctuations. Transistorized pulse height analyzers assembled showed undesirable temperature sensitivity, indicating further refinements of the circuit.

Reactor Decontamination

Further experiments were performed to determine the optimum method for Turco 4306-B disposal after use in reactor decontamination. Recommendation of conditions under which trench disposal could be used were set forth in a document.

Uranium Oxidation Experiments

The uranium oxidation experiments were essentially completed during September. Experiments were conducted on larger specimens (50 gram cylinders) in order to facilitate scale-up calculations. Extrapolation of the data indicates that at 805 C a normal Hanford reactor fuel element will completely oxidize in an air stream in 17 hours. Temperature cycles caused by the heat of reaction were of greater amplitude than those observed for smaller specimens at the same air temperature. Higher air flow rates also accentuated the temperature peaks slightly.

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Analytical Services

Thermal conductivity measurements from 77 F to 280 F were made on organic coolant.

Arsenic down to 1 microgram in aqueous samples was measured colorimetrically. It was distilled as arsine into 0.001 normal iodine. Color was developed with molybdate and hydrazine sulfate reagents.

A gamma spectrometer and detector unit have been assembled for use at 100-KE to provide general activation testing. Having the spectrometer near the reactor will permit measurement of short half-life products like Al^{28} (2.3 minute).

SEPARATIONS PROCESSES

Feed Preparation

Dingot Uranium Dissolution. Further instantaneous dissolution rate studies with unirradiated Dingot uranium-silicon alloys indicate that about 0.05 weight per cent silicon is required to produce an overall dissolution rate in nitric acid comparable to that of production Ingot uranium. Past observation of varying dissolution rates with different samples of both Dingot and Ingot uranium dictates caution in the interpretation of dissolution rate comparisons based on experiments with a limited number of samples. Experience with many batches of production metal would be required for a rigorous comparison.

Solvent Extraction

Coated Pulse Column Plates. Testing of potentially organic-wet pulse plates has been reinitiated (cf. HW-56185 C, p.2). The coalescence characteristics of linear-polyethylene coated stainless steel plates which have been platen-pressed, oxidized stainless steel plates, zirconium plates, and polyethylene Raschig ring sandwiches between two stainless steel plates were evaluated in a 3-inch diameter by 3-foot long glass pulse column. Only the platen-pressed coated plates exhibited coalescence characteristics equivalent to that of solid polyethylene plates.

Anion Exchange Processes

Decontamination of Purex 1BP by Anion Exchange. Continuation of the work reported last month indicates that Purex 1BP can be effectively decontaminated by one cycle of anion exchange using Permutit SK. Addition of aluminum nitrate to the fluoride containing wash solution cuts down the plutonium loss without sacrificing the zirconium removal. The use of a wash solution containing 7.2 M HNO_3, 0.056 M HF, 0.056 M $Al(NO_3)_3$ interposed between two nitric acid washes gave a zirconium-niobium decontamination factor of 3.8×10^4 on Purex 1BP. The ruthenium-rhodium activity in the eluted product was less than 10^3 γ/m/ml. Optimum concentrations and volumes for the wash solutions have not yet been established.

Higgins Ion-Exchange Contactor. The effects of resin push pressure on resin and slip water were continued on a special grade Permutit SK resin (greater than 90 per cent between 30 and 50 mesh) in lieu of the standard grade 20 to 50 mesh Permutit reported last month. Preliminary results indicate very similar behavior

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of the two resins, except that the special grade resin requires higher push pressures to produce a given resin flowrate or to produce jamming. A jamming occurs at about 40 psig on the special resin as contrasted to about 25 psig on the standard grade.

Plutonium Processes

Plutonium Oxide Chlorinator. When exposed at 600 C to a vapor phase containing air and carbon tetrachloride, platinum corrcded at about 0.1, Baker 413, Hastelloy B and Hastelloy C at 5-7, Haynes 25 at 16, and 304-L at 150 mils/mo. Considering these and past data, if a chlorinator were to be constructed to operate in all three environments proposed for chlorination of plutonium oxide - phosgene, hydrogen chloride, and carbon tetrachloride - Hastelloy B or Hastelloy C would be the best choice from a corrosion standpoint.

Chlorinator Gas Scrubber. Studies have been initiated to develop a scrubber to handle the off-gases from the 234-5 plutonium chloride converter. A one-inch diameter, three-foot long glass column packed with 1/4-inch stainless steel Raschig rings was installed. A phosgene, carbon dioxide and chlorine gas mixture (8-to-4-to-1 volume ratio) was fed to the unit at a rate of approximately 100 liters per hour. With 4 N NaOH fed to the column at ten liters per hour, the following observations were made:

(1) Column height is adequate for total absorption under optimum conditions.

(2) The optimum absorption temperature is approximately 40 to 60 C.

(3) Bicarbonate precipitation occurs in the lower packing section when a caustic strength greater than 4 N NaOH is used.

(4) At temperatures greater than 60 C in the lower packing section local scrubber upsets occurred.

(5) An unidentified dark brown "slimy" precipitate formed at the lower end of the packed section.

A second unit containing carbon Raschig rings is presently being installed. The unit consists of a three-foot long, 1-1/2 inch diameter section packed with 1/4-inch rings and a three-inch diameter "gas-feed" section packed with 3/8-inch rings. Provisions are provided for controlling the scrubber temperature.

Corrosion of 304-L by Hydrated $PuCl_3$. An estimate of the attack on stainless steel hoods by contact with hydrated $PuCl_3$ was requested. Samples of 304-L stainless steel in contact with $PuCl_3$, along with a water-saturated cotton swab, were sealed in vials. After two months, the steel samples were severely pitted. The rate of attack was estimated at about 10 mils/mo. While the environment involved is more severe than anticipated in process hoods, a protective coating such as sprayed plastic appears desirable.

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Flurex Development

A sample of platinum-clad tantalum (Metals and Controls Corporation) was evaluated as a possible anode material for the Flurex process. After about 1270 hours use of this material at four amps/in.^{2}, the platinum cladding was almost entirely removed and the cell resistance rose rapidly. The average corrosion rate during this period was 0.026 mg/amp.hr. which is in excellent agreement with previously observed rates for all-platinum anodes. It was concluded that this material has no advantage over all-platinum anodes.

Similarly, a sample of Tirreloy B (Ionics Incorporated) is under evaluation. This material is called "platinized tantalum" and does not have the lustrous surface characteristic of platinum. The sample available is platinized on one surface only. When both surfaces are in contact with anolyte (0.5 M NH_4NO_3, ph 8-9) the electrode resistance is high - characteristic of tantalum. If only the platinized surface is exposed, the resistance is low and comparable to that of a platinum anode. This behavior is not as yet explained. The average corrosion rate observed for the first 66 hours exposure of Tirreloy B (platinized side only) was 0.085 mg/amp.hr.

Pyrochemical Processing

Reduction of Plutonium with Magnesium. Analysis of the plutonium-zinc alloy button produced by the reduction of plutonium chloride from a sodium chloride-potassium chloride system with magnesium at 800 C (cf. HW-57225 C, p. 4) disclosed that heating in vacuo for two hours at 600 C reduced the zinc to less than one part zinc per million parts of plutonium by weight. The residual magnesium content was estimated as one-tenth to one per cent by weight. Vapor pressure data indicate that the vacuum removal of magnesium should be essentially complete if temperatures in the neighborhood of 800 C are used.

Analytical Services

The short-cut cesium method preceding multi-channel analysis has been improved by carrying cesium on copper ferrocyanide. Perchloric acid use was eliminated and Ce^{144} decontamination was better.

WASTE TREATMENT

Nitrate Destruction

Construction and installation of pilot plant equipment for the destruction of nitric acid and formaldehyde is complete. "Shakedown" operations are essentially complete and experimental runs are imminent.

Five semi-continuous electrolyses of a synthetic Purex 1WW solution were performed at a temperature of 30 or 50 C using a stainless steel cathode and Duriron anode. Fresh 1WW was added periodically in all runs to maintain a constant volume in the cell and air sparging was employed in only one run. Operation at the lower temperatures resulted in greatly reduced anode corrosion (10 mg/amp.hr.) but also reduced the current efficiency to 27 per cent at a cathode current density of 1.0 amp/in.^{2} Air sparging at 30 C increased the current efficiency to 39 per cent but increased anode corrosion by a factor of seven.

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Submerged Combustion

Document HW-54624, "Proposal for Plant Scale Submerged Combustion Test," was issued. Based upon 321 Building tests on a 1-million BTU/hour submerged combustion unit the installation of a 5-million unit in a 750,000 gallon 200 Area tank is recommended. The recommended test unit would be used to concentrate 2,300,000 gallons of coating waste to regain 1,500,000 gallons of storage space worth approximately $540,000. It is estimated that capital investment and operating costs would total $250,000 for the proposed test.

Heat Transfer Studies - Packaged Waste or Fission Products

Studies are being initiated to investigate the heat transfer problems associated with the storage of large amounts of concentrated fission products (e.g., calcined high level waste, large fission product sources). Initial studies are to be made in a two-foot length of four-inch pipe. Nichrome V heating wires on half-inch, equilateral triangular spacing will be used to simulate uniform heat generation at a rate of 14,000 BTU/cu.ft. These studies will be initially directed toward learning the effect of particle size on the apparent thermal conductivity of granular solids.

Observation Wells

The concentrations of radioactive material in ground water monitoring wells adjacent to the 216-A-24 crib continue to increase. All four monitoring wells near the site now reveal contamination in the ground water, indicating that its source is probably the boiling tank condensate discharged to the 216-A-24 crib. The appearance of radioactivity in the ground water beneath this site only four months after the crib was put into service may indicate a rather short useful life for the facility.

Soil analyses were performed to evaluate the type of material encountered in drilling well 699-35-54, now under construction (Project CG-764). The contractor reports encountering consolidated "rock" formations cemented with calcium carbonate. Samples from the site contained less than 0.2 per cent calcium carbonate, as compared with 25-40 per cent found in samples of typical cemented materials from other locations.

High Level Wastes

Measurement of specific gravity and surface tension of synthetic, high level, Redox wastes was complicated by the crystallization of solids as the temperature was lowered. For some of the wastes tested this effect reversed the normal temperature relationship of these variables. Measurements were made with wastes simulating the composition as it is discharged to the tanks (1X), wastes concentrated to 3/4 volume (1.5X), and wastes concentrated to half volume (2X). Salt recrystallization was found to occur at 20 C in 1X wastes, 60 C in 1.5X wastes, and 75 C in 2X wastes. The viscosities of these solutions appear to be much less affected by salt recrystallization as the temperature decreases.

Laboratory research to measure the permeability of soils for synthetic, high level, Redox wastes at various temperatures was completed. The analysis and interpretation

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of data from this research is in progress. As part of this study an attempt was made to pass unfiltered, synthetic waste through a column of Touchet soil at 100 C. Even at a hydraulic head of 325 cm of water the waste penetrated but 20 cm. Solids present plugged the soil within a distance of a few millimeters.

Three tests simulating the loss of Redox high level waste which had concentrated to 80 per cent of the original volume were conducted. In all three tests the waste erupted at the ground surface after 60 to 100 gallons were discharged below the center of a seven foot by seven foot plate buried some seven feet underground. Examination of the soil beneath the plate revealed that the waste flowed to the edges of the plate and then upward through the backfill material. The sludge build-up, evident on the soil in contact with the plate, plugged the pore spaces in the soil and encouraged lateral spreading of the waste. This finding suggests that previous estimates concerning "maximum permissible leak before detection" were conservative.

Disposal to the Ground

Laboratory tests were conducted to study the removal of alpha particle emitters in CAW (Recuplex) wastes by soils. It was found that about one fourth of the alpha particle emissions in this stream originate from Pu^{239}, the remainder being largely from Am^{241}.

Soil tests indicate that adsorption of plutonium is very low from these wastes. This low removal may reflect the competition afforded by gross quantities of aluminum salts in the waste or may indicate the formation of a complex plutonium anion. Isotopes representing about one-fourth of the alpha-particle radioactivity in the waste were removed by an anion exchange resin.

TRANSURANIC ELEMENT AND FISSION PRODUCT RECOVERY

Neptunium Recovery

Solvent Extraction in Purex. Batch extraction studies indicate that addition of dichromate in low concentration (e.g., 0.01 M) to the Purex HA system is probably feasible as a means of insuring extraction of neptunium. Oxidation to neptunium(VI) was rapid at room temperature while oxidation of plutonium(IV) was apparently slow as indicated by the fact that the plutonium distribution coefficient was not significantly altered by addition of dichromate. This approach therefore offers the possibility of adjusting both plutonium and neptunium to their most readily extractable valence states, neptunium(VI) and plutonium(IV).

Distribution data indicate that considerable reflux of fission product cerium would occur in a Purex HA system containing dichromate. It is expected that cerium decontamination lost in the first cycle would be recovered in the second cycles, however. Indeed, recovery of cerium-144 in pure form might then be possible from backcycled second-cycle waste.

Physical performance was satisfactory with dichromate-containing feeds and Purex plant 100 solvent (which has been exposed to alkaline permanganate in the solvent

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treatment operation). In earlier work with fresh solvent, however, poor phase separation and formation of organic-soluble chromium(III) compounds was observed.

Laboratory studies indicate that neptunium should exist predominantly as neptunium(VI) in Purex 3WB (backcycled waste). Neptunium(VI) is favored by high acid and low nitrite concentrations in boiling acid-nitrate systems. Reduction of neptunium(VI) by nitrite was found to occur rapidly and completely at 2 M nitric acid but not at higher concentrations.

Reagent grade manganese dioxide proved ineffective as an oxidant for neptunium(IV) in 2 to 6 M HNO_3 solutions with amounts of MnO_2 equivalent to 0.1 or 0.2 M.

Isolation and Purification of Neptunium. Absorption of neptunium from boiled-down Purex plant 2DW by Permutit SK was studied as a function of the concentrations of ferrous sulfamate and uranium. As little as 0.005 M ferrous sulfamate gave satisfactory loading of neptunium. High uranium concentrations (e.g., 130 g U/l) such as are present in current Purex 3WB gave very low resin absorption capacities for neptunium. By analogy with earlier work with plutonium(IV) it will probably be necessary to maintain the uranium concentration in 2DW concentrate at 0.1 M or less to insure the desired resin absorption capacity.

Attempts to remove plutonium and thorium from neptunium solutions on Dowex 21 K (50 - 100 mesh) by washing with 12 M hydrochloric acid gave severe gassing. Reconversion to nitrate and elution at elevated temperature gave a concentrated product solution but the separation from thorium was not complete. Elution at temperatures above 50 C produces considerable gassing, apparently due to oxidation of neptunium(IV) to neptunium(V).

Studies of loading on Dowex 1, X-4 (50 - 100 mesh) showed that high concentrations of nitrite reduce neptunium to neptunium(IV) in 9 M nitric acid. This was confirmed by experiments in which tetraethyl ammonium nitrate was used as a selective precipitant for neptunium(IV). In 4.5 M nitric acid, reduction to the neptunium(IV) still takes place in the presence of a driving force such as a precipitation reaction, but at a lower rate.

Solvent extraction of neptunium with 30 per cent TBP is an alternate means of separation of thorium and neptunium. Adequate separation was demonstrated with macro concentrations of neptunium and thorium. With the approach being studied oxidation to plutonium(VI) would be necessary to obtain separation from plutonium. Oxidation by 0.1 M dichromate proved to be much slower for plutonium than for neptunium, however.

Reprocessing of Irradiated Neptunium. Solvent extraction with diluted tertiary amines is under investigation as an alternate to anion exchange for the reprocessing of irradiated neptunium. Interest in this approach stems from the fact that severe radiation dosages will be encountered in this operation and the products arising from radiation damage to tertiary amines apparently do not hamper their use. Exploratory studies indicate that good separation of neptunium and plutonium from each other and of both from thorium, is possible, and that stripping from the organic phase is satisfactory. Formation of two organic phases has been observed with tri-n-octylamine solutions in xylene and organic phase neptunium

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concentrations of 5 g Np/l or greater. This may not be a severe limitation, however, and may possibly be avoided by use of a different amine such as tri-lauryl amine.

Cesium Recovery

Two additional one liter samples of Purex plant 1WW were loaded into the cell during the month in preparation for cesium recovery runs. Both samples contained solid material (presumably silicic acid) to the extent of about four per cent by volume in the centrifuged samples. Measurements through the cell walls indicated, as was found previously, that most of the total 1WW gamma activity is associated with this precipitate. These recent observations further show that the presence of solids in 1WW is not an isolated chance happening but rather a routine occurrence. Every sample examined to date has contained solids. The presence of these solids can be expected to complicate any contemplated processing of Purex 1WW.

Full scale demonstration of the wet chemistry portion of the cesium recovery process has been initiated using a simulated partially-neutralized Purex 1WW. The feed was first neutralized to a pH of 6-7 using 50 per cent caustic and precipitation temperatures of 25 C and 90 C. Prior experiments have indicated formation of 15.8 and 10.3 volume per cent solids, respectively at the two temperatures. The slurry was fed at five gallons per minute to a B-Plant type 40-inch Bird centrifuge for periods ranging from 90 to greater than 170 minutes (depending on the centrifuge speed and precipitation conditions) before solids were visually detected in the centrifuge effluent. In general, cake removal by 90 psig spray was ineffective. Removal by both plowing and spraying was 80-90 per cent effective for cakes formed at low speed centrifugation. However, hot 30 per cent HNO_3 was required to remove the cake formed in high speed centrifugation.

