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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT

JUNE, 1958

Compiled by
Operation Managers

July 15, 1958

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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By Authority of

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Dr. Bricker 5/12/92
PM Eck 5-14-92

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PRELIMINARY REPORT

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STAFF

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Manager, Chemical Research and Development . .	L. P. Bupp
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Manager, Radiation Protection	A. R. Keene
Manager, Reactor and Fuels Research and Development	F. W. Albaugh
Manager, Employee Relations	T. G. Marshall
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TABLE I. HLO FORCE REPORT AND PERSONNEL STATUS CHANGES

DATE June 30, 1958

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At close of month
Exempt Non-Exempt Total

At beginning of month
Exempt Non-Exempt Total

Additions
Exempt Non-Exempt

Separations
Exempt Non-Exempt

Chemical Research and Development	127	94	221	124	95	219	4	1	1	2
Reactor & Fuels Research & Development	154	104	258	149	102	251	6	2	1	0
Physics & Instrument Research & Development	63	25	88	62	25	87	2	0	1	0
Biology Operation	35	42	77	34	42	76	1	0	0	0
Operation Res. & Syn.	14	3	17	14	3	17	0	0	0	0
Radiation Protection	39	117	156	40	121	161	0	1	1	5
Laboratory Auxiliaries	44	178	222	44	179	223	0	3	0	4
Financial	15	34	49	16	34	50	0	2	1	2
Employee Relations	13	9	22	13	10	23	0	1	0	2
Programming	15	4	19	15	4	19	0	0	0	0
General	1	2	3	1	2	3	0	0	0	0
Totals	520	612	1132	512	617	1129	13	10	5	15
Totals excluding Internal Transfers	520	612	1132	512	617	1129	13	5	5	10

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Composite Separation Rate
Separation Rate (based on separations leaving G. E.)
Controllable Separations Rate

1.7667
.0070
.0044

SUMMARYBUDGETS AND COSTS

Total costs for FY 1958 are \$17,762,000 or 97% of the FY 1958 Budget. June costs of \$2,041,000 were up substantially from \$1,524,000 in May due to the increase in volume of billings and accruals at the year's end. Cost-budget relationships for certain key categories of HLO work are as follows:

	<u>Costs</u>	<u>Budget</u>	<u>% Spent</u>
HLO Research and Development Programs	\$ 5 849	\$ 5 824	100%
R and D for Product Departments	5 056	5 253	96%
Total R and D	10 905	11 077	98%
Process Technology	1 014	1 138	89%
Total HLO	17 762	18 269	97%

Costs do slightly exceed the budget in certain AEC activities. Plutonium Recycle Reactor Research and Development costs exceed the budget by \$39,000. This overrun is offset in part by an underrun of \$30,000 in Reactor Development Equipment Not Included in Construction Projects. The balance, \$9,000 is more than offset by underruns in the Gas-Cooled Reactor Studies and the Maritime Gas-Cooled Reactor R and D leaving the total 4000 Program within the Financial Plan. Biological Research costs exceeded the budget by \$14,000. Underruns in Biophysics, Dosimetry, Instrumentation and Biology and Medicine Equipment Not Included in Construction Projects are adequate to offset this overrun leaving the 6000 Program within the Financial Plan.

RESEARCH AND DEVELOPMENT1. Reactor and Fuels

Over-all design of PRTR is 85% complete. Design verification testing of PRTR components showed the need for flow monitors of shorter response time and for further minor modifications of calandria design to reduce moderator dump time on reactor scram. Shroud tube bellows testing is proceeding satisfactorily.

Fabrication of the end taper of PRTR Zircaloy-2 process tubes, heretofore a major problem, has been accomplished at HAPO by warm swaging and at the Tube Reducing Corporation by tube reducing.

The first sintered PuO₂-UO₂ compacts have been fabricated.

A novel rinsing method may alleviate occasional local corrosion sensitivity of Zircaloy fuel cladding and porosity of Pu-Al injection cast into Zircaloy tubing.

Work has started on capsule irradiation experiments for the in-reactor study of the CO₂-graphite reaction in the pressure range of interest for gas cooled reactors.

The first extended exposure of aluminum alloy-clad fuel elements to 240 C water has been completed in KER Loop No. 4. Hot-pressed I and E segmented

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washer elements were discharged after ca. 500 MWD/T exposure at coolant pH 4.5 with phosphoric acid inhibitor. Preliminary observation indicated negligible corrosion.

Two vendors are nearing completion in the fabrication of prototype full-size NPR Zircaloy-2 process tubes.

Stainless steel clad, 4-rod, cluster fuel elements have been discharged from KER Loop 3 after an exposure of 2250 MWD/T. Coolant temperature was 235 C and core temperatures 400-500 C.

A series of Zircaloy-2 clad uranium rods with varying clad thicknesses have been defected and exposed to 225 C water. Marked difference in sample behavior occurred depending on whether or not the individual sample had been beta heat treated. These experiments indicate that the value of beta heat treatment of such elements must be restudied.

The experimental simulation of events following a sudden flow reduction in a C Reactor process tube containing I and E fuel elements was completed. As for K Reactor, the results indicate that the proper reactor instrumentation can offer adequate protection for such events at power levels higher than the present.

2. Chemical Research and Development

Laboratory studies are reported which assisted Purex plant tests aimed at characterizing recovery of neptunium from back cycle wastes. Neptunium has been shown to build up in concentration as wastes are backcycled and hence these back cycle streams are attractive sources for neptunium needs. Ultimate recovery is by ion exchange.

Work continued on strontium recovery from synthetic low volume per ton waste by a process precipitating strontium nitrate using fuming nitric acid. The process is somewhat complicated by sulfate in the waste feed.

First results from an experimental spray calcination unit show a synthetic waste feed converts to well formed spherical beads with no tendency toward dusting. Bulk density of the beads was low and the particles were fragile. Satisfactory pellets were pressed from the calciner beads. Work is also reported on the direct calcination of conventional and sulfate-free Purex LWW synthetic wastes. Sintering at 1300 C with added phosphate produces solids of reasonably low leachability. Of course, both ruthenium and cesium volatilize in attaining these high sintering temperatures.

Experiments using the laboratory scale Flurex cell continued to supply answers of operational importance. Trace quantities of plutonium in the UNH feed migrated through the cation membrane and maintained about the same Pu/U ratio in the catholyte. Further studies on decontamination from Ru and Zr-Nb confirm previous work to show low decontamination factors for these elements.

Tests with molten (anhydrous) $\text{NH}_4\text{F} \cdot \text{HF}$ confirmed an Oak Ridge report that this material at its melting point (ca. 120 C) will dissolve zirconium oxide films

on Zircaloy-2. Reaction of this melt with the substrate Zircaloy-2 was deemed too vigorous for plant use, however. Addition of hydrogen fluoride to the nominal composition $\text{NH}_4\text{F} \cdot 2\text{HF}$ reduces the melting point to 20 to 30 C, however, and enables the oxide film to be removed at a lower temperature at rates which could be safely considered for a plant application. This process may have application as a backup method to dissolve zirconium oxide sludges or films in the event that zirconium oxide dissolution becomes a problem associated with the zirflex process.

A study was initiated to determine the experimental feasibility of producing low neutron cross-section mercury rich in isotope 204. Laboratory experiments using a distillation-diffusion separation technique have been initiated. Other study showed a Bi-Pb-Hg- UO_2 slurry system to have no apparent instability when mercury was boiled off, condensed, and returned to the system. These very preliminary experiments are scouting the potential use of vaporized mercury to remove heat from a Bi-Pb- UO_2 reactor fuel system.

A facility for the non-destructive testing of MTR fuel plates for plutonium content was designed, fabricated, calibrated and transferred to Plutonium Metallurgy for routine use. The instrument is capable of determining plutonium core content equivalent to 0.020 inches of Al-14 w/o Pu alloy to a precision of one per cent relative. Scanning time per plate is about two minutes.

3. Physics and Instruments Research and Development

Measurements of the reactivity of clusters of 1/2-diameter rods continued for the improved production reactor program. Results to date indicate that enrichment will be required if this fuel element type is used.

In the nuclear safety field, sub-critical experiments were performed with 1.6% enriched fuel elements in water. The good agreement between the results actually obtained and those predicted from exponential type experiments is reassuring inasmuch as exponential experiment results have been used extensively at HAP0 in setting nuclear safety criteria on enriched uranium pieces.

The experiments also served as a shakedown run preparatory to doing experiments with 3% enriched material where no exponential results are available.

A nuclear safety review of fire protection plans for 234-5 Building indicated that hazardous conditions would result from the use of water sprays.

In the Plutonium Recycle Program a method for treating outward neutron flow (leakage) in a lattice reactor has been conceived which represents a substantial improvement in accuracy over simple methods widely used but also avoids the complications of existing more exact methods.

The experiments on the 9-inch lattice have been completed and the results are currently being analyzed.

Field measurements on the atmospheric physics aspects of the Wahluke Slope problem indicated that under unstable atmospheric conditions material originating in the reactor areas will ascend the bluffs across the river with only a small portion diverted downstream.

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Testing of the prototype radiotelemetering data station was completed and it has been returned to the fabricator with recommendations for minor changes and modifications.

In the basic data field, work was resumed on the measurement of neutron slowing down with an improved experimental set-up. The new neutron spectrometer was found to require improvement in the arrangement for obtaining a beam from the reactor.

4. Biology

Completion of 100 days chronic feeding of Sr^{90} and Ca^{45} at various levels of total Ca in the diet showed a variation in the observed ratio of Sr^{90} to Ca^{45} retained in bone from 0.08 on the 0.03 per cent Ca diet to 0.39 on the 2.0 per cent Ca diet. Estimates of Sr^{90} hazard are usually based on the assumption of a constant observed ratio of about 0.25. Local findings in this field continue to have an important bearing on the national posture with respect to fallout.

Concentrations of Sr^{90} in alfalfa harvested from Sr^{90} contaminated plots was not influenced by cultivation and was about half the level observed in the same plots last year. The decrease is presumably due to the establishment of deeper roots by this perennial plant.

Inhalation of EDTA or DTPA aerosols by rats reduced the 48-hour lung retention of intratracheally injected plutonium by a factor of 2. Bone deposition of plutonium was not markedly affected.

5. Programming

In Plutonium Recycle Analysis, a sufficient number of 702 Computer plots should be available by early August to permit the derivation of plutonium fuel values for well thermalized reactor systems. The fuel values are only applicable to reactors operating in an American public utilities environment.

A modified "Lambda" computer code, identified as Wessex B, has been formulated. It is believed this new code will facilitate reactor studies employing different fuel compositions yet using a single spectral index.

Detailed PRTR charge-discharge schedules, based on both H_2O and D_2O reflectors have been prepared for PRTR operation. The substantial benefits accruing from a heavy water reflector are clear in this and other studies in the recycle program.

Technical and Other Services

One apparently minor case of plutonium deposition occurred when an employee in the 234-5 Building received a contaminated puncture wound. As a precautionary measure a small amount of tissue was excised from the finger tip. Analysis indicated less than 5% of the MPL was removed and about the same amount remained at the wound site.

The interim report on the CPD control study was issued during the month and several additional reports containing specific recommendations are in process.

The study of operator coverage of substations in the outer areas was completed and a report submitted.

Statistical and mathematical assistance on 26 separate problems was given within HLO and to other departments and operations. The results of a trial adoption by FPD of a long-standing recommendation that control charts be maintained on each canning line individually and the lag time in posting these charts be reduced were particularly gratifying.

Excluding the major PRP projects, there were 23 authorized projects at month end with total authorized funds of \$6,482,300. The total estimated project cost of these authorized projects is \$9,545,300. One project was completed during the month. Two new projects are awaiting AEC authorization; these have a total cost of \$333,000. Proposals for four new projects are in preparation.

The design and construct contract for the High Level Radiochemistry Cell addition to 325 Building (Project CA-749) was awarded to the B. D. Bohna Company, San Francisco. The contract price is \$574,504; fair cost estimate was \$673,000. The contractor has started work and detailed design work is progressing rapidly.

An engineering report evaluating alternate proposals for constructing the Critical Mass Laboratory was submitted to AEC. This report recommends conventional construction for the facility and the project proposal is being modified accordingly.

Supporting Functions

The amount of underruns on appropriation requests continue to exceed the overruns, however, of the 100 completed requests since July 1, 1957, 58% have deviated (either over or under) by more than 10% from the original estimate. This percentage is unchanged from the previous month.

FY 1958 accrual policies have been determined and preliminary work is being conducted necessary for year end purchase order accruals. Arrangements have been made by letters to vendors and through HOO-AEC to procure June's costs on outstanding Procurement Directives. Accrual entries have been prepared for services rendered but not billed on GE contracts (excluding Zirconium). The administrator of each contract was contacted to determine extent of liability. Accounts payable operation was also contacted to insure against our making an accrual and also receiving an actual charge.

At month's end, the staff of the Hanford Laboratories Operation totalled 1132, including 520 exempt and 612 nonexempt employees. Of the total exempt employees, there were 454 with college degrees, including 436 technical degrees as follows: BS - 225, MS - 106, PhD - 105.

Approximately one-half of the employees in the Physics and Instrument Research and Development Operation have been covered by attitude survey follow-up discussions.

The 1958 AEC Radiological Physics Fellowship Program started June 16, 1958. A total of 15 Fellows are participating; 9 from the University of Washington and 6 from the University of Kansas.

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The Chemical Processing portion of the 1958 Summer Institute of Nuclear Energy started on June 23, 1958. Ten college professors and one AEC employee from Savannah River will take part in this eight-week program.

Laboratories personnel worked a total of 182,035 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,145,225 man-hours have been completed with no disabling injuries. The medical treatment frequency for June was 1.86 as compared with 1.81 during May.

There were 2 security violations during the month, bringing the total for the calendar year to 25.

Negotiations with Regional Monitors have been temporarily suspended pending further discussions within the HAMTC.

The Maki arbitration case is tentatively scheduled for the week of October 6.

Oral notices of force reduction were given to 19 nonexempt employees and 3 exempt employees in Radiation Protection Operation. Placement of these individuals in other assignments is progressing satisfactorily.

At the June Suggestion Board meeting 5 suggestions were approved for awards totalling \$65. For the year to date, 49 suggestions have been approved for awards totalling \$1,405, bringing our average award to \$28.67 and our ratio of awards to savings to 11%.

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

<u>1958</u>	<u>Insurance</u>	<u>Pension Plan</u>	<u>Savings and Stock Bonus</u>	<u>Savings Plan</u>
Jan.	99.6	98.4	60.6	7.5
Feb.	99.7	98.5	61.3	8.2
Mar.	99.7	98.6	61.9	8.7
Apr.	99.7	98.6	61.3	7.9
May	99.7	98.6	61.3	7.6
June	99.7	98.9	61.4	7.6

The necessary work in revising the Employee Relations Operation to include those functions which were transferred from Relations and Utilities effective July 1 were completed during the month.

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

Pickling and Rinsing of Zircaloy-2. Wrought Zircaloy-2 generally has a contaminated surface, and its corrosion performance, at least on short term tests, can be greatly improved by pickling in a nitric-hydrofluoric acid etch. However, very rapid and thorough rinsing is needed after the etch, or accelerated attack will occur. For practical purposes, these rinsing requirements are so severe as to restrict sizes and shapes of fuel elements and tubes to those that can be easily rinsed.

The offending material, which the rinse is to remove, has been identified as either fluoride ion or its reaction products with zirconium. Aluminum ion forms a strong complex with fluoride ion. Aluminum nitrate in the form of a 15% solution of $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ in 15% HNO_3 has been found to be a very effective rinsing agent much better than hot or cold running water or acid rinses. This initial scouting work is being continued.

Corrosion of Uranium in MIPB. It was previously reported that uranium corrodes in monoisopropyl biphenyl (MIPB) by reaction with hydrogen according to the rate law

$$\text{corrosion rate} = k (P_T - P_D)^{5/2} \quad \text{where } k = \text{rate constant}$$

P_T = total H_2 pressure
 P_D = decomposition
pressure of UH_3 .

Since at constant temperature and constant hydrogen partial pressure the term $(P_T - P_D)$ is constant, it follows that a linear corrosion rate should be observed. Recent experimental observations have confirmed this conclusion. At 350 C and 5 psi hydrogen partial pressure, the observed penetration rate was 0.23 mil per day.

Radiometallurgy Laboratory Studies

Radiometallurgy activities during the month in support of the 2000 Fuels Development programs included measurements of the post-irradiation tensile properties of uranium specimens, and completion of the examination of a temperature monitored coaxial fuel element. Results and conclusions are reported in more detail in connection with the respective fuels development programs involved.

Basic Metallurgy Studies

AlSi Bond Studies. Optical and electron microscope studies for FPD of the bond formed between AlSi and U by standard canning procedures have continued. A slug canned under conditions considered to give optimum bond characteristics has been examined. The bond in the region one-half inch from the bottom of the slug showed the typical scrambled inter-metallic network in the AlSi and an almost completely feathered zone adjacent to the uranium. The top section of the slug, however, had very little scrambling in the AlSi, and the bond consisted of as many as six distinct layers. The difference in bond characteristics between top and bottom may arise from the difference in agitation in these two regions. Autoradiography has been applied to the qualitative identification of the scrambled intermetallics found in the AlSi of canned slugs. The high concentration of alpha tracks from the scrambled intermetallics definitely proves that they have a high uranium content.

An x-ray study of the composition of the bond area in lead dipped fuel elements has been made. Three compounds and two free elements were identified. The bond layer at the base of a normal canned slug was exposed by polishing from the uranium side of the layer. This technique developed by the metallography laboratory had the advantage of exposing an extended area of the bond layer for x-ray study. This allowed a diffractometer technique to be used rather than film methods previously attempted. The diffraction pattern obtained was analyzed and the presence of UAl_3 , USi_3 , and UPb_3 ascertained. In addition, free uranium and aluminum were present. The three compounds discovered are rather unique because their structures are all simple cubic and isomorphous. It should also be noted that UPb_3 can exist in either an ordered or disordered state. The exact properties of the two states or the conditions under which they are produced are not too well known.

Recrystallization and Recovery of Zirconium Alloys. The kinetics of recrystallization and recovery in zirconium, Zircaloy-2, and Zircaloy-3 are being determined to establish the optimum conditions of heat treatment during fabrication operations. Percent cold work, temperature, time, and heat treat atmosphere have been selected as the independent variables. Rockwell "G" hardness measurements have been recorded for zirconium heat treated in air for 10 and 100 minutes at six temperatures ranging from 300 to 800 C. Recovery curves for the ten percent cold worked zirconium show a gradual decrease from 68 R_G at room temperature to 55 R_G at 700 C. The hardness of the 50 percent cold worked material is near 76 R_G, and the minimum hardness is 58 R_G after annealing between 600 and 700 C. The hardness increases again after an 800 C anneal. This is assumed to be caused by gas absorption in the zirconium.

Hanford Irradiation PT-3NA. The design of advanced fuel elements depends upon knowledge of the effects of irradiation on the significant mechanical and physical properties of uranium. A program to obtain this information is under way. One specimen irradiated to 0.018 a/o burnup was tested at room temperature following a 100-hour anneal at 600 C. This specimen

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exhibited an ultimate strength of 80,000 psi, a yield strength of 41,800 psi, and 7.3 percent elongation. The elongation compares with 19 percent for the unirradiated control specimens, 5.7 percent for a similar specimen annealed 10 hours at 600 C, and 0.75 percent for the as-irradiated specimen. The rate of recovery of ductility by post-irradiation annealing at 600 C appears to be initially rapid. Beyond ten hours annealing time the rate diminishes, and the recovery approaches a maximum at 100 hours.

Diffusion Studies. A knowledge of the interdiffusion of various uranium/barrier metal/clad metal combinations is essential in the design of fuel elements. Diffusion is being studied in U/Ni/X-8001, U/Zr, U/X-8001, (U-Zr) alloy/Al, and U/A-2 aluminum alloy couples. An interim report entitled "Preliminary Data on U/Ni/X-8001 Aluminum Alloy Diffusion," HW-56513, has been written. This study has shown that the rate of penetration of uranium, toward the outer X-8001 surface, greatly increases shortly after the Ni_2Al_3 phase boundary reaches the uranium. This is largely due to the rapid rate of diffusion of aluminum through the Al/Ni diffusion zone into the uranium. This process results in a reduction in thickness in the X-8001 alloy layer.

A Study of Irradiated Zirconium and Zirconium Alloys with Electron Microscopy and X-Ray Diffraction. The effects of reactor irradiation on the microstructure and properties of zirconium alloys are being evaluated by studies of high resolution metallography, x-ray diffraction, density, hardness, optical microscopy, and damage annealing kinetics. Differences between annealed, cold worked, and beta quenched materials are being evaluated prior to irradiation.

X-ray line profiles have been measured for Zircaloy-3 samples representing one of the four groups to be examined. Line broadening changes were observed which were related to the amount of cold work. Good alpha 1, alpha 2 doublet resolution for a given peak in the annealed specimen decreased appreciably in the ten percent cold worked condition.

Asymmetrical Flux Effects. Exposure of randomly oriented specimens of uranium has frequently resulted in warping of the samples. It is possible that the warping results from an uneven or asymmetrical thermal neutron flux. A turbo-mechanism has been designed which will rotate an irradiation capsule during exposure in the MTR reactor. Rotation of the capsule in the neutron flux will give the samples a radially uniform exposure. It will be used to measure the effect of thermal neutron flux asymmetry on the warping of flat uranium tensile specimens.

The rotating capsule design has been bench-tested and found to operate satisfactorily in an out-of-reactor hydraulic facility. The water flow rate was 20 gal/min, the pressure drop across the capsule was about 5 psi, and the capsule rotated at 1060 rev/min. The test lasted for nine weeks without change in the speed of rotation.

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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.

The quartz insulated and asbestos insulated thermocouple lead wire assemblies have received a total of 1212 hours of irradiation at KW reactor. The resistance between leads of both units is still reading greater than 10^7 ohms.

Inert Gas Mobility and Swelling Experiments. The diffusion and agglomeration of the noble gases, krypton and xenon, produced by fissioning of U-235 have resulted in pronounced swelling of irradiated fissionable materials. This swelling appears to be markedly dependent on irradiation temperature and uranium burnup. Due to the possible effect of such swelling on fuel elements in proposed reactors, a basic study of the diffusion rate of those gases in pure metals and in both single and two-phase alloys have been initiated. A document, HW-55591, was written which proposes a program of in-reactor and out-of-reactor tests for the study of the basic mechanisms of swelling in irradiated uranium. Its title is "A Proposal for the Study of the Mechanism and Effects of Swelling of Uranium Fuel."

Production of High-Purity Uranium. A study of methods for preparation of high-purity uranium is being conducted primarily to provide a supply of this material for use in fundamental physical metallurgy studies. Electro-winning from a molten KCl-LiCl-UCl₃ salt bath produces dendrites of uranium, which may be vacuum melted. The metal obtained from these operations may then be fabricated into the required specimens.

It has been found feasible to consolidate the electrolytic dendrites and fines by melting with an induction unit. Several melts have been made, and the metal obtained has ranged in size from small roundelles to a solid piece, two inches in diameter. Since these melts were only experimental evaluations of the melting practice, no analysis for purity has been made.

New Fuel Element Development

Rod Cluster Fuel. Stainless steel clad 4-rod cluster elements have been operating in KER Loop 3 since September 1957. Their present exposure is 2250 MWD/T. Coolant temperature has been held at 235 C, with power output of 42 kw/ft (11.2 watts/gm). The fuel cores in this test run in the temperature range 400-500 C. Important data on core swelling, support behavior, and external dimension changes will be available when this test is discharged about July 1.

Two fuel elements for a length test of coextruded Zircaloy-2 clad uranium have been completed and delivered to 1706 KER. Both elements are 3-rod clusters with 0.630 Zircaloy-2 clad uranium rods equally spaced in the

KER Loop 3 tube cross section. One element is 24" in length with no internal supports. The second element is 36" in length with an intermediate support at the assembly center.

In the development of the Zircaloy-2 clad uranium core coextruded fuel element concept, it is necessary to support the cluster at points along the length of the element. To do this, it is necessary to attach supports in the span of the element away from the end cups. A satisfactory method of attaching supports to the 0.020" thick clad of Zircaloy-2 has been developed which does not affect the Zircaloy-2 uranium bond. These supports are attached by carefully controlled conditions using the resistance spot welding process.

Four, seven-rod cluster fuel elements are being irradiated in the KE Reactor through hole facility as part of a program to develop a fuel capable of withstanding the high specific powers and operating temperature of a NPR. The four fuel elements were charged May 5, 1958, and are presently running at a calculated specific power of 100 kw/ft. The central core thermocouples show the core temperature to be 415 C, and the uranium-stainless steel interface heat transfer bond coefficient is calculated to be 1350 BTU/hr-ft²-°F. Goal exposure for this irradiation is 2500 MWD/T, of which 665 MWD/T has been achieved to date.

Pressure drop studies on the enriched seven-rod cluster fuel element to be charged into KER Loop 1 in the near future have been completed. The fuel charge starting at the downstream end of the tube consists of 18'6" of perforated dummies, 3' of seven-rod cluster fuel elements, and 14'2" of four-rod cluster fuel elements. Results of these tests showed a total pressure drop of 11.6 psi across the tube at operating temperature conditions of the KER loop facility. This is well within the 25 psi operational drop allowed by the operating personnel of the loop.

Components for fabricating three, seven-rod cluster fuel elements scheduled to be charged into the 3x3 ETR facility have been completed. These fuel elements are scheduled to be fabricated, tested, and made ready for shipment to the ETR during the next month. The proposal document for charging these fuel elements has been started and will be completed as soon as flux data are made available for heat transfer calculations.

Coextruded Tubular Fuel Elements. Zircaloy-2 clad uranium coextruded fuel elements are being evaluated as extended surface fuel elements for the NPR. To develop end cap closure procedures, it was necessary to modify the Electron Beam Vacuum Welding system to accommodate elements up to two-inch outside diameter and thirty-six inches in length. This conversion was made, and a welding procedure for end cap closure of this type of element was developed. Three of these elements were closed using the Electron Beam Vacuum Welding process.

Nuclear Metals, Inc., has supplied seventeen feet of Zircaloy-2 clad uranium tube with an OD of roughly 1-3/4" x 1-3/8" ID. Cladding of 0.030" thickness is bonded to the tube by the coextrusion process. NMI has also

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supplied 50 feet of one inch diameter Zircaloy-2 clad uranium rod. Three, 36" length fuel tubes have been cut from the NMI tube, end closed, and heat treated. These will be fitted with central rods during July. Zircaloy-2 spring rails will support the outer tube in the KER process tube and the central rod within the tube.

Lead-dip I & E Segmented (Washer) Fuel Elements. A four-tube, run-to-rupture charge of C size I & E segmented fuel elements, fabricated to complete the evaluation of the segmented element concept, has been tested, measured, and stored pending reactor charging under PT-IP-106A-Suppl. A.

A group of experiment slugs, exposed under PT-IP-106A (lead-dip canned wafer I & E) was examined in 105C viewing basin after discharge at approximately 740 MWD/T. In general, they showed undulations in the jacket wall, apparently stemming from expansion and contraction of contiguous washers in preferred directions. On one specimen the plane of separation between two adjacent washers was sharply delineated by a necked-in groove in the jacket about 0.008" deep (as measured by the C Viewing Basin Profilometer). This deformation may have been caused by forces during discharge, but the fact that only about 0.013" warp was indicated makes it appear that the neck-in was caused by forces generated between the washers (such as by growth of bumps, oxide, etc.).

I & E Self-Supported Slugs. Examination of a tube load of KER I & E self-supported slugs canned in A-2 aluminum alloy, discharged after approximately 200 MWD/T exposure, at a surface temperature of approximately 250 C, showed the jackets to be in generally good condition. There was evidence of some slight pitting corrosion on two or three of the slugs, and all had become blackened by the action of the water.

Hot Press Canning of I & E Solid Core Fuel Elements. In preparation for a planned four-tube, run-to-rupture production test of hot pressed "C" size I & E core fuel elements, a concerted effort was made to eliminate the folding, or wrinkling, previously observed in the ID tube near the base of the fuel elements. This condition appeared to be more exaggerated with Hunter-Douglas stock than with Alcoa components, probably due to the presence of a 1/8" x 45° chamfer on the base of the Hunter-Douglas cans. Several methods were investigated to overcome this difficulty. Annealing the aluminum components had no effect, but the addition of a small aluminum ring between the outer and inner base punches did correct the folding. This in turn added a second diffusion weld zone which was removed during the trulining of the ends of the fuel elements for reactor loading. The most desirable method found to date is the use of a time delay between seating the dies and the pressing cycle. This allowed the components to reach equilibrium temperature with the dies before pressure is applied. Minimum delay times are being determined as well as the minimum pressing cycle. As soon as these variables are determined, the production test will be started.

Coaxial Fuel Element. The coaxial tube fuel element is of interest because it may offer a better split failure resistance than a corresponding sized cored fuel element. Radiometallurgical examination of the first thermo-

couple coaxial fuel element irradiated in the MTR has been completed. This fuel element was one of two in the second experimental irradiation. Metallographic examination revealed that the maximum temperature attained in this fuel element during irradiation was in excess of the melting point of uranium (1132 C). The melting occurred in the experimental element when the inner coaxial tube was somehow raised from its tapered seat on the outer coaxial tube. By this mechanism the top of the inner tube became sufficiently insulated by the large gap which resulted to raise its operating temperature above the melting point of the uranium. The thermocouple was subsequently attacked by the molten uranium and destroyed. The companion element to the thermocouple element in the second irradiation appeared unaffected by its exposure.

A third MTR irradiation of two coaxial elements is currently in progress. One is equipped with a thermocouple and a tantalum protective tube around the thermocouple sheathing to give a longer service life to the couple in the event of a behavior similar to that of the previous thermocouple coaxial element. The second element of this irradiation test will be exposed to 1000 MWD/T. A coaxial element without the tapered sections for suspending the inner tube within the outer (vertical irradiation in MTR) is being prepared and will be substituted for the 1000 MWD/T exposure piece if there is any indication of the behavior which produced melting in the first thermocouple element.