Detailed drawings of the cesium isolation and packaging prototype are 95 per cent completed except for the main support frame drawing. Work orders have been issued for 25 to 30 per cent of the shop fabrication work.

Four test product containers were fabricated to test the proposed metal "O"-ring threaded cap seal. Preliminary data indicate that the seal is satisfactory. This seal has been tested with steam pressures as high as 600 psig and attendant temperatures of 350 C. The steam pressure was generated by heating water in the container with an electric furnace. The seal has also been subjected to cyclic operation of alternate heating and cooling without losing the seal's effectiveness. Further tests are planned to explore torques other than 50-foot pounds to tighten the cap and different seal groove dimensions to determine the allowable tolerances.

A newly designed ion chamber for measurement of Cs^{137} using a single lavite insulator and a grounded guard ring at the cable connector end of the chamber has been tested. It exhibits an excellent voltage plateau from 75 to 600 volts, in a 60 R/hr radiation field. Another chamber of similar design but using a polystyrene insulator because of its easier fabrication will also be tested and used if satisfactory. Both types will be tested in a flux similar to that expected in the cesium packaging facility (8×10^4 R/hr).

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Strontium Recovery

Experimental work on the nitric acid strontium recovery process has been completed and a summary report is in preparation.

Solvent extraction processes for strontium recovery are under investigation, and scouting experiments are being carried out with di-(2-ethyl-hexyl) phosphoric acid-Amsco mixtures. Ability of 2EHPA to separate the alkaline earths from each other, as well as to separate strontium from the other fission products, is being explored.

Technetium Recovery

Studies are in progress to determine the path of technetium in the Hanford separations plants and to evaluate methods of recovery. An unidentified beta activity in the recovered nitric acid from the uranyl nitrate calciner is suspected of being technetium, and this stream is receiving first attention.

ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Neptunium Analysis

The concentrations of the three most stable valence states of neptunium in a solution can be easily determined by controlled potential coulometry. The method consists of three successive titrations in the same cell as follows: The neptunium(VI) is first selectively titrated to neptunium(V), after which all neptunium(V) is titrated to neptunium(VI). The initial neptunium(V) and neptunium(VI) concentrations are calculated from these results. The neptunium(IV) in the sample, which is not oxidizable at the platinum electrode, is then completely oxidized by ceric ion. The excess ceric ion is selectively destroyed by coulometric reduction after which the total neptunium content of the sample is determined coulometrically by a neptunium(VI)/V) titration.

The development of a radiochemical analysis method for neptunium-237 using anion exchange separations has been completed. The method has some advantages over the TTA extraction method by being applicable to solutions of higher salt concentrations, and by having better plutonium, thorium, and zirconium decontamination.

The recovery of neptunium is at least 90 per cent complete and a neptunium-239 tracer is usually used to permit yield corrections. The neptunium is loaded on a small Dowex-1, X-4 column from a 4.5 M HNO_3 solution containing ferrous ion and semicarbazide to maintain the neptunium(IV) and plutonium(III) states. After a nitric acid wash, the neptunium is eluted with 0.25 M HNO_3 containing a trace of cerium(IV) and determined by alpha counting. Modifications for greater decontamination include successive washes before elution with dilute HF in 4.5 M HNO_3 for better fission product removal and with 12 M HCl containing HI for better thorium and plutonium removal.

Analytical Service

Two improvements were made in the mass spectrometer isotopic assay of plutonium. Directly mounting aluminum-plutonium alloy on the filament gave data equally as

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precise as mounting plutonium alone. If aluminum represents more than 85 per cent of the alloy about 30 per cent longer sample pump-out time was required, however. Secondly, the method for chemically purifying plutonium in dissolver solution was improved. The analyst sustained rather low radiation hazard even though one milliliter of dissolver solution was required. Purification includes a lanthanum fluoride strike, dissolution in saturated aluminum nitrate, extraction into TTA, stripping into 8 M HNO_3, absorption on Dowex-1, and elution with 0.35 M HNO_3.

EQUIPMENT AND MATERIALS

Pump Development

A Randolph, Squee-Gee pump, a peristaltic pump under evaluation for possible 234-5 metering service, has performed fairly well using a Tygon tube while pumping 5 M HNO_3 at room temperature. Using a 1/2-inch O.D. by 5/16-inch I.D. tube the pump has operated at a five liters per hour rate against a 10 foot discharge head for 384 hours. The unit would prime with a 94-inch section lift. Speed control has been erratic but is believed to be due to the Thyratron electrical unit and to a slightly damaged ball bearing in the gear-motor drive. The tubing is to be given irradiation tests before additional mechanical testing.

A Jacuzzi submersible motor-pump, a 21 stage 4-inch diameter brass pump, has been operated for approximately 400 hours, pumping water at an estimated 6 GPM. Life testing is being conducted to determine its suitability for cold chemical service. No "hot" or corrosive application is foreseen since the motor relies on a mechanical seal for winding protection.

Solenoid Control Valve

The magnetic solenoid control valve has proven partially satisfactory, yielding satisfactory flow control over a 3-fold flow range. Currently the coil is being changed to permit DC current use in an effort to obtain greater rangeability.

Continuous Calciner Agitators (224-UA Building)

Hinged-arm agitator arms (Mod II, dwg SK-2-43238) were redesigned (Mod III, SK-2-43238) for the 224-UA Building continuous calciners after two arm failures occurred due to fatigue failure of welds. Each arm had operated about 3000 hours. A Mod IV arm using a beam pin instead of a shear pin is being considered in order to reduce fatigue stress in the arm.

Non-Metallic Materials Testing

Samples of linear polyethylene which were in the Purex H-1 tank from February 28 until May 22, 1958, were inspected. The samples were smooth and strong. There was no evidence of chipping at the edges nor surface damage. The total integrated dose calculated for these samples was 1.2×10^9 rad. A total dose of greater than 10^9 was estimated from the color change of the sample. With proper support this material could be used in Purex HAF and similar solutions for at least 90 days. These data

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also indicate that, if supported to avoid high stress areas (greater than 1000 lb/sq in extreme fiber stress), the HA Column scrub section plates should not disintegrate because of radiation damage at up to 1 x 10^9 rad.

Two blow molded linear polyethylene bellows manufactured on special order by Continental Can Company have been flexed to failure. The bellows were compressed 3/8-inch at a rate of 18 cycles per minute. Failure occurred after less than 10^5 cycles. In their present form these linear polyethylene bellows are not attractive for use in separations plant pulse generators.

Two experimental polyurethane rubber gloves, made in the B.F. Goodrich development laboratory were tested in the usual solutions. One glove was 0.004 inch thick and the other was 0.008 inch thick. The material failed within 10 minutes in 60 per cent nitric acid but lasted one hour in 30 per cent and 24 hours in 10 per cent solutions of nitric acid. The 8 mil sample was penetrated by Recuplex CAX in 4.5 hours while only two hours were required by the thinner material. It also failed after two days in Purex HAX. Hexone, carbon tetrachloride and 50 per cent caustic caused no noticeable effect. Gloves made of polyurethane rubber should offer much more protection in the presence of Recuplex CAX than the gum rubber gloves used at present.

Haveg 093, a product of the Haveg Corporation was tested in the usual process solutions (caustic, nitric, solvents) plus three special acid solutions (1 M HF-1 M HNO_3, 1 M HCl-12 M HNO_3, 2 M HCl-5 M HNO_3). The material was unaffected by 30 days immersion at room temperature. Haveg 093 is offered as a material which will withstand HF. It was noted that this material slowly loses weight when held at 100 C in air. Tests at the boiling point of several solutions are in progress.

PROCESS CONTROL DEVELOPMENT

Assistance to Chemical Processing Department on Process Control Instrumentation

The Purex XAF and XAP gamma absorptiometers became inoperative after eight months of continuous operation. The compensating ion chamber on the XAF unit developed a leak and had to be replaced. The source and ion chamber on the XCP absorptiometer had to be realigned after some displacement which occurred during a maintenance job. Both units have been restored to service and have been in continuous use for three weeks.

Nitric acid concentrations in excess of flowsheet amounts have been detected in Purex acid absorber overheads in recent weeks. At the request of CPD - R&E personnel, a dual range, 60 cycle conductivity instrument which measures nitric acid concentrations from 0.1 to 1.0 and 1 to 10 grams/liter was designed, fabricated and delivered to the plant. The system will have a recorder readout in the central control room and will assist in the control of the acid fractionator and acid absorber to minimize acid carryover to the overheads.

Calciner Control Instrumentation

The programmer to control the steam purge during startup and shutdown of a calciner has operated satisfactorily in tests in the semiworks. Arrangements are underway

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to install the programmer in the 224-U Building in the near future. The programmer to control the main heaters on the calciner has been designed and will be fabricated when the proper switches arrive. The combined operation of these two programmers will effectively automate the calciner startup from stand-by to full operation, and the shutdown step back to the standby condition.

Preliminary semiworks tests with a Foxboro magnetic flowmeter indicate that it will perform satisfactorily on 100 per cent UNH solutions.

NON-PRODUCTION FUELS REPROCESSING

Mechanical Processing

Initial tests with a 40-ton hydraulic shear using straight knives and chopping simulated fuel elements (porcelain-filled stainless steel tubing bundles) showed that:

(a) A 150-ton capacity shear would be required for chopping the largest known non-production reactor fuel element (N/S Savannah) without first making smaller subassemblies.

(b) Chopped segment end closure is more a function of element core material than cutting pressure.

(c) "Fine-size" chopping (less than one-inch segments) of large-cross-section bundles is not practical.

Future work will continue these studies using shear knives and elements of varying materials and geometry.

"Wet" shearing of reactor fuel elements may be necessary to control dusting. Ethylene glycol is a candidate for shear bath liquid during the chopping of Na-bonded elements since it is cheap, water-soluble, has a high boiling point, and will react slowly with Na at water dilutions up to ten per cent. Beaker-scale NaK and ethylene glycol reactions will be studied.

Feed Preparation

Sulfex. Studies of the dissolution rate of 304-L stainless steel in sulfuric acid indicate an optimum sulfuric acid concentration of 3-4 M. Adequate penetration rates and terminal stainless steel concentrations are obtained. Higher concentrations produce more rapid dissolution but would unnecessarily increase the size of the off-gas system and aggravate corrosion problems. Hastelloy F corrodes about 20 and 10 mils/mo. in 4 M and 3 M H_2SO_4, respectively. The presence of stainless steel dissolution products reduces these rates markedly. Solution annealing of welded material is required to prevent preferential attack of weld metal. Hastelloy F specimens present during several laboratory dissolutions of 304-L stainless steel in 3.5 M H_2SO_4 showed average corrosion rates of about five mils/mo. Corrosion rates for Hastelloy F in 4 M H_2SO_4 under heat transfer conditions (metal temperature 140 C) are in excess of 100 mils/mo. These rates are reduced to <10 mils/mo. when stainless steel dissolution products are present. The presence of either ferric

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ion or nitrate ion reduces markedly the corrosion of Hastelloy F by sulfuric acid solutions. However, ferric ion drastically reduces the dissolution rate for 304-L and increases the attack on metallic uranium. Possible use of nitrate ion as a corrosion inhibitor is being evaluated. Low sulfate concentrations (as might occur from incomplete washing of Sulfex declad elements) have no effect on the corrosion of Hastelloy F or 304-L by core dissolution solutions (HNO_3-UNH).

Niflex. A sample of U-9 per cent Mo alloy dissolved at rates two- to three-fold lower than Ingot uranium under Niflex core dissolution conditions. A trace of solid was present in the terminal solution (0.24 M U). About one volume per cent solid (presumably molybdic oxide) was present after the solution was concentrated to 0.46 M U.

Preliminary tests indicate corrosion rates of about 200 mils/mo for Ni-O-Nel and Incoaloy 804 in boiling 1 M HNO_3 - 2 M HF. Ni-O-Nel may also be satisfactory for Sulfex and Zirflex decladding. Evaluation of Ni-O-Nel in solutions high in nitric acid concentration and low in hydrofluoric acid concentration (as might be used for nitric-hydrofluoric acid core-only dissolution of alloyed cores) will be made.

Darex. Pilot plant operations were broadened to include the sequential dissolution of stainless steel and uranium dioxide. Type 304 stainless steel 32 mil tubing (one piece wrapped with a small piece of copper wire to preclude passivation) was dissolved smoothly and completely in 1.25 M HCl and 2 M HNO_3 in two to three hours.

The resultant solution was butted with nitric acid and used for three separate dissolutions of sintered or compacted UO_2. Complete dissolution of the UO_2 was obtained in 7, 5, and 4 hours at nitric acid concentrations of 1.5, 3 and 4 M, respectively. The HCl concentration was in the range of 1 to 1.2 M and the terminal uranium concentration 0.3 M.

The chloride concentration of the dissolver effluent was reduced from 1.25 M (~35,000 ppm) to 50 ppm by a four-step procedure: (a) concentrate the feed by a factor of two, (b) add a volume of 60 per cent nitric acid equal to the volume of the original feed, (c) boil under reflux for three hours, and (d) concentrate slowly to 1/5 of the original volume.

Destruction of Oxide Films on Zircaloy. The rates of destruction of the passive oxide film on Zircaloy by ammonium-hydrogen fluoride melts increase with the hydrogen fluoride concentration; however, the rate of attack of the underlying metal increases even faster. The rate of reaction with metal is greatly reduced by saturating the solution with zirconium. Thus, the optimum solution for selective removal of the oxide film is one low in hydrogen-fluoride and saturated with zirconium.

Zirflex. Additional Zirflex dissolution runs indicate that the ionic conductance in the dissolver pot is at least an empirical index of the completeness of the zirconium dissolution. With a laboratory-type conductivity bridge (not capable of a precision greater than ±2 ohms) the conductance changes from about 0.025 mho at the beginning of dissolution to 0.018 mho at completion. These values have been reproducible in four runs, but differ from those values reported previously

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in that a lower fixed capacitance was used in the bridge circuit. An industrial-type conductivity indicator recorder will be required to improve the precision and obtain a continuous record of conductance vs. dissolution time.

Solvent Extraction

Stability of Process Solutions. Studies on the stability toward precipitation of Redox-type IA Column feeds (IAF) feed point (IAFS) and aqueous raffinate (IAW) solutions were essentially completed for Darex derived feed solutions and continued for those derived by Niflex dissolution. Alloyed cores have not been considered so far in these studies. They will be included in future studies on Niflex dissolved feeds and on feeds prepared by HNO_3-HF dissolution of alloyed fuel cores only (separate decladding). The studies so far can be summarized by the statement that stable solutions derived from either Darex or Niflex dissolver solutions are at a lower pH (ca. 0) than current acid-deficient Redox IAF solutions (pH ca. 1).

Oxidation of Plutonium in Darex and Niflex Feeds. In experiments done to date no difficulty has been found in oxidizing plutonium to Pu(VI) in either Darex or Niflex feed solutions. Greater than 99 per cent Pu(VI) was obtained in less than one hour heating at 95 ± 3 C when the solutions were made 0.1 M in $Na_2Cr_2O_7$.

Solvent Extraction of Darex and Niflex Prepared Feeds. Batch contact studies simulating Redox IA Column extraction of Darex feeds were made in which feed acidity, salt strength, and uranium/stainless steel mole ratio in the feed were varied. At the minimum acidity for Darex feeds (approaching instability toward solids formation) gross beta and gamma distribution ratios were higher by factors of two to five than those obtained in control runs simulating a standard Redox #4 flowsheet. Gross beta and gamma extraction increased markedly with increased acidity. Uranium and plutonium distribution ratios were, in nearly all cases, as high as or higher than those in the control runs. Batch scrubbing of the organics from these runs gave as good or better decontamination as obtained in the control runs. Among the three generally most extractable fission products, ruthenium, zirconium-niobium, and cerium, no one appears to be particularly limiting with respect to decontamination. While IA Column decontamination approaching that in current Redox processing is indicated by these studies for minimum acidity Darex feeds, it is probable that in practice more acidic feeds would be employed as a safety factor against solids formation. Lower decontamination by factors of from 10 to 100 might then be expected.

Mini mixer-settler extraction runs (eight extraction stages - four scrub stages) have been started with simulated Niflex feeds spiked with dissolver solution. In preliminary runs, overall gross beta and gamma decontamination was lower by factors of from 10 to 20 than for a control run simulating a Redox flowsheet at low uranium concentration in the feed. In these runs the aqueous raffinate (IAW) was unstable toward solids formation even when the feed was acid.

Redox Processing of NPF Feeds. Tentative run plans have been established and transmitted to ORNL for the semiworks-scale demonstration of processing NPF materials under modified Redox flowsheet conditions in packed columns. A total of ten radioactively-"hot" HA-HC column runs is proposed: two runs with basic Redox feeds and flowsheets, four runs with varied Darex-type feed solutions, two runs with

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Niflex-type feed solutions, and one run each of Zirflex- and Sulfex-type feed solutions. Emphasis will be placed on confirming chemical compatibility of the flowsheets, determining overall column operating characteristics, determining gross fission product decontamination performance, and obtaining waste loss data. The start of the studies has been delayed until the first part of October. The studies are expected to require about six weeks' time.

Further support activities for this program include the concentration and shipment of the stainless steel solution from the first five Darex runs and shipment of hexone and aluminum nitrate solution to ORNL.