Aluminum Clad Rod and Tube Elements. Experimental fluid (nitrogen) pressure bonds of aluminum to aluminum were made to determine the most practical method of obtaining satisfactory end cap bonds on the rod and tube elements being fabricated for irradiation. Bonds were consistently produced when the aluminum was wire brushed, vacuum baked, vacuum welded and bonded with a 0.001" foil of nickel. The best bonds were brittle, but it is expected that the 10,000 psi bonding pressures available at BMI will improve the ductility over that obtainable with a maximum pressure of 1000 psi locally available.

Self-Supported Aluminum Jacketed Fuel Elements - IP-84-A. Self-supported fuel elements are designed to accurately position fuel elements in smooth bore process tubes. This accurate positioning and supporting should eliminate "hot spot" type failures and the discharge characteristics. This production test is now being irradiated in B Reactor, and three tubes have been discharged at exposure levels of approximately 100, 200, and 300 MWD/T, as specified in the test procedure. Operation has been satisfactory, and the test is continuing with full exposure under this production test to be reached in approximately two months.

Effect of Clad Stiffness on Corrosion Behavior. A study of possible relationships between clad stiffness, bond strength, and rate of corrosion of defected clad fuel rods has been initiated. Zircaloy-2 clad uranium rods were machined to produce clad thicknesses of 0.030, 0.020, and 0.010 inch. Three of these rods were then beta heat treated. All samples were defected by drilling 0.025 inch holes through the cladding and were exposed to 225 C water for three hours. No significant corrosion of the fuel resulted.

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The samples were then exposed to 225 C water for an additional ten hours. The several rods were found to have suffered markedly different degrees of failure. In the beta heat treated samples the rod with the thinnest clad suffered the greatest damage. In the as-extruded samples the rod with the thickest clad suffered the greatest damage. Undercutting along the bond layer was most pronounced in the beta heat treated samples. From this initial test one might conclude that beta heat treatment weakens the bond layer. The test will be repeated and other defect tests initiated.

Tru-Line Washers. One of the methods being developed for the fabrication of tru-line washers is the upsetting of rod stock. The chief advantages of this method are: (1) scrapless production of washers with accompanying economy, and (2) built-in tru-line feature eliminating additional fabrication. An experimental die set is being used to define the material and fabrication conditions required to upset 11/16" diameter rod stock to KER size washers (1.696" outer diameter). A series of upsets were made using beta heat treated, vacuum annealed ingot uranium stock prepared the previous month. Well formed washers with the centers sheared out were produced with dies and punch preheated to 360 C, and the uranium stock heated to 550 C, using 200-ton force on the coining or upsetting punch and 25 tons maximum on the shearing punch. One hundred tons on the coining punch was not sufficient to fill the die cavity with uranium under the same heating conditions. A number of the best formed washers were chemically cleaned and examined for surface flaws. Slight circumferential folds were found on the bottom surface of the washer and on both the upper and lower edges at the periphery of the washer. The upper surface was good and the shear surface of the internal bore was smooth and free of tears. It appears that it will be necessary to form the washers slightly oversize and shear or trim the outer diameter to produce sharp corners. Additional rod stock was rolled and heat treated in both the beta heat treated, vacuum annealed condition, and as-rolled and vacuum annealed condition to determine the necessity of beta heat treating for upsetting at the elevated temperatures.

End Closures. Some success on the production by swaging of elliptical end closures (without end caps) on coextruded zirconium clad uranium rods was achieved. No attempt to make contamination free end welds has yet been made.

Magnesium Clad Fuel Elements. Considerable interest is shown in the report NMI-4352, because it is the only data in the literature on permeation rates of hydrogen through magnesium. Their data show magnesium FS-1 alloy to have an unexpectedly high resistance to permeation that is better than some of the lower values obtained for aluminum. The observed hydrogen pickup of magnesium clad uranium fuel rods statically tested in MIPB was used to predict the hydrogen pressure on the basis of NMI hydrogen permeation constants. The following table shows that the permeation data should not be applied directly to this problem without regard to other factors that effect hydrogen permeation:

Observed Hydrogen Pickup in 0.57" dia. Uranium Rod ppm	Test Time Hrs.	Test Temp.	Test Pressure	Calc. External Hydrogen Pressure Atmospheres
29	117	380	1000 psi	40×10^3
14	24	420	1000 "	55×10^3
22	175	360	1000 "	26×10^3

Assuming the permeation rate data are correct, a possible alternate source of hydrogen is the corrosion of magnesium by water in the MIPB. One mg/cm² corrosion of the magnesium clad would account for the observed hydrogen gain if all the hydrogen released entered the uranium.

Restraint of Uranium Swelling by Zirconium Cladding. Swelling rates of unrestrained uranium irradiated in the 400-800 C temperature range have been measured, but to date, no swelling data are available for unalloyed clad uranium with a 250-350 C cladding surface temperature and a maximum fuel temperature in the range 450-600 C. To provide initial swelling data from the above temperature conditions a NaK capsule irradiation, GEH 3-31 was designed and charged in the MTR on March 5. To date, the desired maximum temperature of 600 C has not been attained. The maximum uranium temperature is now approximately 400 C. At the beginning of Cycle 105, it was necessary to cut the thermocouple lead on the capsule, however, it is still in the same position as it was in Cycle 104, when the temperature was recorded as 400 C. To date, the estimated exposure is 1450 MWD/T.

A series of NaK capsule experiments has been designed for irradiation in Hanford reactors to obtain further information on the dependence of fuel element swelling upon cladding and uranium temperatures, cladding thickness, and exposure. Machining of the capsule body and components is approximately 75 percent complete. To demonstrate the effects of a NaK filled capsule failure in a heated reactor process tube, eight aluminum capsules were deliberately failed in an ex-reactor flow tube. The capsules remained in 98 C water for two hours and showed no distortion or significant corrosion upon discharge. Examination of the inside of the capsules showed that all the NaK had been flushed out and again that there was no significant corrosion. A single capsule irradiation to be run in one of the Hanford reactors is being prepared to test the accuracy of the physics and heat transfer assumptions and calculations for the Hanford swelling capsules.

ETR High Pressure Loops. The 3x3 loop is 90 percent complete. The out-of-reactor portion will be operated at temperature and pressure July 9, 1958. Beneficial occupancy is still scheduled for August 15. Phillips Petroleum Company has issued tentative approval on our in-reactor piping discharge procedure. In order to expedite the insertion of the in-reactor piping, we are proceeding with the discharge equipment pending Phillips' official approval. Beneficial occupancy of the 9x9 position by Hanford is being delayed by the ANP program. Negotiations are in progress for cancellation of the half-time 9x9 assignment and full time use of a 6x9 position.

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2. REACTOR PROGRAM

Coolant Systems Development

Carbon Steel Corrosion in Reactor Effluent Water. Submerged steel samples were uniformly corroded to a depth of 1.7 mils after 40 days exposure in Hanford reactor effluent water. The high initial corrosion rate steadily decreases during the first few months of exposure to an equilibrium value of about 0.5 mil per month. Total penetration of samples exposed for 14-1/2 months was 11.0 mils.

Steel surfaces exposed for 40 days at the water-air interface were lightly pitted at the interface. However, these pits are not significantly deeper than the uniform penetration of submerged steel surfaces, and the overall average corrosion above the water-air interface was much less than under the water. Steel surfaces above the water line were uniformly covered with a tan-colored scale apparently deposited by evaporating effluent. This scale helps protect the metal surface from severe water-line corrosion.

Decontamination Studies. Forty-eight stainless steel washer type coupons have been in the K-4 mockup tube for approximately three weeks. This constitutes the longest single exposure for the crud study to date. Many isotopes contributed to the film activities on aluminum coupons discharged in March and May, the major ones being Co^{60} , Mn^{54} , Mn^{56} , Ag^{110} , and Cu^{64} .

Twenty-four tubular aluminum dummies were exposed in-reactor (KER-2) in 180 C water for a period of 20 days. The pH for this experiment was 4.5; phosphoric acid was added as an inhibitor. The amount of film appeared to be dependent on the flux. The pieces near the downstream end exhibited only a very light film, while those pieces near the center of the reactor had a heavy brown loosely adherent film.

Prototype Equipment for Heated Slug Rupture Tests. The initial phase of this installation has been completed. Since functional testing of the loop indicated that additional heating capacity would be required, a 15 KW immersion heater is being installed. The first co-extruded uranium and Zircaloy-2 cluster slug and holders are currently being designed and fabricated.

Raw Water Heat Exchanger Test. Heat exchanger equipment has been installed in 1706 Building, and shakedown tests and a first run have been completed to determine the feasibility of cooling the NPR effluent water with a heat exchanger cooled by raw or filtered river water or by process water. The primary side of the heat exchanger is heated by liquid Dowtherm at an inlet temperature of 600 F and an outlet temperature of 350 F. The secondary side is cooled by raw river water at a velocity of 7 fps and inlet and outlet temperatures of 62 F and 212 F, respectively. The loop is constructed in five sections to permit evaluation of effects at the different temperature sections of the heat exchanger. Stressed carbon steel and stainless steel coupons are placed in the outlet water line. A qualitative examination of the sections after the first short run showed a very low amount of scale

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formation. In the cooler section, some barnacles had formed. With additional data next month, it will be possible to make a more quantitative evaluation.

High-Temperature In-Reactor Exposure of Aluminum Clad Fuel Elements. The hot-pressed I & E wafer elements (Elephant slugs) discharged after about 20 days exposure at 190 C were examined. All of the slugs had a weight gain after cleaning so that a corrosion rate cannot be calculated. However, it is apparent that the corrosion is much less than that which was predicted based on H-loop experience. The next charge to go into the loop will consist of 1.44" OD Doe alloy core and Mint pieces, four 4-rod cluster pieces with an irregular Zr-U interface, and a 1.44" slug with surface temperature thermocouples. It is planned that this charge will be in the reactor by about mid-July. Elephant slugs clad in A-2 aluminum alloy were exposed in the reactor (KER-4) at 240 C outlet temperature for approximately 90 operating days and were discharged at the end of the month at a total exposure of approximately 500 MWD/T. The water was at pH 4.5 with phosphoric acid inhibitor. This is the first long-term exposure and should give some indication of the suitability of aluminum fuel elements for pressurized water reactors.

Out-of-Reactor Loop Tests. Two aluminum cermet alloys under test performed nearly as well corrosion-wise as aluminum alloy X-8001 (formerly called M-388) in a flowing loop system at 200 C; however, after one to two weeks at 300 C in Elmo-5, the coupons exhibited blisters, pits, and a heterogeneous, flaky corrosion film. These particular experimental lots of the cermet material are now believed to be less than optimum, and better samples are expected for testing at a later date.

A thermocouple slug assembly was developed for the next charge in KER-2. Tests of this assembly in Elmo-7 were satisfactory; there were no leaks through the thermocouple fittings and no apparent problems in charging or discharging. Inhibition of corrosion of aluminum and carbon steel in high temperature water at pH 7 was tested in Elmo-9. Water containing 50 ppm sodium dichromate was circulated at a slow rate past the coupons. The dichromate formed a very protective film on the carbon steel but apparently afforded little if any protection for the aluminum.

Materials for Organic-Cooled Reactors. A soft iron gasket has been cycled from 550 F to 150 F for about 500 times over a thousand hours with no leakage. This is quite encouraging in view of some indications of creeping in the aluminum gaskets being used in the ORA-1 organic test loop. The Barco expansion joint has been in service for about nine months and is still performing satisfactorily.

Organic Loop Studies. The ORA-1 forced convection organic loop was discharged after about two months operation at 370 C in MIPB with AlSi bonded, and nickel diffusion barrier, hot-pressed slugs. There was no sign of bumping or any other visual changes on the aluminum jackets. The fuel elements have been recharged for another month's operation. Zirconium coupons that had been exposed in the loop for about a month in 300 C MIPB were examined and found to contain only about 30 ppm of hydrogen.

Nonmetallic Materials Development

X-Ray Diffraction Studies of Irradiated Graphite. The crystallite size determinations of irradiated graphite are usually made assuming that all line broadening results from decreases in the average size of crystallites. This is an approximation, however, since line broadening can also result from strains produced in the crystal. By consideration of the magnitudes of the Fourier coefficients, it is possible to obtain a value for the crystallite size, L_c , which is not dependent on the assumption that only instrumental broadening and crystallite size broadening are responsible for the observed breadth of the diffraction line. Application of this more elaborate calculational technique on a graphite core recently removed from an uncooled channel at D Reactor resulted in a value of 78 Å for L_c by the Fourier analysis technique, compared with 32 Å by the usual approximate method. Although the values determined by the Fourier analysis method probably better represent the true average crystallite size and are of importance in fundamental irradiation damage studies, the integral breadth method is much quicker and still useful as a relative measure of crystallite size.

High Temperature Graphite Irradiations. The GEH-9 and GEH-13 irradiations at the MTR and ETR, respectively, are designed to provide advance high-temperature graphite irradiation data necessary for NPR design and for prediction of graphite damage in the present Hanford reactors. These data are important to the NPR since, for the expected temperatures of operation, contraction rates and other property change effects are largely unknown. Conceptual design is proceeding on two alternative facilities to provide additional graphite irradiation space in the MTR.⁽¹⁾ One of the methods involves converting the L-48 shim control rod position to an irradiation facility while still maintaining the utility of the control rod. An alternate plan for additional space is conversion of an operating rod in the L-4 row into an irradiation facility by containing the graphite samples in the control rod. Although this latter alternative would not require modification of the reactor, such a facility would not be as useful as the complete modification of the shim rod position.

The ETR is now at full power and could accommodate the GEH-13 irradiation. This position will allow the irradiation of graphite at a high fast flux (upper resonance and fast neutron region). Anticipated temperatures of irradiation are in the range of 750 to 1300 C. However, calibration will be required over the first one to two years of test use in order that damage obtained in the D-14 position of ETR may be related to an equivalent Hanford exposure. Design of the GEH-13 experiment for the D-14 position of the ETR is 80% complete, and installation is planned about August 15.

(1) Davidson, J. M., "Conversion of the Materials Testing Reactor L-48 Shim Rod," HW-56524, June 25, 1958.

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Irradiation Damage to Plastics and Elastomers. In most elastomers it is necessary to add carbon black as a filler to give the rubber more tear and tensile strength and abrasion resistance. Increasing the amount of carbon black increases the hardness and tensile strength while reducing the elongation of the base material. Recent work with nitrile elastomers has shown that the amount of carbon black in the material affects the manner in which the physical properties are changed by radiation. The hardness and tensile strength of a nitrile elastomer with no carbon black loading is greatly increased with increasing radiation exposure. As the carbon black is increased from five parts to 40 parts per hundred parts of polymer, the tensile strength is progressively lowered by gamma radiation to a dose of about 5×10^7 r. At higher doses the tensile strength of all materials - loaded and not loaded - increases. The hardness increases with increasing radiation exposure, the percent change being less as the carbon black content is increased. The elongation of all materials is lowered with increasing radiation exposure with little dependence on the amount of carbon black. This information is useful since a variety of materials are now available with different original properties. Selection can be made with a knowledge of how the material will behave in a radiation field. For example, if an O-ring is required with a certain carbon black loading to give a desired hardness for the particular application, the above work allows the prediction of how the strength of the material will change in a radiation field.

The distribution of carbonyl groups resulting from radiation induced oxidation of polyethylene has been determined on thick samples of polyethylene. The results are in satisfactory agreement with experiments done on thin films, and they corroborate the mechanism for this reaction reported earlier.

Thermal Conductivity and Electrical Resistivity of Highly Irradiated Graphite. Thermal conductivity and electrical resistivity measurements have been made on graphite samples with exposures up to 8400 MD/AT at 30 C. The samples are from a series of reactor grade graphites being irradiated in the Hanford test facilities to monitor physical property changes.

The electrical resistivity of CSF graphite is apparently increasing at the rate of 0.6×10^{-4} ohm-cm per 1000 MD/AT in both the parallel and transverse samples. At 8400 MD/AT values for transverse and parallel samples are 46×10^{-4} and 33×10^{-4} ohm-cm, respectively. TSGBF graphite after reaching a maximum of 45×10^{-4} ohm-cm for transverse and 36×10^{-4} ohm-cm for parallel samples at an exposure of 500 MD/AT, shows a slight decrease in both transverse and parallel samples. At 5500 MD/AT the average for transverse samples is 38×10^{-4} ohm-cm, and for parallel samples it is 32×10^{-4} ohm-cm.

Room temperature thermal conductivities of CSF graphite irradiated to 8400 MD/AT and TSGBF to 5500 MD/AT do not differ appreciably from the values determined at an exposure of 3000 MD/AT. These values are 0.0069 and 0.0085 cal/cm/°C/sec for transverse and parallel CSF samples, respectively, with an exposure of 8400 MD/AT; and 0.0077 and 0.0080 cal/cm/°C/sec for corresponding TSGBF samples irradiated to 5500 MD/AT.

Structural Materials Development

BDF Type Ribbed Process Tubes. Tubes received from Superior Tube Company, have exhibited excessive local ellipticity of cross section which was caused by straightening. Three tubes were returned to Superior to develop techniques for straightening and eliminating the ellipticity. This was successfully accomplished using a rod straightener, and the remaining 22 tubes at HAP0 are being returned to Superior for straightening.

Tube Reducing Corporation, under subcontract to Allegheny Ludlum Steel Corporation, was successful in fabricating three BDF ribbed tubes with acceptable dimensions and twist. Elimination of excessive twist had been the center of activity for the past month. The maximum yield from DDR-6 is now about ten good tubes.

Although considerable interest was shown in the inquiry for the fabrication of 300 ribbed Zircaloy process tubes, formal replies were received from only two vendors. The bids of both companies were disappointing from the standpoints of price, delivery, and the degree of responsibility which the fabricators were willing to assume for delivery of good tubes. Consequently, the two bids will be discarded in favor of further fabrication development orders.

NPR Type Zircaloy Process Tubing. Tube Reducing Corporation under subcontract to Mallory Sharon Metals was able to fabricate two of the possible three 57-ft long NPR type process tubes. The inside surface of the tubing was good, and dimensions are expected to be within specification. The outside surface exhibited small cracks which may have resulted from contamination during extrusion or from insufficient surface conditioning prior to each cold working pass. Final inspection of this tubing will be performed at month's end. Because of the difficulties encountered in setting up the tube reducing machine to produce the tubing, the contract completion date has been extended from June 30 to August 15.

Chase Brass and Copper Company successfully butt welded extrusions to make four tube blanks and cold drew the four blanks into 57-ft long tubes. Tubes are of excellent surface quality and are within dimensional specifications with the exception that the wall thickness varies by a range of plus or minus 10% rather than a plus or minus 5% which was the goal of this contract. Vita gage inspection was used for the first time by this contractor and the results revealed variation in the wall dimensions that had previously not been suspected. Additional work to improve the quality of the extrusions is definitely indicated by the results of this test.

Thermal Hydraulics Studies

Reactor Flow Hazard Studies. The transient heat transfer experiments investigating the events following a sudden flow reduction to a reactor process tube were continued. A total of 42 runs were made with a test section simulating standard C size I & E fuel elements in a C Reactor process tube. These experiments were conducted by partially closing a valve in the water

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supply line while the test section was at initial conditions of 1000 and 1250 KW tube power, 100 and 125 C outlet water temperature, and 0 and 25 psig rear header pressure.

A preliminary survey of the data indicates that the results are similar in most respects to those obtained with the same fuel elements in a K process tube. This means that, in general, excessive fuel temperature resulting from a sudden plugging of the coolant stream can be prevented by the present Panellit system after a flow reduction as much as 91 percent with initial conditions of at least 1250 KW tube power and 125 C outlet water temperature. For most of these cases double protection exists in that the pressure changes at the Panellit tap are great enough to actuate both a low and a high Panellit pressure gage trip.

Only one significant difference was found in the behavior of the C geometry test section as compared to that of the K geometry. When the flow was reduced to the point that film boiling conditions were initiated, the temperature of the simulated fuel element increased slower in the C process tube than in the K process tube. The exact reason for this is unknown.

An evaluation of the heat generation rates in Hanford fuel elements under operating conditions now possible indicates subcooled boiling burnout conditions should be considered in setting reactor operating limits. Initial plans have been made to establish these subcooled boiling burnout conditions for Hanford reactors with more precision than now known.

The analytical solution of thermal events following the water loss to an entire reactor was set up on the GEDA. Plans included solutions over a range of powers and for water loss at various times after shutdown.

Hydraulic Studies. An orifice sizing study was undertaken to determine new orifices for D Reactor flow zones as proposed by IPD personnel. The flow zones were selected to achieve optimum reactor power and water utilization with I & E fuel elements in the central and first orifice flow zones and with solid elements in the other four orifice zones.

The pressure drop-flow relationship was determined for a specific proposed KER loop charge of cluster type fuel elements. The charge included 18 four-rod cluster stainless steel clad uranium fuel elements and three seven-rod cluster stainless steel dummy elements. The pressure drop was about 1/2 of that estimated by extrapolation of data taken on other equipment over very short sections of each of the fuel elements.

High Pressure Heat Transfer Apparatus. Installation was completed of a small Byron Jackson canned motor pump to circulate the water during the time the apparatus is being heated to operating temperature. This should decrease the operating difficulties attributed to temperature changes in the main recirculating pump.

Thermal Stress Cycling Tests. Discussions were held with representatives of ANP concerning the technical feasibility of HLO performing special heat transfer tests for ANP. These tests consist of thermal cycling a model of

a pressure tube to be installed in the ETR. It is anticipated that very high gamma heating will introduce high thermal stresses in the walls of the pressure tube and that the situation will be aggravated by the cycling of the reactor during periodic startup and shutdown. It was concluded that the experimentation was feasible using heat transfer apparatus in the 189-D, but that there were reservations concerning the desirability of cycling the apparatus the required number of times.

Miscellaneous. An analytical study was started of the emergency flow characteristics of the dump valve in the KER-1 loop. It was found that under normal shutdown conditions the valve would allow adequate cooling of the fuel elements even though 75 percent of the valve flow area was blocked. The study was continued for the worst casualty condition that might be expected in the loop.

A study was made to determine the feasibility of moving the Hydraulics Laboratory to 185-D to allow better arrangement of CG-661 equipment (additional heat generating equipment). Although such an arrangement was deemed desirable, it was found impossible due to vertical space requirement of the CG-661 equipment.

Heat Transfer Coefficient Studies. The study to determine heat transfer characteristics of rod cluster type fuel elements was continued. A rather detailed analytical study of the temperature distribution within the individual elements of the cluster indicates that mixing promoters such as wire wraps are desirable. If rod spacing should be arranged to maintain equal coolant temperature rises in each flow channel, mixing promoters may not be necessary although surface "hot spots" will develop, especially if the spacing between rods is small.

Mechanical Equipment Development

Organic Cooling System Components. The MOTS-1 facility has been down for the entire period for modifications which include a larger heater designed to allow thermo-syphoning flow and a test section for automatic thermo-cycling.

Organic Fire Tests. Biphenyl, ortho-terphenyl, meta-terphenyl, and santo wax have been obtained for determining relative characteristics in open pan fire tests, scheduled for July 1.

Shielding Studies

Attenuation Studies. The results of the unheated ordinary concrete experiments are reported in "Neutron Attenuation in Ordinary Concrete" (HW-55938, E. G. Peterson). A fast neutron relaxation length of 12.8 cm was obtained from the first two experiments on ordinary concrete heated to 100 C.

The neutron and gamma attenuation measurements in ferrophosphorus concrete in the cured condition have been completed, and the data are being analyzed. The ferrophosphorus concrete slabs were heated to 100 C and will be put in the test wells during the next 100-DR shutdown.

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Thermal Shield Studies. Samples of ferrophosphorus and samples of 6061 aluminum alloy used in the experimental tank for the C Reactor shield plug are being irradiated in the Quickie Facility at F Reactor. Dose rates from the irradiated samples will be used to confirm calculated dose rates and to indicate dose rates to be expected during work on the experimental tank.

NPR Physics Calculations. The calculations of the effects of temperature and flattening on NPR reflector thicknesses have been completed and are presented in HW-56482 (D. E. Wood, 6/26/58).

H₂O Fluidized UO₂ Pebble Bed Reactor

An evaluation of this reactor concept, first proposed by CPD, is being made to determine its possible use as a dual purpose reactor. New lattice parameter calculations with a revised set of nuclear data have yielded values of f and p which agree well with recent experimental data for UO₂-H₂O lattices. Machine calculations based on this revised data have been conducted for the cells of interest with seven different enrichments ranging from natural concentrations to 1.8% U-235 enrichment. From this latest study it appears that enrichment requirements will be greater than previously reported.

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

ANP Foils

The ANP request for twelve metallic discs of plutonium-239 for use at Even-dale and the Idaho Test Station has been completed and delivered. The plutonium discs were to be 0.75 inch in diameter and contain one gram of pure metal. These discs were double canned in copper containers furnished by ANP and plated with five mils of copper. Details of this fabrication will be reported separately.

Radiometallurgical Examinations

IP-70-A I & E Natural Uranium Failures (RM-237). Two natural uranium I & E fuel elements from tubes 3051-KE and 3655-KE were received after average tube exposures of 425 MWD/T for 3051-KE and 605 MWD/T for 3655-KE. Both elements appeared to have failed in a similar manner, and examination was pursued in an attempt to determine the reasons for the failures. Both elements were characterized by a "hot spot" type water flow pattern in the coating film which surrounded the area of failure. The chief evidence of

failure in both elements was a longitudinal crack lying in a depressed oval area of corrosion product, with bulges or blisters resulting from undercutting corrosion being formed upstream from both cracks.

Upon sectioning a wafer from the primary point of failure of the 3655-KE element an area of probable beta phase grain structure was located at about the midpoint of the radius and 45° from the point of failure. The second wafer from the badly undercut area of this element revealed a macro-crack running radially from the undercut surface nearly to the inner core.

Metallography of two wafers from 3051-KE has revealed no beta phase grain structure in the uranium. Canwall examination revealed severe intergranular attack of the 1245 alloy in the vicinity of the failure crack, but there is no evidence that mechanical damage could have initiated the corrosive attack. The appearance of the aluminum grains in the AlSi eutectic suggests that sufficiently high temperatures were attained in the vicinity of the failure point to have annealed any mechanical damage from the aluminum.

A section of canwall from 3051-KE taken from an area of numerous cracks, lying between the initial failure crack and the large undercutting blister had been examined. The external surface is one continuous band of intergranular corrosion which, however, is not very thick. The primary aluminum grains in the eutectic at one end of this sample were normal, while those at the other end lost most of their dendritic fingers, indicating a fairly steep temperature gradient across the length of the sample. In all other respects this piece of canwall showed normal grain structure.

Examination of Heavily Corroded Enriched Elements (RM-235). Two internally and externally cooled, 1245 aluminum clad, E metal pieces, with heavily corroded external jackets were examined to determine the nature and extent of the corrosion attack. Two tubes, 5157-KE and 0873-KE, were discharged prematurely at an exposure of 67 MWD/T because calculations indicated that they were operating at conditions which might produce accelerated corrosion of the slug jackets. The slug which exhibited the most severe corrosion attack was selected from each of the two tubes for detailed examination. The corroded areas formed an oval which extended nearly the full length of the slugs and included approximately one fourth of the uppermost circumference opposite the ribs. The slug from 5157-KE was warped at the male end of the slug so that the bend was directed toward the top of the tube. On the side opposite the ribs, in the center of the concave area, approximately 1-1/2 inches from the male end, an area with more severe corrosion attack was seen. The area was approximately one inch long and one-half inch wide, and the canwall thickness was reduced 0.030-0.040 inch more than the adjacent canwall.

IP-81-A Blunt Nosed True Line Solid M-388 Rupture From 105-DR (RM-228). A blunt-nosed true line, M-338 jacketed, solid production fuel element, irradiated in tube 3376-DR as part of IP-81-A, failed at an exposure of 410 MWD/T after 42 effective days of operation. Visual examination to determine the cause of failure showed a "hot spot" near the center of the slug in which the canwall thickness was reduced by corrosion. There was a crack in the jacket located at the center of the heat-affected zone. This crack was approximately

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one inch in length and was the only visible site of water entry. Bulging of the can was noted both above and below the cracked canwall, indicating undercutting of the canwall and reaction between the water and the uranium core. Several pits were noted in the non-heat-affected area of the jacket.

Enriched I & E Fuel Element Failure (RM-218). Examination of an enriched I & E failure from tube 3784-KE continued. Metallographic examination of a section of jacket adjacent to the hole revealed no evidence of intergranular attack or overheating. The grain structure at the edge of the hole indicated a tensile failure at this point.

C Reactor Problem Tubes (RM-227). Several sections from process tubes 3681-C and 2169-C were examined to determine whether these tubes had melted, and a small piece of aluminum which was removed from a horizontal control rod channel was examined to determine whether it originated from a melted tube. Both of these tubes had been converted to air channels as a result of ruptures and were cooled only by the reactor atmosphere flowing around the outside of the tubes. Visual and metallographic examination and chemical analysis of the piece removed from the rod channel indicated that it originated from a portion of process tube which had melted and flowed into the rod channel. Examination and chemical analyses of the tube sections are not complete; however, observations thus far indicate that at least two sections from each tube partially melted.

KAPL-120 Loop Valve and Pipe (RM-231). A three-inch valve in the KAPL-120 loop was submitted for examination to determine the cause of failure. The valve was decontaminated and examined for cracks using a dye penetrant crack detector. A crack was found on an internal machined face which extended through the walls of the valve to the outside surface. Examination of the valve is continuing.