Criticality Studies - Feed Materials Preparation. The feedstock for the second PCTR criticality experiment (H/U atomic ratio of 6) using three per cent U-235 enriched UO_3 was prepared and delivered. This shipment included UO_3 to which boron had been added as a poison.

Analytical Services

Uranium in Darex solutions was measured with the gamma absorptiometer at a precision of ±5 per cent. The uranium was first salted into 30 per cent TBP with aluminum nitrate.

Bismuth was measured colorimetrically with a bismuth - potassium iodide complex. Low level uranium and preponderant aluminum did not interfere. An error of about 25 per cent was not excessive for immediate needs.

REACTOR DEVELOPMENT - 4000 PROGRAM

Potassium Chloride-Aluminum Chloride System

The behavior of plutonium in the $AlCl_3$-KCl-Al system is apparently unaffected by uranium present to the extent of about 15 w/o in the metal phase. Using a salt-to-metal ratio of 1.5 and a uranium-to-plutonium ratio of 100, about 7.7 per cent of the plutonium and 92 per cent of the uranium were found in the metal phase. These values agree, within experimental error, to the reduction yields observed when uranium and plutonium are equilibrated in this system independently of each other.

The effect of salt modification on the reduction of uranium in the alkali aluminum halide-aluminum system was investigated in preliminary experiments. The replacement of potassium chloride with sodium chloride resulted in an increased reduction yield for uranium, while the use of cesium chloride had an opposite effect. An increased reduction yield was also noted when the potassium chloride was replaced with potassium bromide. The above findings are in accord with the behavior expected from theoretical studies (cf. HW-57225 C, p. 5).

Preliminary experiments were performed to test the possible removal of cerium from a Ce-144 spiked plutonium-aluminum alloy by liquation in a magnesium oxide crucible. Although the reaction is thermodynamically favored, holding at 800 C for two hours failed to reduce the Ce-144 activity of the metal. At 1300 C some activity was transferred to the crucible but data are incomplete.

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The behavior of cerium in the reduction of plutonium by magnesium in the $AlCl_3$-KCl-Al system was briefly studied using cerium-144 tracer. Under conditions of 95 to 99 per cent reduction of plutonium, 65 to 75 per cent of the cerium was reduced. The reduction of the cerium can be partially suppressed by addition of excess magnesium chloride, however, it is suspected that this would also result in a decrease in plutonium reduction.

Zirflex Decladding of PRTR Pu-Al Fuels

Uranium-aluminum alloy rods of 2.25 weight per cent uranium (as stand-in for plutonium) were exposed to boiling 5.5 M NH_4F - 0.5 M NH_4NO_3 for 5 hours. Uranium losses based on nominal content were 2.9 per cent which corresponds to 4×10^{-4} grams lost to the solution per square centimeter. The rods were coated with a light green film and had a nine per cent gain in weight.

Combustible Gas Analyzers

On the basis of information currently available, it appears that a combustible gas analyzer using platinum filaments will be suitable for dissolver off-gas analysis for control of explosive mixtures. Two general conditions must be considered for determining the lower explosive limits (L.E.L) in dissolver off-gases. In one case, the L.E.L. must be determined in a mixture of hydrogen, oxides of nitrogen, and air, such as in the acid dissolution of plutonium aluminum alloy fuel elements. The other case, the L.E.L. must be established in a hydrogen, ammonia, air mixture such as in Zirflex dissolutions. The combustible gas analyzer will work satisfactory with either of these systems but a problem still exists in that the L.E.L. changes with composition and temperature. A literature search has revealed some information on the L.E.L. of these mixtures for room temperature conditions, but little for higher temperatures. For initial application a very conservative L.E.L. will be used until additional information is available.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Geology and Hydrology

Analysis of recent magnetometer survey data indicates the presence of a ridge of basalt connecting the Yakima Ridge and Saddle Mountain anticlines in the area southeast of 200 East Area. This low, buried ridge divides the previously defined Cold Creek syncline into two depressions in the basalt surface.

Data from wells recently drilled due east of the 300 Area in the Columbia Basin Irrigation Project disclosed an east-west trending, low but broad basalt ridge, reflected in part in the overlying Ringold formation. The ridge appears to be the continuation of the northernmost of the two Yakima Ridge anticlines recently detected and traced by magnetometric surveys. The anticline apparently turns eastward and crosses the Columbia River, its crest about 200 feet above sea level, about a mile north of the 300 Area.

Pumping tests were completed in three locations to further evaluate aquifer characteristics. The wells pumped were all located between the Hanford townsite and the 300 Area. In well 699-42-12 the mixed glaciofluviatile and upper Ringold

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aquifer was found to have an average permeability of about 5000 gal/ft^2/day. In well 699-35-9 the average permeability of the upper Ringold aquifer was determined to be about 420 gal/ft^2/day. In well 699-16-5 the silty Ringold aquifer was found to have an average permeability of about 190 gal/ft^2/day. These permeabilities are consistent with those measured for the same formations in other wells.

Further model tests were performed to determine the equipotential lines beneath a simulated crib. It was found that the laboratory model could be effectively doubled in size by moving the "crib" to one edge and examining the moisture distribution under one-half the affected soil volume. This produces no evident distortion of the equipotential lines.

Field Apparatus Development

The field work for evaluating the magnetic method for geophysical exploration at Hanford was completed. A report was written which concluded that the method was valuable particularly in conjunction with any local seismic work. Negotiations were initiated to obtain professional consultant assistance for complete interpretation of the results of our surveys.

Thermistor parameters affecting the performance of a ground water velocity probe were evaluated. Externally heated probes proved less sensitive than self-heated probes. Greater sensitivity was achieved with the probe in a vertical position. Sensitivity was also increased by increasing the temperature of the probe and by increasing the length.

Ground Waste Investigations

Previously it was found that the ions accompanying radiostrontium in a waste solution had more influence on the rate of removal of the strontium by soils than did the ions initially occupying exchange sites on the soil. Tests were completed to determine if this situation were equally true at low concentrations of accompanying ion. For this purpose, soil column tests were run with solutions containing 2 ppm of the accompanying sodium or calcium ion. These concentrations are about 0.1 of that of river water. It was found that even of these low concentrations the influence of the accompanying ion on the uptake of strontium (0.1 ppm) for solution by soils was approximately six times that of the ions initially saturating the soil. This research indicates the importance of proper chemical control of waste streams discharged to the ground.

Soil Chemistry and Geochemistry

Tests were completed to evaluate the influence of temperature, phosphate concentration, and flow rate on the uptake of strontium by a calcite bed. Of the three variables, the temperature appears to be most significant. Through a 12-cm column at a flow rate of 750 ml/cm^2/hr the C/Co value for a 0.005 M phosphate solution containing Sr^{90} was found to be 0.88 at 25 C, 0.21 at 40 C, and 3.3 x 10^{-5} at 60 C. The C/Co value varies by as much as 10^2 with phosphate concentrations

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ranging from 0.005 M to 0.05 M. The influence of flow rate is dependent on the other variables. For a 0.005 M phosphate solution at 60 C the C/Co value varies from 6.7×10^{-7} at 50 ml/cm^2/hr to 3.5×10^{-5} at 750 ml/cm^2/hr.

It was established that vermiculite removes Cs^{137} from a phosphate solution by cation exchange only, but strontium removal involves a chemical reaction between the mineral and phosphate ion.

The removal of plutonium by bauxite from acidic phosphate solutions was found to be independent of temperature and not sensitive to phosphate concentrations above 0.01 M. The removal by a crushed bauxite bed is very sensitive to flow rate. Significant plutonium removal occurs only at flow rates less than 100 ml/cm^2/hr. This low flow rate may be a deterrent to plant application.

Rupture Monitor Calibration

Tests of monitor response to an Sb^{124} source (2 Mev gamma) over a two-day period showed satisfactory reproducibility in each of six instruments. Significant differences in response (by a factor of three) among the six instruments tested, however, suggested a poor original calibration or inherent differences in sensitivity, either of which would make a universal fission product calibration factor of limited value. Further testing with the source is scheduled.

Radioisotopes in Reactor Effluent Water

Results from additional activation analyses have confirmed some of the preliminary findings reported in the June, 1958, report on the origins of P^{32} and As^{76} in reactor effluent water. Most of the P^{32} arises from activation of material entering the reactor from dissolved salts present in the Columbia River water used. Impurities in the alum may account for as much as one-third of the P^{32}, while the sulfuric acid and aluminum corrosion account for about 5 per cent and <0.1 per cent, respectively. Almost all of the As^{76} arises from activation of material entering the reactor from dissolved salts in the river water. Aluminum corrosion may contribute one to ten per cent and the sulfuric acid contributes less than 0.3 per cent. The previously reported value for alum has not yet been confirmed.

Continuous removal of radioisotopes from reactor effluent water on a column of aluminum turnings has been followed for over 500 hours. The removal efficiencies for P^{32} (after 220 hours), Mn^{56}, Cu^{64}, Zn^{65}, As^{76}, and Np^{239} were measured as 70 per cent, 45 per cent, 88 per cent, 88 per cent, 70 per cent, and 25 per cent, respectively. Removal efficiencies for some of these radioisotopes are still increasing somewhat with time.

Analytical Services

Cesium uptake studies were supported by sodium and potassium flame photometric measurements. Matrices were acid extracts of plant and animal tissues. Indicated error was about 5 per cent.

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The 329 Building 256 - channel energy analyzer was outfitted with an additional lead cave. It has a one-foot square access port and permits analyzing 3-quart samples. Previously, sample size was limited to one-half pint. Calibrations are proceeding.

O. F. Hill for

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
R. McNamee C. Hylton	9/2-4/	Oak Ridge National Lab. Oak Ridge, Tennessee	Discuss fuel elements reprocessing problems.	AM Platt KJ Schneider RE Burns WW Schulz	Yes
F. M. Teetzel R. L. Hodgson	9/8-9/	National Lead Company of Ohio Cincinnati, Ohio	Discuss in-line instrumentation and related problems.	GJ Alkire MT Walling EE Voiland FA Scott WR DeHollander	Yes
E. J. Jungman	9/8/	Midland Drilling Co. Walla Walla, Wash.	Illustrating a new type of commercial sampler.	DJ Brown	No
G. Macinko	9/16/	University of Idaho Moscow, Idaho	Discuss ground water problems of Columbia Basin Irrigation Project as part of PhD thesis problem.	RE Brown DJ Brown	No
Mr. Crompton	9/18/	National Lead Company of Ohio Cincinnati, Ohio	Discuss in-line instrumentation and related problems.	MT Walling EE Voiland FA Scott WR DeHollander	No
G. W. Watt	9/15-19/	University of Texas Austin, Texas	Technical consultations.	LP Bupp OF Hill AM Platt LL Burger RE Burns MT Walling EE Voiland	Yes
D. A. Hicks J. B. Polwarth	9/18/	Boeing Aircraft Co. Seattle, Wash.	Discussed low level radiochemical methods.	JM Nielsen	No

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
H. D. Hoge	9/25/	Bechtel Corporation San Francisco, Calif.	Discuss Plutonium Recycle Technology	LP Bupp	No
E. P. Meyers	"	Pacific Gas & Electric San Francisco, Calif.	" " "	"	"
D. E. Brater	9/26/	Union Carbide Nuclear Company Oak Ridge, Tennessee	Discuss Flurex	RE Burns WW Schulz	Yes
E. Shank	9/29-30/	Oak Ridge National Lab. Oak Ridge, Tennessee	Discussion of processing technology.	LP Bupp	Yes
M. Twichell	9/29-30/	Union Carbide Nuclear Company New York, New York	Discussion of processing technology.	LP Bupp OF Hill AM Platt GJ Alkire	Yes
C. C. Thomas, Jr.	9/29-30/	Westinghouse Pittsburgh, Penn.	Discuss instrumentation.	GJ Alkire	Yes
H. E. Malde	9/29-30/	US Geological Survey Denver, Colorado	Procure samples of volcanic ash and discuss regional geological problems comparable to Snake River plans area.	RE Brown	Yes

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
D. W. Pearce	9/1-12/	2nd International Conf. on the Peaceful Uses of Atomic Energy Geneva, Switzerland	Present paper	Other Delegates	No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
R. J. Brouns R. L. Moore A. S. Wilson	9/1-15/	2nd International Conf. on the Peaceful Uses of Atomic Energy Geneva, Switzerland	Present papers	Other Delegates	No
O. F. Hill	9/8-10/	ACS Fall Meeting Chicago, Illinois	Present paper		No
	9/11-12/	Oak Ridge National Lab. Oak Ridge, Tennessee	Discuss problems of mutual interest relating to the reprocessing of non-production fuels.	FL Culler	Yes
W. E. Keder	9/8-12/	ACS Fall Meeting Chicago, Illinois	Attend Meeting		No
	9/8-12/	Argonne National Lab. Lemont, Illinois	Discuss neptunium chemistry and process technology.	J Hindman S Lawroski	Yes
	9/15-16/	Oak Ridge National Lab. Oak Ridge, Tennessee	" " "	FL Culler	Yes
	9/17-18/	Savannah River Lab. Aiken, South Carolina	" " "	JO Morrison F Tober	Yes
G. J. Alkire	9/15-18/	Instrument Society of America - Instrument-Automation Conference Philadelphia, Penn.	Attend Conference		No
K. H. Hammill	9/17-19/	B. D. Bohna Company San Francisco, Calif.	Consultation regarding High Level Radiochemistry Facility	JJ Brezina	No
R. W. Wirta	9/24/	AIChE Meeting Salt Lake City, Utah	Presented 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 Restricted Data
G. J. Alkire	9/19/	Oak Ridge National Lab. Oak Ridge, Tennessee	Discuss process control and instrumentation applicable to HAPO separations processes.	TS Mackey JW Landry	Yes
R. W. Wirta	9/26/	Oak Ridge National Lab. Oak Ridge, Tennessee	Discuss fission product recovery and general separations problems.	FL Culler C Watson	Yes
H. G. Rieck	9/29-30/	(ORNL Sponsored) Gatlinburg, Tennessee	Present paper		No
H. J. Anderson E. W. Christopherson	9/29-30/	Second Conference on Analytical Chemistry Sponsored by Union Carbide Company Gatlinburg, Tennessee	Attend Conference		No

BIOLOGY OPERATION

A. Joel R. McKenney joined the Experimental Animal Farm as a Biological Scientist on September 15, 1958.

B. TECHNICAL ACTIVITIES

FISSIONABLE MATERIALS - 2000 PROGRAM

BIOLOGICAL MONITORING

Atmospheric Contamination

Concentrations of I^{131} in thyroid glands of jack rabbits were about two times higher than a year ago.

Collection Site	μc/g thyroid Average	Maximum	Trend Factor
Wahluke Slope	8×10^{-4}	2×10^{-3}	-
Prosser Barricade	5×10^{-4}	7×10^{-4}	- 4
4 Miles SW of Redox	3×10^{-4}	5×10^{-4}	-

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

Sample Type	μc/g wet wt. tissues Average	Trend Factor
Bone	5×10^{-5}	-
Feces	5×10^{-5}	-
Muscle	9×10^{-6}	-
Liver	8×10^{-6}	-

Columbia River Contamination

Contamination levels for beta emitters were about the same as a year ago.

Samples	Location	μc/g wet wt. tissue Average	Maximum	Trend Factor
Minnows (entire)	Hanford	3×10^{-2}	3×10^{-2}	+ 8
Whitefish flesh	Priest Rapids	7×10^{-6}	1×10^{-5}	Not sampled last month.
Whitefish flesh	F - 1	2×10^{-3}	6×10^{-3}	+ 2
Whitefish flesh	Ringold	7×10^{-4}	2×10^{-3}	-
Shorebirds flesh	Hanford Reserv.	5×10^{-3}	9×10^{-3}	*
Gulls flesh		4×10^{-3}	9×10^{-3}	*
Terns flesh		4×10^{-3}	6×10^{-3}	*
Merganser flesh		1×10^{-3}	2×10^{-3}	*
Herons flesh		2×10^{-4}	6×10^{-4}	*
Grebes flesh		2×10^{-4}	3×10^{-4}	*
River ducks		1×10^{-4}	5×10^{-4}	*

* Waterfowl from the Columbia are sampled bi-annually.

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Effect of Reactor Effluent on Aquatic Organisms

Young rainbow trout held in 3 per cent strength reactor effluent since June had a mortality rate only slightly higher than control fish, their rate of growth was greatly retarded, however. This strength of effluent has previously been considered as threshold for toxicity and the greater effect observed this year may well have resulted from the unusually high ambient temperature of the Columbia River.

Mechanical difficulties with the well water supply to the Aquatic Biology Laboratory were corrected and no mortality of trout held in this water was experienced during the month.

BIOLOGY AND MEDICINE - 6000 PROGRAM

METABOLISM, TOXICITY, AND TRANSFER OF RADIOACTIVE MATERIALS

Phosphorus

Approximately 350 young trout of a size suitable for an isotopic feeding test were obtained from the State of Washington Department of Game. As soon as these fish have been acclimated to experimental conditions they will be used to measure the change in turnover rate of P^{32} under different temperatures.

Zinc

Barley grown to maturity in plots irrigated with 100 per cent reactor effluent contained 1×10^{-5} μc Zn^{65} per gram dry plant matter compared with an average concentration of 5×10^{-5} μc Zn^{65} per milliliter of effluent. The efficiency of uptake is even less than it appears since about 1/3 of the Zn^{65} added last year remains and was available for uptake this year. The lower uptake under field conditions than in the laboratory is presumably due to poor penetration of Zn^{65} into the root zone. In columns containing local soil over 94 per cent of the Zn^{65} was in the upper half inch even after several liters of water had passed through the column. Addition of salt greatly enhances movement of the Zn^{65} through the soil.