Metallography Service

Three uranium compounds are now known to exist in the braze layer of standard ALSi canned slugs. They are UAl_3 , USi_3 , and UPb_3 . Identification of these compounds was made by the Physical Metallurgy x-ray laboratory on a specially prepared metallographic sample. It was decided that the identification of the compound layers could best be determined if the sample were mounted with the flat base of the slug parallel to the plane to be polished and if metal removal during grinding and polishing proceeded from the uranium side toward the aluminum base. This method has two advantages. First, it results in a larger surface area to be scanned by the x-ray beam, and second, it removes the source of interference lines from free uranium. A cross sectional surface at right angles to the plane to be polished and analyzed was also prepared to provide visual reference of the compound layers during preparation of the sample. Careful grinding and polishing was continued until all the uranium was removed. It had been contemplated that identification of the layers would be made by successive grinding, polishing, and x-ray analysis of each distinct layer as seen metallographically. However, the surface roughness of the uranium produced during acid pickling prior to canning made this impossible. Nevertheless, this roughness may have been advantageous on the first sample, since the polished plane being analyzed intersected all three compounds and thus proved their existence simultaneously. The preparation of some slugs with a smooth

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surface at the base end is under way, and it is hoped that the compounds can be identified individually.

Samples Processed During the Month.

Total samples processed: 228

Photographs:

Micrographs	235
Macrographs	<u>45</u>
Total	280

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-56640 A2.

F.W. Albaugh

Manager, Reactor and Fuels Research
and Development Operation

FW Albaugh:kb

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JC Fox	6/5-6	General Mills, Inc., Minneapolis, Minn.	PRTR fueling vehicle design.	GC Kelly	No
HH Purcell	6/16	Jackson Pump Co., Los Angeles, Calif.	Consultation on mechanical seals & pumps for organic facilities.	A Bunke	"
	6/17	Solar Aircraft Co., San Diego, Calif.	Consultation on R&D contract.	WJ Emery	"
RG Clark	6/6	Atomics International, Downey, Calif.	Discuss nuclear instrumentation	JE Owens	"
EG Peterson	6/4	"	Observe shielding program	RL Tomlinson	"
DE Wood	6/3-4	"	Discuss shielding program	RL Ashely RL Tomlinson	"
DC Kaulitz	6/2	KAPL, Schenectady	Discuss loading & discharge procedures in ETR	R Anderson	Yes
	6/3	GEL, Schenectady	Present paper at vacuum symposium	TW Moller	No
	6/5-6	American Bearing Corp., Indianapolis, Ind.	Discuss design vacuum welding equipment.	H Lambertus	Yes
FB Quinlan	6/2	Fenn Mfg. Co., Newington, Conn.	Check on equipment & specifications	T Scattergood	No
	6/3-4	Loewy Hydropress, New York, N.Y.	"	GL Sanders	No
	6/5	Abbey Etna Co., Perrysburg, O.	"	MC Mull	No
JJ Cadwell EA Evans	6/12-13	Atomics International (NAA), Canoga Park, Calif.	Discuss cooperative HAPO-AI fuel development program.	BR Hayward	Yes
DC Kaulitz	6/18	Harms Machine Co., Seattle, Wn.	Inspect capsules for swelling program.	W Harms	No

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
KR Merckx	6/11-14	Brown University, Providence, R.I. (3rd US Congress of applied mathematics sponsored by ASME)	Present paper, discuss HAPO's program with H. Poritsky, discuss Ames assistance to HAPO with G. Murphy.	--	No
	6/16	Nuclear Metals, Inc., Cambridge, Mass.	Discuss fabrication problems & fuel element handbook.	HF Sawyer	Yes
	6/17-27	M.I.T., Cambridge, Mass.	Attend Short Course & discuss strain cycling program with LF Coffin of GEL.		
RS Kemper	6/16	Lindberg Eng. Co., Chicago, Ill.	Discuss specialized vacuum equipment & furnace installations.	--	No
	6/17	A. F. Holden Co., Detroit, Mich.		--	No
	6/18	R. D. Brew Co., Concord, N.H.	"	CR Chambers	No
	6/19	High Vacuum Equip. Co., Hingham, Mass.	"	J Merrill	No
	6/20	NRC Equip. Corp., Newton Highlands, Mass.	"	D Reese	No
	6/23-27	New York University, New York, N.Y.	Attend Vacuum Metallurgy Course.	--	No
LJ Chockie	6/16-21	Instron Eng. Corp., Boston, Mass.	Attend Short Course on Instron tensile machine	DR Erb	No
	6/23-24	GEL Schenectady	Discuss testing & failure analysis.	RL Burney	No
RJ Anicetti	6/19-20	Kux Machine Co., Chicago, Ill.	Observe acceptance tests of 300-ton automatic tableting press.	J Kux	No
SH Bush	6/23-24	Battelle Memorial Inst., Columbus, O.	Discuss assistance to Hanford program	FR Shober	Yes
	6/25-26	ASTM Subcommittee Mtg., Boston, Mass.	Attend meeting on light metals for nuclear application.	--	No

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JL Bates	6/26-27	Carborundum Co., Niagara Falls, N.Y.	Discuss high temp. micro-scope	VE Wolkodoff	No
	6/27	GE Research Lab., Schenectady	Discuss sintering of oxides.	DW Lillie	No
RL Dillon VH Troutner RE Nightingale PG Pallmer RB Richman	6/16-17	Portland, Oregon	Attend ACS Meeting	--	No
	6/2-5	Los Angeles, Calif.	Attend Annual Meeting of American Nuclear Society	--	No
DR DeHalas	6/17-18	Atomics International, Idaho Falls, Ida.	Discuss OMRE operation	CA Trilling	No
CL Boyd	6/12-13	Columbus Tool & Die Co., Columbus, O.	Check on manipulators being built.	OP Haegele	No
FW Woodfield RE Nightingale	6/24-26	AEC, DRD, Washington, D.C.	Attend Gas Cooled Reactor Meeting called by DRD.	JM Atwood	Yes
RE Nightingale	6/23	Battelle Memorial Inst., Columbus, O.	Discuss assistance to Hanford work on graphite	WC Riley	Yes
	6/26-27	ORNL, Oak Ridge, Tenn.	Discuss R&D work for gas cooled reactor.	R Megrehblan	Yes
JA Ayres	6/4-5 6/6	Alcoa, Pittsburgh, Pa. KAPL, Schenectady	Aluminum Alloy Task Group Discuss corrosion problems	RH Brown MB LeBoeuf	No Yes
HP Oakes	6/2 & 6/20 6/3	Harvey Aluminum Co., Torrance, Calif. Nuclear Metals, Los Angeles, Calif.	Consultation on zirconium fabrication "	GR Smith --	No No

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
RC Aungst	6/2	Nuclear Metals Co., Cambridge, Mass.	Consultation on zirconium fabrication	TA Tarpey	No
	6/3 & 26	Tube Reducing Corp., Wallington, N.J.	"	SN Randall & W Goad	No
	6/4 & 27	New Rochelle Tool Co., New Rochelle, N.Y.	"	CA Tudbury	No
	6/5	Superior Tube Co., Norristown, Pa.	"	HW Cooper	No
	6/6 & 24-25	Chase Brass & Copper Co., Waterbury, Conn.	"	DK Crampton	No
PJ Pankaskie	6/9	Superior Tube Co., Norristown, Pa.	"	HW Cooper	No
	6/10	Chase Brass & Copper Co., Waterbury, Conn.	"	DK Crampton	No
	6/12	New Rochelle Tool Co., New Rochelle, N.Y.	"	CA Tudbury	No
JW Riches	6/16	Chase Brass & Copper Co., Waterbury, Conn.	"	DK Crampton	No
	6/17-18	Tube Reducing Corp., Wallington, N.J.	"	WD Goad	No
	6/19	Allegheny Ludlum Steel, Watervliet, N.Y.	"	RE Rohrbaugh	No
RW Stewart	6/2	Argonne National Lab., Lemont, Ill.	Discuss pyrophoricity studies.	JG Schnizlein	Yes
LC Lemon	6/12-13	Dow Chemical Co., Rocky Flats Plant	Discuss welding fabrication problems.	LA Matheson	Yes
FW Albaugh	6/2-13	Sydney, Australia	Present paper at Australian AE Symposium and participate in AEC Mission.	DH Sangster	Yes

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VISITS TO HANFORD WORKS

Name	Dates of Visit	Company and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Buildings Visited
M Tribus	6/9	GEL, Schenectady	Consult with HLO & IPD on heat transfer technology.	JM Batch	Yes	100D, 1707 189
BW LeTourneau	6/10	WAPD, Bettis Field, Pittsburgh, Pa.	Discuss techniques in experimental heat transfer.	JM Batch	Yes	100D, 1707 189
EF Thurston FA Geraldson BL Arnold	6/18	GE-ANPD, Idaho Falls, Ida.	Discuss special heat transfer experiments for ANP at Hanford.	JM Batch	Yes	100D, 1707 189 300, 328
H Poritsky	6/2-3	GEL, Schenectady	Consult re fuel element development	JJ Cadwell JE Minor KR Merckx	Yes	300, 303, 325, 326 700 & 100D
J Dunbar	6/6	KAPL, Schenectady	Discuss fuels development & application of Zr to non-fuel problems.	JJ Cadwell JC Tobin SH Bush JE Minor	Yes	300, 303, 325, 326
A Willis	6/9-10	KAPL, Schenectady	To discuss irradiation effects in fuel elements	JJ Cadwell SH Bush JE Minor JC Tobin EA Evans	Yes	300, 303, 325, 326
MJ Sinnott	6/16-20	U. of Michigan, Ann Arbor, Mich.	Consultant Agreement No. CA-169	FW Albaugh JJ Cadwell OJ Wick	Yes	300, 303, 325 326, 328
L Overholster	6/3	ORNL, Oak Ridge, Tenn.	Discuss CO ₂ graphite reactions.	RE Nightingale DE Baker	Yes	300, 326 100K, 105
P Hastings	6/12	National Carbon Co., Cleveland, O.	Graphite development discussions	RE Nightingale EM Woodruff	Yes	300, 326
HE Bechtold	6/23	B.F. Goodrich Co., Los Angeles, Calif.	Discuss plastics & elastomers.	R Harrington	No	300, 326

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VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Buildings Visited
HW Cooper	6/23	Superior Tube Co., Norristown, Pa.	Consultation on zirconium fabrication.	JW Riches	No	300, 306
MH Bartz	6/2-5	Phillips Petroleum Co., Idaho Falls, Ida.	Discuss MTR fuel elements	QJ Wick TC Nelson	No	200W, 231, 2704
EH Davidson	6/4-5	"	Attend meeting on MTR fabrication	QJ Wick TC Nelson	No	200W, 231, 2704
JE Cunningham JH Erwin	6/4-5	ORNL, Oak Ridge, Tenn.	"	"	"	700 700 200W, 231, 2704
JM Simmons	6/4-5	AEC, Washington, D.C.	"	"	"	700
MH Bartz R Lambert	6/16	Phillips Petroleum Co., Idaho Falls, Ida.	Discuss MTR fuel elements	QJ Wick TC Nelson	No	200W, 231, 2704
J Delapena	6/23	UCRL, Livermore, Calif.	Discuss Project Whitney	ID Thomas	Yes	200W, 231, 2704
MH Bartz	6/30	Phillips Pet. Co., Idaho Falls, Ida.	Discuss MTR fuel elements	TC Nelson RW Stewart	No	200W, 231, 2704

PLUTONIUM RECYCLE PROGRAMMONTHLY REPORT - JUNE 1958REACTOR & FUELS RESEARCH & DEVELOPMENT OPERATIONPlutonium Fuels DevelopmentMTR Capsule Irradiations.

The last two capsules which contained Al - 1.65 w/o Pu and Al - 12 w/o Si - 1.65 w/o Pu alloy cores and which were irradiated to a fractional burnout of 55-60 percent of the plutonium atoms in the MTR as part of the GEH-3-24 test are currently under examination in the Radiometallurgical Laboratory. The examination is essentially complete except for the preparation of Fax-Film replicas which will facilitate the observation of any fuel core microstructural changes at magnifications higher than 250X. Gross dimensional changes were small.

Plans are under way to irradiate about twelve capsules with Al-Pu alloy cores (1.5-2.0 w/o Pu) and Zircaloy-3 cladding in the MTR. Four capsules, two of which will have 12 w/o Si additions, will be employed to verify and supplement the results obtained from the GEH-3-24 experiment and to furnish data on the irradiation behavior of Al-Pu alloys subjected to fractional burnout of the plutonium atoms of 60-100 percent. Four capsules will be used to evaluate the following injection casting methods: (1) vacuum type and (2) air-pressure operated or mechanically actuated type. The last four capsules are intended to establish whether or not the proposed fuel material core diameter and Zircaloy jacket inside diameter tolerances for the plutonium-bearing PRTR fuel element clusters are satisfactory or need modification. In all of the capsule tests the majority of the irradiated material will be made available for separations and reprocessing studies.

Al-Pu Alloy Clusters for KER Irradiation. The Al-Pu and Al-Si-Pu alloy cores have been selected for four-rod cluster irradiation tests in KER and assembly of the clusters is in progress. Tentative plans are to irradiate one four-rod cluster to about 25 percent fractional burnout of the plutonium atoms and follow it with another four-rod cluster to 50 percent. Successful tests on the two clusters would be followed by a seven-rod cluster irradiation test.

Plutonium Oxide Fuel Materials. Investigations of vacuum sintering of compacted pellets have been halted temporarily due to unavailability of the 30 KW induction furnace. The pellets previously sintered in vacuo to a density of 83% of theoretical have been sent to the Spectrographic Laboratory. These pieces had a metallic appearing deposit over much of the surface, undoubtedly due to a reaction between the UO_2 and the molybdenum liners which were in intimate contact with the pellets.

Mixed oxides of plutonium and uranium in an atom ratio of 1:5 have been processed and compacted into pellet form. The treatment consisted of adding a binding material (carb Wax), mixing, drying, and sieve shaking. The -20 mesh material was claimed and blended with 0.2 w/o sterotex, which functions as a lubricant during pressing. Pellets were pressed at 26 tsi to a green density of 63% of theoretical. These pieces will be sintered in a reducing atmosphere as soon as possible.

With the exception of the gas manifold, the sintering furnace piping has been completed and checked. The electrical system is complete except for the installation of the pyrometer controller-recorder. The furnace should be available for use by July 1.

Air Pressure Injection Casting. Porosity is still a major problem with air injection castings. The reason for the distinct difference in density between castings of 2S aluminum injected into stainless tubing and castings in Zircaloy-2 tubing remains unresolved. Air injection pressure was increased from 75 to 100 psig with no improvement in density and an aluminum alloy containing 8% Mg was injected into Zircaloy-2 tubing with negative results. A slight reduction of the size and number of gross voids was experienced when a Zircaloy-2 tube, vented at the end opposite the dip tube, was enclosed in a one inch steel tube which was evacuated to 29 inches of Hg, thus evacuating both the interior and exterior of the Zircaloy tube. Improved cleaning and outgassing of the Zircaloy tubing will be pursued in an attempt to overcome the porosity problem. The hydrogen content of the as-received tubing is less than 50 ppm, suggesting that this is not the source of the porosity.

Die Casting. A contract has been let to the Kux Machine Company for a development program involving die casting of Pu-Al alloy fuel elements. The program involves some fabrication of new equipment and a one-week testing period in which attempts to fill 50 stainless steel and Zircaloy tubes will be made. The final design approval and fabrication of components is expected to take approximately eight weeks.

Welding Development. Further progress has been made in maintaining a stable welding arc in a helium atmosphere without a flow of inert gas through the torch. Increased high frequency voltage was needed to initiate the arc and this required special precautions to minimize high frequency leakage. Shorter power cables and a lucite torch holder improved this condition. A rotating neoprene seal in the wall of the small vacuum welding chamber has proven to be successful. The end of the fuel rod is inserted through the seal and the chamber is evacuable with the rod either stationary or in rotation. This vacuum seal during rotation indicates that welding could be accomplished in a high vacuum with an electron beam.

Facilities. The following items of equipment for the development of plutonium fuels have been fabricated and are currently being installed: glove boxed autoclaves, canning glove box, glove boxed end preparation lathe, cryolite process and alloy remelt facility, glove box mounted extrusion press, glove boxed injection caster (prototype A), and glove boxed centerless grinder. These new facilities along with the installed oxide preparation glove box have been designed specifically to support plutonium fuels development and are based largely on knowledge obtained utilizing uranium as a stand-in for plutonium.

UO₂ Fuel Development

Fundamental Ceramic Studies. The high temperature behavior of UO₂ is being studied to decrease fuel costs by (1) lowering sintering temperatures, (2) sintering in atmospheres other than hydrogen, and (3) operating fuel elements

with cores at temperatures higher than those now employed in power reactors. Visual observation and normal time, time-lapse, and still photography of the sintering of UO_2 at temperatures up to 1800 C in a helium atmosphere and of UO_2 with additives such as Nb_2O_5 and TiO_2 , were accomplished with the filament furnace-microscope combination.

High Temperature Irradiations. The behavior of ceramic fuel materials under extreme temperature conditions is being investigated. Four test elements, the so-called "ash cans", have been irradiated, and they are being examined in Radiometallurgy. The status of these elements is as follows: (1) Element Ia. Sectioning of this element revealed extensive relocation of the UO_2 in the core. The UO_2 , which was originally in the form of a loose powder, was almost completely sintered, much of the core had operated in a molten state, and a grain structure was observed which may radically affect future fuel element design. (2) Element Ib. This element is awaiting fission gas measurement. (3) Element IIa. This element is awaiting sectioning. (4) Element IIb. This element ruptured shortly before the end of the scheduled cycle in the MTR. Sectioning of it reveals that the UO_2 sintered and moved to the top of the can, where UO_2 -Zr reaction occurred because of the poor cooling between the ends of the adjacent vertically positioned elements.

Swaged UO_2 . Two swaged, four-rod cluster fuel assemblies were designed and fabricated for irradiation in KER loops. One assembly contained enriched UO_2 , 1.6 w/o U-235, swaged in Zircaloy-2 tubing to form fuel rods 12" long x 0.625 OD. The second assembly contained natural UO_2 .

To study the irradiation stability of swaged UO_2 at long exposures, three test assemblies were delivered to the MTR for irradiation to 15,000 MWD/T under conditions in which a portion of the core will be molten. UO_2 of 2.44 w/o U-235 in U was swaged in Zircaloy to 84 percent of theoretical density. Requested heat generation is 31.6 kw/ft.

Irradiation of UO_2 in Horizontal Position. Two twelve-inch long, four-rod clusters of 92-93 percent dense sintered UO_2 pellets clad in Zircaloy-2 were fabricated and delivered to the KER-3 loop for the first known irradiation of such fuel assemblies in a horizontal position.

UO_2 Elements for Processing Studies. Sixty capsules of sintered UO_2 pellets in Zircaloy-2 tubes six inches long were assembled for chemical processing studies.

Tapering of PRTR Process Tubing. The process tubes for the PRTR are designed to have a reduced section on the lower end. The transition from the maximum OD to the minimum (approx. 4" to 2") is made by a tapered section with a gradually increasing wall thickness. Such an end section has been successfully made. The job of tapering the tube was accomplished by warm swaging over a collapsible mandrel. A section of schedule 80 steel pipe was machined to fit inside the Zircaloy-2 process tube. A shoulder was left on one end of the pipe to prevent it from sliding through the process tube. The tube and its steel mandrel were heated to 440 F in an oil bath and then swaged with a pointing die. The restraining force of the mandrel and the increased ductility of the Zircaloy-2 at 440 F were the governing factors in producing a tapered section free of cracks and severe wrinkling.

Corrosion Studies

PRP Steel Shot Test. Corrosion tests in hot softened water have been completed on five grades of steel shot proposed for the PRTR shield. None of the grades exhibited satisfactory corrosion resistance at the test conditions with softened water. During the 76-day test period, weight losses of 0.3 to 0.6 pound out of the original 15 pounds were measured. At the end of the test the shots were so rusted together it was necessary to hammer on the test section to remove the shot. A new test is now in progress using process water instead of softened water, and equipment modifications are also being made to operate two test sections with inhibitor-injection into softened water.

Zircaloy Tubing

Process Tubes. The tapering of four prototype PRTR Zircaloy process tubes on a Rock Rite tube-reducing machine was accomplished without cracking or excessive roughening of the tube wall. The eccentricity of the extruded blank caused marked eccentricity of the tapered end; however, subsequent straightening experiments were successful. Minor problems were encountered in welding a flange on the upper end of the tube. Shipment of four complete tubes is expected by mid-July.

Efforts to taper tubes fabricated by Chase Brass and Copper were stopped because of the lack of success in swaging at Fenn Manufacturing Company. Preliminary results of warm swaging experiments at HAP0 were very encouraging, and the flanged tubes will be shipped from Chase to HAP0 for tapering.

Radiometallurgy Laboratory Studies

Radiometallurgy activities during the month in support of the Plutonium Recycle Program included the examination of Al-Pu alloy capsules, and examination (except for completion of burnup analysis) of a swaged UO₂ three-rod cluster fuel element, both after irradiation in the MTR. Results and conclusions are reported in more detail in connection with the respective fuels development programs involved.

Thermal Hydraulics

PRTR Calculations. Calculations were made to determine the approximate orifice sizes for PRTR fringe flow zones. It was found that a 3/4-inch single orifice would be suitable for a 60 gpm flow. It was calculated that with such an orifice the minimum flow path pressure would be about 70 psi above the maximum allowable tube outlet saturation pressure and about 170 psi above the normal tube outlet saturation pressure.

Construction of the full-scale electrically heated mockup of the Mark II b fuel element was about 80 percent complete.

Selection was made of preliminary test sections to investigate subcooled boiling burnout for PRTR conditions. These test sections include annuli of sizes bracketing PRTR fuel element dimensions and will have heat generation in both surfaces of the annulus.

PRTR Flow Monitor Instrument Tests. Hydraulics Laboratory equipment was set up to provide a suitable differential pressure signal at 1050 psig static pressure with cold water flow through a venturi. The ΔP signal was fed to a "Panellit" and a "Bristol" flow indicator-transmitter. By use of the high speed Offner recorder, a fast acting air operated valve, and a microswitch arrangement on the valve travel indicator, the response time (to trip) was determined for the flow monitors under various conditions of initial flow and flow reduction. It was found that each flow monitor had a response time of 0.6 to 0.7 second for a 40 percent flow reduction, starting with the flow monitors reading 100 percent initially and having the trip point set at 75 percent of the full scale reading. The original PRTR specifications call for this response time to be 0.3 second or less.

Mechanical Equipment Development

Design Test PR-20-Calandria Characteristics. Dump tests following the extensive modifications to the dump chamber in May gave unsatisfactory results. The second major modification is now 75% completed.

Design Test PR-24-Shroud Tube Bellows. After two months the two bellows being corrosion tested in steam still do not show signs of failure that were noted previously. The simulated bellows with cast aluminum ends had a satisfactorily low leakage rate and a corrosion test has begun. Bellows for testing were received from Parts Engineering Company and Master Products Company.

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

Design Test PR-50-Reactor Piping Seal Testing. The flared process tube inlet fitting was equipped with leak collectors to monitor leakage and was installed on Elmo-7. The fitting failed and was removed after 175 thermal cycles. Leakage was 155 ml/hr on the split ring end and 235 ml/hr on the screwed end. The welded tubing was thought to be the reason for this leakage.

The flanged process tube inlet fitting utilizing a solid "O" ring has undergone 270 thermal cycles without noticeable leakage. The same flanged joint utilizing a flexitallic gasket has been installed for thermal cycling. Gas leakage tests will be conducted during thermal cycling.

Nozzle cap "A" was refitted with two flexitallic gaskets following the failure of the "skinner" seal. One flexitallic was leaking considerably after 304 cycles and was replaced. After a total of 332 cycles, leakage was 20 ml/hr on the original gasket and six ml/hr on the replacement. The leakages after 537 cycles with temperature held at 550 F were 55 ml/hr and 10 ml/hr, respectively. Testing is continuing with new gaskets.

Process tube assembly "A" has been thermocycled 270 times between 535 and 135 F. Excessive leakage was evident after 140 cycles; however, after disassembly and cleaning, all joints resealed and are holding well. Portions of process tube assembly "B" have been received from Marman "Conoseal" Company.

Design Test PR-51-Reactor Piping Structural Integrity. The simulated inlet jumper was reinstalled with 5/16" initial stretch tension following the 30,000-cycle testing in the non-stressed installation. During 37,500 cycles (1" vertical to 1/2" horizontal travel) in this position, no permanent deformation was evident. A 600-amp arc welder was attached to the jumper for heating; however, the maximum temperature obtained was 225 F.

A jig table has been constructed to check the shape of the inlet and outlet jumpers. All the inlet jumpers have been fabricated but will require modifications due to print revisions.

Design Test PR-63-Process Channel Leak Detection Facility. The facility was completely torn down to repair leaks in the shroud tube, which made deliberate leaks undetectable during hot operation. Three cracked welds were found at leak injection points, and one pinhole was found through the shroud tube.

Single Tube Prototype Facility. Construction of the facility was approximately 76% physically completed.

PRTR Inlet Valves. Pressure drop tests through the valves were satisfactory. At 123 gpm, cold, the pressure drop was 3.4 psi through the 2" Hammel-Dahl valve with 1-1/2" weld ends. The 1-1/2" Powell valve had a drop of 7.7 psi at identical conditions. The stems were covered with collectors to monitor leakage at operating conditions.

Test Shaft. Construction of a test shaft, 7' x 7' x 10' deep, is approximately 75% complete. The thermocycling facility and the tube rupture facility are being moved to this new location.

Tube Rupture Facility. Four pieces of B-D-F Zircaloy-2 tubing have been annealed and flared, and are ready for burst testing when the facility is ready for use again in the new location.

PRTR Instrumentation

Testing of the two 0-25 psi flow transmitters for PRTR was continued this month. This portion of the test program is about 90% complete. Testing of the resistance temperature detectors was interrupted due to equipment difficulties. Additional test equipment has been obtained and the tests have been resumed.

PRTR Design Development

Design and Construction Schedule for PRTR. The Phase I PRTR contract is estimated to be 3.6% completed as compared to 5% scheduled. Excavation for the containment shell and service area, and the concrete work pad and pedestal (pour number one), were completed.

The Phase II PRTR contract was awarded to the Hoffman Construction Company by AEC-H00.

The Phase III PRTR design is estimated at 80% completed. Total design is estimated at 85% completed.

Reactor Piping. Purchase requisitions for the ring headers, inlet valves, and process tubes were approved and are issued. Outlet nozzle revisions are in progress. Revisions are being made to the inlet gas seal to facilitate process tube installation.

Core Components. The calandria, top and bottom shield, and moderator storage tank drawings were revised to decrease moderator dump time, to facilitate construction of the calandria and to add certain new items to calandria and shield fabrication package. These revisions will not be incorporated in the original bid but will be negotiated with the successful bidder in order to forestall extending the bidding period.

Process Piping. All bids received for the steam generator blowdown flash tank were rejected, and the specifications were rewritten to conform with the special provisions of the State of Washington code for flash tanks.

Invitations to bid on the reflector, moderator, and primary coolant purification heat exchangers were released during the month. An order was placed for the steam generator.

Bids for boiler feedwater deaerating equipment were received for analysis. As a consequence of widespread substitution of undersized types of auxiliary devices, failure to include sufficient information to permit satisfactory evaluation of bids, and a general misunderstanding concerning the dew point requirement for vent condenser off-gas, all bids were rejected and new invitations were released.

Instrumentation and Control. The PRTR containment philosophy was reviewed and finalized during the month. The system is currently being designed to have the following features:

- (1) High activity level in the building air, or significant increases in building air pressure, will scram the reactor and close the ventilation containment valves.
- (2) Very high activity levels in the reactor coolant effluent will scram the reactor, close the ventilation containment valves, and, after a 20-second delay, will close all containment valves including the process effluent valves. Blowoff steam from the steam drum safety valves will be vented within the building when under containment conditions. The 20-second delay in process containment valve closure is provided to permit decay of reactor thermal power, avoiding release of excessive quantities of steam into the reactor hall.
- (3) Two manual containment trip buttons will be provided to initiate "ventilation containment" and "total containment" trips as per (1) and (2).

Prototype limit switches for the PRTR shim control assemblies are being irradiated in the gamma test facility. Other components of the shim control assemblies will be tested in a like manner as they are received.

Invitations for expressions of interest in the PRTR automatic controller contract were sent out.

Analysis of control system analog studies made in May has been completed. The information obtained from the analog studies was inadequate to describe sufficiently the system dynamics. The difficulty of obtaining sufficient machine accuracy and reproducibility for the purposes of the problem was the chief reason for the poor analog results. However, the information available will serve as a check on that obtained by other methods.

Difficulty is being encountered in obtaining an accurate flow element for the PRTR power calculator because of the short length of pipe which is available for flow element installation. The power calculator system as planned employs a Dall tube. Inquiries are being made concerning the performance of Dall tubes in similar environs to determine the degree of accuracy obtainable, currently estimated from 1 to 6%. Consideration is also being given to the possibility of summing the individual tube flows to obtain a signal for the power calculator.

Helium Gas System. No bids were received on helium heat exchangers HX-6 and HX-7. It was discovered that a non-standard fin thickness was specified. The fin thickness will be changed, and further attempts to obtain bidders will be made on a rebid.

Heavy Water Leakage Recovery System. It has been determined that two 1200 cfm centrifugal blowers of sufficient head capacity can be purchased at less cost than two 600 cfm rotary positive compressors. The piping arrangement is being designed on the basis of centrifugal compressors.

Fueling Vehicle. Design of the fueling vehicle is estimated by General Mills to be 25% complete.

Fuel Element Examination Facility. The scope document (HW-56367) describing the facility was issued for comment. Scope drawings of the 5-X and wide angle viewers were completed. A mockup of the 5-X viewer was built and tested in the optical shop.