Strontium

Data are available through 64 days from the experiment studying the retention of a single dose of Sr^{90} and Ca^{45} in mature rats as influenced by the total calcium level of the diet. At all dietary calcium levels Sr^{90} is lost more rapidly than Ca^{45} and does not appear to be influenced by the level of Ca in the diet. On the two lowest calcium level diets (.03% and 0.1%) there appears to be no significant turnover of the initially deposited Ca^{45}.

Preliminary data through the 39-day sacrifice from the weanling rat experiment, in which Sr^{90} and Ca^{45} are chronically fed with diets of various calcium content, indicate higher OR values (approximately 0.5) than those seen in mature rats. There appears to be no significant change in the OR values as a function of either time or dietary calcium level.

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Three adult miniature pigs were given Sr^{90}-Y^{90} citrate solutions via the intravenous route. The injected doses used will give a retained dose of approximately 60 μc Sr^{90}-Y^{90}/kg bodyweight, which is about 2000 A MPC for Sr^{90} in man. Complete blood and excreta data are being obtained.

Two miniature pigs, 57 and 66 days of age, were placed in baby pig metabolism cages and fed one 100-μc Sr^{90}-Y^{90} feed pellet. Excreta samples will be collected daily for 15 days, after which the animals will be sacrificed for tissue activity determination.

Preliminary examination of the data from the pigs administered Sr^{90} intragastrically shows the following: the feces and urine excretion curves for growing and mature pigs are very similar, the only apparent difference being the magnitude of the curves relative to dose. At the higher dose levels a greater proportion of the Sr^{90} is excreted in the feces and the attainment of maximum excretion rates is delayed. Increasing the administered dose by a factor of five (20 μc - 100 μc in the growing pig, 100 μc - 500 μc in the adult pig) resulted in only a 2 - 3 fold increase in bone deposition of Sr^{90}. The growing pig retained twice as much Sr^{90} in the bone following a dose of 100 μc as did the adult pig.

Alfalfa harvested from plots contaminated with Sr^{90} contained less and less Sr^{90} in successive cuttings made through the growing season. Whether this is a seasonal effect or due to roots becoming established at levels deeper than the surface contamination will be evident only after an additional year's cropping.

Iodine

Generally, higher Q/D ratios (ratio of I^{131} in the thyroid to quantity of I^{131} fed daily) were observed in the experimental sheep for the month of September as compared to August 1958. This is a normal rise due to weaning of the lambs and cessation of lactation.

The Q/D of all swine on I^{131} feeding continued to drop this month. This could be a continuation of the downward trend experienced with the extremely hot weather this year. If this is true, the cooler weather now being experienced will probably be reflected in next month's Q/D's.

A new group of 8 weaned control lambs was started on 5 μc I^{131} per day during September. These animals will be kept for possible thyroid tumor development. This will permit comparison of uterine and non-uterine fetal exposure to I^{131} as a factor in thyroid tumorigenesis.

A single dose of 3 mc of I^{131} was given to 13 ewe lambs. These animals will serve as pathological controls for the 17 ewe lambs that received the same dose of I^{131} (3 mc) in October, 1957. The animals in the new group will be sacrificed at six-month intervals starting two years hence, for study of pathological damage to the thyroid.

A single tracer dose of 5 μc of I^{131} was administered to the 3-mc 1957 ewes mentioned above in order to determine the extent of thyroid damage at one year after dosing.

Average uptake at peak was 17 per cent as compared to 50 per cent a year ago.

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Plutonium

The following expressions for tissue and blood concentrations and excretion rates were determined from data obtained over a period of approximately 300 days following intravenous injection of plutonium into rats. All data are expressed in terms of per cent of initially ingested dose.

SUMMARY OF PLUTONIUM TISSUE CONCENTRATIONS

Tissue	Concentration (%/gm)
Liver	$8t^{-.77}$ (a)
Kidney	$1.2t^{-.55}$
Lung	$.081t^{-.19}$
Bone	$4.9e^{-.0031t}$
Spleen	$1.04 \pm .68$ (b)
Ovary	$.14 \pm .10$ (b)
Salivary Gl.	$.12 \pm .12$ (b)

(a) Time, t, in days post injection.
(b) Constant values $\pm$ std. dev.

SUMMARY OF BLOOD CONCENTRATION AND EXCRETION RATES

Parameter	Units	Time Period (days)			
		$1 \leq t \leq 308$	$1 \leq t \leq 10$	$10 \leq t \leq 130$	$130 \leq t \leq 308$
Blood concentration, B	%/ml	$1.78 \times 10^{-3} t^{-.37}$			
Daily urinary excretion, du/dt	%/day		$0.8t^{-1.3}$	$0.054t^{-.14}$	$2.5 \times 10^{5} t^{-3.8}$
Daily fecal excretion, dF/dt			$1.32t^{-.10}$	$23.5t^{-1.2}$	$3.2 \times 10^{11} t^{-5.9}$
Excretion ratio dU/dt/dF/dt			$0.61t^{-1.2}$	$2.3 \times 10^{-3} t^{1.06}$	$7.9 \times 10^{-7} t^{2.1}$
Total daily excretion, dE/dt			$2.05t^{-.32}$	$12t^{-1}$	$7.7 \times 10^{9} t^{-5}$

Gastrointestinal Radiation Injury

Experiments were initiated to study the effect of chronic oral sub-acute doses (0.5 to 1.0 mc/da) of beta radiation (Y^{90}) on the gastrointestinal tracts of rats.

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Radioactive Particles

Two dogs were exposed to plutonium oxide dust and killed immediately for determination of quantities deposited in the respiratory and gastrointestinal tract. Although the plutonium deposited in the dog was detectable in the whole-body dog monitor, it is hoped in future experiments to increase the quantity deposited several fold to permit long-term study of the pulmonary clearance rate.

Fallout

Biological organisms, soil, and water were collected from stations representative of seven different environmental areas of Washington.

Relative Biological Effectiveness

Membrane leakage seems to be the system in which radiation damage can be most readily tested biochemically. Potassium, phosphorus, and UV-absorbing compounds all diffused out of irradiated yeast cells with the increase, relative to unirradiated cells, greatest for K and least for UV-absorbing compounds. Uptake of methylene blue was observed in only a very few cells even after doses of 240,000 r.

Sectioned yeast cells previously exposed to Po^{210} show by autoradiography that very little of the alpha emitter was within the cell.

Tests for Ability to Sense Ionizing Radiation

To observe for obvious signs of distress in a radiation field, D. melanogaster flies were placed in a glass tube which was then placed over a very intense source of beta radiation in such a way that the flies could move into or out of the field at will. There was no evidence of response of flies in the field nor of an avoidance of the radiation field.

There is as yet no evidence of avoidance of areas of radiation by flies reared in a population cage under conditions selecting against flies laying their eggs in the radiation field. Avoidance was tested by rate of egg laying in the two areas of the cage.

Roy C. Thompson

Acting Manager
BIOLOGY OPERATION

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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 and Buildings Visited
VISITS TO HANFORD WORKS						
Dr. M.E. Ensminger	9/23	WSC, Pullman, Wash.	Consult with Animal Farm personnel.	WJ Clarke	No	100-F, 141-M
VISITS TO OTHER INSTALLATIONS						
R.F. Foster and P.A. Olson	9/4	US Public Health, Portland, Ore.	Attend Symposium on Short-Term Bioassay	EF Eldridge	No	-
J.J. Davis W.C. Hanson H.A. Sweany	9/11-9/27	Collection sites in State of Wash.	Collecting samples	Various farmers	No	-
R.H. Schiffman	9/16	Pullman, Wash.(WSC)	Attend seminar by visiting professors	-	No	-
J. Olivard	9/16	Pullman, Wash. (WSC)	Attend lectures	-	No	-
F.P. Hungate	9/16	" " "	" "			
H.A. Kornberg	9/23-9/26	Atomic Energy Research Establishment, Harwell, England	Present papers at Harwell Conference	Russell,Loutit	No	-
R.F. Foster	9/25-9/26	Spokane, Wash.	Attend Pac. NW Sewage and Industrial Wastes Assn.	-	No	-
R.T. O'Brien	9/26	Pullman, Wash.	Attend NW Branch of Soc. of Am. Bact. and discuss research.	Dr. Campbell	No	-

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D. Lectures

a. Papers presented at meetings

R.F. Foster, "Aquatic Life Studies - An Index of Radioactivity Control," Sept. 2, 1958, Kennewick Kiwanis Club.

H.A. Kornberg, "Biological Effects of I^{131} in Sheep and Swine"

"Hazards Due to Inhalation of Radioactive Particles"

"Radiostrontium-Calcium Relationships in Plants and Animals"

Presented at Conference on the Passage of Fission Products Through Food Chains , Harwell, England, September 23-25, 1958.

R.F. Foster, "Biological Aspects of and Methods Used in Control of Water Pollution," (moderator for panel discussion) Industrial Wastes Committee of the Pacific Northwest Sewage and Industrial Wastes Association, September 25, 1958, Spokane.

R.T. O'Brien, "Post Irradiation of Phosphorus of Yeast," Northwest Branch of Society of American Bacteriologists, Pullman, Washington, Sept. 26, 1958.

b. Seminars

R. T. O'Brien, "Radiation Effects on Permeability Changes in Yeast," Sept. 23, 1958.

A. C. Case, "Radioactivity Counting Systems Used by the Biology Operation," Sept. 23, 1958.

E. Publications

a. HW Publications

W. J. Bair, "Translocation and Excretion of Pulmonary Deposited Plutonium Oxide," Document HW-56636 (UNCLASSIFIED) August 1, 1958.

b. Open Literature

Thompson, R.C. and O.L. Hollis, "Irradiation of the Gastrointestinal Tract of the Rat by Ingested Ruthenium-106", The American Journal of Physiology 194, 308-312 (1958).

Hanson, W.C., "Arctic Tern and Black Brant in Eastern Washington," Murrelet 39, #1, 12 (Jan.-Apr. 1958).

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OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

September, 1958

ORGANIZATION AND PERSONNEL

There were no changes in personnel during September.

OPERATIONS RESEARCH ACTIVITIES

Economic Studies

The task force for evaluation of capital expenditures has progressed to the point of estimating operating expenditures. This study will be completed during October.

A rough draft describing some of the factors entering into uranium pricing was prepared.

The development of computational programs for generating Hanford input-output response simulation models was completed this month. A data preparation schedule calling for a computational target date of November 15, 1958 was agreed to by OR&S personnel and IPD-FPD consultants. Steps were taken to gain the cooperation of the Data Processing Operation in meeting the deadline of December 31, 1958 at which time completed statistical models are to be available.

All analytical work and pre-computational data preparation on investigation into the effect of R & D expenditures on CEO activity has been completed.

CPD Control Study

Examination of book-physical inventory differences and their relationship to material control was continued. A complete study of data from the material balance areas established for the Finished Products Operation and Plutonium Recovery Operation was made and the desired characteristics of the system compared with the data. From the study it appears that control would be improved if (1) material balance areas were defined by type of material processes as opposed to administrative areas; (2) an inventory processing procedure was provided which would segregate scrap material by type and time of generation; and (3) increased reliance were placed on immediate "batch" or "item" control techniques.

A complete historical study has been made of the uranium B-PID's throughout CPD and a report will be issued early in October. Of major interest are fluctuations which are apparently due to the redefinition of material balance areas.

A report was issued exemplifying methods of utilizing available process control information for the improvement of SS accountability. A report was also issued on a survey of bias correction data for the past two years with recommendations as to the utilization of this data for the purpose of making material balance corrections.

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Effort during the month on the Z plant information study was directed toward the development of an appropriate code to identify the process steps and materials for analytical purposes. A coding system of this type is not only necessary for purposes of the study but can also be adapted to production scheduling and quality control. Immediate by-products of this study have been check weighing before any operation where a change in state or form transpires and a renewed effort to devise means of sufficient line storage at appropriate locations.

Other

A report describing a basic characteristic of employee communication which may prove useful for directing and/or predicting the results of various types of publicity campaigns was completed during the month.

Work has been started in connection with a practical model for NPR spare equipment and spare part procurement. The objective is to obtain minimum cost consistent with both construction and operation needs and practices.

In connection with attitude survey activity, assistance was provided IPD personnel in devising a method of analysis for a survey to be conducted in one of the reactor operations, and a new approach toward the development of a questionnaire for plant-wide attitude surveys was suggested to the Employee Relations managers.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Metallurgy

A regression analysis of log corrosion rate on power to determine whether or not in the given experimental situation upstream and downstream regression functions were identical was completed.

Discussions were held to firm up the experimental procedure to be used in connection with proposed accelerated life testing experiments to investigate the relative corrosive properties of several aluminum alloys.

A statistical analysis was initiated on data from a recent experiment to investigate the hardness of various metals as a function of irradiation time measured in spike cycles.

2000 Program - Reactor

Work continued on the analysis of NPR design experiments to investigate the physical properties of zirconium alloys as a function of temperature, stress, and time. Analysis of variance techniques are being used to establish the functional dependency of secondary creep and stress rupture time on temperature and stress for both annealed and cold work zirconium alloys.

4000 Program

In connection with studies of the mechanism and effects of the swelling of uranium fuel, work was initiated on the development of a mathematical model for the formation of gas bubbles in irradiated uranium. Discussions were held to obtain background information and delineate the mechanism involved. Statistical methods are

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also being considered for estimation of bubble formation distributions from electron microscope enlargements of two dimensional sample cross sections of uranium.

A related estimation problem also under consideration is the determination of the distribution of pit depths resulting from molecular diffusion away from the interface of bonded metals. The estimation of the maximum penetration of uranium into aluminum silicon eutectic alloy and vice versa in bonded couples as a function of time and temperature is of particular interest.

6000 Program - Biology and Medicine

A final draft of the formal report on the multicompartment migration model has been prepared, and will be submitted to interested personnel of the Biology Operation.

A sampling scheme was devised for the detection of malignant tumors in the lungs of mice which has certain optimum properties. A rough draft report on the method is currently being prepared.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

Process Control (Fuels Preparation Department)

Assistance was given in setting up continuous methods of analysis for reject rate data arising from the external penetration tester. The primary purpose is to correctly differentiate "out-of-control" situations due to testing errors from those due to a real shift in the product quality. In this connection, data resulting from a designed experiment to evaluate the sorting efficiency of the tester were analyzed.

Process Experimentation (Fuels Preparation Department)

A report was issued presenting the results of the analysis of data from a designed experiment dealing with the effects of certain process variables on total bond count of a fuel element. A discussion of the experimental design employed was included.

At their request, a series of sessions on statistics is being planned for presentation to FPD personnel. Rather than using the lecture type approach, it is planned that the sessions will consist of practice sessions in considering problems typical of those encountered in FPD and simulated on the Process Simulator, with full group participation encouraged.

Production Tests (Irrad. Proc. Dept. and Fuels Prepar. Dept.)

A report was issued presenting the results of an analysis of partial data from production test IP-120-A-94FP dealing with an evaluation of low hydrogen dingot fuel elements. A second report will be issued when the complete set of data is analyzed.

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An analysis is being made of dimensional distortion data from IP-60-A. Four treatments are involved, consisting of the possible combinations of low and normal hydrogen content and recrystalized and not recrystalized material. The Latin Square design was employed in addition to the use of solid charges of a given treatment exposed to various levels.

Rupture Analyses (Irrad. Proc. Dept.)

Side failure experience data for I and E natural uranium fuel elements at the K reactors were compared with the number of failures expected to occur on the basis of the solid fuel element side failure experience.

A report was issued presenting methods of comparing small "rates" such as rupture rates, incidence of hot spots, and certain reject rates. In this report, formulas were given for determining sample sizes at the experimental design stage, and testing for statistical significance at the data analysis step. The statistic employed is the ratio of such rates rather than the difference.

Tank Calibrations (Chem. Proc. Dept.)

Calibration data from two tanks, the A-2 and H-7 tanks, were analyzed to establish the calibration curves and determine confidence statements for predicted volumes, and two reports were issued. One of these reports included a rather complete discussion of the whole calibration problem and specific recommendations for improving future calibrations.

General (Chem. Proc. Dept.)

Tables were developed which give the minimum counting time on a counter with known background necessary to say with α % confidence that the source count rate is less than N counts per minute.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

A statistical study of the precision of General Chemical Analysis Operation determinations was completed and a report issued. Precision statements in the form of 95% confidence intervals were constructed for several qualitative analytical methods, including organic and aqueous nitric acid titrations and uranium analysis by the fluorimetric method, for both undiluted and diluted samples.

A course on statistical methodology is being conducted for personnel of Theoretical Nuclear Physics Operation. To date lectures have been devoted to fundamental statistical and probabilistic concepts; future lectures are to cover non-parametric inference, confidence interval estimation, regression analysis and related topics.

The final draft of a formal Hanford report on "Occupancy Probability Tables Based on the Multinomial Distribution for Equally Probable Events" has been completed.

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OFFSITE VISITS AND VISITORS

There were no offsite visits or visitors during September.