PRTR Physics

Calculations of critical loading configurations using the three-group VALPROD IBM-650 code are continuing. In addition to the H₂O reflector results reported last month with fresh plutonium loadings, cases with a D₂O reflector and with plutonium depleted in Pu-239 by 50% have also been investigated. A summary of results obtained to the present time is given in the following table:

Reflector	% Burnout Pu-239	No. Tubes Spike	No. Tubes UO ₂	UO ₂ Position cm	Spike Position cm	k _{eff}
D ₂ O	0	24	61	0 -83.3	83.3-98.3	1.059
D ₂ O	0	18	67	0 -64.9 79.1-98.3	64.9-79.1	1.064
D ₂ O	0	12	73	0 -46.5 59.4-98.4	46.5-59.4	1.060
H ₂ O	50	66	19	0 -46.5	46.5-98.3	1.041
D ₂ O	50	55	30	0 -58.44	58.44-98.3	1.065

The power distributions associated with these loadings is not in all cases acceptable due to the requirement of an effective k greater than unity to allow for poison and burnout. This will be refined at a later date by including poison cross sections in the code. Plutonium depleted in Pu-239 by 25% is currently being studied.

Supercritical Pressure Reactor Physics. A reactor which would serve as a heat source for a supercritical pressure steam-electric generating plant is being conceptually designed. The reactor has been sized as a 300 MW unit (supplying steam to a plant similar to the Philo number 6 supercritical unit) employing a heavy water moderator, a light water coolant, and an internally cooled only (12 channels) uranium dioxide fuel element. The reactor is comprised of 300 10-foot long fuel elements arranged on an 8-inch square lattice. The demands of the supercritical steam turbine are 675,000 lbs per hour of steam at 4500 psi and 1150 F with two subsequent reheats. The generating unit driven by this turbine nets 120 MW of electrical power. Steam is reheated in two stages: the first to 1050 F and 1150 psi, and the second to 1000 F at 180 psi. These conditions are met by passing the primary coolant through the reactor in a four-pass arrangement in which the first two passes bring the feed water to temperature and the additional two provide heat to the two reheat heat exchangers.

Physics calculations to support the conceptual design of this reactor have been completed. Thermal utilization and thermal diffusion area were calculated by the P-3 method. Resonance escape probability and fast effect were calculated by conventional methods using the resonance integral data of Hellstrand and fast cross sections from Chalk River calculations for UO_2 . Reactor parameters obtained for the eight-inch square D_2O lattice are as follows:

Thermal Utilization	0.829
Resonance Escape Probability	0.903
Fast Effect	1.020
Thermal Diffusion Area	112.0 cm ²
Slowing Down Area	133.0 cm ²
Geometric Buckling	224×10^{-6} cm ⁻²
Total Non-Leakage Probability	0.947

A total excess reactivity allowance of 0.075 was estimated to allow for saturable poison, fuel temperature coefficient and burnout. Exposure calculations were carried out for enrichments ranging from natural to two percent U-235 assuming uniform graded irradiation for both plutonium recycle and single pass fuel cycles.

Plutonium Fabrication Pilot Plant

Phase II Design. Minor revisions to the Phase II design were made for inclusion in an addendum to the bid invitation. Shielding walls for the radiography room and revisions to the darkroom were included.

Functional specifications and special conditions for the door alarm system were prepared.

The necessity for backflow prevention in the main building exhaust system and in the hood exhaust system is being considered. It appears that the system is reasonably free from danger of low-pressure gas explosions and that protection against high pressure gas explosions is impractical, because so much other damage would be incurred that protection against backflow would be of little significance.

Phase III Design is approximately 20% completed.

Scope interpretations for the oxide fuel element line are complete except for the hydrogen sintering furnaces and the coolant system for the finishing line, where a criticality problem exists.

Design specifications have been prepared for the horizontal and vertical hydrogen sintering furnace design-development contracts.

Value analysis studies being conducted in collaboration with Purchasing should bring about a substantial reduction in costs of gloveports and inner retainer glovebands.

Gas Cooled Power Reactor Program

Graphite Studies. Work was started on the capsule irradiation experiments designed to study the CO₂-graphite reaction in the pressure range of interest for gas cooled reactors (100 to 400 psi). The container material for the capsule experiments must not react with carbon dioxide and graphite up to 600 C. Quartz has been selected for the initial irradiation because it becomes only slightly radioactive, and hence facilitates post-irradiation handling. The effect of radiation damage on quartz strength is not well known and the first tests will evaluate the use of quartz for this purpose. Two types of quartz containers having different break seals have been fabricated. A vacuum line is being constructed which will allow the addition of a known amount of liquid CO₂ to a weighed graphite sample. The quartz ampoules will be positioned in a graphite bar and irradiated in a hot test hole for one month. The quartz containers will be examined and if they have not failed, gas analyses will be performed. Also, the loss in weight and other changes in the graphite will be determined. The initial irradiation is scheduled for charging during July.

At the request of the Atomic Energy Commission the factors affecting the rate of reaction of carbon dioxide with graphite have been reviewed. Their application to the CO₂-cooled, partially enriched, prototype reactor proposed by Kaiser Engineers and ACF Industries has been reported in HW-56362, "Gas Cooled Power Reactor Coolant Choice."

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HW-56640

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATION

MONTHLY REPORT

JUNE 1958

FISSIONABLE MATERIALS - 2000 PROGRAM

METALLURGY

The study of water-flooded arrays of 0.95 percent enriched uranium fuel elements encased in iron pipe was completed. Results are reported in HW-56423, "Nuclear Safety of Iron Encased Fuel Elements."

Nuclear safety problems in handling plutonium shapes were evaluated for Plutonium Metallurgy. The results are reported in HW-56514, "Pu Metal Storage in Refrigerators of Vault A - 231 Building."

REACTOR

STUDIES RELATED TO PRESENT PRODUCTION REACTORS

Data analysis continued on the temperature coefficient of natural and simulated 1000 MWD/T and 2000 MWD/T uranium in a graphite lattice. Pu and U²³⁵ detector pins used in this series of experiments were normalized by measuring their induced activities following a standard neutron irradiation in the PCTR.

A feasibility study was begun to determine the incentives in a program for measuring the temperature coefficients of resonance integrals. The measurements would be made on uranium metal and uranium oxide and would be made as a function of the surface-to-mass ratio of the fuel elements.

Foil normalization was completed on the "neutron temperature" experiment and the actual experiment was begun. One irradiation was made at room temperature in the TTR thermal column.

Another feasibility study was started to determine the advisability of additional neutron thermalization experiments. Interest in such experiments was stimulated by conception of an alternate theoretical treatment of the neutron flux problem in the vicinity of a temperature discontinuity. The conception is to use a two-group analysis where the groups are two maxwellian distributions characterized by the temperatures on either side of the discontinuity.

Machine calculations are in progress on the two prior approaches to the above problem.

STUDIES RELATED TO FUTURE PRODUCTION REACTORS

Buckling measurements continued on seven rod clusters of 0.5-inch-diameter natural uranium rods. Measurements were made on 7 3/16-inch and 10 3/8-inch graphite lattices. This brings the total number of lattice spacings completed to four. All four wet buckling values are negative, showing that enrichment

will be required for reactors built with these geometries.

Enriched uranium-aluminum alloy was obtained to use in developing a technique for measuring k_{∞} in the PCTR when k_{∞} is less than one.

Experimental data from horizontal flux traverses of three small exponential piles were analyzed to determine the extrapolation length for each pile. The preliminary results gave a discouraging spread from 1.16 inches to 1.69 inches. The source of this large spread in values is not understood. Previous work had indicated that an extrapolation length of 1.66 inches is needed to make small pile and large pile buckling measurements agree.

A set of linear differential equations relating isotopic concentrations in a fuel rod to flux and time are being programmed for the new Litton Computer.

Instrumentation

The investigation continued on the magnetic core storage elements. The concepts of addressing the storage elements were reviewed and printed circuits were developed.

STUDIES RELATED TO SEPARATIONS PLANTS

Subcritical multiplication measurements were made on 1.6 percent enriched I. and E. uranium rods in water. Two lattice spacings were used. Both wet core and dry core critical approaches were made on one lattice spacing. From these data, a prediction was made of the critical mass for each of three cases. These predictions agreed with critical mass estimates derived from exponential-type measurements within five percent. Experimental errors are about this large. This work was done as a warm-up for similar experiments using three percent enriched uranium rods.

Absorption cross section measurements on B_4C impregnated polyethylene were made in the PCTR. This material will be used in k_{∞} measurements on three percent enriched UO_3-H_2O systems.

Analysis was completed on buckling data taken with random arrays of 1.0 percent and 1.44 percent enriched fuel elements. The average values for the measured bucklings are less for the random arrays than for corresponding uniform arrays. However, the experimental errors are so large as to make it impossible to declare that this is a fact. Further random array experiments will be done by the critical mass group at ORNL to obtain more accurate critical mass predictions for random arrays.

Preliminary cost estimates were prepared by CEO personnel on more conventional critical mass laboratory designs. For Phase I costs are comparable. For Phase I plus Phase II, conventional construction is about ten percent cheaper.

A nuclear safety review was made of fire protection methods planned for the 234-5 Building. The current plans involve the use of water sprays. This appears unwise because very few, if any, of the vessels in Recuplex are safe with water reflection. Similar problems occur elsewhere in the building.

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HW-56640

Bases for nuclear safety specifications in Purex were reviewed in the light of process changes which have occurred since the safety specifications were written.

Work continued on modifying apparatus to be used in a second neutron age experiment. New indium neutron detector foils were fabricated and calibrated. Counting chambers have been improved. The tank and shielding have been reinstalled in the 325 Building basement.

Mechanical portions of the mass spectrometer are being assembled in Room 4-A of the 326 Building. Most of the basic instrumentation is now complete and installed.

REACTOR DEVELOPMENT - 4000 PROGRAM

PLUTONIUM RECYCLE PROGRAM

Analysis continued on PCTR data taken to measure k_{∞} and f for 19-rod UO_2 and 16 UO_2 - 3 Pu Al rod clusters in a nine-inch spacing heavy-water lattice.

A report is being written covering recent work on resonance escape calculations. This calculation is based on an analysis of eighteen resolved neutron cross section resonances in U^{238} .

Work continued on the formulation of resonance escape probability for an infinite lattice of supercells. An analytic expression was obtained for the relative number of fissions occurring in the elements of different materials in the lattice.

Continuation of the work on improved methods for calculating neutron flow in lattices has resulted in the development of a method for correcting simple diffusion theory which is much less complex than previous methods. The range of general applicability of the method is being explored.

Instrumentation

Scope drawings were prepared on the wide angle and 5X viewers for the PRTR fuel examination cell. In the course of preparing the drawings, many of the construction details were worked out.

GAS COOLED REACTOR STUDY

Preliminary calculations of the corrections to the PCTR data necessary to obtain k_{∞} and f for the exact prototype lattice have been made. The corrections appear to be small. A study was begun on the problem of how to measure control rod strengths.

CROSS SECTION MEASUREMENTS PROGRAM

Low resolution data on subthreshold fission of Np^{237} and Am^{241} were analyzed. There are no significant differences between the final numbers and those reported as preliminary. The DR spectrometer was modified for a higher resolution study of the resonances in the e.v. region.

A replacement neutron beam shutter was installed on the KE neutron spectrometer. This shutter, like the first one, is unsatisfactory and cannot be operated as planned. The KE spectrometer was used in its present condition to make further studies on the reflection characteristics of the two new beryllium crystals.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

Field measurements of the transport and diffusion of materials emanating from the 100 Areas and moving across the Wahluke Slope were continued. Another field experiment was completed on June 9th when the source was placed about 3.5 miles northwest of the Hanford Ferry landing and airborne concentrations near ground level were measured on both sides of the river. The purpose of the test was to determine whether the tracer material would tend to follow the river downstream or would rise over the bluffs across the river. The atmosphere was very unstable and the wind light and variable at the generator site. Results indicated clearly that the major portion of the tracer material crossed the river and ascended the bluffs, with only a small portion traveling downstream. Values of the dilution ratio were quite variable along the roadway along the east bank of the river, ranging from the detection limit up to 5×10^{-9} sec/m³, depending somewhat on the distance from the generation site. Values on the west side of the river ranged up to 2×10^{-10} sec/m³, whereas values up to 3.5×10^{-9} were observed at this same distance on the east side of the river. Plans were made to repeat this experiment during a period of strong atmospheric stability.

Plans and arrangements were completed for comparative measurements of the vertical transfer of mass, momentum, water vapor, and sensible heat at the University of Washington's Friday Harbor Laboratories.

Vertical profiles of tracer material over water and at several distances from a continuous point source are to be measured. From these data and simultaneous measurements made by University of Washington personnel, direct comparison of vertical transfer coefficients over a uniform and simple surface is to be made. The data are basic to our studies of deposition phenomena.

Two experiments designed to measure particle erosion and translocation were successfully completed during the month. These experiments were conducted at a site near the Meteorology Tower, using the Portable Mast equipment. Dust loading and the temperature and wind stratification up to 40 feet above the ground were measured. The first experiment was conducted during low wind speed conditions and should provide a "background" measurement of natural dust during relatively non-erodible conditions. The second experiment was conducted during a period of relatively high wind speed, averaging greater than 15 mph at 7 feet above ground. Summarization of the data, although not complete, indicates that the dust loading was much higher during the second test. Analyses of the data were in progress at month end.

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HW-56640

DOSIMETRY

Bioassay data obtained on a patient showed about 30 mg of uranium in his lungs while counting methods on the same day showed less than nine mg of uranium in the lungs and less than three mg of uranium in the kidneys. The reason for this disagreement is being investigated.

A second patient who had a specimen of flesh removed from his finger to remove plutonium contamination showed about .0014 μ c of plutonium remaining in the finger. Measurements on the removed piece of flesh showed an activity of about .001 μ c.

The errors in the measurements of w were investigated and turned out to be about 1% for each gas measured. The results expressed in ev/ion pair are: argon, 26.3; nitrogen, 36.7; carbon dioxide, 34.5; air, 35.3; tissue-equivalent gas, 30.1.

The annual maintenance which was performed on the positive ion accelerator revealed only minor troubles. When the .002-inch thick tantalum strips were replaced in the background suppressors, it was found as has been suspected, that the formation of carbon deposits which have been such a troublesome source of neutron background in the past was almost completely inhibited by the heat generated in the strips by the beam bombardment.

INSTRUMENTATION

The transistorized circuitry for the combined alpha-beta-gamma Hand and Shoe Counter is being fabricated. This instrument which is to be of the scintillation transistorized type, can replace the present Four-Folds and Five-Folds in one instrument one-half the size of a Five-Fold.

The vacuum tube model alpha-beta-gamma combined Hand and Shoe Counter is still working satisfactorily in general use in the 329 Bldg. It has now worked continually for four and a half months with a total downtime of 15 minutes for recalibration purposes.

A light-beam method for proximity detection for the Robot Monitor is being investigated. This system would provide a pulsed light transmitting source and a photocell or phototube receiver to indicate object nearness.

Three new scintillation gamma dose-rate meters are being fabricated for field evaluation and demonstration. These have already been laboratory evaluated. The two portable slow and fast neutron scintillation detectors and dose-rate meters are being field demonstrated and tested. Laboratory evaluation tests have been successfully completed. This instrument can be used as a replacement for both the BF_3 thermal and slow neutron detector and the "Neut" fast neutron two-chamber detector.

The experimental sensitive alpha air monitoring system worked successfully during the month after installation of a modified amplifier and multivibrator circuit. The instrument will alarm on a 60 mpc level of airborne plutonium in 20 minutes. Fabrication is progressing on a model for use by Biology Operation.

A small lead cave has been set up for neutron foil activation studies and experiments. Investigations are being continued to find a good scintillation detector which is not neutron sensitive for use in reading the foils once activated. Various detectors and isotopes are being studied with the idea of developing new detector types.

A manual was completed on the adjustment and calibration procedures for the Radiotelemetering Data Stations. The prototype remote data station was returned to the fabricator in Seattle with recommended changes and modifications. A new electrometer tube was chosen and tested for the Radiation Integrator portion of the data station. Battery tests are being conducted during the development of a new lower drain battery regulator for the data station battery.

Two modified transistor count-rate meter circuits were developed. One is for portable instrument use and one for use in driving recorders with 1.0 milliamperes driving coils. Both use a single battery supply.

Development work was started on a portable battery-operated Dose-Rate Integrator for field usage. The device will be completely transistorized for long battery life, and greater reliability. The device will indicate dose received by an individual if the dose rate is known.

The zinc sulfide particle detector for the Atmospheric Physics Operation has been in successful operation for about one month.

A Fish Scanner demonstration unit was set up for the Biology Operation. The Fish Scanner will determine the location and energy of various radioisotopes within the fish's body. The principal problem is to keep the fish alive and motionless during the scanning with as little water shielding as possible. The device is principally for P^{32} , Sr^{90} , Ru^{103} , Ru^{106} and Ru^{239} radioisotopes.

The testing and investigation of methods of using film for photographing oscilloscope tracings for pulse-height analysis was completed. None of the films tested proved to be too successful for such work. Because of the poor films, the resolution abilities of the film were not good enough for good, pulse-height analysis work.

Evaluation testing was continued on the portable scintillation gamma energy analyzers along with simultaneous field testing.

Further testing was completed on the DuPont-developed air monitor for air-borne particulate radioisotopes.

Tests were completed on the new commercial alkaline-type batteries for replacement of the older zinc cell types. The cost per unit amount of energy is about the same.

The commercial RCL large gas-tube-type slow and fast neutron detectors were evaluated. Medium sensitivity for fast neutrons and a poor metering readout were two factors.

Test procedures for the German-built pocket size dose alarms were devised. Many of these alarms are to be purchased.

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HW-56640

WASHINGTON DESIGNATED PROGRAMS

Final assembly of the mass spectrometer for this program is in process in the mass spectrometer laboratory, Room 4-A, 326 Building.

CUSTOMER WORK

Analog Computing

The major portion of computer time for the month was spent on the Slug Heat Transfer Program for IPD.

An initial study of a new type pressure control for glove hoods was completed on the analog computer.

A desk top digital differential analyzer has been received and is being set up.

Weather Forecasting and Meteorology Service

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	90	83.7
24-Hour General	60	82.2
Special	135	89.6

The past month was the second warmest June of record in the Hanford Area. The temperature average of 73.9 has been exceeded in June only by the 75.4 average of 1922.

June precipitation totaled 0.81 inch, which was 0.16 inch above normal. This was the sixth consecutive month of above normal precipitation and brought the total for the year thus far to 5.89 inches.

Analyses of data taken in studies of the problem of oxides of nitrogen in the vicinity of the 321 Building, resulting from calciner operation, were completed. Alternate recommendations were made for alleviating this condition as follows:

1. Reduce production of the oxides of nitrogen at the source.
2. Clean up off-gases to an emission rate of less than one pound per hour.
3. Increase the stack height to 80 feet or higher for release of the effluent at the measured rate of 10 pounds per hour.

It was further recommended that the emission rate from the dissolver vent should be determined and these results compared with the environmental measurements from the calciner study to determine whether the dissolver off-gas may also be a nuisance.

Instrumentation

Fabrication continued on a dual alpha air monitor of the scintillation type for use at Purex. The instrument employs two high-level alpha air monitors with a differential indication for better sensitivity.

Fabrication work is continuing on a sensitive alpha air monitor for use at the Biology Operation. The instrument will be similar to the experimental one which has been in use successfully for several months now.

The fabrication of the transistorized circuitry for a very large crystal and phototube monitoring system was partly completed. The device will be for the Regional Monitoring Operation and it will provide highly reliable counting in a very small and efficient instrument.

The single probe alpha-beta-gamma detection and aural-indicating instrument has been successfully used at the Calibrations Operation for the past month. One loud speaker indicates alpha particles detected and the second speaker, with different tone qualities, indicates beta-gamma contamination detected.

Optical Service

Trips have been made about twice a week to inspect the installation of periscopes on the second remote crane at Purex. Assistance was given in the design of mounting brackets for the periscope motors. The location and mounting of four relay periscopes was made more clear by the addition of dimensions to existing drawings.

The routine Optical Shop work included the repair of 105-H and 105-B Underwater Viewers, two crane periscope heads at Redox, and three borescopes for the IPD Irradiation Testing Operation; and the fabrication of a weld-bead inspection device for the FPD Quality Control Engineering Operation, of filters for an incline photometer for the Electronics Fabrication Operation, and of two lamp sections for the small Lenox borescopes.

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
Harold Thompson	6/4	Beckman & Whitley San Carlos, Calif.	Discuss meteorological instrumentation.	GR Hilst	No	200-W: 622
R. L. Waterfield	6/4	U. S. AEC Washington, D. C.	Discuss diffusion and transport studies.	GR Hilst JJ Fuquay	No	200-W: 622
Dr. H. Claus	6/4-5	U. S. AEC Washington, D. C.	Discuss Radiological Physics & Instruments.	WC Roesch RA Harvey	No	300: 329
G. H. Daly	6/5	U. S. AEC Savannah River, Ga.	Discuss meteorological factors in waste disposal.	GR Hilst JJ Fuquay	No	200-W: 622
D. H. Pack	6/5	U. S. Weather Bureau Washington, D. C.	Discuss meteorological studies of diffusion and deposition.	GR Hilst JJ Fuquay	No	200-W: 622
Frank Feiner	6/9-10	Knolls Atomic Power Laboratory Schenectady, N. Y.	Discuss plutonium re-cycle program and reactor lattice work.	JE Faulkner RE Heineman BR Leonard	Yes	300: 303 100: 105-DR 105-KE
Iver Linstrom	6/13	University of Oregon Eugene, Oregon	Discuss job opportunities.	RA Harvey	No	300: 329
N. E. Meyers	6/16	Mass. Inst. of Tech. Cambridge, Mass.	Discuss job opportunities.	RA Harvey	No	300: 329
Norman Wagner	6/16	University of Texas Austin, Texas	Discuss meteorological instrumentation and data processing.	GR Hilst JJ Fuquay GE Driver	No	200-W: 622
J. A. Harvey	6/23-24	Oak Ridge National Laboratory Oak Ridge, Tenn.	Discuss neutron cross sections.	BR Leonard	Yes	300: 303 100: 105-DR 105-KE

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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
J. L. Powell	6/23-27	University of Oregon Eugene, Oregon	Consultation.	JE Faulkner	Yes	300: 303 100: 105-KE
D. D. Porter	6/23-7/1	Goodyear Aircraft Corp. Akron, Ohio	Service Analog Computer	AE Tucker	No	300: 326

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
C. R. Lagergren	6/2	Knolls Atomic Power Lab. Schenectady, N.Y.	Discuss mass spectrometer instrumentation.	TL Collins	Yes
	6/3-6	American Society for Testing Mat'ls Committee E-14 New Orleans, La.	Attend meeting on mass spectrometry.	--	No
R. A. Bennett R. E. Heineman	6/2-5	American Nuclear Society Meeting Los Angeles, Calif.	Present a paper.	--	No
E. D. Clayton N. Ketzlach	6/5	Dow Chemical Co. Rocky Flats, Colo.	Discuss critical mass experiments.	CL Schuske	Yes
R. E. Heineman E. D. Clayton R. A. Bennett N. Ketzlach	6/6	Vallecitos Atomic Laboratory Pleasanton, Calif.	Attend Nuclear Safety Conference.	--	No
E. D. Clayton N. Ketzlach J. A. Berberet	6/9	Livermore Radiation Laboratory Livermore, Calif.	Discuss critical mass experiments.	J. Carothers	Yes

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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
A. E. Tucker	6/9-12	Litton Industries Culver City, Calif.	Discuss operation of Digital Differential Analyzer.	Rudy Rutishauser	No
E. D. Clayton J. A. Berberet H. E. Handler	6/12	Goodyear Aircraft Corp. Los Angeles, Calif.	Discuss Analog Computer operation.	John Herrel	No
	6/10	Atomics International Canoga Park, Calif.	Discuss KEMB experiments and analysis of reactor measurements.	M. Remley	Yes
J. J. Fuquay	6/13-14	University of Washington Friday Harbor Laboratory Friday Harbor, Wash.	Arrange for joint experiments in July.	RG Fleagle	No
I. T. Myers	6/17-27	American Physical Society Ithaca, N. Y. Mass. Institute of Tech. Cambridge, Mass. Nat'l Bureau of Standards Washington, D. C.	Present paper. Discuss calorimetry. Discuss calorimetry.	Members JL Bear HH Seleger A Schwebel B Zendle HO Wyckoff	No No No
B. R. Leonard	6/18-19	University of California Radiation Laboratory Livermore, California	Attend Neutron Cross Section Advisory Group Meeting.	Jacob Benveniste	Yes

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Chemical Research & Development

ORGANIZATION AND PERSONNEL

H. T. Blaine, Engineer, was transferred in from Relations and Utilities and assigned to Chemical Development Operation.

K. J. Schneider, Engineer I, was transferred in from Chemical Processing Department and assigned to Chemical Development Operation.

J. R. Grundvig of the University of Utah was hired as a summer employee and assigned to the Chemical Development Operation.

J. L. Carroll, Chemist I, was hired as a summer employee and assigned to the Chemical Research Operation.

R. K. Henrich, Science Instructor in the Richland schools, was hired as a summer employee and assigned to the Chemical Research Operation.

Professor H. Freund of Oregon State College, was hired as a summer employee and assigned to the Chemical Research Operation.

R. D. DeWitt, Engineer II, who has been assigned to Chemical Development Operation terminated.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Decontamination of Carbon Steel Reactor Components

The dissolution of UO_2 by solutions compatible with carbon steel is under study as a part of the general problem of decontaminating mild steel reactor components. Uranium dioxide used was prepared (Corrosion and Coatings Operation) by contacting metallic uranium with water at 350 C (autoclave). Dilute (0.05 M) $NaCO_3$ - $NaHCO_3$ solutions containing hydrogen peroxide dissolve the finer particles (-325 mesh) of this oxide rapidly. Complete dissolution of the larger particles (16-325 mesh) was not obtained in two hours contact time. Analyses showed the larger particles contained appreciable (1 to 15 per cent) Al_2O_3 which may account for their failure to dissolve. The peroxide is decomposed rapidly when the solution is in contact with mild steel surfaces; continuous addition of peroxide would probably be required in actual use.

A stainless steel pressure vessel in which to prepare UO_2 by contact of U metal with hot (ca. 300 C) water has been constructed. Uranium dioxide prepared at 260 C was finely divided (minimum settling rate in water ca. 0.5 inch/hr.) and adhered readily to oxide coatings on mild steel. Arrangements are in progress to have some of the dioxide irradiated in a reactor for use in fission product decontamination studies.

Automatic Analyzing Monitor

Data obtained with the Analyzing Monitor under development to provide automatic recording of the primary isotopes in reactor effluent, showed a uniform progressive decrease in the P^{32} concentration over a two day period. This information suggests that short-term fluctuations in certain isotopes may be significant yet overlooked in the present infrequent laboratory determinations. Other isotopes appeared to have only random fluctuations during the same period, although further definition of point-to-point reproducibility in these isotope concentrations must be made before accurate short-term fluctuations are established. The use of commercial single channel analyzers was resorted to for replacing the built-up discriminator circuits to achieve greater channel stability. Calibrations with pure separated isotopes proceeded.

Reactor Decontamination

Analytical results of samples on spent Turco 4306-B cleaning solution used for test decontamination of individual tubes of the K Reactors were examined for possible means of disposal. Due to the large amount of radioactive material involved, the extensiveness of IPD's decontamination plans, and the river flow being past the maximum, it appears that these wastes will have to be discharged to a crib or trench. The benefits gained by the filtering action of the soil and the increase in detention time will minimize increases of radioisotope concentrations in the river. A laboratory study was started to obtain data which will permit more quantitative estimations.

Uranium Oxidation Experiments

The laboratory investigation of the oxidation of uranium in air was continued. The oxidation rate versus temperature curve was extended to 1120 C. The effect of specimen size was investigated and found to be inconsequential for short periods of time, but larger samples required longer times for complete oxidation. With 11.5 gram samples, the oxidation proceeded in a parabolic manner for 20-25 minutes at 780 C, then became linear until the specimen was entirely oxidized. Oxidation rates in air at temperatures up to 1400 C will be measured next after which an investigation of oxidation in steam atmospheres will be started.

Analytical Service

Fuel burnup analysis is complicated by Cs^{136} (13 day half life) when short cooling is involved. For 33-day cooled material nominal Cs^{137} activity was found actually to contain a few per cent Cs^{136} .

The emission spectrographic is proving useful for measuring arsenic and phosphorous in reactor effluent cooling water. Detection limit is one part per billion and precision, one half part per billion.

Plutonium is being routinely assayed in plutonium-aluminum fuel alloy. Controlled potential coulometric titration is used. The 2 - 8 per cent plutonium content is

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being established with an error of less than one part in 200 - often with only 40 milligrams of available alloy. Coulometry appears quite versatile. For example, it also is useful for measuring iron in highly radioactive liquid materials. As little as 20 micrograms of iron is required to limit error to 0.5 per cent. Unlimited uranium may be present. Personnel exposure is much less than that from measuring iron with o-phenanthroline.

SEPARATIONS PROCESSES

Feed Preparation

Dissolution of Dingt Metal

Laboratory-scale tests indicate that, for dissolution to 100 per cent heel and 0 M HNO_3 , the presence of either 0.005 M $(\text{NH}_4)_2\text{SiF}_6$ or 0.02 M H_3PO_4 increases the dissolution rate of dingt metal such that the total dissolution time is slightly less than that for ingot metal without an additive. For dissolution to zero heel, 0.01 M $(\text{NH}_4)_2\text{SiF}_6$ was required to produce the same decrease in total dissolution time for dingt metal. To date, the effect of most of the common inorganic anions, as well as several organic acids, on the dissolution rate of dingt metal has been surveyed in instantaneous dissolution rate studies. Only sulfate, sulfite, pyrosulfate, phosphate, phosphite and fluosilicate have produced promising increases in the dissolution rate.

Preliminary data indicate a corrosion rate of about four mils/mo. for non-sensitized 304-L stainless steel in boiling 6 M HNO_3 -0.5 M UNH -0.01 M $(\text{NH}_4)_2\text{SiF}_6$.