Carl A. Bennett

Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

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PROGRAMMING OPERATION
SEPTEMBER 1958

A. FISSIONABLE MATERIALS - 2000 PROGRAM

Neptunium-237 - Plutonium-238 Processing

The study of the process scope and costs involved in establishing facilities for the processing and recovery of Np-237 and Pu-238 from irradiated Np-237 was continued. The Hot Semiworks could be modified to provide a facility for the routine processing of irradiated Np-237 for about $1,000,000. A new shielded pit-type facility serviced by a mobile crane could be provided for about $2,500,000. This latter involves a remotely maintained "hot" cell and a direct maintained "warm" cell. All proposals involve a combination of an ABC type solvent extraction cycle followed by ion exchange for final isolation and decontamination of the products. In the study of the process the principal problems relate to the chemistry of Np and Pu reduction and oxidation and the selection of suitable reagents for these processes.

B. REACTOR DEVELOPMENT - 4000 PROGRAM

1. Plutonium Recycle Program

Plutonium Evaluation

Machine computation procedures were refined and extended by the inclusion of additional price schedules for enriched uranium and new data on the cross-section of Pu-242.

At the request of the Division of Reactor Development, discussions were held in Washington, D.C. on September 25, dealing with a "crash" program (jointly with ORNL and ANL) to appraise the economic performance of plutonium fuels of specific compositions in several specific power reactors now under construction or under serious consideration. These economic data are desired by the AEC for background in establishing plutonium pricing policies.

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

The study of the costs, timeliness, and value of alternate methods for PRTR fuel examination and sectioning was concluded. Facilities could be provided at 221-U plant at a cost of about $1,000,000. Aside from this high cost, timing could be unsatisfactory for the PRTR schedule and thus would require additional costs for temporary facilities at 327 Building in the 300 Area. It was concluded that an "all purpose" cell at 327 Building should be provided instead of temporary plus future permanent 221-U plant facilities. The costs would range from about $350,000 to $600,000 depending on type of construction and extent of auxiliaries provided.

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PRTR Hazards Analysis

Certain nuclear hazards aspects of the PRTR were reviewed with personnel of the AEC Hazards Evaluation Branch at a meeting in Washington, D.C., on September 15.

High Exposure Plutonium Requirements

A study to appraise the high exposure plutonium requirements of the PRTR was concluded. Based on current plans for fueling the PRTR, it is estimated that 34 kg of high exposure plutonium from an external source could be used to advantage. This amount, used in place of low exposure plutonium, would shorten by two years the time to reach a steady state, almost self-sustaining condition in the reactor. About 22 kg from the MTR and PWR have already been requested from the AEC. Analysis of methods for obtaining the remaining 12 kg indicates the least expensive and most expedient to be the irradiation of depleted uranium in the Hanford reactors. This method is estimated to be capable of providing the needed material in ample time at a cost of $13 per gram more than the cost of low exposure plutonium. Other methods, such as irradiation of natural uranium or plutonium, are appreciably more costly and would require some unknown amount of development work. The use of reactors other than Hanford's, such as NRU, appears less desirable at the present time.

C. RADIOLOGICAL CONSULTATION

A review of the possible environmental hazards accompanying the simultaneous maximum credible accident and release of the liberated radioactive materials was made for the preliminary hazards report of the critical mass laboratory. The present limits for restricting the work of individuals who have positive quantities of plutonium in the body were reviewed. Critical points in the assessment of such limits are the accuracy of the bioassay technique for determining the deposition in the individual and the estimation of the probability that he will later become involved in an incident where he will have a sufficient quantity deposited to put him over the limit.

Information was submitted to the Division of Biology and Medicine on programs at Hanford in which fallout is measured in order to inform them of the type of data available. A brief review of unclassified information and programs relating to the concentrations of radioisotopes in the environs was submitted to the Division of Biology and Medicine in answer to a query on the classification of data on concentrations in whitefish. Reviews were made of the CPD waste program and the calculation of exposure from Columbia River drinking water with comments submitted to appropriate parties. A general proposal for studies on DNA in the effects of radiation and cancer therapy was prepared. Studies were also made of the desirability of acceleration of the fuel element melting program and on the need for a radiological evaluation program; appropriate recommendations were formulated.

Proposals for the maximum permissible limits for strontium and radium isotopes for the forthcoming report of the NCRP Internal Dose Subcommittee were received

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and comments submitted to the Committee Chairman. A review of the scope and possible work of the subcommittee on Site Evaluation of the ASA N6 Committee was sent to the Chairman.

D. OTHER ACTIVITIES

HLO Science Colloquium

Arrangements were made for the third session, at which Dr. Henry Eyring, noted physical chemist, will speak on October 2.

L H McEwen

Manager, Programming Operation

LH McEwen:dl

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VISITS TO HANFORD:

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	HAPO Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
W. J. Ozeroff (ACCESS PERMIT)	9/22-23/58	General Electric Co. Atomic Power Equipment Division San Jose, Calif.	To discuss physics and computer methods.	JR Triplett EA Eschbach	No	300 - 328
Henry D. Hoge Eugene P. Myers (ACCESS PERMIT)	9/25-26/58	Bechtel Pacific Gas & Electric San Francisco, Calif. (Commonwealth-Edison)	To discuss plutonium recycle technology.	JR Triplett	No	300 - 328

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
J. R. Triplett	9/15-16/58	AEC-Division of Reactor Development Washington, D.C.	To attend plutonium recycle reactor preliminary hazards report discussion.	C.W. McLaughlin	Yes
E. A. Eschbach	9/17-18/58	AEC-Division of Reactor Development Washington, D.C.	To discuss formulation of plutonium fuel values.	D. Coburn	Yes
E.A. Eschbach G.J. Busselman	9/25-26/58	AEC-Division of Reactor Development Washington, D.C.	To discuss formulation of plutonium fuel values.	D. Coburn	Yes

RADIATION PROTECTION OPERATION MONTHLY REPORT - SEPTEMBER 1958

A. ORGANIZATION AND PERSONNEL

K. F. Baldridge and O. M. Hanson were reassigned within RPO. During the month, three employees--R. L. Watters, J. F. Evans, and Katherine J. Beebe--returned to school. E. R. Wood was reactivated into Exposure Evaluation & Records on September 8, 1958. S. M. Bradbury was transferred into Radiation Monitoring from CPD on September 29, 1958. Blanche L. Acorn and G. H. Whitsett terminated on September 12 and September 26, respectively. Six employees were transferred to other assignments, namely, W. L. Beem to HLO-Biology on September 1, 1958; Lequita J. Branum to HLO-Laboratory Auxiliaries on September 1, 1958; Bernice R. Jones and Wanda L. Raines to HLO-Laboratory Auxiliaries on September 15, 1958; Edith F. Snyder to HLO-Facilities Engineering on September 15, 1958; and L. L. King to HLO-Laboratory Auxiliaries on September 29, 1958.

B. ACTIVITIES

There were no new cases of internal deposition confirmed through bioassay analyses in September. One case of localized overexposure to the skin resulted from coverall contamination. The dose to the CPD employee involved was about 1.05 rads including 0.02 mr.

A potential exposure occurred when a leak from an overhead line contaminated a small floor area to a level > 200,000 d/m plutonium per probe area. The contamination was spread to two rooms and a corridor and the protective apparel of two employees before it was discovered and controlled. Decontamination efforts were successful.

Investigation of a high badge result revealed the source of gamma radiation was in a hood in an adjacent room. Dose rates at the office wall were 30 mr per hour and at the employee's desk 5 mr per hour. The total exposure was estimated at less than 200 mr over any consecutive seven-day period.

There were no additional inquiries regarding the exposure report cards.

The steel plate for the Shielded Personnel Monitoring Station was received and the three-inch floor plate was grouted. Vendor's bids indicated that a 200-channel analyzer could be obtained at slight additional cost as compared to the 100-channel analyzer originally specified. A supplemental appropriation request was submitted for the additional funds. Provision of the 200-channel analyzer will increase the rate of monitoring personnel and provide for anticipated future expansion.

The Bioassay laboratory records system was converted to electronic data processing methods and is operating satisfactorily.

I^{131} emission from separations facilities averaged 11.4 curies per week, primarily from the Purex plant. Difficulty with the vessel vent system was suspected as the source of increased emission. The average weekly emission rate for the past 12 months has been 8.1 curies.

The 15 produce samples obtained from the Franklin County Irrigation District and mentioned in last month's report were analyzed by gamma spectroscopy during September. The measurements indicated the absence of detectable gamma emitters except for natural potassium (K^{40}), one positive measurement for Zn^{65} in corn kernels, and one positive measurement for $Ru^{103-106}$ in string beans. Analyses for Cr^{51}, Zr^{95}-Nb^{95}, I^{131}, Cs^{137}, Ba^{140}-La^{140}, and $Ce^{141-144}$ were below the respective detection limits.

The study for measuring high-level gamma radiation with film was advanced substantially. Two methods were demonstrated which can be used to measure 2,000 r of 1 Mev. gamma. One of the methods utilizes X-ray spectrometry and has the disadvantage of requiring a very high X-ray dose which damages the film. The other is by removal of the sensitive emulsion from the Eastman Kodak Type 2 film and measuring the optical density of the insensitive emulsion with a conventional densitometer. Further efforts will establish the accuracy with which large doses can be measured using both of the methods. Several other methods were tested for possible application, but found unsuitable.

A prototype pencil reader which utilizes the pulse method was provided IPD for field test in the 100-K area. A group of specially marked pencils charged to 60 volts was also provided. The useful range of the pencils is about 150 mr at that voltage.

The pulse pencil reader used by the Regional Monitoring Operation was modified and adjusted to provide ranges having peak values of 18 and 30 mr. Further increases in the range require an increase in the voltage of the pencils which is presently 20 volts.

At the request of the AEC, arrangements were made for local fabrication of three pulse-type pencil readers for use in a background radiation survey.

A study was initiated to determine the necessity of some of the calibrations work. The approach is to ascertain if some of the calibrations can be predicted with sufficient accuracy from other calibrations. The first application of this approach was with the CP dose rate meter to determine whether the beta response can be adequately predicted from gamma response (or vice versa). Results to date are favorable. Upon completion of the analysis of the CP data, the approach will be extended to other instruments and film.

The Pu-Be neutron source calibrated by the National Bureau of Standards was received. Physical inventory of all of the radium in HLO was completed.

Prototype gamma monitoring equipment for use in the river monitoring stations was calibrated and field tested. The response to radium-gamma radiation was found to be 230,000 cpm equivalent to 1 mr per hour. The equipment was located at the 183-H settling basin and operated continuously for one week. The operating characteristics of the instrument were satisfactory and it appears to have sufficient sensitivity.

A plant-wide network of about 240 disaster monitoring stations was established. Each of the locations is monitored with a neutron badge from which the gamma dose may also be measured. The film will be exchanged monthly and will provide an evaluation of background radiation as well as a measure of the radiation in the event of an incident.

The RPO display, "Radiation Protection at Hanford", initially presented at the Benton-Franklin County Fair was viewed by several thousand people at the Small Business Procurement Fair in Seattle on September 25 and 26, 1958.

C. EMPLOYEE RELATIONS

Negotiations with the Regional Monitoring field inspectors were completed with the incorporation of these employees into the same seniority group and job classification as the radiation monitors. The agreement was effective September 29, 1958.

Of 27 employees scheduled for ROF in the Radiation Protection Operation, all but eight employees have been placed. Written notice was given a month in advance to each employee scheduled for ROF on November 1. Placement efforts are continuing.

Negotiations were resumed with the HAMTC on the Wonacott Grievance which involves the Union Jurisdiction of Radiation Monitoring employees. A proposal was made which the Company has directed to the HAMTC in writing and which they are currently considering as a possible resolution to this long-standing problem.

A Climate Review was held with all members of the Radiation Protection Operation staff participating.

There were four medical treatment injuries for a frequency of 1.75. No security violations occurred during the month.

One suggestion was submitted by an RPO employee. Two evaluations were completed. No additional suggestions were received for evaluation. Two RPO employees received awards totaling $20.

Radiation Protection Operation has 95.7% participation in the Savings and Security Program.

D. SIGNIFICANT REPORTS

HW-56827 "A Personnel Film Badge Neutron Dosimeter" by Frank Swanberg.

HW-56985 "Waste Disposal Monitoring Activities Summary, July, 1958" by R. M. Bernard.

HW-57304 "Waste Disposal Monitoring Activities Summary, August, 1958" by K. F. Baldridge.

HW-57306 "Regional Monitoring Activities, August, 1958" by B. V. Andersen.

HW-57411 "Calculation of Drinking-Water Radiation Exposure from Columbia River Water Sources" by H. V. Clukey and M. W. McConiga.

HW-57399 "Surface Dose Rate Measurements" by J. F. Evans.

HW-57608 "Monthly Report - September 1958, Radiation Monitoring Operation" by A. J. Stevens.

Conf. Undoc. "Inventory of Radioactive Liquid Wastes to Active Disposal Sites - June, 1958" by K. F. Baldridge.

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VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings
Major D. E. Bogan Capt. D. F. Hulin Major M. A. Alex	9/22/58	Chemical Section 4th Infantry Div. Office of Post Surgeon, Ft. Lewis, Washington.	Discuss field emergency monitoring team activities and equipment and radioactive waste disposal.	BG Lindberg	Yes	300:3760
Richard A. Matthews Vernon R. Roberts	9/10/58	Electronic Mfg. Co. 3200 First Ave. So. Seattle 4, Washington	Discuss the development of electronic equipment used in the field of radiation protection.	RL Junkins FL Rising	No	300:3706

VISITS TO OTHER INSTALLATIONS

L. J. Defferding	9/30 - 10/3/58	Argonne National Laboratory, Lemont, Illinois	Present paper at Alpha-Gamma Hot Laboratories Conference.	Ray Goertz		Yes
H. V. Clukey	9/23/58	Spokane, Washington	Attend meeting of the Pacific NW Pollution Control Council and Subcommittee on Water Supply and Water Pollution Control of the Columbia Basin Inter-Agency Committee.	H. C. Clare		No
J. W. Vanderbeek	9/12-13/58	Boeing Airplane Co. Renton, Washington	Attend Northwest Chapter of the AIHA Conference			No

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REGIONAL MONITORING - RESULTS (August 24 - September 21, 1958)

Sample Type and Location	Activity Type	Monthly Average	Units*	Trend** Factor
Drinking Water				
100-F Area	Isotopic	1.0	% MPC_{GI}	--
Separations Areas	Total Beta	7.0×10^{-7}	µc/cc	+5
Pasco	Isotopic	0.2	% MPC_{GI}	--
Kennewick	Isotopic	0.1	% MPC_{GI}	--
Richland	Total Beta	$< 3.0 \times 10^{-8}$	µc/cc	--
Columbia River Water				
Above 100-B Area	Total Beta	$< 3.0 \times 10^{-8}$	µc/cc	--
100-F Area	Isotopic	3.1	% MPC_{GI}	--
Hanford Ferry	Total Beta	3.9×10^{-5}	µc/cc	--
Pasco	Isotopic	0.9	% MPC_{GI}	--
McNary Dam	Total Beta	9.3×10^{-7}	µc/cc	+3
Vancouver, Washington	Total Beta	No Sample	µc/cc	
Waste Water				
Outlying Test Wells	Total Beta	1.2×10^{-6} (max)	µc/cc	--
Reactor Effluent Retention Basins to River	Total Beta	19,000	curies/day	--
Atmosphere				
Gross Dose Rate -				
Separations Areas	Beta-gamma	0.6	mrad/day	--
Residential Areas	Beta-gamma	0.6	mrad/day	--
I-131 Separations Areas	I-131	9.5×10^{-13}	µc/cc	+2
I-131 Separations Stacks	I-131	11.4	curies/week	+2
Active Particles - Project	--	4.1	ptle/100 m^3	--
Active Particles - Environs	--	3.1	ptle/100 m^3	--
Vegetation				
Separations	I-131	1.9×10^{-6}	µc/gm	-2
Residential	I-131	$< 1.5 \times 10^{-6}$	µc/gm	--
Eastern Washington and Oregon	I-131	$< 1.5 \times 10^{-6}$	µc/gm	--
Fission Products less I-131 - Wash. and Ore.	Beta	2.7×10^{-5}	µc/gm	-2

* 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.

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EXPOSURE EVALUATION AND RECORDS

Exposure Incidents Above Permissible Limits

	Whole Body	Localized
September	0	1
1958 to Date	4	10

Gamma Pencils

	Pencils Processed	Paired Readings 100-280 mr	Paired Readings Over 280 mr	Lost Readings
September	39,426	36	3	0
1958 to Date	385,512	333	47	20

Beta-Gamma Film Badges

	Badges Processed	Readings 100-300 mrads	Readings 300-500 mrads	Readings Over 500 mrads	Lost Reading	Average Dose Per Film Packet mrad(ow)	Average Dose Per Film Packet mr(s)
September	13,241	695	51	13	40	3.54	16.93
1958 to Date	169,977	6,696	272	74	367	3.03	10.13

Slow Neutron Pencils

	Pencils Processed	Paired Readings 4-12 mrem	Paired Readings Over 12 mrem	Lost Readings
September	0	0	0	0
1958 to Date	25,880	297	94	8

Neutron Film Badges

	Film Processed	Readings 50-100 mrem	Readings 100-300 mrem	Readings Over 300 mrem	Lost Readings
Slow Neutron					
September	1,026	5	0	0	0
1958 to Date	1,026	5	0	0	0
Fast Neutron					
September	589	0	0	0	0
1958 to Date	9,299	10	1	0	7

Bioassay

	September	1958 to Date
Plutonium: Samples Assayed	884	10,606
Results above 2.2×10^{-8} µc/sample	41	357
Fission Product: Samples Assayed	876	10,964
Results above 3.1×10^{-5} µc FP/sample	1	23
Uranium: Samples Assayed	156	2,753
Confirmed Plutonium Deposition Cases	0	15*

* Bringing all-time HAPO total to 227.