The presence of silicon, iron, or nickel as an impurity in dingt metal increases its rate of dissolution in 8 M HNO_3 . On a weight basis, silicon is the most effective. Chromium appears to decrease the dissolution rate.

Solvent Extraction

"Sandwich" C-Column Cartridges. Additional experimental testing of variations of "sandwich" cartridges has continued in an effort to develop a cartridge which will retain high efficiency with a large rangeability in capacity. Column performance with a top interface and a one-inch pulse amplitude showed marginal capacity superiority for the "sandwiches" as compared to a standard plant cartridge, but color line observations indicated a distinct superiority in efficiency for the "sandwiches."

IBX Column Capacity. Four small scale runs were made to determine the effects of nitric acid concentration (0.5 M to 1.5 M) and the presence of ferrous sulfamate on the capacity of the IBX Column. Under constant pulse frequency and amplitude conditions, increasing the acid concentrations from 0.5 M to 1.5 M decreased the column capacity by 0.6 to 1.0 capacity factor. Addition of 0.03 M ferrous sulfamate also reduced capacity but to a lesser extent.

These studies were made in a three-inch diameter glass column with a cartridge composed of stainless steel sieve plates (33 per cent free area, 3/16-inch hole

diameter) on four-inch spacing and a 24 per cent free area stainless steel louver plate every three feet. Pulse amplitude was 0.8 inch and column temperature was approximately 45 C.

Preparation of U(IV) in Nitrate Solution. A molar adsorption coefficient of $4 \text{ mole}^{-1} \text{ cm}^{-1}$ was found for the adsorption, in UNH solutions, of that portion of the light from a G.E. RS Sunlamp effective in catalyzing the reduction of U(VI) to U(IV) by HCHO. At 0.2 M UNH, six centimeters of solution will adsorb more than 99 per cent of the effective radiation. Maximum production of U(IV) obtained (initial rate) in 0.2 M UNH - 0.2 M HCHO - 2 M HNO_3 by a single G.E. RS Sunlamp placed two centimeters above a six centimeters depth of solution was about nine millimoles/hr. This rate is the equivalent to the production of about 0.2 mole of uranium(IV) per day per lamp. Attempts to determine optimum wave length for the reaction with a Beckman spectrophotometer were unsuccessful due to the low radiation intensity available.

Anion Exchange Processes

Fission Product Decontamination. A series of exploratory experiments was performed in an effort to improve fission product decontamination in anion exchange processes employing Permutit SK. The most encouraging results to date have been obtained in experiments in which hydrofluoric acid has been incorporated in the 7.2 M nitric acid wash solution. Two runs were made using Purex LBP as the source of fission products and employing 7.2 M nitric acid, 0.056 M hydrofluoric acid and 7.2 M nitric acid, 0.0056 M hydrofluoric acid as the wash solution. Efficient removal of fission products was obtained by these washes as subsequent elution gave a 45 g/l plutonium product in which fission product activity was below the analytical detection limit, indicating an anion exchange decontamination factor of greater than 10^6 . With the 0.056 M hydrofluoric acid wash, the plutonium loss was 1.1 g/l and with 0.0056 M hydrofluoric acid, 0.2 g/l as compared with 0.1 g/l for the straight 7.2 M nitric acid wash.

Plutonium Chloride Systems. Absorption and desorption rates of the plutonium(IV) chloride complex on Dowex 1, X-4 (50 - 100 mesh) were studied briefly for comparison with the nitrate system. Absorption of plutonium from a 7.2 M hydrochloric acid feed containing 1 g Pu/l proceeded rapidly at 25 C reaching the equilibrium loading of 450 mg Pu per gram of dry (chloride-form) resin in about 500 minutes. At 60 C an equilibrium loading of 390 mg Pu per gram of dry chloride form resin was reached in about 150 minutes. This is in sharp contrast to the nitrate system where it appears by extrapolation that a period of at least a month would be necessary to reach the equilibrium loading at 60 C and a period of the order of years would be necessary at 25 C for this resin. The elution of the plutonium chloride with 1 M hydrochloric acid is also very rapid. At 25 C elution of 90 per cent of the plutonium is achieved with 1 M hydrochloric acid in 2.8 minutes and 99 per cent in 8 minutes. In the nitrate system this same resin requires 100 minutes for 90 per cent elution at 25 C with 1 M nitric acid. At 60 C the initial chloride elution rate is increased over that at 25 C but elution is incomplete, probably because of polymer formation.

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Higgins Ion-Exchange Contactor. The stainless steel connectors between the resin reservoir and the XA column and the XA extraction section were replaced with glass pipe to permit observation of the resin movement around the bends of the cross-over and to provide a comparison of the resistance to resin flow offered by the relatively rough stainless steel surfaces and the smooth glass. Preliminary observations indicate very little channeling of the resin around the three-inch glass bends during normal operation.

Channeling was detected in the stainless steel XA column in four runs employing a uranyl sulfate complex as the transferring ion. The aqueous raffinate uranium concentration was two- to four-fold higher at one side of the column than at the other side or at the center. Similarly, samples taken of the wet resin at various points across the column denoted channeling by up to two-fold variations in uranium concentrations from one side of the column to the other.

Flurex Development

The stability of ion exchange membranes (Permutit) under operating conditions is being checked in a long-term run of a laboratory-scale cell. Membrane current density was one amp/in.² Physical and electrochemical properties of the cation membrane appear essentially unchanged after 500 hours of operation. Beginning at about 360 hours, there appeared to be a rising trend in the NH_4^+ transference number, with a consequent decrease in current efficiency for uranium transfer, indicating some loss in permselectivity of the anion membrane. The anode for this run was stainless steel. Corrosion products from the anode were insoluble in the alkaline anolyte. Deposition of these solids on the anion membrane was not observed. A small amount of uranyl ion diffused through the anion membrane and precipitated on the anolyte surface of the membrane. So far, no interference with normal cell operation was noted due to this deposition of solid. It can be removed readily with an acid wash.

During this run the UNH feed was spiked with plutonium to about one ppmp uranium. The Pu/U ratio in the catholyte changed very little during three days of operation with this feed indicating that plutonium migrates through the cation membrane in about the same proportion as it is present in the feed.

Further studies on decontamination from Ru and Zr-Nb obtained in Flurex cell operation confirm previously reported low decontamination factors. Ruthenium decontamination increases with increasing catholyte HF concentration. The amount of contamination associated with a fixed weight of product increases as the initial level of the contaminants in the catholyte is increased.

Removal of uranium from Flurex catholyte (to recover uranium from catholyte bleed solutions) by adsorption on a cation exchange resin and elution with 6 M HNO_3 does not appear practical due to the large volume of elutriant required.

Pyrochemical Processing

Aluminum-Potassium Chloride System. A series of experiments was undertaken to more fully evaluate the effects of potassium chloride concentration and temperature on the distribution of uranium in the system $\text{KCl-AlCl}_3\text{-UCl}_3\text{-U-Al}$. Although

a $KCl/AlCl_3$ ratio of two had previously been reported to markedly suppress the extraction into aluminum (HW-56185-C, C-5), the effect of varying this ratio from 0.7 to 1.2 had little effect upon the distribution. Variation of the temperature from 625 C (with 50 per cent zinc in the metal phase to reduce its melting point) to 825 C and the time from 60 to 230 minutes also appeared to have little effect upon the extent of reduction which in these experiments ranged from 55 to 65 per cent. The discrepancy between this value and the 88 per cent reduction previously reported under similar conditions has not yet been satisfactorily explained.

Analytical Service.

Aid continued for the Z Plant gamma personnel exposure study. Multi-channel scintillation counting with thick and thin crystals served to measure X- and gamma ray intensities of U^{237} , Pu^{239} , Am^{241} , and common fission products. Absorption measurements were made for each energy through lead, steel, zinc, rubber, lucite, masonite, safety glass, and lead glass. Sample sizes often exceeded a pound of plutonium. Metal, salt, and solution were examined.

One 256 - channel energy analyzer was fitted with a well crystal. It is equally as accurate as a solid crystal and provides additional information when needed.

WASTE TREATMENT

Calcination of Purex Waste

Further experiments on the extent of volatilization and leaching of fission products from calcined LWW wastes show the threshold temperature for volatilization of cesium from sulfate-free LWW to be about 800 C. This threshold is much higher than that observed by workers at ICPP and Argonne. The experiments also do not show the marked decrease in ruthenium volatilization observed by Argonne workers when the temperature is raised from 400-500 C. Leachability of fission products was found to be much reduced when the sintering temperature was raised to 1300 C. Thus, the amounts leached from "standard" LWW, sulfate-free LWW, phosphate-borate treated LWW, and phosphate treated-sulfate-free LWW materials after sintering at 1300 C were 4.2, 0.20, 0.03, and 0.002 per cent, respectively.

The first runs were made in the experimental spray calcination equipment with very promising results. The product consisted of well formed spherical beads, and there was no tendency toward dusting. Particle size was in the range 0.005 to 0.015 inches. Bulk density of the product was rather low (0.17 g/cc), and the particles were rather fragile and friable. The tap density is related to drying temperature and increases with temperature. The density can be further increased by pressing, and a linear relationship was found between pellet density and the logarithm of the pressure. A density of 1.9 g/cc was obtained for a sample pressed at 10,000 psig.

Special Geological Studies

The areal extent of Ringold sediments rising above the ground water table near the 300 Area was further determined by correlation of well data to data from regional geologic

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studies. Appendix H of HW-55943 (Supplementary Study - Effects on Hanford Works of a Proposed Dam at Columbia River Mile 348) shows the situation from the Yakima Horn to the dam site. The conglomerate member of the Ringold formation apparently similarly lies a few feet above the ground water table in an area extending to or slightly beyond the Hanford - 200 Areas road wye, thence southwestward toward the Rattlesnake Hills. These sediments are about one-tenth as permeable as the directly overlying fluvial sediments, hence here may divert some ground waters eastward around the north apex of the conglomerate "island."

Disposal to the Ground

The interference of calcium in solution with the removal of Sr^{90} from wastes by soil was again demonstrated in tests performed with ^{224}U condensate wastes. This waste is neutralized by means of a lime bed before being discharged to the 216-WR-1, 2, and 3 crib system. Present condensates contain less than MPC radiostrontium, but the cribs previously received wastes containing up to 10^{-3} uc/cc, and an estimated total of 800 curies of Sr^{90} . Current laboratory soil column research indicates strontium breakthrough after passage of less than one column volume. Although much more than this has been sent to the crib no evidence of radiostrontium has been found in nearby ground water monitoring wells.

Laboratory soil column tests with Purex boiling tank condensate wastes indicated an estimated capacity for the A-24 crib of about five column volumes.

Research was initiated to study the feasibility of using the phosphate-calcite reaction for removing plutonium from Z-Plant process and laboratory wastes. When samples of the waste were treated with phosphate ion a white, flocculent precipitate was formed that removed 98.5 per cent of the Pu from solution. The phosphate added was sufficient to produce a 0.05 M phosphate solution. Tests are continuing to evaluate the removal of the remainder of the Pu on a calcite column and to identify the precipitate.

The need for the proportional sampling equipment on the Redox process condensate stream was emphasized after project plans for a replacement crib and associated sampling equipment were cancelled by CPD. As a result, Redox has agreed to install the necessary facilities to provide improved sampling and a more accurate inventory of the fission products being routed to the S-7 crib.

Observation Wells

With a Sr^{90} detection limit of 7×10^{-8} uc/cc, samples of ground water from three monitoring wells gave evidence of radiostrontium breakthrough from nearby cribs. Two wells near the 216-S-1 and 2 cribs contained 9.6×10^{-8} uc/cc and 1.0×10^{-6} uc/cc of Sr^{90} , respectively. A sample from a well near the 216-BY cribs (scavenged waste cribs) was found to contain 1.9×10^{-7} uc/cc Sr^{90} , the first evidence of strontium breakthrough from this site. Both of these crib disposal sites were abandoned more than two years ago.

The well scintillation probe indicated the movement of contamination to a depth of 120 feet beneath the new Purex tank condensate crib (216-A-24). Wastes were

detected moving to a depth of 100 feet during the first three weeks of crib operation and an additional 20 feet during the second three weeks of operation. Fourteen wells in the 241-SX tank farm were probed to examine the possibility of a high-level waste leak from the 241-SX-113 tank. No contamination was detected during this survey, but only one of the wells is located within 50 feet of the 113 tank. An attempt will be made soon to install a two-inch driven well (60 feet) near the northwest edge of this tank.

Additional samples of soil were obtained from 150 foot monitoring wells near the 216-Z-1, 2, 3, and 9 cribs. Analysis of these samples for plutonium was arranged, using an analytical method that would distinguish Pu from other alpha-emitters. Samples from two of the wells contained detectable concentrations of Pu, the maximum concentration being 2.1×10^{-6} uc/g. These wells bottom at an elevation approximately 50 feet above the water table.

TRANSURANIC ELEMENT AND FISSION PRODUCT RECOVERY

Cesium Recovery

Hot Laboratory Results. A ten per cent level cesium zinc ferrocyanide run was completed without incident; however, analytical results are not yet complete. One liter of full level Purex 1WW was transferred into the cell in preparation for the first full level run. A portion of the 1WW was drawn off into a centrifuge cone and examined. It contained a large amount of suspended material which settled to a volume of about 7.5 per cent in two hours. This gelatinous precipitate was further compacted by centrifugation to 2.5 per cent of the initial solution volume. About 90 per cent of the gross gamma activity associated with the precipitate was removed with acidified oxalic acid. It is thought that the precipitate consists of silica with adsorbed zirconium-niobium. The routine presence of this material in 1WW may have important consequences for both fission product recovery and waste treatment. Further experiments are in progress to characterize both the precipitate and the associated radioactivity.

Pilot Scale Studies. Studies of the first step in the process for recovery of cesium from Purex 1WW, the precipitation and centrifugation of ferric hydroxide, have been started. In the initial tests, the iron (0.18 M) in a solution made up to simulate partially-neutralized 1WW was precipitated at 80-90 C with agitation using 50 per cent NaOH, aqueous NH_4OH , or solid urea, and centrifuged for five minutes in a clinical centrifuge. The volumes of solids ranged from 16 to 21 per cent of the neutralized feed.

Neutralization of the 1WW with NaOH at 90 C over a four-hour period resulted in 18.5 volume per cent solids using the 26-inch baffled, solid-bowl centrifuge operating at 1100 G. Although the centrifugate was essentially clear at the start of the centrifugation (20-minute holdup), an increasing volume of precipitate appeared in the centrifugate during the last half of the run.

When the iron was precipitated with gaseous ammonia at 95 C over a period of four hours, the volume of centrifuged precipitate was 5.5-6.0 per cent and solids removal was greater than 99.9 per cent with holdup times as low as three minutes.

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Detailed construction drawings for the Cesium Isolation and Packaging Facility are 80 per cent complete. The drawings of the Receiver Tank and the Waste Catch Tank were completed, approved, and submitted to the Purchasing Operation for off-site procurement.

Neptunium Recovery

Batch extraction studies and a demonstration miniature mixer-settler run were performed in support of a Purex plant test to study recovery of neptunium which had accumulated in the plant during operation on the waste backcycle flowsheet. The results of these laboratory studies indicated that neptunium could be efficiently recovered from the plant 3WB with the flowsheet proposed by Purex Technology personnel. In the Mini run, which simulated the Purex HA, HS, LBX, and LBS columns, (except for materials inventory - hold up effects) the neptunium waste loss in the HA unit was only about 10 per cent, only moderate reflux was noted in the scrub section, and efficient partition from uranium was effected in the LBX-LBS unit with only 0.7 per cent of the neptunium following the uranium.

Similar behavior was observed in the plant test until the feed was exhausted. Continued operation with only scrub and solvent being fed to the HA-HS columns resulted in a large loss of neptunium to the HAW, however. This observation prompted a second Mini run in which an attempt was made to simulate the plant shut-down procedure by terminating the feed flow and continuing operation for five hours with only scrub and solvent being fed to the HA-HS unit. Analytical data on this run are incomplete. However, the fact that the HAW alpha activity (which corresponded to about 10 per cent of the neptunium in the feed) did not decrease in the five hours' operation after the feed flow was interrupted indicates that a substantial portion of the neptunium which had been present in the unit was subsequently lost to the aqueous waste.

Present effort is being directed toward development of a more reliable flowsheet in which neptunium(IV) is the species extracted.

Absorption of neptunium from boiled-down Purex plant 2DW was demonstrated on a laboratory-scale Permutit SK column.

Strontium Recovery

Further work has been done on the "acid side" recovery of strontium from 1WW by the technique of precipitating barium and strontium nitrates with fuming nitric acid. Based on tracer level experiments with synthetic solutions, this appears to be a feasible process for sulfate free waste with volume $\leq$ 40 gallons/ton U. Attempts were made to remove sulfate from 1WW by addition of barium or lead. The barium sulfate carried too much strontium (17 per cent), but lead sulfate carried only 9 per cent and may be acceptable. A combined lead sulfate, fuming nitric acid process should give an overall strontium recovery of about 60 per cent. Further reduction of 1WW volume or higher MWD/T levels would improve this yield.

The precipitated strontium nitrate was of good radiochemical purity except for contamination with about 0.6 per cent of the cerium and 10 per cent of the zirconium.

ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Non-Destructive Testing of Plutonium-Aluminum Fuel Plates

A facility for the non-destructive testing of MTR type fuel plates for plutonium content was designed, fabricated, calibrated and transferred to Plutonium Metallurgy for routine use. Employing an 85 KV G.E. Model D-4, X-ray head, a dual chamber ion chamber, a Beckman Model V micro-microammeter, Brown recorder and mechanical drive for scanning the plate, the instrument is capable of determining plutonium core content equivalent to 0.020 inches of aluminum-14 w/o plutonium alloy to about one per cent, relative. Scanning time per plate is approximately two minutes.

Estimation of Plutonium in Purex HAW

An instrumental method for the estimation of the plutonium content of three cycle flowsheet Purex HAW has been developed and successfully tested on synthetic solutions (containing flowsheet concentrations of nitric acid, iron(III), uranium, and plutonium). The procedure consists of a mercury cathode electrolytic separation of interfering materials (notably iron) followed by a derivative coulometric estimation of the plutonium. Plutonium concentrations as low as 5×10^{-6} molar are easily detectable.

Formal Oxidation Potentials of Neptunium

The formal oxidation potentials of the neptunium(V/VI) couple have been determined in nitric acid solutions using the controlled potential coulometer. The solutions were 6.79×10^{-3} M neptunium and 0.02 M sulfamic acid. The formal potential of the couple with reference to the standard hydrogen couple in nitric acid was constant at 1.153 volts in the range 0.5 N through 5.0 N nitric acid. The potential in 0.25 N nitric acid was -1.158 volts, and in 6.0 N, 7.0 N, and 8.0 N acid the potentials were -1.149, -1.148, and -1.140 volts, respectively. The values for the latter three potentials are doubtful, since oxidation of the neptunium(V) by the nitric acid was indicated. Preliminary investigation of the neptunium(IV/V) couple in nitric acid has shown that part of the neptunium(V) is reduced rapidly and apparently reversibly at the platinum electrode, while the remaining neptunium(V) does not undergo appreciable reduction. The reduction potential of the portion of neptunium(V) which undergoes reaction was 0.754 volts in a solution 1.0 N nitric acid, 0.02 M sulfamic acid and 6.97×10^{-3} M neptunium.

Ion Exchange Separation of Actinides from Fission Products

Experiments were performed to study the behavior of fission products in dissolver solution on Dowex 1 resins with thiocyanate complexing using the method demonstrated by Surlis (UCRL-3209) for the separation of lanthanides from actinides. It was found that the constituents of a dissolver solution were eluted from the Dowex 1 by 2.5 M ammonium thiocyanate in the following order with fair to good separation: Cs-137, Ba-140, La-140, Ce-141, and Am-241. Zirconium, niobium and ruthenium were strongly absorbed and eluted very slightly with all fractions throughout the run. The Am-241 was added as a tracer for actinides in general. Dowex 1, X-4 (100-200 mesh in the thiocyanate form) was used in a 3 mm by 7 cm column with a flow rate

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of 0.7 ml/cm²/min of elution agent. The method may be useful for rapid cesium and cerium separations from dissolver solutions and for simple decontamination of actinides for analytical purposes.

EQUIPMENT AND MATERIALS

Filtration Studies

Three commercial disposable filter cartridges (Glass-kleer, a glass fiber cartridge manufactured by Porous Plastic Corporation; Micro-kleen, a wool fiber cartridge manufactured by Cuno Filter Corporation; and Ful-Flo, a glass fiber filter cartridge manufactured by Commercial Filter Corporation) were tested for possible use in removing 10 micron particles from aqueous solutions. Cartridge loading and flow characteristics, filtration efficiencies and backflushing properties were determined for each of the cartridges. On the basis of these tests, both the Ful-Flo and Micro-kleen filter cartridges were considered superior to the Glass-kleer cartridge. Since the plugging and regeneration qualities of the Ful-Flo cartridge were poorer than those of the Micro-kleen cartridge, the Micro-kleen filter was considered best for systems in which wool fiber may be tolerated.

Pump Development

On the basis of 321 Building tests, a conical seal (two piece splined cone design) designed to minimize throttle bushing leakage, is being installed on a Purex Johnston deepwell turbine pump. After assembly the pump will be returned to Purex for "in-plant" testing.

Non-metallic Materials Testing

Plexiglas 5009, a transparent, flame resistant, cast acrylic sheet produced by Rohm and Haas, was tested by static immersion in a wide variety of solutions which it might contact in the Recuplex and 234-5 operations. Ordinary Plexiglas was tested in the same solutions as a control. Both samples became opaque in the vapors above HF and both dissolved in trichlorethylene. The 5009 Plexiglas became opaque in 30 per cent nitric acid solution. Other test solutions had no appreciable affect. At 10⁶r gamma conventional Plexiglas darkened more than the Plexiglas 5009.

Three samples of bearing quality graphite submitted by National Carbon were tested by static immersion in boiling solutions of (a) 60 per cent nitric acid, (b) 1M Al(NO₃)₃ and (c) simulated Redox 2DF. AUU Graphite dissolved in 60 per cent nitric acid and increased slightly in size in both the other solutions. Both AJT and CS 312 Graphite swelled slightly in 60 per cent nitric acid but were unaffected by the other two solutions.

EC1291, an adhesive manufactured by Minnesota Mining and Manufacturing Company, was tested by static immersion in hexone, 50 per cent caustic, and in 10 per cent nitric acid. The material failed in nitric acid but was unaffected by the other two solutions.

Plutonium Oxide Chlorinator

Gold, platinum, Baker 413 (Au-Pt-Pd alloy), Hastelloy B and C, and Haynes 25 samples were exposed to phosgene gas at 400, 500, and 600 C to determine their suitability as materials of construction for plutonium oxide chlorination equipment. The noble metals were unsatisfactory. Hastelloy B and Hastelloy C corroded at about 0.02, 0.7, and 8 mils per month at 400, 500, and 600 C, respectively. Haynes 25 was comparable to the Hastelloys at 400 C but corroded at 2 and 37 mils/mo. at 500 and 600 C, respectively. Exposure of these same materials and some additional ones to HCl-H₂O gas mixtures is currently in progress.

Pressurized Plutonium Dissolver

In a preliminary investigation of materials of construction for an autoclave plutonium dissolver, 309 SCb, Hastelloy F, and 304-L stainless steel were exposed to boiling 13 M HNO₃ - 0.025 M HF at atmospheric pressures. Corrosion rates of about 14 mils/mo were observed for 309 SCb and Hastelloy F and 140 mils/mo for 304-L were observed. These are maximum rates and they will decrease rapidly as plutonium dissolution progresses. It was concluded that 309 SCb is satisfactory for construction of laboratory test equipment. A more thorough corrosion study will be made if laboratory tests of autoclave dissolution indicate the desirability.

PROCESS CONTROL DEVELOPMENTGamma Monitor Sample Cells

The performance of glass and fluorothene gamma monitor sample cells now in plant service confirms earlier data pointing to the superiority of unplasticized fluorothene. Cells of the latter material will be used as rapidly as they become available. The background activity of unplasticized fluorothene has remained low in comparison to that of partially plasticized fluorothene or glass. For example, an unplasticized fluorothene cell in service for six months on the IPB stream of the Redox plant retains a low background of only six per cent of the full cell activity, whereas a three per cent plasticized cell in service for only two months on the 2EU stream of the Purex plant has a background of 13 per cent of full cell activity and a glass cell in service for two months on the 2BP stream of the Redox plant has a background activity of 33 per cent of the full cell activity.

UO₃ Calciner Control Modifications

Work has started on a program to convert the operation of a calciner to complete automatic control. The first step undertaken is to be the automatic start-up of a calciner from the idling (standby) condition. A programmer for controlling certain of the start-up operations is being assembled and will be tested initially in the cold semiworks.

Extraction Column Control

The feasibility of controlling a column at its instability threshold has been demonstrated. The column is maintained at this threshold by controlling the

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pulsing frequency, which is in turn controlled by the column static pressure. Studies are continuing with a LC type column, in which the LCX flow rate will be controlled by the uranium concentration in the LCU stream, and the frequency controlled by the column density.

Remote Instrument Probe

A pH sensing unit for use in the Purex F-16 (neutralized waste) tank has been extensively tested in the "cold" semiworks. A second unit has been fabricated and is ready for plant testing. This sensing unit is immersed in the process solution and avoids the necessity of transporting a sample to the unit. Details of the assembly are shown on prints SK-3-7825, sheets 1 and 2, and SK-3-7830.

NON-PRODUCTION FUELS REPROCESSING

Zirflex Process

Decladding of Zircaloy clad fuel elements by the Zirflex process would take place at a faster and probably at a more predictable rate in the absence of the passive zirconium oxide film which is formed on the elements by reaction of the zirconium with high temperature water. Information from ORNL indicating that molten $\text{NH}_4\text{F} \cdot \text{HF}$ would dissolve zirconium oxide as well as zirconium suggested the use of such a system as an oxide removal step.

It was found that a specimen of oxidized Zircaloy-2 (11 days in 400 C air) dissolved in 6 M ammonium fluoride at a rate equivalent to that of unoxidized Zircaloy-2 when the specimen was exposed to molten $\text{NH}_4\text{F} \cdot \text{HF}$ at ca. 120 C for two to three minutes before being placed in the ammonium fluoride solution. However, the reaction of molten $\text{NH}_4\text{F} \cdot \text{HF}$ with unoxidized Zircaloy-2 also proceeded very rapidly and exothermally. A mixture having the approximate composition $\text{NH}_4\text{F} \cdot 2\text{HF}$ was prepared to permit operation at a lower temperature. The rate of dissolution of Zircaloy-2 in this melt was found to be strongly temperature dependent. Exposure of an oxidized specimen of Zircaloy-2 (12 days in 400 C air) to this melt at 25 C for 0.5 hour had little effect on the passive character of the oxide film but exposure of a similar specimen to the melt at 52 to 36 C for 0.5 hour resulted in the destruction of the oxide film as judged by the dissolution behavior of the Zircaloy-2 on subsequent exposure to ammonium fluoride solution.

Since molten $\text{NH}_4\text{F} \cdot 2\text{HF}$ at 45 C corroded unoxidized Zircaloy-2 at a rate of only about 10 mils/hr, it is felt that ammonium hydrogen fluoride melts hold promise as a means of removing the zirconium oxide film from spent reactor fuels before feeding them to the Zirflex decladding operation.

Mechanical Processing Cell Design

Mechanical processing cell design studies continued with a cell concept embracing a 16-foot wide x 28-foot long x 20-foot high air space containing a crane, manipulator, unloading table, two cutoff saws, shear, shear feed device, and saw vacuum system. Chopped fuel fragments are assumed gravity-discharged to a dissolver or collection bin.

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The design of a direct-acting 40-ton hydraulic shear is complete (SK-3-7911), and fabrication costs are estimated at \$2500. Fabrication of a prototype for installation in the 321-A Building will start about July 1.

Powered hack saw performance in cutting solid and open stainless steel rod bundles, and ceramic-filled bundles of stainless steel tubing, was evaluated for comparison with the high-speed circular saw tested earlier. Results show that commercial hacksaw blades are unsatisfactory for the tube and open rod bundles, with essentially "zero" life due to blade and tooth breakage.

Design of a cut-off saw for removing fuel element end fittings in the mechanical processing cell is 90 per cent complete. The 4-foot long saw is the swinging-arm type with a 40-inch diameter friction blade direct-driven by a 1750-rpm, 20 hp motor. An integral electric brake enables the motor shaft to be locked so that the blade retaining nut can be removed by impact wrench. Auxiliaries include a work clamp, work stop, scrap basket, and blade shroud, which connects to a vacuum system for dust control.

Feed Preparation

Darex. Equipment installation and preliminary testing including calibrating and water boilup tests have been completed.

Zirflex. Oxidized Zircaloy-3 sheets (2 weeks in air at 400 C) and sintered UO_2 pieces were dissolved under normal conditions. Zircaloy dissolution was complete in four hours and the off-gases contained from two to four per cent hydrogen with an air leakage of less than 0.1 standard cubic foot per minute per pound of Zircaloy charged. Apparent uranium losses to the solution before centrifugation were 0.035 per cent. Centrifugation recovered approximately 30 per cent of this uranium. Uranium losses prior to centrifugation have been erratic in the pilot studies and apparently vary with the characteristics and the surface area of the UO_2 as well as the "free" fluoride concentration. Further investigation of this situation is in progress.

Subsequent exposure of the UO_2 to 10 M HNO_3 and 0.2 M $Al(NO_3)_3$ dissolved the 1/2-inch thick pieces in four hours. Acid consumption in numerous tests with no nitrogen oxide recovery was 2.4 to 3.0 moles of nitric acid per mole of uranium dioxide dissolved.

Corrosion Studies. Corrosion rates for 304-L stainless steel in ammonium fluoride solutions (Zirflex process) were found to be appreciably higher when determined in Teflon equipment than those previously determined in glass equipment even though the attack on glass by these solutions was not severe. Further studies indicate that small amounts (0.05 to 0.001 M) of additives such as SiO_2 , B_2O_3 , $Cu(NO_3)_2$, and $Al(NO_3)_3$ will reduce the corrosion to acceptable rates (ca. 2 mils/mo.) under the most severe conditions expected in the decladding step. Coupons which had been exposed to both cladding and core dissolution steps in the 321 Building dissolver showed overall corrosion rates of about 2.5 mils/mo. for austenitic stainless steels (304-L, 347, and 316) and one mil/mo. for Hastelloy F.

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Studies on the dissolution of 304-L stainless steel in HNO_3 -HF solutions show that, for hydrofluoric acid concentrations from one to two molar, a fluoride to dissolved stainless steel mole ratio of at least five is required to maintain penetration rates of two mils per hour or greater. This relationship appears to be independent of the concentration of dissolved stainless steel. For a single addition of dissolvent, 2 M HF-1 M HNO_3 appears optimum. A total penetration in boiling solution of 10 mils can be obtained in two hours with the final solution about 0.4 M in dissolved stainless steel. Corrosion of Hastelloy-F base metal under these conditions is about 0.05 mil for the two hours exposure.

TBP Processing of Darex Feeds

Stability toward precipitation and solvent extraction characteristics with TBP-diluent as extractant of Darex feed solutions are under study in support of projected service runs to recover uranium from feeds prepared in the "cold" semiworks. Solutions representing all combinations of 1.0, 1.5, and 2.0 M UNH, 0.0, 1.0, 4.0, and 7.0 M HNO_3 , and uranium to stainless steel (304-L) mole ratios of 5.0, 2.5, and 1.0 were prepared. At 1.0 M UNH all solutions were stable at room temperature except those with a U/ss ratio of one and containing 4.0 or 7.0 M HNO_3 . At 1.5 M UNH, only the solutions at 0 and 1.0 M HNO_3 and with U/ss ratio of 5.0 and 2.5 were completely stable (room temperature). At 2.0 M UNH only the solutions at 0.0 M HNO_3 and with U/ss ratio of 5 were stable (room temperature). Uranium distribution ratios for the stable solutions are being determined.

Packed Purex Solvent Extraction Columns

As part of a program to determine the feasibility of using TBP-diluent systems in the Redox plant, a three-inch diameter glass tower packed with 3/8 x 3/8 x 1/16-inch polyethylene raschig rings was operated under Purex Phase II HA extraction section conditions with 30 per cent TBP in Shell Spray Base. The column was operated with a bottom interface. Under these conditions the column flooded at 480 gal/hr/ft² and indicated a minimum HTU of 1.6 foot at 320 gal/hr/ft².

In the same column under Purex Phase II C-Column conditions preliminary observations indicated poor stripping efficiency and low capacity (of the order of 200 gal/hr/ft²).

REACTOR DEVELOPMENT - 4000 PROGRAM

Pyrochemical Processing

The reduction of plutonium and aluminum in the system PuCl_3 - KAlCl_4 -Al was successfully accomplished by addition of magnesium. In a series of 30 minute equilibrations at 700 - 750 C and with magnesium excesses ranging from 60 to 150 per cent, residual plutonium in the salt phase ranged from 2.1 to 0.2 per cent. Such distribution behavior has not been noted in other similar systems. For example, the distribution ratio of plutonium between magnesium chloride and magnesium has been reported as 17 (CK 1529), favoring the salt phase. A possible explanation for this behavior is a marked lowering of plutonium activity in the aluminum phase.

Separation of Mercury-204

Because of the many apparent advantages of using mercury as a heat transfer agent or a fissile material supporting media in thermal heterogeneous nuclear power reactors, a study was initiated to determine the feasibility of producing low cross-section mercury rich in isotope 204. Initial experiments using the distillation-diffusion method of Harkins (cf. HW-54812, pp. 13-16) have been run in an apparatus employing a stainless steel diffusion barrier 36 inches long, 2 inches in diameter, having a 1/16 inch wall thickness and a pore diameter of 20 microns. A non-limiting throughput of 250 grams per hour was readily obtained in these experiments. After running four stages of separation, end streams will be analyzed for isotopic distribution.

Non-Rigid Core Studies

An experiment was run to observe the distillation behavior of the system Bi-Pb-UO₂-Hg, a system of potential use if mercury of suitably low cross section can be produced. Approximately equal volumes of bismuth-lead eutectic containing 8 w/o uranium as uranium dioxide and mercury were continuously distilled in an evacuated loop for 3.1 days. At the termination of the run, the cross member connecting the receiver and distillation pot was frozen and the system analyzed for uranium. Approximately 95 per cent of the uranium was found in the pot. The remainder was in the downcomer, presumably due to physical carry-over of the slurry when the system occasionally "slugged" over. No uranium was found in the cross member sample. The observed operation of the system was very good. The pot material appeared metallic at all times and there was no evidence of separation of the uranium dioxide. In this preliminary experiment the Bi-Pb-UO₂ slurry proved quite compatible with mercury.

Reprocessing of PRP Fuels by Amine Extraction

Although formation of two organic phases has been observed at high plutonium concentrations with tri-n-octylamine diluted with xylene and with tri-laurylamine diluted with Amsco-n-octyl alcohol, it has now been found that no third phase is formed with tri-laurylamine diluted with xylene, at least for the conditions studied (10 volumes per cent amine, 2 to 10 M nitric acid). Furthermore, the amount of plutonium extracted exceeds the 4:1 amine:plutonium "saturation ratio" previously reported. Other aromatic diluents of higher flash point will be tested to see if they behave similarly.

BIOLOGY AND MEDICINE - 6000 PROGRAM

Analysis of Reactor Effluent Water

A re-examination of the rare earth and yttrium radioisotopes in reactor effluent water was undertaken to clarify some apparent discrepancies in earlier results. Only about one-fifth as much Y⁹⁰ was found to be present as had been previously reported. This makes Y⁹⁰ about fifteenth in importance as a contributor to the GI tract dose rather than fourth. Since larger samples were taken and greater separation achieved, six additional rare earth radioisotopes were identified. They are Tb¹⁶⁰, Tb¹⁶¹, Ho¹⁶⁶, and Er¹⁷¹ with measured concentrations of

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3×10^{-9} , 2×10^{-6} , 8×10^{-8} , and 1×10^{-7} uc/ml, respectively. Yb^{175} and Lu^{177} were identified but their concentrations cannot be determined until their decay schemes are clarified.

The examination of Turco purge material for the study of the origin of radioisotopes in reactor effluent water was continued with analysis of material from a tube near the outer edge of a reactor. In comparison with data obtained from a central tube, higher concentrations of radioisotopes were released. This may be explained in part by the more vigorous purging conditions which removed more of the film and/or aluminum from the slug jackets and process tubes, but other factors such as time since last purge or loading must also be considered. Mn^{54} was determined in addition to the other isotopes measured as reported last month and it was found that one purge removed the equivalent of 540 days normal operating amount of this radioisotope.

In the study of chemical form of P^{32} in reactor effluent water it was found that during reactor operation most of the P^{32} was present as the orthophosphate. During shut-down periods increased concentration of a polymer, more condensed than the tetrametaphosphate, was observed. In an effort to explain this observation, aerated solutions of six phosphate anions were irradiated in a Co^{60} facility to an absorbed dose of 1×10^8 rad and measurements made of the changes in the ultraviolet absorption spectra of each solution. An absorption band maximum of 204 mμ was measured in each case, but its source has not yet been determined.

Geology and Hydrology

The stratigraphic sequence in the Ringold formation in the White Bluffs and as determined from wells drilled in the Columbia Basin Irrigation Project east of the Columbia River was projected onto the Hanford area and correlated to wells lying between the 300 Area and Hanford townsite. The correlation further defined the presence of various Ringold beds at the ground water table level near the Columbia River. It permitted a better determination of the materials through which waters from the separations areas must pass immediately prior to entering the Columbia River.

A deep well being drilled south of 200 East Area encountered basalt at a depth of 685 feet, about 100 feet shallower than had been predicted by projecting the slope of the basalt surface from the 200 East Area. The finding indicated a somewhat shallower synclinal trough between Gable Mountain and Rattlesnake Mountain than had originally been thought. Magnetometer surveys conducted south of 200 West Area also indicated a somewhat shallower basalt surface than was originally indicated.

Two pumping tests were completed in wells near plant coordinates N 8000, W 17,000, and N 8000, W 32,000, respectively. The aquifer tested in both cases is in the Ringold conglomerate. The coefficients of transmissibility determined by these tests were 67,000 and 4,200 gal/day/ft. The former value indicated an average permeability of 450 gal/day/ft² which supported that previously estimated for this formation. The latter test indicated an exceptionally low permeability, and is interpreted to reflect a somewhat thinner aquifer zone than present data indicate. It is possible that the basalt surface lies just a few feet beneath the bottom of this well, which could explain the anomalous results.

Soil Chemistry and Geochemistry

Tests demonstrated the effectiveness of even small percentages of calcite in soil for removing strontium from phosphate solutions. Clean sand mixed with various proportions of calcite was used to prepare columns that were tested with phosphate solutions spiked with Sr^{90} . Sand mixtures containing only 2 per cent calcite removed 98.6 per cent of the strontium at a flow rate of $10 \text{ ml/cm}^2/\text{hr}$. Under the same conditions the sand alone did not measurably reduce the Sr^{90} concentration of solutions passed through it.

The phosphate-calcite reaction was found to remove other fission products from solution with varying degrees of efficiency. A 0.05 M phosphate solution containing Ce^{144} , Zr^{95} , and Ru^{106} was passed through a 50 g. bed of calcite. The phosphate-calcite reaction produced the following decontamination factors for these isotopes: Ce^{144} - 5,000, Zr^{95} - 10, and Ru^{106} - 100.

The ability of clinoptilolite to remove cesium from a sample of Purex boiling tank condensate was measured. The waste sample was spiked with additional Cs^{137} to simplify analyses. A concentration reduction of >99 per cent was obtained after passage of more than 40 column volumes of waste. A significant reduction in the ability of clinoptilolite to remove cesium from solution was detected with mineral grain size larger than 0.25 mm. This is ascribed to the fact that the clinoptilolite is present as discrete grains in an inert matrix of the rock material used for tests. The material must be sufficiently crushed to expose the zeolite. Clinoptilolite appears to remove cesium effectively from solution over the unusually wide pH range from 1.0 to 14. The removal is slightly more efficient with increased pH and the mineral is destroyed in stronger acid solutions.

Ground Waste Investigations

Research continued on the development of techniques for studying the shape and geometry of the effective soil column beneath a crib. The studies are currently limited to laboratory models filled with homogeneous porous material. Tests demonstrated the feasibility of using solutions traced with I^{131} for mapping the moisture content of the model with a scintillation-type gamma monitor. A method was developed for establishing the shape of the phreatic surface beneath the crib using an electric analog field plotter. This surface defines the boundary between saturated and unsaturated flow.

Data obtained during the study of methods of interpreting soil column tests demonstrated the pronounced influence of Ca^{+2} on radiostrontium removal by soil. Using identical columns, solutions containing 1000 ppm Ca^{+2} required 2.5 column volumes to a Sr^{90} breakthrough while solutions containing 2 ppm Ca^{+2} required 250 column volumes to produce a Sr^{90} breakthrough and solutions containing no calcium but containing 2 ppm Na^{+} have not produced a Sr^{90} breakthrough after passage of 850 column volumes.

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Field Apparatus Development

An experimental ground water velocity instrument employing thermistors as sensing elements was tested in two wells. In one well, in a region in which relatively high flow rates are known to exist, the instrument gave rather wide fluctuations which could be interpreted as eddies formed around the instrument. In a well of slower ground water flow, a rate of 57 feet per day was observed. The tests give encouragement that this instrument may yield valuable data on ground water velocity.

The feasibility was established of using a vertical field magnetometer for identifying certain underlying basalt irregularities such as ridges. A basalt ridge previously identified by a well driven in the vicinity was delineated through the magnetometer test. It is therefore believed that additional magnetic surveys in conjunction with other geologic data will be of considerable value in establishing basalt features in underlying sediments.

The accuracy of elevation measurements made with a micro-altimeter recently acquired was found to be entirely adequate for many applications in the geophysical work. An accuracy of the order of ± 1 foot is possible when a reference bench mark elevation for establishing the zero point is available.

A closed-circuit TV system was received and briefly tested; its useability for in-well observations and ground water measurements will be studied.

V. P. Bupp

Manager

Chemical Research & Development

LP Bupp:bp

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
G. H. Daly	6/4/	Savannah River Operations Office, AEC Savannah, Georgia	Discuss waste disposal process at Hanford & the scope of research work in soil sciences.	JF Honstead	No
W. Klaus	6/6/	Washington, AEC Div. Biol. & Med.	Tour facilities & discuss current research program.	LP Bupp DW Pearce	No
E. J. Jungmann W. Jungmann	6/6/	Midland Drilling Co. Walla Walla, Wash.	For purposes of bidding on drilling project CA-794.	RE Brown DJ Brown	No
R. H. Graham	6/4/	Reactor Safeguard Committee (ACRS)	Discuss geological findings bearing on earthquake probability studies.	RE Brown	No
W. Claus	6/5/	Div. Biol. & Med. Washington, AEC	Discuss progress and proposed programs.	JM Nielsen	Yes
J. V. Nehemias	6/6/	The National Science Foundation Ann Arbor, Michigan	Discuss environmental monitoring techniques.	JM Nielsen RW Perkins	No
L. M. Knights	6/6/	AEC Idaho Falls, Idaho	Discuss radiochemistry and analytical methods.	EW Christopher HJ Anderson DL Reid	Yes
J. R. Powell	6/10/	Brookhaven Nat'l. Lab. Upton, New York	Discuss pyrochemical reports.	WH Reas	No
T. S. Mackey	6/17/	ORNL Oak Ridge, Tennessee	Discuss Gamma Monitors.	GJ Alkire CL Pleasance	Yes

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VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data
H. H. Waesche W. G. Pierce	6/16/	USGS Menlo Park, California	Discuss waste disposal work the Geological Survey is beginning.	DW Pearce RE Brown	No
D. W. Rhodes	6/18-19/	Phillips Petroleum Co. Idaho Falls, Idaho	Discuss waste disposal technology and gaseous waste sampling techniques.	JM Nielsen LC Schwendiman DW Pearce JF Honstead	Yes

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
R. J. Sloat	6/2-3/	Savannah River Plant Aiken, South Carolina	Discussion on non-production fuel processing, fission product recovery, hot cell construction and fabrication; process equipment.	M. Davis, Jr.	Yes
	6/3-5/	ORNL Oak Ridge, Tennessee	" " "	H Goeller C Watson	Yes
J. H. Kleinpeter	6/2-6/	GEL Schenectady, N.Y.	Attend Plastic Tooling Course.		No
	6/10/	Hills McCanna Co. Chicago, Illinois	Discuss valve diaphragm problems.		No
	6/9/	Argonne National Lab. Lemont, Illinois	Discuss non-metallic materials & manipulators.	S. Lawroski	Yes

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
W. L. Lyon	6/4-5/	Atomics International Canoga Park, Calif.	Discuss thermodynamics of fused salt systems, vapor pressure determinations, and laboratory equipment.	EE Motta	Yes
	6/6-7/	LASL Los Alamos, N.M.	" " "	RD Baker	Yes
L. C. Schwendiman	6/9-11/	Health Physics Soc. Berkeley, Calif.	Attend annual meeting and present paper.	---	No
R. E. Brown	6/13/	State of Oregon Dept. of Geology Portland, Oregon	Procure mineral samples for geochemical work; present paper to Geological Society of Oregon Country.	H. Dole P. Howell	No
W. W. Marshall F. M. Smith	6/11/	Harvey Aluminum Co. The Dalles, Oregon	Consult on Baird direct-reading spectrometer.	Dr. Rochon	No
M. C. Lambert	6/16/	Phillips Electronic Co. New York City, N.Y.	Discuss X-ray spectroscopy.	P. Wolf	No
	6/17/	GEL Schenectady, N. Y.	" " "	H. Schmidt	No
	6/17/	G.E. Research Lab. Schenectady, N. Y.	" " "	HA Lievhafsky	No
	6/18-20/	University of Michigan Ann Arbor, Michigan	AEC Symposium on Reactor Fuel Measurement Techniques (Present paper).	---	No
J. R. Morrey	6/17-20/	G.E. Research Lab. Schenectady, N.Y.	Attend Analytical Chemistry Symposium.	---	No

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
R. E. Burns	6/16-17/	ACS Northwest Regional Meeting Portland, Oregon	Attended Meeting	---	No
E. W. Neuvar			Presented Paper		
L. L. Burger			Presented Paper		
R. E. Connally			Presented Paper		
D. R. Kalkwarf			Presented Paper		
R. L. Moore			Attended Meeting		
H. H. VanTuyt			Presented Paper		
A. S. Wilson			Presented Paper		
M. H. Aldrich			Attended Meeting		
H. J. Anderson			Attended Meeting		
W. L. Delvin			Attended Meeting		
L. F. Lust			Attended Meeting		
H. E. Palmer			Attended Meeting		
D. M. Robertson			Attended Meeting		
H. Tenny			Attended Meeting		
A. M. Platt	6/22-25/	Philadelphia, Pa.	Attend Golden Jubilee of AIChE.	---	No
J. J. Shefcik					
W. R. DeHollander	6/23-27/	AEC Headquarters Germantown, Maryland	Present paper on Zirconium Hazard Evaluation at the 1958 AEC & Contractor Safety & Fire Protection Conference.	DF Hayes	No
P. P. Rowe	6/25/	Washington State Coll. Pullman, Washington	Observe equipment and methods of moisture measurements used at the college.	H Ferguson	No
K. C. Knoll					
J. L. Nelson					
A. M. Platt	6/26/	ORNL Oak Ridge, Tennessee	Discussions on product separation processes and non-production fuel reprocessing.	FL Culler	Yes
J. J. Shefcik					

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
D. L. Reid	6/23-24/	New York Operations Office, AEC New York, New York	Discuss radiochemical analytical methods and related instrumentation for environmental samples.	RT Graveson JS Alencio I Whitney	Yes
	6/24-27/	ASTM Committee D-19 Mtg. Boston, Mass.	Present paper on radiochemical methods.	---	No
D. M. Robertson	6/23-25/	ASTM Meeting Boston, Mass.	Attend Meeting.	---	No
	6/26/	ORNL Oak Ridge, Tenn.	Discuss analytical chemical methods and activation analysis.	GW Leddicotte	Yes
	6/27/	ANP Cincinnati, Ohio	Discuss radiochemical methods, uranium burn-up, fuel sampling and hot cells.	HW Edwards	Yes
D. M. Hunnicutt	6/27/	Vallecitos Lab. Pleasanton, Calif.	Discuss Analytical Chemistry in area of mutual interest.	R Trevithick	No

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BIOLOGY OPERATIONA. Organization and Personnel

No major or significant items relating to personnel changes or activities occurred during June 1958.

B. TECHNICAL ACTIVITIESFISSIONABLE MATERIALS - 2000 PROGRAMBIOLOGICAL MONITORINGAtmospheric Contamination

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

<u>Collection Site</u>	<u>$\mu\text{c/g}$ thyroid</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Wahluke Slope	2×10^{-3}	5×10^{-3}	-
Four Miles S.W. of Redox	1×10^{-3}	2×10^{-3}	-
Prosser Barricade	1×10^{-3}	3×10^{-3}	-

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

<u>Sample Type</u>	<u>$\mu\text{c/g}$ tissue</u>	<u>Trend Factor</u>
	<u>Average</u>	
Bone	8×10^{-5}	-
Feces	7×10^{-5}	+ 2
Muscle	9×10^{-6}	- 4
Liver	7×10^{-6}	- 3

Columbia River Contamination

Contamination levels for beta emitters were as follows:

<u>Sample Type</u>	<u>Collection Site</u>	<u>$\mu\text{c/g}$ wet tissue</u>		<u>Trend Factor</u>
		<u>Average</u>	<u>Maximum</u>	
Minnows (entire)	Hanford	1×10^{-3}	2×10^{-3}	-

These values are slightly higher than one year ago.

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Effect of Reactor Effluent on Aquatic Organisms

Monitoring of the effluent from the 100-F reactor with young Chinook salmon was terminated early in the month after a "run" of 29 weeks. The four per cent strength effluent was slightly toxic. The same quantity of effluent varied in concentration from 3 to 6.2 per cent to simulate the magnitude of fluctuation, which may result from power production at Priest Rapids Dam, did not increase the toxic effect and actually seemed to be slightly more favorable. Four per cent effluent from the 100-KE reactor also produced threshold toxicity at the end of eight weeks; effluent from Tube No. 4936 (pH 6.5) produced similar results. Monitoring of the 100-F effluent was resumed during the month with juvenile trout in a test which will evaluate the effect of three per cent strength effluent and also the toxicity of well water now available at the laboratory.

Reactor Effluent

Early harvests of barley from plots watered from reactor effluent are consistent with similar harvests in previous years, the concentration of beta emitters in plants watered with 100 per cent reactor effluent is about twice that in the plants irrigated with well water. Preliminary tests have failed to identify significant amounts of Zn^{65} in the vegetation although it is readily identified in the effluent water used for irrigation.

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

Equipment was set up and trout were conditioned to determine the effect of temperature on the uptake and deposition of P^{32} .

Zinc

From 50 to 60 per cent of ingested Zn^{65} is absorbed by the rat. Most of this is rapidly excreted in the feces. Sixteen per cent of a single intragastric dose is retained after 24 hours.

Strontium

Trout were conditioned and invertebrate organisms obtained in preparation for a test on the comparative uptake of Sr^{90} directly from the water and via food. Surgical techniques are being developed which should permit the measurement of the transport of isotopes across membranes of the intestine and gills.

Complete data are available from the 100-day experiment studying the chronic deposition and retention of Sr^{90} and Ca^{45} in rats as a function of dietary calcium level. Results from the 100-day sacrifice do not appreciably alter conclusions previously reported on the basis of incomplete data. After 100 days' feeding, the ratio of percentage Sr^{90} retained in bone to Ca^{45} retained in bone varied from 0.08 on the 0.03 per cent calcium diet to 0.39 on the 2.0 per cent calcium diet.

The experiment studying the retention of a single dose of Sr^{90} and Ca^{45} as a function of dietary calcium level was continued with rats sacrificed 16 and 32 days after injection. No results are as yet available.

An experiment was initiated to study the effect of dietary calcium level on the chronic deposition and retention of Sr^{90} and Ca^{45} in weanling rats.

Five ewes and six lambs have been sacrificed thus far from the experiment designed to study the effects of dietary calcium on the absorption and turnover of Sr^{90} fed to ewes with suckling lambs. Radioanalysis results will be available next month.

The last three of a series of six swine were utilized to study the uptake and excretion pattern of single-dose orally administered Sr^{90} during a ten-day period. Blood, urine, and feces samples were collected at pre-determined intervals after dosing. Tissue samples and total skeletons were collected at post-mortem.

Uptake of Radioactive Substances by Growing Plants

Cinebar soil contaminated with Sr^{89} and Ca^{45} and treated with CaCl_2 , CaSO_4 , and CaCO_3 has now been cropped successfully with beans, barley and radishes for nearly a year. It appears that the greatest effect on both Sr^{89} and Ca^{45} uptake was due to calcium addition. Differences between the chemical nature of the calcium addition and between levels of calcium addition were less than that observed between the controls and the lowest level of calcium used.

The first cutting of alfalfa was made from the Sr^{90} plots. There was no difference in the concentration of Sr^{90} in leaves and stems between plots which had been cultivated and those not cultivated. The concentrations of Sr^{90} are about half those observed in alfalfa harvested last year. Presumably this is a consequence of the establishment of deeper roots by this perennial plant.

Iodine

The Q/D (quantity of I^{131} in the thyroid divided by the daily quantity of I^{131} fed) for the month of June still reflects the effects of lactation. While the Q/D increased in some groups, this increase is attributed to the small number of animals in each group and the number of lambs suckling.

The effects of continued low-level I^{131} feeding to swine on high or low level of nutrition show Q/D figures which compare favorably with those of one year ago on the lower dietary level. The drop as compared to last month is due to the very hot weather experienced during June.

Cesium

Pollen from cattails grown in the pond spiked with Cs^{137} contained about four times more Cs than the seeds and about two times more than leaves.

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Plutonium

Completed results are available from the experiment studying the effect of chelating agents administered via aerosol on the retention of plutonium citrate deposited in the lung. A considerable portion of the administered plutonium was unaccounted for in analyses, possibly due to extensive holdup in the gastrointestinal tract at the end of the 48-hour experiment period. Analyses were not performed on contents of the GI tract. Retention of plutonium in the lung was reduced from 42 per cent in controls to 20 per cent in animals treated with DTPA via aerosol. EDTA via aerosol was only slightly less effective than DTPA. The doses administered via aerosol were relatively low (.05 mM). A 50 per cent larger dose of EDTA administered intraperitoneally was as effective as the EDTA administered via aerosol.

Deposition of plutonium in the skeleton was not markedly affected by any of the treatments although there was some indication of an increase in deposition resulting from the EDTA aerosol.

Radioactive Particles

A lymphosarcoma was observed in a mouse 334 days after intratracheal administration of 0.15 μc $\text{Ru}^{106}\text{O}_2$. The tumor appeared to be within the lung and surrounded a primary bronchus. Assuming uniform distribution of Ru^{106} in the tissue and exponential removal from the lung with an effective half-life of 36 days, a dose of 300 rad to lung tissue was calculated.

Seventy-eight per cent mortality occurred in a group of 51 mice during a period of 35 weeks after inhalation of 0.45 μc $\text{Pu}^{239}\text{O}_2$. Only four per cent mortality occurred in a group inhaling 0.16 μc and no deaths were noted in those inhaling 0.07 μc .

After one day the thyroids of mice contained an average of 2.5 per cent of the total I_2^{131} inhaled. Two days later the I^{131} level in the thyroid was decreased by half. The pulmonary retention half-time for I^{131} was about four hours.

The whole-body retention half-time of Sr^{90} in mice after inhalation of $\text{Sr}^{90}\text{SO}_4$ for two hours was about 25 days during the period from one to ten weeks after exposure. This is comparable to the whole-body retention of Ru^{106} and Pu^{239} during the same period after inhalation of the oxides. Following cessation of daily exposures (25 hours per week for six months) to $\text{Sr}^{90}\text{SO}_4$ aerosols, the whole-body retention half-time was as long as eight weeks. The skeleton contained 80 to 90 per cent of the total Sr^{90} .

Gastrointestinal Radiation Injury

Fifty rats were used to study the protective action of cysteine injected into sections of the intestinal tract prior to and following 2100 r of x-ray to the abdominal region. No significant protective effects were noted.

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Previous experiments on the effect of radiation dosage and intestinal shielding on nucleic acid metabolism were repeated to improve the statistical validity of the results obtained.

Relative Biological Effectiveness

Experiments using Chlorella grown in Myer's medium containing appropriate concentrations of P32 or tritium gave an RBE for tritium as compared with P32 the same as previously obtained for yeast and bacteria. Pending further tests on dosimetry, this value appears to be close to 1. These tests depended on growth depression. Related viability experiments were unsuccessful due to lack of growth of survivors plated on solid medium.

Techniques for autoradiography of ultra thin sections of yeast were worked out on non-radioactive cells. Following this, yeast cells were exposed to Po²¹⁰, fixed, and imbedded in methacrylate with good retention of the Po²¹⁰ during these processes. The exposure has not been completed so that it is impossible at the moment to be sure of the position of the Po²¹⁰ in or on the yeast cells. Cells smeared by routine blood smear techniques and exposed to thin photographic emulsion showed that the Po²¹⁰ is not present on the cells or in the solution in the form of large aggregates.

Biochemical studies are continuing, and it now appears that yeast cells exposed to x-rays lose up to 16 per cent of their total intracellular phosphorus. Work with P32 indicates that this loss occurs even when the cells are suspended in phosphate buffer.