Uranium Analyses

Sample Description	Following Exposure Units of 10^{-9} µc U/cc Maximum	Average	Number Samples	Following Period of No Exposure Units of 10^{-9} µc U/cc Maximum	Average	Number Samples
Fuels Preparation	35	2.4	45	8.9	3.2	8
Hanford Laboratories	24	5.2	23	16	3.4	20
Chemical Processing	17	5.8	37	17	5.3	22
Chemical Processing*	-	-	-	-	-	-
Special Incidents	0	0	0	0	0	0
Random	0.4	0.4	1	0	0	0

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

Thyroid Checks	September	1958 to Date
Checks Taken	0	25
Checks Indicating >0.01 µc	0	0

Hand Checks		
Checks Taken - Alpha	33,268	390,734
- Beta-Gamma	22,340	315,768

Skin Contamination		
Plutonium	34	265
Uranium	3	62
Fission Product	31	493

CALIBRATIONS

Portable Instruments	Number of Units Calibrated September	1958 to Date
CP Meter	927	8,604
Juno	314	2,918
GM	1,305	11,895
Other	217	1,983
Total	2,763	25,400
Personnel Meters		
Badge Film	1,051	10,327
Pencils	1,465	30,540
Other	452	3,459
Total	2,968	44,326
Miscellaneous Special Services	344	6,716
Total Number of Calibrations	6,075	76,442

R. L. Jenkins for the
Manager
RADIATION PROTECTION

AR Keene:RLJ:kc

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LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - SEPTEMBER, 1958

GENERAL

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 1.95 per cent, which is considerably below average experience.

The absenteeism rate was 2.69 per cent, which is below average experience.

There were no security violations charged to the Operation.

TECHNICAL SHOPS OPERATION

Total productive time for the month was 12,519 hours. The total shop work backlog is 16,103 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 2.8% (498 hours) of the total available hours.

Distribution of time was as follows:	Man Hours	% of Total
Fuels Preparation Department	1883	15.0
Irradiation Processing Department	760	6.1
Chemical Processing Department	675	5.4
Hanford Laboratories Operation	8913	71.2
Construction Engineering Operation	108	.8
Miscellaneous	180	1.5

Customer requests for emergency service increased sharply over the previous month and necessitated an overtime level which approximated the average level for FY-1958. The backlog increased slightly and currently stands at 5 crew weeks.

Security performance was considered satisfactory with no violations. Safety performance showed improvement with no major injuries and 6 medical treatment injuries versus 11 for the previous month.

RADIOGRAPHIC TESTING OPERATION

Average activity for Radiographic Testing Operation was recorded this month. A total of 6,077 tests were made, of which 1,135 were radiographic exposures (including X-ray and gammaray), and 4,942 were supplementary tests. The supplementary test work included dimensional measurements (micrometric and radiographic layout), eddy current, leak detection, penetrant, borescope, and ultrasonic (thickness measurements and flaw detection).

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The feet of material examined was nearly identical to that of last month, amounting to 12,842 feet. The number of pieces examined this month reflected the drop in total number of tests, and amounted to 1,202 pieces. Work was done for 18 different organizational components, representing all 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 15 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in Part II.

Additional work has been done on the radiographic examination of thin walled components for the Plutonium Metallurgy Operation. The work consisted of a quite radical departure from the super voltage radiographic techniques currently being used. It involved the use of lower energy X-ray levels based on the penetration of thinner sections.

By the use of this new method, remarkable improvement in the radiographs was achieved. Microstructural details hitherto unsuspected were revealed. In addition, the true nature of what appeared to be a fault in one of the pieces was demonstrated as being due to an entirely different condition than originally though. Provisions are being made to evaluate additional production pieces using this improved method.

Liaison work on the PRTR containment vessel is progressing satisfactorily. The contractor had fallen behind in his testing schedule to the extent that he has obtained additional help from Industrial X-ray Engineers of Portland. The progress reports and records being maintained for CEO on the radiographic testing have proved to be very helpful and are being extended at their request to include leak tests and penetrant testing.

Further work has demonstrated the feasibility of the radioactive isotope application for the detection of rotting of wooden power poles. Using a small Co^{60} source, resolution of 1/2" of wood is possible in a total thickness of 18".

Testing Statistics

Component	No. of Tests	Ft. of Weld or Material	No. of Pieces	Description
A. CPD	87	103 1/2	29	30" diameter ammonia scrubbers, SS Model 3, SS silver reactor.
B. CEO	1385	3163 1/2	149	Project AEC 160, gas recirculating gas loop. PRTR containment vessel. SS welders coupons.
C. FPD	25	61	10	CS pressure autoclaves, cinder ash wash lines, 300 powerhouse.

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Component	No. of Tests	Ft. of Weld or Material	No. of Pieces	Description
D. HLO	4362	9125	842	Al tech. charts; Zr. clad U; UO_2, Pu-Al fuel elements; 2, 5, 10, 15, 20% Pu-Al cast rods; 10, 12, 14, 15% Pu-Al wafers; U-238 Al-wafers. Core locations and jig fit-up of fuel plates. Pu dialatometer samples. .505", .690", .938", 1.418", 1.802", 2.212" I.D. Zr tubing with 30 mil wall. External ribbed Zr tubing; 3" O.D. extruded Zr tubing.
E. IPD	74	168 1/2	21	Welds on CS, air cylinder, air receiver, and propane gas tanks. Cross header on rear face 105-B, affluent and effluent lines, 105-D.
F. RUO	144	221	151	Linemen's climbers. Isotopic calibrations for power pole rot survey program.
TOTALS	6077	12,842	1202	

FACILITIES ENGINEERING OPERATION

Project Activity

There were 20 authorized projects at month end, with total authorized funds of $4,161,800. The total estimated cost of these projects is $8,487,800. Two projects were completed during the month. One project proposal was submitted during the month and is awaiting AEC authorization. Project proposals for twelve new projects are in preparation.

The attached monthly project report covers the individual project activity.

Engineering Services

Title	Status
Modification of Elevator, 327 Building	Security Fire Door Company has submitted installation drawings for approval.
Installation of New Hood, Lab. 14-A, 329 Building	Hood fabrication is complete and installation work is in progress.
Fabricate and Install XY Manipulator in Metallographic Cell	Work is approximately 80% complete.

Title	Status
Extend Annunciator System - 1706-KE Building	Installation work remains to be performed.
Provide Operating & Safety Improvements 340 Building Tank Pit	Installation work has started.
Study of Cut-Off Facility for PRTR Fuel Elements	Engineering complete.
Revisions to Office Space 328 Building	Work is essentially complete. Delay was due to receipt of materials.
Revisions to Room 108, 3706 Building	Service piping & lighting installation has been completed. Benches & pierceway remain to be installed.
Improvements to Process Pump House - 147-F Building	Engineering work has started.
Additional Pasture - 100-F Area	A lump sum contract for $9,000 was given to Co. for preparing the pasture. Work is 20% complete.
Provide Procurement Assistance for Die Casting Machine	Engineering work was started during the month.
Removable floor Grating - 3745-B Building	Engineering work was started.
Improvements to Traveling Crane - 314 Building	Vendors recommendation and estimate for conversion work has been received.
Removal of Obsolete Equipment - 231-Z Building	Work scheduled to start 9-29-58 and completed by 10-24-58.
Noise Attenuation - 3760 Building	Work is progressing in a planned pattern.
Minimize Vacuum Pump Oil Spray - 325 Building	Entrainment material is being installed in present equipment.
Replace Desert Cooler - Physics Lab. 3706-C Building	Work is progressing.
Storm sash & Shade Screens for Buildings	Job complete.

Design and Drafting Services

Title	Status & Description
Cesium Recovery	The present scope of work indicates this job to be approximately 90% complete.

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Title	Status & Description
Pit Cover - 3745-B Building	Provide cover over pit 20' x 21' x 6' deep. Cover to carry a 200 pound live load. Plate and beams to be removable without the aid of hoist or crane. Check prints issued. Work 90% complete.
Ceramic Fuel Test Element	Work completed.
Accelerator Positioner - 3745-B Building	Work completed.
Vacuum Annealing Furnace	Work in progress.
In-Reactor Experiment Assemblies for 6 x 9 Facility in ETR	Work completed.
Apparatus for Physical Metallurgy Study of Irradiation Effects on Mechanical Properties of Uranium	Work completed.
Prototype Swelling Capsule	Capsules to operate at different levels of power and temperature to determine swelling characteristics of uranium. Work 60% complete.
Fuel Element X-Ray Densitometer	Job has progressed through the detail stage. Installation data on blower is pending information from Vendor. 80% complete.
ETR Critical Facility	Design and detail a container for reactor elements. Design work is being revised to accommodate new container dimensions. Work 90% complete.
Gatling Gun Type Cask	Work 94% complete.
Fuel Element Assembly Patterns	Two proposed assemblies modify preliminary designs. These modifications are being developed so the assemblies could be tested in the K Reactor experimental tubes and also at Arco. This necessitated a basic design with three variables because of the three different sized tubes in which they will be tested.

Title	Status & Description
Fuel Rod Separator	Work was transferred to CEO for completion.

Maintenance and Building Engineering - Landlord Functions

Painting - The following work was authorized:

222-U - Miscellaneous interior and exterior
141-F - Exterior trim
141-M - Exterior trim
1705-F - Exterior
108-F - Complete interior painting
326 - Exterior completed

Alterations - The following work was accomplished:

The Tower Control Room and Forecasters' Room, Meteorology, complete.

Work was initiated to increase the lighting levels in:

329 Building - Rooms 1-C, 2-C, 8-C, 12-C, 13-C, and 14-C
328 " - Room 215
3702 " - Room 28
3760 " - Room 202

Repairs were made to roofs of 3705, 329, 306, and 3745-A Buildings.

Modifications were made to the electrical service in 3760 Building.

325 Gas Storage - The new wall has been installed and painted, and the railing is being fabricated. Installation of the rail will complete the job.

3707-C Heating Installation - The heaters for the south end of the building have arrived and installation work is scheduled to start immediately.

306 Roof Units - A work order to clean all roof unit traps has been issued and work is in progress. Five perimeter units will be equipped with double traps to prevent coil freeze-up.

3706 Building, Room 313, Laboratory Renovation - The laboratory was ready for occupancy 9-4-58. Touch-up painting remains to be completed.

Miscellaneous

The Material Requisitioning and Standardization component completed 9 requisitions, alterations, BPF's, and bid reviews during the month. The total estimated cost of the requisitions issued was $11,500.

Work Order A-46582 - Survey and inspection of HLO pressure vessels is 100% complete. Data sheets on inspected vessel together with operating recommendations have been received.

A Third Party Inspection was conducted of the elevators in 325, 326, 327 and 3760 Buildings. Orders have been issued to correct exceptions noted during this inspection.

Drawings and specifications are currently being reviewed by the AEC for re-roofing 146-FR and 222-U Buildings.

TECHNICAL INFORMATION OPERATION

A new procedure which substantially reduces the keypunching load in Document Accountability was instituted on September 10. The procedure eliminates punching an individual IBM card when multiple consecutive copies of a document are added to the site accountability tape. The first and last copies are punched in designated fields on a single IBM card, and the remaining copies are added to the tape automatically by the 702 machine.

Three title listings of U.S. papers for the Second International Conference on the Peaceful Uses of Atomic Energy have been distributed to plant personnel. The three listings cover approximately 600 papers. Many requests have been received for individual copies of the papers. One copy each of the Canadian papers has been received, and these papers will be announced to plant personnel in a separate listing. We expect to receive microcards of the other foreign papers in the near future.

The first 50 copies of the Technical Abstract Bulletin from ASTIA (Armed Services Technical Information Agency), were received and distributed to interested personnel. We are receiving numerous requests for reports listed in the bulletin.

Arrangements are being made to routinely supply the Technical Data Center, Schenectady, with four copies of all Research and Development reports distributed from Hanford via TID 4500, the Standard Distribution List for Unclassified Research and Development Reports. Placing HAPO reports in the Technical Data Center will make Hanford unclassified information more readily available to other components of the Company.

Four showings of the British reactor films were given during the month. A total of 2243 individuals saw the films, representing all Areas and Departments and HOO.

A proposed meeting of the Company information specialists appears nearer to becoming an actuality. A tentative agenda has been prepared and is being circulated for comment. The first meeting will probably be restricted to a few people primarily concerned with the administration of technical information activities.

The Specialist, Classification-Declassification was a speaker at the September Safety and Security meeting of the Process Design and Development group of CPD's Facilities Engineering Operation. Declassification procedures, status of the Proposed Hanford Classification Guide, and the new instructions on classification of maps and photographs were discussed.

The new instructions recently issued by the AEC Division of Classification for the classification of maps and photographs are proving unduly restrictive. Since interior shots of all buildings except those "solely housing administrative activities" must be classified CONFIDENTIAL - RESTRICTED DATA, many quite harmless photographs (of the lunchroom in the 234-5 building, for example) must be born classified. While they can be declassified, no provision has been made for doing this locally, and processing the material through the normal declassification channels is very time-consuming. A meeting has been held with AEC Security, GE Security, GE Photography and AEC and GE classification personnel to attempt to resolve the problem.

Revisions to OC-DOC-44, "Declassification Guide for Responsible Reviewers" were received from the Division of Classification. These revisions relate to the fabrication and metallurgy of plutonium. In addition, authority to revise the Hanford Classification Guide to make it consistent with OC-DOC-44 was received. Topics covering PRTR Fuel Elements will be revised to permit unclassified release of information pertaining to the design and fabrication of plutonium alloy fuel elements containing up to 90 atomic per cent plutonium. Prior to this, 50 atomic per cent was the limit. Corresponding topics in the Proposed Hanford Guide will be revised to reflect the change.

The Division of Classification also advised that the topics in the approved Hanford Guide covering the PRTR, apply to the design, construction and operation of the Plutonium Fabrication Pilot Plant. Specific topics covering this facility have been submitted to HOO for approval to include them in the Hanford Guide.

Review and typing of the Fuel Element Design Handbook (HW-51000) has been completed, and the report is being reproduced. Also, several parts of the National Academy of Sciences' report on Inhalation Hazards have been completed for the second working draft.

Working Volume Statistics

Document Distribution and Files	August	September
Documents routed and discharged (copies)	15,561	16,645
Documents issued (copies)	10,064	10,735
Documents sent offsite (copies)	3,574	4,949
Document reserves filled (copies)	784	785
Documents picked up and delivered	18,655	21,985

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Document Accountability	August	September
Holders of classified documents whose files were inventoried	317	446
Documents inventoried in Files (copies)	8,937	20,484
Documents destroyed or retired (copies)	3,316	6,134
Documents revised (copies)	781	792
Documents pulled and documents filed (copies)	10,884	15,040
Documents reclassified	328	682
Accountable copies of SECRET and DOCUMENTED CONFIDENTIAL documents on site	204,290	204,370

Reference and Publication		
Books cataloged (new titles)	68	59
Books added to the collection (volumes)	217	137
Ready reference questions answered by professional staff	64	133
Literature searches by professional staff	109	94
Reports abstracted (titles)	198	188
Formal reports prepared (titles)	14	14
Offsite requests for HAPO reports (copies)	278	242
Reports released to CAP (titles)	20	32

Library Acquisitions and Circulation		
Books ordered (volumes)	361	322
Periodicals ordered	33	114
Books circulated (volumes)	1,380	1,667
Periodicals circulated (issues)	3,697	3,451
Inter-library loans	72	55
Films borrowed or rented	27	20
Industrial film showings	58	95
Bound periodicals added to the collection	95*	14

Library collection:

	Main Library	W-10 Library	108-F Library	Ind. Med.	Totals
No. of books	24,160	8,094	1,356	1,898	35,508
No. of bound periodicals	11,178	1	1,426	96	12,701
	35,338	8,095	2,782	1,994	48,209

* July and August figures combined.

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Classification and Declassification	August	September
Documents, including drawings and photographs, reviewed for downgrading or declassification	80	81
Documents submitted to Declassification Branch, Oak Ridge	7	12
Documents and papers (intended for oral presentation or publication) reviewed for appropriate classification	26 26	92*

* Includes 39 brief articles and 19 photographs intended for the January issue of GE Review.

LABORATORIES ADMINISTRATION

Manual, Property Management (August 29, 1958) was distributed.

Manual, Authorization and Performance of Work (September 22, 1958) is ready for distribution.

Timely revisions were issued on six Organization and Policy Guides. As a result of these revisions and the issuance of the Manual, Property Management, sixteen OPGs have been retired.

Three new contracts were signed: No. DDR-35, Aluminum Company of America for aluminum tubes; and No. CA-199, M. J. Sinnott, for consulting services on metallurgical problems; No. DDR-47, Harper Electric Furnace Corp. for a furnace design.

Renewal contracts are being negotiated. The present contracts are:
No. MRO-12, RCA Service Company, Inc.;
No. MRO-13, Philips Electronics, Inc.;

Contract No. SA-53, Future Farmers of America, Inc. was pending for approval at the end of the month.

The property management was closed out on Assistance to Hanford authorization No. ATH-HLO-2-58, Solvent Extraction Study Using An Analog Computer.