HA Kornberg /
Manager
BIOLOGY OPERATION

HA Kornberg:es

C. OFFSITE VISITS AND HLO VISITORS

Name		Dates of Visits	Company or Organization Represented & Address	Reason for Visit	H.W. Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
VISITS TO HANFORD WORKS							
Adm. Bledsoe, 5 naval officers, 5 civilians	6/2/58	U.S. Navy	Tour facilities.	Foster, Clarke	No	100-F, 146, 141	
Col. HL Gullickson and Capt. J.M. Garvey	6/4/58	Camp Hanford	Tour facilities	Foster, Clarke, No Bair, Warner	No	" " " and 108-F	
Dr. Walter Claus	6/6/58	AEC, Wash. DC	Discuss Sr90 fallout	Kornberg, Davis, No Thompson, Hungate	No	" " "	
Dr. Daubenmire	6/9/58	WSC, Pullman, Wash.	Soil sampling.	Hanson	No	100-F, 146-FR	
Dr. L. K. Bustad	6/16/58	U. of Wash., Seattle, Wash.	Discuss current animal farm projects.	Clarke, Kornberg	No	100-F, 141-M	
Dr. Olaf Gustav Bjornerstedt	6/16-17	National Research Institute of Defense, Stockholm, Sweden	Discuss fallout.	Kornberg and Staff	No	100-F, 108-F, 146, 141	
18 WSC faculty members and 3 graduate students	6/12/58	WSC, Pullman, Wash.	Tour facilities.	Kornberg and Staff	No	100-F, 108-F, 146, 141	
Dr. J. N. Stannard	6/17-18	Univ. of Rochester, Rochester, N.Y.	Discuss inhalation studies.	Kornberg, Bair and staff	No	100-F, 108-F, 146, 141	
Capt. McIntosh and Maj. Dugaw	6/17	Army Reserve, Yakima Firing Range	Tour facilities	DE Warner, Clarke, No Foster	No	100-F, 108-F, 146, 141	
Dr. H. L. Berke	6/17-18	Univ. of Rochester, Rochester, N.Y.	Discuss inhalation studies.	Kornberg, Bair	No	100-F, 108-F, 146, 141	
Dr. L. W. Tuttle	6/18	Univ. of Rochester, Rochester, N.Y.	Discuss current studies.	Kornberg, Bair	No	" " " "	
15 AEC Radiological Physics Fellows	6/19	Various universities.	Tour facilities.	Clarke, Bair, Foster, Warner	No	" " " "	
Maj. William E. Mayer	6/19	U.S. Army	Tour facilities	Clarke, Foster	No	100-F, 146, 141	
Drs. Howard Rickenberg, Stanley Zahler, Howard Douglas, Charles Evans, Russell Weiser	6/23	Univ. of Washington, Seattle, Wash.	Tour facilities and discuss microbiology.	Hungate	No	108-F - 100-F. 146-FR, 141-M	
Drs. N. B. Everett, John Luft, 6/25 and Lyle Jensen	6/25	Univ. of Washington, Seattle, Wash.	Tour facilities and discuss research.	LA George	No	100-F, 146-FR 141-M, 108-F	

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C. OFFSITE VISITS AND HLO VISITORS (Continued)

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
<u>VISITS TO OTHER INSTALLATIONS</u>					
N. L. Dockum	6/7-11/58	Microscopy Symposium, Chicago; Argonne National Lab., Lemont, Ill. Berkeley, Calif.	Attend symposium and discuss bone sectioning.	McCrone Associates Dr. Norris	No
J. E. Ballou	6/8-13/58	Berkeley, Calif.	Attend Health Physics Mtg. and visit USNRDL	Tompkins	No
M. F. Sullivan	6/8-13/58	" "	Present paper at Health Physics Mtg. and visit USNRDL	Tompkins	No
R. C. Thompson	6/8-13/58	" "	" "	" "	No
D. H. Willard	6/9-12/58	" "	" "	" "	No
W. J. Bair	6/9-11/58	" "	Present paper at Health Physics Mtg.	-	No
P. L. Hackett, B.J. McClanahan, and A. C. Case	6/16-17/58	Portland, Ore.	ACS Regional Meeting	-	No
R. L. Uhler	6/13-20/58	Logan, Utah	Attend AAAS Mtg. and procure soil from Utah State for exptl. purposes.	SA Taylor HB Peterson	No
J. F. Cline	6/15-19/58	Logan, Utah	Present paper at AAAS.	-	No
P. A. Olson	6/21-26/58	Sun Valley, Idaho	Attend Western Division of the Am. Fisheries Soc.	-	No
W. J. Clarke	6/23-25	Salt Lake City, Utah	6th Annual June Mtg. Univ. of Utah	Staff	No
H. A. Kornberg	6/23-25	" " " "	" " " "	Staff	No
J.J. Davis, W.C. Hanson, H.A. Sweary, and G.D. Smith	6/24-7/5	Collection sites in Washington State	Collect samples.	-	-

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D. Lectures

a. Papers presented at meetings

Sullivan, M. F., "Acute Gastrointestinal Radiation Injury in Rats Following Radioisotope Ingestion," Health Physics Society Meeting, Berkeley, California, June 10, 1958.

Thompson, R. C., "Factors Affecting the Relative Deposition of Strontium and Calcium in the Rat," Health Physics Society Meeting, Berkeley, California, June 10, 1958.

Bair, W. J., "Metabolism of Plutonium Oxide after Lung Exposure," Health Physics Society Meeting, Berkeley, California, June 10, 1958.

Willard, D. H., "Metabolism of Inhaled Radioactive Particles," Health Physics Society Meeting, Berkeley, California, June 10, 1958.

Cline, J. F., "Effect of Various Concentrations of Calcium on the Uptake of Sr^{90} by Plants from Deficient Nutrient Cultures," American Society of Plant Physiologists, AAAS, Logan, Utah, June 17, 1958.

b. Seminars

June 17, 1958 - Dr. Olaf Gustav Bjornerstedt, "Fallout Problems"

E. Publications

a. HW Documents

Borasky, R., "Progress Report - Electronoscopic Particle Studies," Document HW-55172, May 1, 1958 (UNCLASSIFIED).

b. Open Literature

Thompson, R. C., M. H. Weeks, O. L. Hollis, J. E. Ballou, and W. D. Oakley, "Metabolism of Radioruthenium in the rat - considerations of permissible exposure limits," Am. J. Roentgenol. 79, 1026 (1958).

Ballou, J. E. and R. C. Thompson, "Metabolism of Cs^{137} in the rat - comparison of acute and chronic exposure experiments," Health Physics 1, 85 (1958).

Palmer, R. F., R. C. Thompson, and H. A. Kornberg, "Effect of calcium on the deposition of Sr^{90} and Ca^{45} in rats," Science 127, 1505 (1958).

Borasky, R., "Reactivite du collagens avec des metaux," Revue Technique des Industries du Cuir, Vol. L, No. 4, 79-87 (April 1958).

Dockum, N.L., E.J. Coleman and G. Vogt, "Detection of Plutonium Contamination in Humans by the Autoradiographic Method," Stain Technology 33, No. 3, 137-142 (1958).

Palmer, R.F. and F.B. Queen, "Normal Abundance of Radium in Cadavers from the Pacific Northwest," Am. J. Roentgenol. 79, No. 3, 521-29 (1958).

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OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

June, 1958

ORGANIZATION AND PERSONNEL

There were no changes in personnel during June.

OPERATIONS RESEARCH ACTIVITY

Economic Studies

Two meetings of the task force for the evaluation of capital expenditures were held during June. After considerable discussion, methods of translating the appropriate production forecasts into a program description suitable for evaluation were agreed upon and this work is proceeding. The methods agreed upon are diverging somewhat from the original conception in that the degree of measurability with respect to production will not be significantly affected.

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

CPD Control Study

An interim report (HW-56453) on this study was issued during the month. Prior to its issuance, several discussions were held with SS Accountability and CPD personnel concerning the appropriate integration of the accountability function and the engineering effort. Several additional reports on specific suggestions are in process.

Other

The study of operator coverage of substations in the outer areas was completed during the month and a report submitted.

At the request of the Irradiation Processing Department, work was started on setting forth philosophy and establishing methods and procedures which would enable more effective control of spare parts. In this connection a method has been devised which appears to be useful in setting up minimum stock levels, "when to order," and also "how much to order" when this minimum is reached. Investigation of applicability of this method and other phases of the spare parts problem is continuing.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Metallurgy

A statistical analysis was completed this month of a recent pilot study investigation of certain physical properties of annealed zircaloy as a function of temperature and hydrogen content. The report submitted included a discussion of the facets of the experimental technique responsible for the excessive experimental error observed in the data. Improvement in these areas would result in increased precision in future experiments.

A problem of heat transfer in metallurgical samples which are to be irradiated in a reactor was considered. The appropriate four-region, non-homogeneous partial differential equation and boundary value problem was set up, and approximate solutions obtained.

Assistance was given in designing a computational scheme for the interpretation of experimental data obtained in x-ray diffraction studies of irradiation-damaged materials. An appropriate program was developed and has been turned over to the Data Processing Operation for implementation.

2000 Program - Reactor

Discussions were held concerning the derivation of propagation of error formulas for estimating the precision of parameter estimation involved in k_{∞} calculations.

2000 Program.- Separations

Work continued on the computation of confidence interval estimates of parameters which occur in buckling studies.

Development and evaluation of a mathematical model to study the behavior of a proposed radiative heat calcinator was discussed. The problem was one of developing expressions which could be used to estimate the quantity of radiative heat available at any point within a cylindrical calcinator under various assumptions on the distribution and intensity of heat sources, and the opaqueness of the medium of radiative transfer.

Assistance was given in setting up a mathematical model to study the operational characteristics of an inductive heater which is being designed in connection with the Cesium recovery program.

6000 Program - Biology and Medicine

Work continued on the development of a migration model to depict the transfer of radioactive tracer particles from region to region within a biological system. Current effort is directed toward applying the general model to radiocalcium-strontium deposition studies on mice.

Assistance was provided in connection with the statistical analysis of data on the chronic feeding of radiophosphorus to Rainbow trout. With slight revision to account for the chronic feeding aspect of the experiment, in lieu of a single acute dose, the above migration model will apply to this problem. Work continues in this area.

Further discussions were held concerning an optimum sampling scheme for the detection of malignant tumors in the lungs of mice which have been administered a carcinogenic agent.

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STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

Process Control - Fuels Preparation Department

Control charts have been maintained in the past on various reject categories using composite values for all canning lines over a period of a shift or longer. However, experience has shown that there are significant differences between canning lines. Also, control charts in which results lag by as much as a shift do not really function as controls, but only as historical records. For these reasons, recommendations have been made on various occasions that charts be maintained by line, and that the lag time be reduced to one hour. These recommendations have recently been adopted for braze layer contamination rejects on those lines canning solid fuel elements with gratifying results.

It is known from past experience that the voltage setting on the bond tester necessary to reject a standard with a given void area is a variable quantity. This has been overlooked on occasions with the result that the instrument has been adjusted when adjustments were not necessary. Assistance was given in designing experimentation to evaluate this inherent variability. This will result in a control chart which will indicate when adjustments are necessary, i.e., when the voltage setting required to reject the standard needs to be changed.

Pre-irradiation warp data were submitted for analysis to assist in determining appropriate specifications on warp for permitting re-canning of a rejected fuel element. These data consisted of the maximum recorded warps for a number of samples of size N. From these data, inferences were drawn as to the distribution of individual pre-irradiated warp values for the whole population by working with the distribution of the maximum of N observations.

Process Experimentation - Fuels Preparation Department

An experiment was designed to evaluate possible causes of excessive porosity as reflected by total bond count.

In an effort to reduce the loss of uranium during fuel element recovery, several methods of processing recovered fuel elements were used experimentally, and the resulting data analyzed as requested.

Acceptance Sampling - Fuels Preparation Department

A rough draft of a document describing in detail sampling plans for use in acceptance of aluminum components was submitted for comments. A major recommendation which was adopted concerned the use of variables plans for two-sided as opposed to two one-sided specifications.

Absenteeism - Fuels Preparation Department

An evaluation of the "blue Monday" index as a measure of "voluntary" absenteeism was made as requested. Also, absenteeism data from calendar year 1957 were described statistically, and tests of significance between different groups with respect to absenteeism experience were performed.

Production Tests - Irrad. Proc. Dept. and Fuels Prep. Dept.

A document was issued explaining the bases for using an additional statistic to describe the dimensional distortion of irradiated fuel elements. The statistic, called the tube filling capacity, is in most cases the arithmetic sum of the concave warp and the diameter growth (which may be negative) at the fuel element center.

Dimensional distortion data from Production Test IP-508A-87FP were analyzed, primarily to compare alpha extruded with alpha rolled (standard) fuel elements. Since this was the first production test utilizing the finer breakdown of data necessary for calculating the tube filling capacity, several interesting results were found relating to the behavior of fuel elements with respect to the type and degree of distortion experienced as a function of position within a tube.

Rupture Analyses - Irradiation Processing Department

A rather complete study was made of certain production test data and other existing visual examination data in order to determine factors which influence the occurrence of hot spots. The subjectivity of the data, which gave rise to some glaring inconsistencies, obscured the results in general, although one interesting relationship between the flux pattern and the distribution of hot spots was observed. Specific recommendations were given for further study along this line.

General - Irradiation Processing Department

Assistance was requested with the integration of several $K_{1/2}$ -Functions in the hope that a relatively simple expression could be found, thereby obviating a large scale computing program. Such an expression, involving sums of products of Bessel functions, was derived for one of the integrals.

Final Products Specifications - Chemical Processing Department

Some tentative acceptance limits were determined for Pu chemical assay results on the final products. The limits were based on a somewhat different rationale than that used in the past. While the consumer's risk remains small, the limits are more liberal from the producer's standpoint than before. It is expected that these limits will change somewhat when more data, and consequently better estimates of pertinent variances, become available.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIESActivities for other Departments

A report was written to point out quantitatively how mathematical dependency gives rise to non-zero correlation coefficients. This situation arises in particular when correlating B-PID's with inventory differences. The serial correlation between successive B-PID's was also quantified on this basis.

Activities within HLO

A discussion was held to clarify the results, and the interpretation of results, of a recent analysis of the sensitivity of duPont and Eastman personal monitoring film.

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OFFSITE VISITS AND VISITORS

H. Poritsky of the General Engineering Laboratory visited on June 2 for consultation on applied mathematics.

Myron Tribus of UCLA visited on June 10 for consultation on engineering systems analyses.

W. Scott Hill of Engineering Services visited on June 23 to discuss recruiting practices.

Carl A. Bennett

Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

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PROGRAMMING OPERATION
JUNE 1958

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. Rare Gas Recovery

As a part of the continuing activity related to the rare gas recovery problem, study was initiated on the feasibility and justification for the preparation of fractions of the rare gases highly enriched in certain components by techniques of isotope separation. The thermal diffusion method has received most attention. Experienced personnel at Oak Ridge are also assisting in this study.

2. Non-Production Fuels Reprocessing

The cost study on the installation of the Darex process in 221-U plant for the preparation of feed for Redox processing of stainless steel clad power reactor fuels was completed. This high-chloride process which involves dissolution of the whole fuel element, boil-down to remove chloride, neutralization for disposal of the chloride containing condensates and storage of the chloride-free fuel element solution for delivery to the Redox plant utilizes titanium for all the high-chloride solution processing equipment. Other corrosion resistant alloys, such as Hastelloy B, Haynes-25 and stainless steel are to be used wherever required to minimize the use of costly titanium. The Darex equipment capable of processing two tons of uranium per day will require three cells in the 221-U Building. Not included in this study are the facilities for fuel element handling prior to the dissolution and the transport line for delivery of the feed to the Redox plant. Project costs have been transmitted to Research and Engineering of the Chemical Processing Department.

B. REACTOR DEVELOPMENT - 4000 PROGRAM

1. Plutonium Recycle Program

Non-Recycle Burn-up Analysis

Several revisions in the "Lambda" code described last month were made on the basis of the first runs. The code, now known as WESSEX B, now computes the quantity

$$\Lambda(\tau) = \frac{-\int \ln p(\tau, r, s)}{\sum_k N_k(\tau) (I_{ak} - v_k \in p I_{rk})}$$

and its exposure average. This average is now identified with the ratio of the fuel mass to the volume and slowing-down power of the moderator for the case of continuous-irradiation fuel cycles. Results show clearly the requirements for designing a physical lattice to meet prescribed spectrum conditions. One anomalous case was found, consisting of a

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mixture of Pu-239 and U-238 at low neutron temperatures. In this case the contributions of resonance fission in Pu-239 and resonance absorption in Pu-239 and Pu-238 nearly compensate initially so that relatively little moderator is required to provide a highly thermalized spectrum. Buildup of 240 with only slight exposure then has a drastic hardening effect. It should be noted that effects such as this which produce softening or hardening of the spectrum as a whole may often have the opposite effect on the thermal portion alone.

Plutonium Fuel Values

Debugging was accomplished of the IBM programs used to determine plutonium values, and runs were made in production quantities.

The current analyses being performed deal with well thermalized reactors operating in an American utilities environment using 15 per cent per year depreciating and 12 per cent per year non-depreciating capital charges and the current AEC price schedule.

During the month the following reactor parameters were used to calculate plutonium recycle fuel costs with varying fabrication costs of \$20, \$30 and \$40 per pound of uranium and plutonium values of \$5 and \$15 per gram.

<u>Temperature</u>	<u>K_{∞}/ϵ</u>	<u>p</u>	<u>f</u>	<u>Specific Power MW/T</u>
400 80	1.10	0.9	0.95 0.90 0.80	15, 10, 5, 1, 0.5, 0.1
400 80	1.10	0.7	0.6	1.0
200	1.15	0.9	0.95 0.90 0.80 0.70 0.60	10.
200	1.20	0.9	0.95 0.90 0.80 0.70 0.60	10

In addition, separations costs were varied (\$2, 4, 8, 12, 16 and 20) with the following reactor parameters:

Temperature	200 C
K_{∞}/ϵ	1.10
p	0.90
f	0.80
Specific Power	10 MW/T

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Due to some difficulty in correlating recycle output data with input to the IBM 702 plotter program, only 370 plots thus far have been obtained. It is expected that the balance of the data can be ready for the plot program by the first of August. Correlation and tabulation of results in terms of a probable market value of plutonium may then be undertaken.

Other parameters are scheduled for future computer work. These include various interest rates, plutonium separations costs, plutonium losses during processing, and reactor operating efficiencies.

Charge-Discharge Schedules

Tentative schedules for fueling the PRTR were circulated for comment by Laboratories personnel concerned with producing fuel elements. Both schedules, one with lightwater reflector and one with heavy water reflector, can be met easily with proposed facilities. Based on refined physics calculations now being made, the schedules will be revised, if necessary. It is anticipated that these schedules will be the subject matter of a report and distributed to Laboratories personnel in early August.

Design Support

Strength of monel shim rods was calculated. The monel is approximately 25 per cent more strongly absorbing than stainless steel, in accordance with the cross section ratio.

PRTR Reflector Material

Relative advantages of light water and heavy water reflectors were considered. Both appear feasible for operation of the reactor with definite, but not decisive, advantages of the latter reflector material in terms of experimental and operational flexibility. A recommendation was made that the initial operation of the PRTR be with a heavy water reflector, providing funds are available for its acquisition.

Task Schedules and Facilities

Task schedules for Physics and Instruments Research and Development Operation have been completed and have been submitted as an example of the "schedule book" format. Information for the task schedules for Reactor and Fuels Research and Development and Chemical Research and Development Operations is being compiled.

A survey of chemical processing facilities now available or to be acquired that may be applicable to the Plutonium Recycle Program has been completed. This survey includes the major or unique facilities belonging to Chemical Research and Development Operation and the facilities in the 234-5 Development Laboratory operated by Chemical Processing Department. Information on facilities in Reactor and Fuels Research and Development and Physics and Instruments Research and Development is being compiled.

C. OTHER ACTIVITIES

The 1958 "Summer Institute on Nuclear Energy - Chemical Processing" program was begun with attendance of ten professors and one AEC representative from the Savannah River Office. The ten lectures, three tours and other activities for the period were completed as scheduled.

A training course on the use of the recently received Litton 20/40 Differential Digital Analyzer was completed at the manufacturer's plant by one Programming Operation engineer. As further experience is obtained in the test operation of this new research tool, this engineer will assist in the instruction of others as required.

Calculations on the Wahluke Slope were presented to the GE Advisory Committee on Reactor Safeguards on June 5 and 6, 1958.

Calculations of meteorological consequences of a reactor accident were presented to the GE Reactor Safeguards Council in Denver on June 24, 1958.

All photos for the Geneva exhibits on Plutonium Recycle and Plutonium Fuel Fabrication for the MFR were forwarded to the exhibit design contractor, W. D. Teague Associates in New York. Copies were sent to AEC-OIC in Washington.

Major William E. Mayer, U.S. Army psychiatrist, addressed the second meeting of the Colloquium on June 19 on the subject "Educational Principles of Communist Indoctrination." The Colloquium was exceptionally well received.

An organization directory for the Hanford Laboratories in which is indicated the field of activity and abilities of persons engaged in research and development work was printed and distributed.

W. H. Reas

for Manager, Programming Operation

WH Reas:dl

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VISITS TO HANFORD:

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Name	Dates of Visit	Company or Organization Represented & Address	Reason for Visit	HAPD Personnel Contacted	Access to Restricted Data	Bldgs. & Areas Visited
Ed Albenisius	6/2 thru 6/6/58	DuPont Savannah River Plant	Discuss problems in radiation protection and status of research work.	JW Healy	Yes	3746, 300
Dr. W.D. Claus	6/4-5-6/58	AEC Washington, D. C.	Review programs in Biology & Medicine	JW Healy	Yes	3746, 300
Dr. C.R. McCullough	6/5-6/58	Chairman, Advisory Committee on Reactor Safeguards	Review Wahluke Slope problem.	JW Healy	Yes	3760, 300
J. R. Powell	6/9-10/58	Brookhaven National Laboratory, Upton Long Island, New York	To discuss plutonium recycle data.	JR Triplett M Lewis EA Eschbach	No	713-A, 700

4-5

VISITS TO OTHER INSTALLATIONS:

Name	Dates of Visit	Company Visited & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
R.W. Benoliel J.G. Bradley J.R. Triplett	6/2-5/58	American Nuclear Society Los Angeles, California	Attend ANS meeting.	----	No
J.G. Bradley	6/6/58	Atomics International Canoga Park, California	Discuss Pu-U separations processes & reactor fuel design & testing.	F.C. Gronemeyer	Yes
6/9-13/58	Litton Industries Beverley Hills, Calif.	Operation and maintenance course on a purchased item.	J.B. Davis	No	
6/16/58	Vallecitos Laboratory Livermore, Calif.	Discuss utilization of test facilities.	F. Coyle	Yes	

HW-56640

DECLASSIFIED

VISITS TO OTHER INSTALLATIONS (CONT.)

	Dates of Visit	Company Visited & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
J.W. Healy	6/23-24/58	G.E. Reactor Safeguards Council, Denver, Colorado	Presented calculations.	Karl Cohen and members of Council.	Yes
M. Lewis	6/16-17	American Chemical Society Portland, Oregon	Chairman of Physical Chemistry Session of the N.W. Regional Meeting of the ACS.	----	No
	6/29 and 7/1/58	Oak Ridge School of Reactor Technology, Oak Ridge, Tenn.	To give a lecture on Hanford technology at their request.	F. P. Napp	Yes
J. R. Triplett	6/6/58	American-Standard, Atomic Energy Division Mountain View, California	To discuss RBU computer code work concerning their contract with us.	E. J. Leshan	No
E. T. Merrill	6/23-24/58	Mound Laboratory Miamisburg, Ohio	Consultation and inspection pertaining to isotope separations processing.	C.R. Grove	Yes
	6/25/58	Oak Ridge National Lab. Oak Ridge, Tenn.	"	G.A. Garrett	Yes
	6/26/58	W. Kidde Labs Garden City, Long Island, N.Y.	"	S.A. Lenin P. Miller F.A. Zenz	Yes

RADIATION PROTECTION OPERATION
MONTHLY REPORT-JUNE, 1958

A. ORGANIZATION AND PERSONNEL

Roberta C. Buchanan and J. F. Stevens terminated on June 9 and June 27, respectively. A. R. Maki transferred from IPD and L. E. Munson transferred to IPD on June 16, 1958. Eula M. Smith and Gayla R. Baird transferred to Relations & Utilities and Lena V. Nelson transferred to Facilities Engineering-HLO on June 30, 1958.

B. ACTIVITIES

Two minor cases of plutonium deposition were confirmed following inhalation exposures in the 234-5 Building. A contaminated puncture wound occurred to an employee in the 234-5 Building during the removal of plutonium waste from a hood. High-level contamination in the immediate vicinity of the wound indicated the necessity to excise a small piece of tissue from the finger tip. Large-crystal monitoring results indicated that less than 5% of the MPL remained in the finger at the site of the wound. Analysis of the excised tissue indicated that about 5% of the MPL was removed. No radiation incidents occurred in which permissible limits were exceeded.

Fabrication of the body monitoring cell is in progress at Todd Shipyards, Seattle, Washington. Negotiations for extra costs were settled at \$4,400 total instead of the \$17,000 originally requested by the vendor. The edges of all steel plates that butt together and the door will be milled and the other edges will be flame cut. The estimated arrival time at Hanford for the cell is about October 15 with another two months for completion of the facility. These delays in cell fabrication will probably extend the completion date to the full contract time which is about the end of the year.

Microfilming of 1957 exposure records was completed.

The average weekly stack emission of I^{131} from separations areas decreased as a result of an extended shutdown of the Purex facilities to permit modification of the processing equipment. All measurements of I^{131} on vegetation outside of the plant perimeter were below the detection limit of 1.5×10^{-6} $\mu\text{c}/\text{gram}$. Minor amounts of nuclear bomb debris fallout continued.

Concentrations of radioactive materials in the Columbia River water at 100-F area and Pasco were normal. The seasonal peak flow in the Columbia River occurred around June 5. The maximum flow rate was about 400,000 cfs.

Half of the order for 3,000 neutron monitoring badges was received. This badge contains NTA film as well as regular beta-gamma film which will provide for the measurement of fast neutrons with the NTA film and for the slow neutrons through activation of the cadmium shield and the resulting darkening of the beta-gamma film due to the emission of beta and gamma rays from the cadmium.

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Drafting and detailed design were completed on the feed system for the badge processing machine. It was demonstrated that eddy current measurements can be used for the detection of missing shields in the film badges. Such a detection procedure will be incorporated on the present machine.

Debugging of the conversion of bioassay data to electronic data processing machines continued. The conversion should be completed in July. Some difficulty was encountered with the low-level pencil reading system because of hot weather during the past few weeks. This difficulty was centered in those pencils which were used by Regional Monitoring and which were exposed to the sun throughout the day. Small sun shades were fabricated and other steps were taken to remedy the erratic readings due to the heat.

Film calibration and source handling equipment for the PuF_4 neutron source was assembled and ready for operation in Calibrations. Calibrations, using this new neutron source, will start in the near future. This calibration will permit more accurate evaluation of the dose received from neutrons encountered in the 234-5 operation.

Dose rates encountered by construction personnel who are working on Project CG-682 in the 327 Building were as high as 1.5 r/hr. Dose rates up to 300 r/hr were measured two inches from the waste line after flushing B-cell in the 327 Building. Body dose rates up to 2 r/hr were encountered upon entry between the faces of the Physical Constants Test Reactor. Handling of Ra-Be sources at a distance of six feet caused personnel dose rates of 1 rem/hr.

Three technical papers were presented at the annual meeting of the Health Physics Society at Berkeley, California.

C. EMPLOYEE RELATIONS

Advance notice was given to all Exposure Evaluation & Records personnel about the planned reduction of force which will take place in the latter part of the year. Each employee was contacted and provided with specific information pertaining to his job security. Three affected employees were placed in positions outside of the Radiation Protection Operation.

Working conditions were improved in the Bioassay Laboratory by the installation of bulk acid dispensing equipment, installation of additional heating facilities and thermostatic controls, and provisions for installation of a sink and cabinet in the lunchroom.

Selection of the employee who will operate the body monitoring facility was made. This employee will be in training with Radiological Physics personnel until start up of the facility.

Negotiations with Regional Monitors did not progress. It is understood that a poll by mail of the entire membership took place to determine whether or not the Bargaining Unit would accept the Company's offer. The results of the survey by the Union are not known.

There were three medical treatment injuries for a frequency of 1.24. No security violations occurred during the month.

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Nine suggestions were submitted by RPO personnel. Five suggestions were received for evaluation and seven were completed. Two RPO employees divided a suggestion award for \$5.00.

D. SIGNIFICANT REPORTS

HW-54842 - "Radioactive Contamination in the Hanford Environs for the Period October, November, December, 1957" by M. W. McConiga, J. M. Selby, and J. K. Soldat.

HW-56226 - "Regional Monitoring Activities, May, 1958" by Regional Monitoring personnel.

HW-56550 - "Monthly Report - June 1958, Radiation Monitoring Operation" by A. J. Stevens.

"Inventory of Radioactive Liquid Wastes to Active Disposal Sites - March, 1958" by R. M. Bernard.