A request was filed with Transportation and Maintenance Operation for five power wagons, three pickups, and two station wagons for use by Atmospheric Physics Operation for calendar year 1959 for the Air Force Study Program. Two sedan deliveries were reassigned within Hanford Laboratories Operation to balance the usage of the vehicles. A sedan was replaced with a new one and a sedan delivery was replaced with a new station wagon.

Manager
LABORATORY AUXILIARIES

JL Boyd:jcw 1238420

UNCLASSIFIED

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW – MONTH September, 1958

BUDGET CLASSIFICATION: General Plant Projects - FY 1957 - AEC-23-57-n-2

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED. ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED. ACTUAL	STARTING DATE DESIGN / CONST.	DIRECTIVE COMP. DATE DESIGN / CONST.	ESTIMATED COMP. DATE DESIGN / CONST.
CA-658	Shielded Personnel Monitoring Station - 747 Building	$140,000	$150,000 2-4-57	100 100	65 67	2-18-57 3-11-58	-- 12-31-58	12-19-57 12-15-58

USING COMPONENT: Radiation Protection Operation

FEO ENGINEER: D. S. Jackson

REMARKS:
The steel plates for the shielded cell arrived on the construction site. The contractor set the base plate and is currently cleaning and assembling the cell plates. The base plate was slightly concave upward after the grout set up. The contractor assurred the Commission this would not cause him any trouble in assembly of the cell. Interior finishing in the building was also resumed.

BUDGET CLASSIFICATION: General Plant Projects - FY 1958 - AEC-2-23-58-L

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED. ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED. ACTUAL	STARTING DATE DESIGN / CONST.	DIRECTIVE COMP. DATE DESIGN / CONST.	ESTIMATED COMP. DATE DESIGN / CONST.
CA-765	Additions to the 314 Building	$40,000 (a)	$46,000 11-15-57	100 100	90 90	10-14-57 3-27-58*	-- 11-15-58	3-7-58** 11-15-58

USING COMPONENT: Reactor & Fuels R&D

FEO ENGINEER: A. W. Hervin

REMARKS:
The contractor has installed the built-up roof. Work is progressing on the installation of the asphalt tile on the floor, electrical, and the plumbing for the rest rooms.
(a) The contractor is installing partitions in the new and existing office space; hence, increase in estimated cost. Also, included in the cost are funds for office furniture which is pending Commission approval.
* CPFF Construction Contractor started work on 3-27-58 and FP Contractor started on 5-14-58.
** Actual date.

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED. ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED. ACTUAL	STARTING DATE DESIGN / CONST.	DIRECTIVE COMP. DATE DESIGN / CONST.	ESTIMATED COMP. DATE DESIGN / CONST.
CA-778	Expansion of the 305-B Building	$55,000	$55,000 12-11-57	N.S. 100	87** 47**	4-4-58 6-7-58	5-15-58 10-15-58	5-7-58* 10-10-58#

USING COMPONENT: Physics & Instrument R&D

FEO ENGINEER: R. C. Ingersoll

REMARKS:
Concrete block work has been completed. Steel beams are in place. Interior partitions and roof framing has been started. The truck strike delayed material delivery and the contractor cannot meet his scheduled completion date. The Commission project engineer is currently requesting an extension of time.

* Actual date.
** Includes work performed by GE Plant Forces and CPFF Construction Contractor.
\# Contract completion date.

AM-7800-019 (8-58)

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BUDGET CLASSIFICATION: General Plant Projects - FY 1958 - AEC-2-23-58-L

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57636
MONTH September 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT / DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED. / ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED. / ACTUAL	STARTING DATE DESIGN / CONST.	DIRECTIVE COMP. DATE DESIGN / CONST.	ESTIMATED COMP. DATE DESIGN / CONST.
CG-779	Additions to Separations Development Facilities - 321 Building	$27,900	$ 27,900 5-22-58	100 85	90 90	5-26-58 6-19-58	- - - 1-31-59	- - - 12-1-58

USING COMPONENT: Chemical Research and Development
FEO ENGINEER: J. T. Lloyd

REMARKS:
Painting of platform over H cell and ventilation additions have been completed. A supplemental work order has been issued and design made for Hydrofluoride manifold and rack, and for an explosion-proof exhauster of HF fumes. The rectifier is scheduled to be shipped from Lynchberg, Va., in last week of October, 1958.

CAH-794	Geological and Hydrological Wells - FY 1958	$ 49,000	$ 49,000 4-16-58	100 100	68 32	4-7-58 7-8-58	- - - 12-31-58	5-15-58* 1-31-59

USING COMPONENT: Chemical Research and Development
FEO ENGINEER: H.E. Ralph

REMARKS:
The contractor is currently drilling on wells #1, 3 and 10. A total of 1200 feet of hole has been completed. Rig #3 was set up over well-site #10 on 9-25-58. Rig #4 is due in the immediate future. The contractor should be able to get back on schedule 30 days after the fourth rig has been put into operation.

* Actual date.

CGH-796	Facilities for Isotope Study on Animals	$ 49,800	$ 49,800 5-22-58	N.S. 100	N.S. 90	5-22-58 6-12-58	7-27-58 11-1-58	7-25-58* 11-1-58

USING COMPONENT: Biology
FEO ENGINEER: J. T. Lloyd

REMARKS:
All stall and feed troughs are installed and painting is complete. A preliminary inspection has been made and punch list items are being completed. A supplementary work order has been issued for a V. C. pipe sewer, swinging stops in feed troughs and reworking on available feed bin. It is expected that the Experimental Animal Farm will obtain beneficial use of this facility on October 2, 1958.

* Actual date.

12 384 23

BUDGET CLASSIFICATION: General Plant Projects - FY 1958 - AEC-2-23-58-L

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - [illegible]

MONTH September, 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION	PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DESIGN SCHED.	CONST. SCHED.	DESIGN	DESIGN	DESIGN
			DATE	DESIGN ACTUAL	CONST. ACTUAL	CONST.	CONST.	CONST.
CGH-803	Alterations - Building 231-Z	$49,600	$ 49,600	--	85	N.S.	- - -	- - -
			6-2-58	--	85	7-7-58	11-15-58	11-15-58

USING COMPONENT: Reactor & Fuels R & D

FEO ENGINEER: J. T. Lloyd

REMARKS:

The large hood in Cell No. 3 has been completed. The obstructing column was removed and temporary beam and column supports were installed. The original column was replaced after hood removal. All painting has been completed and it is estimated Cell No. 3 can be used on about October 12, 1958. Operations is using Cell No. 6 B and C.

CGH-804	Ceramic Fuels Press Enclosure - 325 Building	$ 41,000	$ 41,000	100	N.S.	6-19-58*	- - -	8-1-58*
			6-2-58	100	40	10-2-58#	1-15-19	12-24-58**

USING COMPONENT: Reactor & Fuels R & D

FEO ENGINEER: R.C. Ingersoll

REMARKS:

Notice of Award and Notice to Proceed on Contract No. AT(45-1)-1407, for press enclosure (CGH-804) and press installation (CG-758) were issued 9-24-58. The contractor, McInnis Construction Co. has 90 days in which to complete his work. Construction to start October 1, 1958.

* Actual date
** Contract completion date
#Project Proposal date

CGH-809	Electrical Modifications - 328 Building	$ 40,000	$ 40,000	N.S.	0	7-30-58	- - -	11-30-58
			6-30-58	50	0	10-30-58	3-1-59	3-1-59

USING COMPONENT: Laboratory Auxiliaries

FEO ENGINEER: R.C. Ingersoll

REMARKS:

Construction Operation went out for bids 9-18-58 for the main switchgear. Closing date for acceptance of bids is 9-30-58.

AM-7308-019 (5-58)

UNCLASSIFIED

BUDGET CLASSIFICATION: General Plant Projects - FY 1958 - AEC-2-23-58-L

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - [illegible]
MONTH September, 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION - AMOUNT	AUTHORIZATION INFORMATION - DATE	PROJECT PROGRESS IN PER CENT - DESIGN SCHED.	PROJECT PROGRESS IN PER CENT - DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT - CONST. SCHED.	PROJECT PROGRESS IN PER CENT - CONST. ACTUAL	STARTING DATE - DESIGN	STARTING DATE - CONST.	DIRECTIVE COMP. DATE - DESIGN	DIRECTIVE COMP. DATE - CONST.	ESTIMATED COMP. DATE - DESIGN	ESTIMATED COMP. DATE - CONST.
IR-240	Removal of Obsolete Melt Plant Equipment - 314 Building	$19,000	$19,000	6-24-58	None	None	N.S.	97	None	6-27-58	-- -- --	11-11-58	-- -- --	11-11-58

USING COMPONENT: Reactor & Fuels R & D
FEO ENGINEER: A. W. Hervin

REMARKS:
The two bag filters and cyclone separators which were located on the north side of the melt plant have been removed and have been placed on the north side of the 306 Building. The miscellaneous ductwork has also been removed and taken to the 306 Building. Work is progressing on the installation of the checkered plate flooring.

	Modification of the 15-Ton Canyon Crane - 327 Building	$49,500	None to date	0	0	1*	None	3*		
			None	0	0	5*	None	7*		

USING COMPONENT: Reactor & Fuels R & D
FEO ENGINEER: R. C. Ingersoll

REMARKS:
The project proposal is being held up pending the sponsor's decision to proceed.

*Months after authorization.

Equipment Not Included in Construction Projects - Program Class 2900

CG-661	Additional Heat Generating Facility - 189-D Building	$475,000	$664,000	100	0	12-6-56	10-1-58*	11-1-58		
			[illegible]	99	0	12-1-58	8-31-59	8-31-59		

USING COMPONENT: Reactor & Fuels R & D
FEO ENGINEER: A. W. Hervin

REMARKS:
The bid package for the lump sum work was forwarded to the Commission on September 29, 1958 with one exception. The drawings for relocation of generator controls have not been completed. The saturable reactor was not shipped as reported last month. The following materials have been received from the General Electric Company: two transformers, switchgear, two M.G. set units, circuit breaker, the DC bus for the 189-D side. Tests on the reactor and rectifiers are being performed at the vendors plant.

** Scheduled date.

AM-7300-019 (5-58)

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

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - [illegible]
MONTH September, 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.	USING COMPONENT	FEO ENGINEER
CA-681	Hanford Equipment in the ETR	$1,200,000	$1,200,000	8-12-57	100	100	N.S.	89	9-17-56	4-7-58	None	12-15-58	9-2-58	5-1-59	Reactor & Fuels R & D	H. Radow

REMARKS:
Phillips has agreed to proceed with the 3 x 3 insertion. This will be at the time of the next outage, currently scheduled for early October. Bid opening for the 6 x 9 fabrication is scheduled for October 2. Three " no bids" have already been returned and no actual bid has yet been received. Remaining prospective bidders are being contacted by phone with a promise of one bid to date.

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.	USING COMPONENT	FEO ENGINEER
CG-682	High Level Cut-Off and Examination Cell - 327 Building	$420,000	$430,000	8-20-57	100	100	100	100	7-18-56	3-27-58	- - -	10-1-58	6-28-57*	9-30-58*	Reactor & Fuels R & D	A. W. Hervin

REMARKS:
This project was completed with exceptions on September 30, 1958, with start-up items remaining to be completed. The can sealers have been received. The vendor of the patch panel completed his re-work. Construction Operation have completed their work. Major start-up items remaining to be completed are modifications of the cut-off saw and manipulators. Numerous small items of start-up remain to be completed.

* Actual dates.

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.	USING COMPONENT	FEO ENGINEER
CA-695	Radio Telemetering Network	$105,500	$105,500	1-10-57	100	100	N.S.	25	2-22-57	7-25-57	4-15-57*	2-1-59	5-27-57**	2-1-59	Physics & Instruments R & D	J. T. Lloyd

REMARKS:
The AEC prepared and approved a project proposal revision. The AEC Directive approving the full amount of $105,500 and giving a new directive completion date, has been received by the General Electric Co. Two more wind generator supports have failed and Duke Electric Company (the sub-contractor for Frank Lohse) will be asked to install suitable supports. The AEC is preparing contract modifications for fabrication of the revised (21) data stations.

* Scheduled date. ** Actual date.

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

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57636
MONTH September, 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION	PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
				DESIGN SCHED.	CONST. SCHED.	DESIGN	DESIGN	DESIGN
			AMOUNT					
			DATE	ACTUAL	ACTUAL	CONST.	CONST.	CONST.
CG-785	In-Reactor Studies Equipment - 105-KW Building	$276,000	$15,000*	100**	0	3-10-58	None	10-15-58
			2-12-58	99**	0	None	None	None
		USING COMPONENT: Reactor & Fuels R & D				FEO ENGINEER: H. Radow		

REMARKS:
The revised project proposal, based on the permanently installed portion of the facility, is being circulated for approval signatures.

* For preliminary design and services for project proposal preparation.

** Preliminary design only.

CGH-801	X-Ray Diffraction Cell - 327 Building	$120,000	$10,000	46	0	6-10-58	- - -	12-24-58
			6-7-58	28	0	None	None	7-30-59
		USING COMPONENT: Reactor & Fuels R & D				FEO ENGINEER: R. W. Dascenzo		

REMARKS:
The schedule as shown is a target schedule, the official schedule has not been prepared as complete design funds have not been obtained. Design is progressing smoothly and four comment drawings have been issued.

CGH-805	High Temperature Tensile Testing Cell	$140,000	$10,000	9	0	8-26-58	4-1-59	4-1-59
			8-4-58	10	0	None	10-1-59	10-1-59
		USING COMPONENT: Reactor & Fuels R & D				FEO ENGINEER: R. W. Dascenzo		

REMARKS:
Design has been initiated and several work sheets have been prepared.

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects - Program Class 4900

MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - MONTH September, 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.
CG-758	Ceramic Fuels Development Press and Furnace Additions	$172,000	$172,000	7-16-58	100	100	N.S.*	100	8-22-57	1-20-58	2-1-58	10-1-58	2-28-58	9-26-58

USING COMPONENT: Reactor & Fuels R & D

FEO ENGINEER: R. C. Ingersoll

REMARKS:
This project was completed with exceptions on September 26, 1958. The Physical Completion Notice is being prepared with accruals for press installation as noted in the Project Proposal Revision 1. Press installation and press enclosure (CGH-804) will be performed under Contract No. AT(45-1)-1407 awarded to McInnis Construction Company on September 24, 1958.

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

New Construction - FY 1958

CG-731	Critical Mass Laboratory	$1,800,000	$175,000	5-12-58	27	24	0	0	5-22-58	2-15-59	2-1-59	None	10-31-59

USING COMPONENT: Physics & Instruments R & D

FEO ENGINEER: D. S. Jackson

REMARKS:
Design of Stage I continued during the month. Part of the lag behind schedule was overcome. At the request of the Commission a preliminary cost estimate was prepared. The estimated cost of Stage I was $1,000,000. The cost of Stage II was estimated to be $800,000.

CA-744	Metallurgical Development Facilities	$2,600,000	$60,000	4-28-58	31	31	0	0	6-30-58	N.S.	- - -	None	9-1-59	9-1-60

USING COMPONENT: Reactor & Fuels R & D

FEO ENGINEER: J. T. Lloyd

REMARKS:
The project proposal requesting total project funds is still in AEC-Washington. Design is progressing with emphasis on locating fire wall and doors. Use of hydrofluoric acid and its special handling facilities has not been resolved. A revised Work Release Authorization, providing CEO $11,000 additional funds, has been prepared.

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MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57636
MONTH September, 1958

BUDGET CLASSIFICATION: New Construction FY 1958

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.
CA-749	High Level Radiochemistry Facility	$935,000	$1,070,000	4-21-58	88	84	9	1	6-15-58	8-14-58	- - -	7-10-59	11-15-58	6-30-59

USING COMPONENT: Chemical Research & Development
PED ENGINEER: R. W. Dascenzo

REMARKS

Schedules shown are those of the B. D. Bohna Company. Construction has been delayed pending delivery of reinforcing steel for the footings, by a sub-contractor, Soule Steel Company, who were behind schedule due to the motor carrier strike. The footings were delivered on September 24, 1958. The north end was excavated deeper as per a recent design change. Field layout for column and wall lines and elevations has been completed for the form work. The footing forms are being placed and hand excavation is proceeding.
The design is behind schedule due to past design changes.

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.
CGH-790	High Level Radioactive Receiving and Storage Addition - 327 Building	$325,000	$325,000	6-25-58	77	62	0	0	6-23-58	2-1-59	- - -	2-1-60	12-1-58	2-1-60

USING COMPONENT: Reactor & Fuels R & D
PED ENGINEER: A. W. Hervin

REMARKS

Design has been held up pending award of the crane bid. Original bid opening was scheduled for September 8, 1958, however, an extension of time to September 18 was requested by a prospective bidder. This request was granted by purchasing. Bids were reviewed during the last week of the month and the apparent low bidder is Ederer Engineering Company of Seattle. The crane bid was approximately $45,000 which is $7,000 over the project estimate of $40,000 including installation. Electrical work has been started and the heating and ventilating drawings are nearing completion. The structural and architectural drawings are progressing. Construction Operations work may start in October.

PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT	AUTHORIZATION INFORMATION DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED.	PROJECT PROGRESS IN PER CENT DESIGN ACTUAL	PROJECT PROGRESS IN PER CENT CONST. SCHED.	PROJECT PROGRESS IN PER CENT CONST. ACTUAL	STARTING DATE DESIGN	STARTING DATE CONST.	DIRECTIVE COMP. DATE DESIGN	DIRECTIVE COMP. DATE CONST.	ESTIMATED COMP. DATE DESIGN	ESTIMATED COMP. DATE CONST.
CGH-819	Increased Laboratory Waste Facilities - 300 Area	$300,000	None	None	0	0	0	0	1*	9*	- - -	21*	7*	21*

USING COMPONENT: Chemical Research & Development
PED ENGINEER: A. W. Hervin

REMARKS

The project proposal requesting $60,000 preliminary money is being reviewed by the Commission.

* Months after authorization.

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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 & Buildings Visited
Ernest W. Milburn	9-23-58	X-ray Dept. GE Co. San Francisco, Calif.	Tech. consultation regarding X-ray techniques & equip.	R.B. Socky	No	200-E & 300, 221-B, 224-B, 231-Z, 336, 325
Bernard Weidenbaum T. J. Pashos	9-23-58	GE Co. Vallecitos, Calif.	Discuss exchange of technical info.	C.G. Stevenson S.P. Gydesen	No	300 - 3760
Science Class Students	9-25-58	White Swan High Sch. White Swan, Wn.	Learn about Tech. Info. Operation	C.G. Stevenson	No	300 - 3760

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
Shirley P. Gydesen	9-8 & 9-12-58	Argonne National Laboratory Lemont, Ill.	Discuss tech. info. liaison with ANL personnel, & discuss preparation & publication of Research & Devel. reports.	H.D. Young	Yes
	9-15 & 9-16-58	Tech. Info. Services Extension Oak Ridge	Discuss mutual technical information problems with TISE personnel.	R.L. Shannon	Yes
R. W. Dascenzo	9-18 & 9-19-58	B.D. Bohna & Co., Inc. San Francisco, Calif.	Review & approve Contractor's detail design for project CA-749.	J.J. Brezina E.D. Arndt	No
P. F. X. Dunigan	9-29 & 9-30-58	Argonne National Laboratory, Lemont, Ill.	Alpha Gamma Hot Laboratories Meeting	R. Gartz	No
R. E. Rostenbach	9-25 & 9-26-58	Spokane, Wn.	Industrial Wastes Assoc. Annual Meeting	--	No

EMPLOYEE RELATIONS OPERATION MONTHLY REPORT

GENERAL

At month's end, the staff of the Hanford Laboratories Operation totalled 1193, including 562 exempt and 631 nonexempt employees. Of the total exempt employees, there were 499 with college degrees, including 478 technical degrees as follows: BS - 269, MS - 106, PhD - 103. There were 32 nonexempt employees with college degrees.

EMPLOYEE RELATIONS

Attitude survey follow-ups have been conducted within the Reactor and Fuels Research and Development Operation and the report is currently being prepared.

Preliminary planning is underway for the next attitude survey. The survey is tentatively scheduled for March 1959.

PERSONNEL DEVELOPMENT

Fourteen nonexempt positions were filled during the month with 15 continuing open. Currently, there are three transfers pending.

Placement of excess Radiation Protection personnel is continuing at a satisfactory level with a total of 8 who had not been placed by the end of the month.

COMMUNICATIONS

The most intensive mass communications program of 1958 was conducted during September in support of the new Savings and Security Program.

As a part of a program to improve HLO mass media and distribution systems, the Hanford Laboratories News was discontinued in order to promote a more intense effort in other areas.

It appears that HLO tours for school groups are increasing during the remainder of the fiscal year. To date, there have been four scheduled and one was conducted during September for students of White Swan High School.

HEALTH, SAFETY AND SECURITY

Laboratories personnel worked a total of 186,581 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,709,121 man-hours have been completed with no disabling injuries. The medical treatment frequency for September was 1.23 as compared with 1.86 during August.

There were 2 security violations during the month, bringing the total for the calendar year to 36.

UNION RELATIONS

One meeting was conducted during the month by the Company and the HAMTC regarding the Wonacott case. Although the two groups were closer to agreement than in the past, there were some differences of opinion, particularly pertaining to Monitors' use of dose rate instruments. The Company is rewriting the proposal

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in an attempt to arrive at a mutually agreeable basis for settlement of this case.

Regional Monitor negotiations were completed on September 26 with the signing of a contract by the Company and the Union representatives.

The Maki arbitration case was scheduled for hearing in Portland on October 6. It is anticipated that five to six weeks following that date will be required for the arbitrator's decision.

One grievance was received during the month of September. The grievance was submitted by a CPD employee claiming that non-bargaining unit personnel in Plutonium Metallurgy had been performing bargaining unit work. The Step I answer was satisfactory.

PROFESSIONAL PERSONNEL PLACEMENT

During September, employment offers were extended to 8 PhD candidates. Three candidates accepted our offer and one was placed on the roll. One of those accepting employment will be placed in HLO. In addition, employment offers were extended to 10 experienced BS/MS candidates with 6 accepting and 4 placed on the roll. Of these numbers, 5 will be placed in HLO. Offer action to Program BS/MS candidates was confined to employees on leave of absence to the military service. In this area, four offers were extended with one acceptance and one employee placed on the roll.

Firm recruiting dates for all schools to be visited by Hanford recruiters during the fall have now been established. PhD recruiting will begin October 16 at Iowa State College. BS/MS recruiting will begin October 6 at Oklahoma State University. Overall Company requirements for PhD's are down slightly from last year--from 346 to 322, while BS/MS requirements are up substantially from 400 to 600. HAPO's requirements for PhD's are roughly the same as last year while Program BS/MS requirements appear to be up substantially from approximately 20 to approximately 65.

Philip A. Ard, who suffered a disabling injury on August 18 due to contact with a 13.7 kilovolt highline, reported back to work on September 23. Medical restrictions require that he avoid rough or heavy work.

All summer program participants have terminated to return to their respective school activities. Assignment supervisors report that Program members' performance and contributions were very satisfactory.

EMPLOYEE COMPENSATION

Nonexempt Compensation Study is proceeding on schedule with six progress reports having been issued to date.

Thirteen suggestions were approved for awards totalling $275 at the September meeting of the HLO Suggestion Board. The average year to date suggestion award for HLO was $24.81 with a ratio of awards to savings of 12.1%.

R. Rider, Katherine Beebe, R. Percy, J. Loe, and J. Poe terminated during the month to attend colleges of their choice under the General Electric Educational Loan Program. Each employee received a loan in the amount of $300.

Effective October 1, the participating agencies in the Nucleonics Good Neighbor Fund were changed. The agencies now covered are the Cancer Society, Heart Association, Benton-Franklin United Crusade, Yakima Valley Good Neighbor Fund, Prosser United Good Neighbor Fund and Sunnyside Good Neighbor Fund. Appropriate publicity will be furnished to all HLO employees.

At month's end, Hanford Laboratories participation in the Savings and Security Program of those eligible employees was 95.3%.

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

Year 1958	Insurance	Pension Plan	Savings Stock Bonus	Savings Plan
Mar.	99.7	98.6	61.9	8.7
June	99.7	98.9	61.4	7.6
Sept.	99.7	98.8	61.6	6.5

Manager
Employee Relations

TG Marshall:tr

TABLE II. NONEXEMPT EMPLOYMENT

Nonexempt Employment Status	Aug.	Sept.
Requisitions		
At end of month	23	15
Cancelled	0	1
Received during month	25	7
Filled during month	12	14
Candidates Considered		
Total applications	44	48
Total transfer requests from other at HAPO	6	8

Nonexempt Transfer Requests	Aug.	Sept.
Transfer Requests		
Active cases at end of mo.	54	57
Cancelled	6	6
New during month	7	10
Transfers effected	2	1

TABLE III. UNION RELATIONS

Grievances Processed - January 1, 1958 to date

Total processed	25	(includes 3 non-unit grievances)
Step I		
Answered satisfactorily*	15	
Step II		
Pending Step II discussion	2	
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 acheduled 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.

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TABLE IV. PROFESSIONAL PERSONNEL PLACEMENT

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

	Visits to Richland				Offers*			
	Cases Considered	Invited	Visited	To Visit	Extended	Accepted	Open	On the Roll
Ph.D.	96	22	4	6	8	3	4	1
Exp. BS/MS	46	6	6	0	10	6	3	4
Program BS/MS	6	-	-	-	4	1	2	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

	Visits to Richland				Offers*			
	Cases Considered	Invited	Visited	To Visit	Extended	Accepted	Open	On the Roll
Ph.D.	96	22	4	6	4	1	3	1
Exp. BS/MS	41	5	5	-	8	5	3	3
Program BS/MS	(Off Program Placement)				2	2	0	2

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

Ph.D.	2
Exp. BS/MS	2

C - Technical Graduate and Technician Training Program
Month Ending September 30, 1958

	TG Program	TT Program
Number personnel on assignment (HAPO TG Program 35) (West. District E.P. 2)	37	16
Distribution of assignments by Depts.		
HLO	10	11
CEO	1	0
R&UO	0	1
FPD	1	0
IPD	22	4
CPD	3	0
Distribution of assignments by functions		
R&D or Engineering	33	15
Other	4	1

FINANCIAL OPERATION MONTHLY REPORT

Personnel

There were no changes in Financial Operation personnel during September.

Activities

General Accounting Operation

Preparations are under way for establishing the approved central storage area for HLO equipment and material in the 325 Building basement. A job description for the assigned Financial man was submitted to Wage Administration and a job rate established. A letter was prepared for distribution to all HLO Control Custodians and Property Representatives advising them of the forthcoming storage area. Property Accounting will in the interim make an inventory of all existing storage areas and provide each custodian with a listing of equipment for his review. Listings of equipment determined to have no foreseeable need will be circulated within Laboratories prior to issuing a Declaration of Excess. Laboratory Auxiliaries are currently preparing an IR to cover a truck access to the 325 Building basement and other work required for the storage area.

Field work and the reconciliation in connection with the physical inventory of uninstalled cataloged equipment in the custody of Laboratory Auxiliaries Operation is complete and a report of results issued. Four hundred sixty-nine items were inventoried valued at $1,048,744 compared to FY 1958 inventory of 380 items valued at $862,778. Three items were added to record valued at $1,850 compared to 50 items valued at $31,929 in 1958. All equipment was located during the current physical inventory as well as in the FY 1958 inventory. No missing equipment and only three pick-up items indicate close control by custodial personnel and the use of proper procedures in transferring or retiring equipment.

The annual physical inventory of Reactor and Other Special Materials was taken September 29 and 30 and will be reconciled to include all material held in inventory as of 8 o'clock a.m., September 30, 1958. In addition to HLO Financial personnel, a team from the Commission, consisting of one Financial and one Property man, also witnessed the inventory. A report of results will be issued upon completion of the reconciliation.

Work is progressing on a review of HLO composite depreciation rates. In connection with the review, a reconciliation of the final unitization of Project CA-546 with the preliminary unitization voucher prepared in March 1957 was made. This was necessary to insure that the total dollar value of the project ($1,589,259) was properly recorded in our plant and equipment subaccounts.

The Property Management Manual issued under the direction of HLO OPG 08.11 was distributed during the month of September. This Manual was prepared to present in one publication the property management policies, procedures and requirements of HLO. Control of the distribution of this Manual will be maintained by Property Accounting and all revisions will be distributed to registered holders.

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The running analysis of estimating accuracy on appropriation requests is as follows:

	No. of AR's	Authorized Funds	Actual Cost	(Over) Under-Run
Over-Run				
By more than 10% Supplement Required	30	$130,788	$183,079	($52,291)
By less than 10%	33	203,528	211,462	(7,934)
Under-Run				
By more than 10%	44	263,815	177,289	86,526
By less than 10%	35	237,004	230,426	6,578

In connection with inventories, we have designed a new form for recording physical inventories that will be used plant-wide, also a standard form was designed for use by all custodians in making up quarterly inventories. Previous to this time, a number of different quarterly inventory reports were used by custodian personnel.

Cost Accounting

The HLO Target Budget for FY 1959 has been reviewed and approved by the Manager-HLO and submitted to the General Manager - HAPO. In preparing the Target Budget, the authorizations for HLO Research & Development Programs and work sponsored by the Product Departments were used as the target. The only area of HLO activity where the Target Budget differs from the current budget is in the area of General Overhead. To reflect the cost reductions made in the general overhead functions over the past years, a schedule was included in the Target Budget submission which compares the amounts included in the Target Budget for these functions with FY 1957 and FY 1958 actual and previous budget data for FY 1959.

A revised authorization has been received from UCRL for Project Whitney operating expenditures for FY 1959, increasing the interim authorization of $200,000 to $600,000. There is no change anticipated in the present FY 1959 authorization for equipment in the amount of $50,000.

A revised financial plan is forthcoming from HOO-AEC which reflects a reduction in authorized funds for the 4000 Program. Other programs are unchanged from the September 15 Financial Plan.

Preliminarily it appears the AEC has apparently recalled the funds authorized in the September 15 Financial Plan for the Waste Disposal and Fuel Cycle Development Programs.

A uniform system for accumulating costs by individual prototypes was developed during September and appropriate instructions issued to the R&D components. Hereafter, we will use the new system for all prototypes over $20,000 for all R&D components except the Mechanical Equipment Development Operation. MEDO has been using account classification codes to identify prototype costs for approximately one year and we do not feel that it would be practical to change.

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A procedure for accumulation and reporting on all R.D.S. work orders and purchase orders as well as individual pieces of prototype equipment was published during the month. The format of the report will provide total estimated costs, expenditures to date, and balances to complete for each R.D.S. item. It is planned to issue the report monthly.

A new work identification code was established to separately identify costs associated with the special isotope separations work requested by CPD. The code and title are .64 - Special Separations and will be funded from CPD - Separations R&D funds.

A report was issued for the first time in September showing costs of the U.S. Air Force "Atomospheric Diffusion Studies".

Personnel Accounting

Consolidated Reports and Statistics in Schenectady requested that we prepare on IBM cards certain salary administration statistics in accordance with a guide for coding and punching such cards. This job is similar to that performed in October 1957. Completed punched cards are to be forwarded to L. L. Weiss so as to reach him by October 15, 1958. We anticipate mailing cards by October 10.

As of this date duplications of personnel records formerly maintained by Salary Administration on exempt employees have been discontinued. All information except the appraisal form has been removed from the personnel folders formerly maintained by Salary Administration and each individual record has been compared with those in the Personnel Accounting personnel folder to determine that an original is on file and all duplicates have been destroyed.

Auditing

Field work on the Audit of Material Furnished AEC Contractors continues. Progress during the past month was small because of work on the Traveling Auditor memorandum follow-up and preparation for the Business Review.

The report of action taken or to be taken on Traveling Auditor recommendations was completed. A need for further action was indicated for (1) attempting to eliminate Technical Shops tool room attendant and material handler slack time, (2) investigating the feasibility of eliminating accelerator overtime by converting to mechanical refrigeration systems and (3) reducing the lag in removing completed items from the EWIP.

The audit schedule for the year ended July 31, 1959 was submitted to Contract Accounting for its consolidated submission to the AEC.

Measurements

Interviews continued with the different managers. Measurements has been discussed with 25 managers to date. Consolidation of business review information is under way. An outline of recommended measurements reporting for the remainder of CY 1958 is nearing completion.

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Procedures

Central Stores will stock Huron Copysette (carbon attached manifold tissue). As soon as a stock number has been assigned the HLO secretarial force will be informed. This action was prompted by a suggestion from an HLO employee.

Preliminary contacts have been made with Data Processing and Stores personnel concerning the weekly store order cost distribution run in an effort to change the input and ouput slightly. The change will be the addition of the name of the man who signed the store order. Initial reaction was not too favorable but Stores is going to examine possibilities more closely. Such a step would eliminate the need for distributing store orders by Stores and sorting and filing by cost groups. This is dependent also on acceptance by the Auditor and Manager - Cost Accounting.

Payroll Statistics

Number of HLO Employee Changes During Month	Total	Exempt	Non-Exempt
Employees on Payroll at Beginning of Month	1 232	584	648
Additions and Transfers In	21	6	15
Removals and Transfers Out	(60)	(28)	(32)
Employees on Payroll at End of Month	1 193	562	631

Overtime Payments During Month	September	August
Exempt	$ 5 838	$ 7 600
Non-Exempt	5 411	6 848
	$11 249	$14 448

Gross Payroll Paid During Month		
Exempt	$454 617	$463 984
Non-Exempt	272 558	342 365
	$727 175	$806 349

Participation in Employee Benefit Plans at Month End	No. Participating		% Participating	
	September	August	September	August
Pension Plan	1 170	1 186	98.8	98.7
Insurance Plan				
Personal Coverage	1 228	1 248	99.7	99.8
Dependent Coverage	797	799	-	-
U.S. Savings Bonds				
Stock Bonus Plan	735	755	61.6	61.9
Savings Plan	77	86	6.5	7.0

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Insurance Claims	September		August	
	Number	Amount	Number	Amount
Employee Benefits				
Life Insurance	-	-	1	$18 700
Weekly Sickness & Accident	7	807	10	718
Comprehensive Medical	37	2 630	21	1 525
Dependent Benefits				
Comprehensive Medical	96	11 322	57	5 558
Total	140	$14 759	89	$26 501

Good Neighbor Fund	September	August
Number participating	763	789
Percent participating	64.0	64.0

Manager - Finance

W. Sale/bk

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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	TITLE OF INVENTION OR DISCOVERY
M. O. Rankin	Medium-Level Continuous Alpha Air Monitor

H M Parker

1238441