RECEIVED
[REDACTED]

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Buildings	Areas and Buildings
E. L. Albenisius	6/2/58 thru 6/6/58	E. I. du Pont, Aiken, South Carolina	Discuss procedures for regional monitoring, bioassay, and personnel meters	AR Keene and Staff	Yes	3746, 3706 3705, 329:300 747:700
G. H. Daly	6/3/58 thru 6/6/58	AEC, Savannah River, Aiken, So. Carolina	Discuss radiation protection procedures & problems	AR Keene and Staff	Yes	3746, 3706 3705, 329:300 747:700 2723, 2724:200-W
A. Way	6/4/58	G. E. Co., Schenectady New York	Discuss audit of RPO	AR Keene	No	3746:300
W. D. Claus	6/5/58	AEC, Div. of Biology and Medicine, Washington, D. C.	Discuss functions and organization of RPO	AR Keene	No	3746:300
J. V. Nehemias	6/6/58	The Nat'l. Sanitation Foundation, Ann Arbor, Michigan	Environmental survey techniques and instrumentation	AR Keene BV Andersen	No	3746, 329:300
R. F. Moffer H. E. Klode	6/12/58 and 6/13/58	ANP, Cincinnati, Ohio	Discuss radiation protection procedures	AR Keene and Staff	Yes	3706, 3705 3746:300 747:700
R. H. Boutelle	6/12/58 and 6/13/58	Brookhaven Nat'l. Lab., Upton, New York	Health Physics aspects of pile and hot laboratories	AJ Stevens BG Lindberg	No	3746:300
W. H. Darlington	6/16/58	Dawn Mining Co., Ford, Washington	Observe air sampling and uranium analysis	GM Rolph GD Brown	No	329, 325:300 747:700

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VISITS TO MANFORD WORKS (Continued)

R. Merritt	6/17/58	Arva Seattle, Washington	Discuss equipment	TC Mehas FL Rising	No	3706:300
E. Pollock	6/17/58	Victoreen Inst. Co., Cleveland, Ohio	Discuss equipment	TC Mehas FL Rising	No	3706:300

VISITS TO OTHER INSTALLATIONS

G. A. Little	6/9/58 thru 6/14/58	UCRL, Berkeley, California Aerojet Gen'l. Nucl., San Ramon, California	Discuss radiation protec- tion problems with emphasis on neutron monitoring	RJ MacGill DR Sawley	Yes No	
E. C. Watson F. L. Rising M. V. Clukey	6/9/58 thru 6/12/58	Univ. of California, Berkeley, California	Present a paper at and/ or attend Health Physics Society Meeting	JF Ege, Jr (ANL) LC Emerson (ORNL)	No	
R. L. Junkins	6/15/58 thru 6/23/58	Bar Ray, Brooklyn, NY Lexington, Ky. Sig. Depot E.I. du Pont, Parlin, New Jersey Eastman Kodak, Roch- ester, New York Bureau of Standards, Washington, D. C.	Examine equipment for film dosimetry and discuss film dosimetry problems	WE Sandman CO Slover RL Kuber EM Cleare M Ehrlich	No	
W. V. Baumgartner	6/26/58 thru 6/27/58	AEC, Idaho Falls, Idaho	Discuss and observe operation of automatic Personnel film process- ing system	M Wilhelmsen	No	
A. J. Stevens	6/2/58 thru 6/4/58	Atomics International, Canoga Park, Calif. Univ. of California, Los Angeles, Calif.	Observe the radiation protection program	JC Land IB Silverman	No No	

REGIONAL MONITORING - RESULTS (May 26 - June 22)

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Monthly Average</u>	<u>Units*</u>	<u>Trend** Factor</u>
<u>Drinking Water</u>				
100-F Area	Isotopic	0.3	% MPCGI	-3
Separations Areas	Total Beta	1.5×10^{-7}	$\mu\text{c/cc}$	--
Pasco	Isotopic	0.17	% MPCGI	-2
Kennewick	Isotopic	0.12	% MPCGI	-5
Richland	Total Beta	$<3.0 \times 10^{-8}$	$\mu\text{c/cc}$	--
<u>Columbia River Water</u>				
Above 100-B Area	Total Beta	4.1×10^{-8}	$\mu\text{c/cc}$	--
100-F Area	Isotopic	1.4	% MPCGI	-4
Hanford Ferry	Total Beta	8.8×10^{-6}	$\mu\text{c/cc}$	-3
Pasco	Isotopic	0.55	% MPCGI	-3
McNary Dam	Total Beta	6.6×10^{-7}	$\mu\text{c/cc}$	--
Vancouver, Washington	Total Beta	2.5×10^{-7}	$\mu\text{c/cc}$	--
<u>Waste Water</u>				
Outlying Test Wells	Total Beta	$<2.0 \times 10^{-7}$ (max)	$\mu\text{c/cc}$	--
Reactor Effluent Retention Basins to River	Total Beta	23,000	curies/day	--
<u>Atmosphere</u>				
Gross Dose Rate -				
Separations Areas	Beta-gamma	0.8	mrad/day	--
Residential Areas	Beta-gamma	0.9	mrad/day	-2
I-131 Separations Areas	I-131	9.8×10^{-13}	$\mu\text{c/cc}$	--
I-131 Separations Stacks	I-131	4.4	curies/week	-2
Active Particles - Project	--	5.5	ptle/100 m ³	--
Active Particles - Environs	--	6.6	ptle/100 m ³	--
<u>Vegetation</u>				
Separations	I-131	4.6×10^{-6}	$\mu\text{c/gm}$	--
Residential	I-131	$<1.5 \times 10^{-6}$	$\mu\text{c/gm}$	--
Eastern Washington and Oregon	I-131	$<1.5 \times 10^{-6}$	$\mu\text{c/gm}$	--
Fission Products less I-131 - Wash. and Ore.	Beta	5.1×10^{-5}	$\mu\text{c/gm}$	--

* The % MPCGI 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.

<u>RADIATION MONITORING</u>	<u>Hanford Laboratories</u>	<u>Minor & Major Construction</u>	<u>Others</u>	<u>June</u>	<u>1958 to Date</u>
Special Work Permits	1,401	99	465	1,965	11,837
Routine and Special Surveys	1,419	111	208	1,738	9,812
Air Samples	2,274	3	259	2,536	14,501
Skin Contaminations	6	2	0	8	39
*Class II Radiation Incidents	0	0	0	0	0
**Class II Radiation Incidents	0	0	0	0	11

EXPOSURE EVALUATION AND RECORDS

<u>Gamma Pencils</u>	<u>Pencils Processed</u>	<u>Paired Readings 100-280 mr</u>	<u>Paired Readings Over 280 mr</u>	<u>Lost Readings</u>
June	39,628	24	4	1
1958 to Date	271,750	217	30	17

Beta-Gamma Film Badges

	<u>Badges Processed</u>	<u>Readings 100-300 mrad</u>	<u>Readings 300-500 mrad</u>	<u>Readings Over 500 mrad</u>	<u>Lost Readings</u>	<u>Average Dose Per Film Packet</u>	
June	22,415	673	33	13	33	<u>mr(ad)ow</u>	<u>mr(s)</u>
1958 to						2.76	8.34
Date	131,367	4,834	153	46	250	3.10	9.38

Slow Neutron Pencils

	<u>Pencils Processed</u>	<u>Paired Readings 4-12 mrem</u>	<u>Paired Readings Over 12 mrem</u>	<u>Lost Readings</u>
June	3,416	32	25	1
1958 to Date	23,368	275	94	8

Fast Neutron Film Badges

	<u>Badges Processed</u>	<u>Readings Above 50 mrem</u>	<u>Lost Readings</u>
June	1,094	0	1
1958 to Date	6,969	11	6

Bioassay

	<u>June</u>	<u>1958 to Date</u>
Plutonium: Samples Assayed	1,103	7,721
Results above 2.2×10^{-8} $\mu\text{c/sample}$	37	249
Fission Product: Samples Assayed	1,147	8,013
Results above 3.1×10^{-5} $\mu\text{c FP/sample}$	4	20
Uranium: Samples Assayed	350	1,961
Confirmed Plutonium Deposition Cases	2	13*

*HLO Radiation Monitoring Customers

**Other Plant Components

*Bringing all-time MAPO total to 225

Uranium Analyses

<u>Sample Description</u>	<u>Following Exposure</u> <u>Units of 10^{-9} μc U/cc</u>			<u>Following Period of No Exposure</u> <u>Units of 10^{-9} μc U/cc</u>		
	<u>Maximum</u>	<u>Average</u>	<u>Number</u> <u>Samples</u>	<u>Maximum</u>	<u>Average</u>	<u>Number</u> <u>Samples</u>
Fuels Preparation	10.8	3.6	47	7.5	2.6	42
Hanford Laboratories	122.9	15.1	31	318.7	18.4	27
Chemical Processing	21.3	4.1	59	34.7	4.0	61
Chemical Processing*	152.5	19.8	26	12.9	3.5	25
Special Incidents	0	0	0	0	0	0
Random	7.8	1.3	32	0	0	0

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

Thyroid Checks

	<u>June</u>	<u>1958 to Date</u>
Checks Taken	8	25
Checks Indicating >0.01 μ c	0	0

Hand Checks

Checks Taken - Alpha	46,672	281,708
- Beta-Gamma	37,792	230,637

CALIBRATIONSPortable Instruments

	<u>June</u>	<u>1958 to Date</u>
CP Meter	930	5,778
Juno	303	1,923
GM	1,246	7,857
Other	205	1,316
Total	2,684	16,874

Personnel Meters

Badge Film	1,032	6,736
Pencils	5,984	27,587
Other	418	2,076
Total	7,434	36,399

Miscellaneous Special Services

220 5,200

Total Number of Calibrations

10,338 58,473

A. R. Keene
A. R. Keene, Manager
RADIATION PROTECTION

ARK:kc

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - JUNE, 1958

GENERAL

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 2.66 per cent which is considerably below average experience.

The absenteeism rate was 1.94 per cent, which is a substantial improvement over the year to date experience.

There were no security violations charged to the Operation.

TECHNICAL SHOPS OPERATION

Total productive time for the month was 12,187 hours. The total shop work backlog is 18,513 hours of which 60% is required in the current month, with the remainder distributed over a three month period. Overtime worked during the month was 2.8% (483 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
Fuels Preparation Department	2081	17.0
Irradiation Processing Department	850	7.0
Chemical Processing Department	847	6.9
Hanford Laboratories Operation	8080	66.4
Construction Engineering Operation	211	1.7
Miscellaneous	118	1.0

The total backlog of work decreased from the previous month, which is normal for this period. Requests for emergency service remained high, resulting in a higher than normal overtime level.

Security performance was considered satisfactory with no violations. Safety performance showed an improvement, if the number of medical treatment injuries is used as the criteria. Seven medical treatment injuries were experienced in June versus 14 for the month of May. No major injuries occurred.

A major piece of equipment, a Cincinnati horizontal, universal milling machine, was received and installed.

RADIOGRAPHIC TESTING OPERATION

Activity for the Radiographic Testing Operation remained at a high level for the past month. A total of 3,823 tests were made, of which 1,773 were radiographic exposures (including X-ray and gamma ray) and 2,050 were supplementary tests. The supplementary test work included ultrasonic (thickness measurements and flaw detection), eddy current, dye penetrant, dimensional measurements (micrometric and air gauge and densitometry). The other indices of activity remain at substantial levels. The feet of material examined amounted to 7,183. This amount represents work on 2,670 pieces. Work was done for 14 different organizational components

representing most of the operating departments and service organizations. A total of 18 reports were issued, detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on 26 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in part II.

Work on the mobile laboratory for testing field work has been delayed. The AEC has requested a detailed work break-down to establish usage of the equipment. Design work has been slowed down pending development of the information that has been requested.

Testing Statistics

<u>Component</u>	<u>No. of Tests</u>	<u>Ft. of Weld or Material</u>	<u>No. of Pieces</u>	<u>Description</u>
A. Chemical Processing Department	20	27	14	Test-weld plates, wet ammonia scrubbers, SS. D-6 drain line, 234-5 Bldg., 2-W, 8" sch 40, 347 SS.
B. Construction Engineering Operation	139	330 1/2	81	Recirculating gas loop. 3x3 process loop for ETR, SS welding coupons, 12" CS pipe filled with water.
C. Hanford Laboratories Operation	3435	6595 1/2	2393	I&E fuel elements, UO ₂ clad in SS, Zircaloy. SS sheathed T.C. MTR aluminum control rods, cores, rolled plates and finished fuel plates. Density scans of fuel plates. Zirconium tubular products. KER ribless Zr process tubes, DDR-11.
D. Irradiation Processing Department	96	84	31	Welds on CS air receivers, backing bar intersections to girth seams on He storage tanks. Thickness measurements on riser piping rear face, 105-B.
E. Relations & Utilities Operation	133	136	151	Testing of linemen's climbers, belts, buckles, etc. Develop technique to detect amount of rotting of power poles.
Totals	<u>3823</u>	<u>7183</u>	<u>2670</u>	

FACILITIES ENGINEERING OPERATIONResponsibility

Responsibility for Suggestion System coordination for Laboratory Auxiliaries was transferred to Technical Information Operation.

Project Activity

Project status and current activity is included in the attached project report and summary.

Projects

Following is a summary of project activity:

Number of Authorized Projects at End of Month	23
Projects Authorized During Month	3*
Projects Completed During Month	1**
Project Proposals Submitted to AEC During the Month	2***
Projects Awaiting AEC Approval	2****
Project Proposals in Preparation.....	4#
Total Authorized Projects Funds	\$ 6,482,300
Total Estimated Cost of Authorized Projects	\$ 9,545,300
Service Engineering During Month (Approximate).....	\$ 4,550

* CGH-790, High Level Radioactive Material Receiving & Storage Addition - 327 Bldg.
IR-240, Removal of Obsolete Melt Plant Equipment - 314 Building.
CGH-809, Electrical Modifications - 328 Bldg. (Dir. HW-467, 6-30-58).

** CG-733, Plutonium Metallurgy Facility.

*** CGH-809, Electrical Modifications - 328 Bldg.
CGH-805, High Temperature Tensile Testing Cell - 327 Bldg.

**** CG-760, Expansion of 3745-B Facility
CGH-805, High Temperature Tensile Testing Cell - 327 Bldg.

Crane Improvements - 327 Building.
Biology Facility Addition - 108-F Building.
300 Area Waste Disposal Facilities Expansion.
Dynamic Test Facilities - 314 Building.

Engineering ServicesTitleStatus

Modification of Elevator - 327 Building.

AEC-H00 will negotiate with the Security Fire Door Company for this work during week of 7-1-58.

Acid System & Acid Dispenser Installation - Bioassay Lab - 747 Building.

Complete. Minor alterations to be made in system.

Install Intercom System - 326 Building.

Work Completed.

Resistance Seam Welder - 325 Building.

Work approximately 90% complete.

Repair Damaged 100-KW Water Heater, HEW-445692, for Code Compliance.

Work completed.

Move Army Hutment and Install Near 108-F Building.

Preliminary grading of hutment site near SW corner of 108-F has been completed. The concrete curtain walls and footings have been poured and earth fill placed and compacted for slab support. Re-inforcing for floor slab has been placed. The 20' x 48' hut, No. T-21-7G was moved from Army Site H-21 and placed on foundation walls. AEC was notified.

Electrical Service - 325 Building.

Job complete except for installation of circuit breaker. Breaker was shipped by vendor on June 27, 1958.

Install Hot Water Heater - 327 Building.

Installation complete, except for insulation of the tank.

Clean Up West End of 314 Building.

Construction Operation is performing the work. Job is about 65% complete.

Service and Outlets - 141-H Building.

Job complete, will be closed out when "As Builts" are finished.

Greenhouse - Roof of 108-F Building.

Costs of installing greenhouse on roof of 108-F are excessive. Other possible sites are being investigated.

Development for Biology Operation.

Study is approximately 90% complete.

Installation of New Hood, Laboratory 14-A, 329 Building.

GE Purchasing has requested vendor information from S. Blickman Co. Purchase order for circuit breaker for induction generator issued, delivery expected 8-15-58.

Pig Farrowing House - 100-F Animal Farm.

Work complete.

TitleStatus

Sprinkling System for Aquatic Biology
Building - 100-F.

Construction Operation was given a Work Order for \$1,750 to perform necessary work in pond area and two sides of the building. Excavation for the underground piping system has been started.

Extend Annunciator System - 1706-KE
Building.

Installation drawings are being re-vised to comply with the IPD recommen-dations.

Canopy and Lean-to 141-H Building.

Work complete.

Heating and Ventilating Study - 325 Building.

Study 75% complete.

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

Truck inspected. Components of fab-rication being studied.

Investigate Ventilation 321 Building and
Make Recommendations.

Work complete..

Provide Operating and Safety Improvements -
340 Building Tank Pit.

Methods of performance being reviewed.

Engineering Study - Increase Heating and
Ventilating Facilities - 3760 Building.

Study is complete.

Design and Drafting Services

Major designs completed or in progress.

TitleStatus

Cesium Recovery.

Required design and drafting services for this item increased during the month. Present status is as follows:

2 drawings approved,
13 drawings completed and awaiting
approval or checking,
16 drawings 40% - 70% complete,
23 drawings not started.

Non-Production Fuel Elements.

Design 60% complete. Estimated com-pletion date, October 1958.

Wide Angle and 5X Viewer - PRTR Fuel
Examination Facility.

Work in progress on 4 scope drawings.

Inspection Casting Al-Pu Mixture.

Drawings 97% complete.

Discharge Cask and Framing - HAPO 3 x 3
Facility - ETR.

Work completed.

TitleStatus

Vacuum Annealing Furnaces.

Work completed.

Capsule for Uranium Swelling Studies.

Work completed.

Project CG-660 - Remotize Metallograph.

Design 80% complete.

Maintenance and Building Engineering Services

108-F Building

Exterior painting of the building was accomplished.

306 Building

Work was initiated on air filter modifications. Construction of access catwalks to the ventilation equipment is also planned. Construction of a platform for the process water filter was started. Preliminary work was initiated for installation of a water softener.

325 Building

Construction of an extension to the gas storage dock was started. It is estimated this work will be completed in July.

326 Building

Enclosure of outside stairway was completed.

3702 Building

The building floors are being covered with 1/4" plywood and asphalt tile. This work is to be completed in July.

3707-C Building

A large evaporative cooler was ordered for installation in this building. Estimated costs to improve the heating and ventilation system were prepared by Construction Operation and are currently being evaluated by HLO.

3760 Building

Lighting improvements in the mail and periodical rooms were completed.

General

Sun Screen Products, Incorporated of Spokane, Washington, was awarded Contract AT (45-1)-1290 for providing and installing storm sashes on 306, 325, 327, 328, and 3760 (first floor) Buildings and shade screens on 306, 325, 327, 328, 3702, 3707-C, and 3760 (first floor) Buildings. The contract price is \$10,734.74 and the work is scheduled for completion by August 21, 1958.

Progress on the "As Built" program continued. The 3760 Building inspection was continued, and work was started on 329 Building.

Miscellaneous

Survey and inspection of code vessels is 80% complete.

The engineering study, to determine HLO and HAPO liquid helium and hydrogen requirements, is 80% complete.

An audit, including physical inspection of all platinum and gold, was taken of LAO Reactor and Other Special Materials.

Approximately 143 drawings, including sketches, work sheets, graphic illustrations and formal drawings, were completed by the Drafting Operation during the month; in addition revisions were made to 25 others.

Approximately 17,500 square feet of prints were produced for work, check or comment.

TECHNICAL INFORMATION OPERATION

A system of commitment accounting has been worked out with HLO Cost which will make possible closer control of expenditures for books and periodicals. Under the new system, orders for books and periodicals will be separately coded to 7322-404 and 7322-403 respectively. Amounts committed monthly will be accumulated, and Cost will supply a monthly supplemental cost report showing the balance at the beginning of the month, new commitments during the month, payments during the month, and ending balance.

Reports required by the Atomic Energy Commission for (1) payment of page costs during FY 1958 and (2) expenditures during FY 1958 for reprints of HAPO-authored journal articles purchased under public printer waivers, were completed and forwarded to HOO. Page costs were \$950 (HOO had set a limit of \$1500) and reprint costs were \$901.24.

A purchase order was placed for binding periodicals over an extended period. The order specifies approximately 300 volumes, an approximate cost of \$1,000, and several shipments over about a six month term. This is an experiment to avoid the necessity of using one purchase order per binding shipment.

The File Record Cards for unclassified documents which have been replaced by micro-cards are being destroyed. Filing space was being wasted, since the information on the cards was of little value. Extension of this procedure to declassified offsite-originated documents is being studied.

An electrically-operated Diebold elevator file has been installed in the Classified Files. It houses about half the total collection of File Record Cards, and the more active cards are being filed in it. If it proves as satisfactory as it now appears, another file will be procured for the remainder of the FRC file.

Expanded use of the addressograph equipment presently in Files is planned. Addressograph plates have been ordered for persons on the distribution list for the "Weekly List of Additions to Technical Information Files," and plates will be ordered for persons receiving other publications of Technical Information Operation.

A meeting was held recently with personnel from the HOO Operations Division, the HOO Security Division, and GE Security, to review the Commission's request to translate the access categories in use at HAPO (100-U, 200-U, 100-L, 200-L, and combinations of these) into Standard Distribution List categories. As indicated last month, the Commission program would exclude certain categories of Research and Development reports from each of the present HAPO access categories except 100-U-200-U. The list of exclusions was reviewed at the meeting and some changes agreed upon.

Following a request from Technical Information, Security has agreed to extend the use of the "Service Access" category without delay to all employees at HAPD who are required to handle classified documents but who do not "need to know" the information in the documents for the proper performance of their work. Clerks, secretaries, and messengers fall into this category. Total adoption of the "Service Access" system will reduce Files' costs, improve security, and clarify the "need to know" concept.

Recommendations of the HOO Finance Division on the classification of Hanford financial data were received by HAPD members of the HOO Classification Committee for comment. With one exception, HAPD is in complete agreement with the HOO recommendations. This point of disagreement will be resolved prior to submission to the Division of Classification, Washington. The Division of Classification has also requested recommendations for the inclusion of financial data in the proposed Hanford Classification Guide. Specific topics will be submitted after the classification of Hanford financial data is resolved with Washington.

Work continued on the survey of the literature to collect and organize information on the metallurgy of uranium alloys. About 3,000 catalog cards have been examined for documents of interest. Seventy-five documents have been abstracted, and the corresponding punch cards coded and delivered to the requester.

Orientation talks about the Operation were given by the professional staff to the members of the Summer Institute for Nuclear Energy. It has also been necessary to carefully instruct Files personnel on how to serve this group (as well as the AEC Radiological Physics Fellows and persons here on the Company's summer employee program), since each of these groups require special handling when withdrawing documents from Files.

Work Volume Statistics

MayJune

Document Distribution and Files

Documents routed and discharged (copies)	13,828	20,360
Documents issued (copies)	6,586	10,197
Documents sent offsite (copies)	2,975	4,230
Document reserves filled (copies)	772	949
Documents picked up and delivered	20,529	22,458

Document Accountability

Holders of classified documents whose files were inventoried	327	406
Documents inventoried in Files (copies)	54,362	31,376
Documents destroyed or retired (copies)	7,241	7,305
Documents revised (copies)	1,044	2,201
Documents pulled and documents filed (copies)	8,779	9,894
Documents reclassified	403	492
Accountable copies of SECRET and DOCUMENTED CONFIDENTIAL documents on site	204,107	201,688

Work Volume StatisticsMayJuneReference and Publication

Books cataloged (new titles)	105	51
Books added to the collection (volumes)	321	141
Ready reference questions answered by profession staff	126	186
Literature searches by professional staff	122	119
Reports abstracted (titles)	196	186
Formal reports prepared (titles)	12	12
Offsite requests for HAPO reports (copies)	141	279
Reports released to CAP (titles)	21	39

Library Acquisitions and Circulation

Books ordered (volumes)	177	211
Periodicals ordered	424	196
Books circulated (volumes)	2,384	1,718
Periodicals circulated (issues)	4,794	3,702
Inter-library loans	61	72
Films borrowed or rented	17	20
Industrial film showings	45	36
Bound periodicals added to the collection	38	20

Library collection:

	<u>Main Library</u>	<u>W-10 Library</u>	<u>108-F Library</u>	<u>Ind. Med.</u>	<u>Totals</u>
No. of books	23,631	8,013	1,335	1,878	34,857
No. of bound periodicals	11,116	1	1,383	92	12,592
	<u>34,747</u>	<u>8,014</u>	<u>2,718</u>	<u>1,970</u>	<u>47,449</u>

Classification and Declassification

	<u>May</u>	<u>June</u>
Documents, including drawings and photographs, reviewed for downgrading or declassification	29	114
Documents submitted to Declassification Branch, Oak Ridge	87	112
Documents and papers (intended for oral presentation or publication) reviewed for appropriate classification	23	32

LABORATORIES ADMINISTRATION

Timely revisions were issued to three Organization and Policy Guides. Two new Organization and Policy Guides were issued: No. 02.3.2, Hanford Laboratories University Relations Council and No. 09.15, Control of Top Secret Documents.

One delegation of authority for work authorization was issued. Specific delegations of authority were issued as covered by OPG No. 02.3.1, Approval Authorizations.

A renewal contract, Consultant Agreement CA-195, was entered into with Professor George W. Watt. Also, new contract, Consultant Agreement CA-197, was entered into with Dr. R. Wells Moulton. A new contract, Design, Development and Research Contract DDR-39 was entered into with Solar Aircraft Company for a bellows assembly. A modification was approved to increase the contract amount under Design, Development, and Research Contract No. DDR-29 with Nuclear Metals, Inc. for extrusion of tubing.

The following Assistance to Hanford authorizations were issued:

No. ATH-HLO-1-58-E to General Engineering Laboratory assigning \$800 for consultations by Myron Tribus.

No. ATH-HLO-1-59-A to General Engineering Laboratory assigning \$5000 for consultations by Dr. Poritsky during FY-1959.

No. ATH-HLO-1-59-B to Research Services assigning \$4,500 for research assistance and facilities for Dr. T. I. Moran during FY-1959.

No. ATH-HLO-3-58 to Atomic Power Equipment Department assigning \$6,450 for irradiation of fuel elements.

A report was submitted to Transportation and Maintenance Operation compiled by Radiation Protection Operation on radioactive contamination of vehicles assigned to Hanford Laboratories Operation.

Manager
LABORATORY AUXILIARIES

JL Boyd:jcw

UNCLASSIFIED

H-11

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56640	
General Plant Projects - FY 1957 - AEC-23-57-N-2		HANFORD LABORATORIES OPERATION										MONTH June, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	DESIGN	CONST.	
			AMOUNT	DATE	DESIGN SCHED.	CONST. SCHED.	ACTUAL						
CA-658	Shielded Personnel Monitoring Station - 747 Building	\$ 150,000	\$ 150,000	2-4-57	100	55	100	2-18-57	-	12-19-57*	3-11-58	12-31-58	12-15-58
REMARKS: Interior piping and electrical services are in place. Interior work in the building is progressing slowly. Delays in fabrication of the monitoring cell have extended the required date for completion of the building. A meeting was held between General Electric, AEC, and contractor representatives to resolve fabrication methods to be used on the monitoring cell; and to arrive at an agreed price for extras requested by the contractor. A final figure of \$4,400 was agreed upon. It is anticipated that the cell will be delivered to the work site about October 15, 1958.		D. S. Jackson PEO ENGINEER											
*Actual date.													
CG-729	Ventilation System Improvements - 222-U Building	\$ 80,000	\$ 73,000	3-12-57	100	98	100	4-23-57	6-12-57*	5-28-57**	9-15-57	9-15-58	8-1-58
REMARKS: The contractor has appealed to the Contracting Officer for further consideration of his claim for \$1,200. The new outside doors have not been received by the CPFF Construction Contractor; as a result no additional work was performed during the month. Plant Forces changed the controls on the supply unit feeding the counting room.		A. W. Herwin PEO ENGINEER											
*Scheduled date. **Actual date.													
CG-733	Plutonium Metallurgy Facility	\$ 293,000	\$ 295,000	5-10-57	100	100	100	5-14-57	-	10-1-57	6-10-57	6-15-58	5-29-58*
REMARKS: A Field Release was issued closing out this project effective June 1, 1958. The Physical Completion Notice, dated June 11, 1958 has been issued. All work unfinished will be completed on a \$1,500 Work Order, given to Construction Operation, as an accrual item. Only two items remain unfinished; (1) door alarm and (2) one door to be placed in Corridor "C". This work is scheduled for completion by July 27, 1958. This project will no longer be carried in this report.		J. T. Lloyd PEO ENGINEER											
*Actual completion date.													

AM-7200-010 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-12

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56640	
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION										MONTH June, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE			
			AMOUNT	DATE	DESIGN SCHED.	ACTUAL	DESIGN CONST.						
CG-760	Expansion of the 3745-B Facility	\$ 193,000	None to date	None	0	0	N.S.	1*	None	6*			
		USING COMPONENT	0	0	0	0	9*	None	None	16*			
REMARKS:		Physics & Instruments Research & Develop. R. C. Ingersoll											
The project proposal was resubmitted to the AEC-HOO on March 13, 1958. The Commission has requested the General Electric Company to further clarify the relationship between this proposed expansion and proposed R & D Programs. A reply is being prepared and will be forwarded to the Commission during the month of July, 1958.													
*Months after authorization.													
CA-765	Additions to the 314 Building	\$ 46,000	\$ 46,000	100	100	31	10-14-57	- - -	3-7-58**				
		USING COMPONENT	11-15-57	100	30	3-27-58*	11-15-58	11-15-58	11-15-58				
REMARKS:		Reactor & Fuels Research & Development A. W. Hervin											
The contractor, Hale Construction Company, has installed the underground water line inside the existing building. It is now being used by operating personnel; however, a small amount of backfill and concrete work remain to be completed outside the building. The contractor has installed the underground electrical conduit in the new addition and poured the concrete slab. Work has progressed on laying up the concrete block; however, this work has stopped pending the contractor's decision as to whether he will give us a deduction on the windows he purchased or order new windows. The windows procured by the contractor are acceptable; however, the type of opening was not as specified, and the windows were not as costly.													
*Date CPFF Construction Contractor started work. **Actual date.													
CA-769	Additions to the 622 Building	\$ 80,000	None to date	None	0	0	None	None	None				
		USING COMPONENT	None	0	0	0	None	None	None				
REMARKS:		Physics & Instruments Research & Develop. J. T. Lloyd											
Using component personnel are continuing their study of other possible alternates.													

UNCLASSIFIED

H-13

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56640 MONTH June, 1958				
General Plant Projects - FY 1958 - AEC-2-23-58-L		EST. TOTAL PROJECT COST		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT				STARTING DATE		DIRECTIVE COMP. DATE		ESTIMATED COMP. DATE		
PROJECT NUMBER	TITLE			AMOUNT	DATE	DESIGNED	SCHED.	ACTUAL	ACTUAL	DESIGN	CONST.	DESIGN	CONST.	DESIGN	CONST.	
CA-778	Expansion of the 305-B Building	\$ 55,000		\$ 55,000	12-11-58	N.S.	10**	10**		4-4-58	5-15-58	5-7-58*				
		USING COMPONENT		100						6-7-58*	10-15-58	10-1-58#				
REMARKS:		Physics & Instruments Research & Develop.														
		Bids were opened June 23, 1958 on, Invitations to Bid No. AT(45-1)-1286 which combined projects CA-778 and CA-750. The low bid of \$77,900, submitted by Jensen-Rasmussen was rejected because the bidder did not comply with instructions on invitations to bid. The Commission awarded the contract on June 27, 1958 to the next low bid of \$78,400 submitted by Patton & Hill. Estimated breakdown of bid is; \$37,200 on CA-778 and \$41,200 on CA-750.														
		*Actual dates. # A-E scheduled date. ** Represents work performed by GE Plant Forces relocating conduit in 305-B Building and outside electrical work performed by CPFF Construction Contractor.														
CG-779	Additions to Separations Development Facilities - 321 Building	\$ 27,900		\$ 27,900	5-22-58	40	4	8		5-26-58	1-31-59	6-15-58				
		USING COMPONENT								6-19-58	12-1-58					
REMARKS:		Chemical Research & Development														
		A Fixed Price Contract was negotiated with Construction Operation for the proposed work. AEC will open rectifier bids on July 3, 1958. Work was started on June 19, 1958. The concrete adjacent to the stairs has been removed to the new platform level.														
CAH-794	Geological and Hydrological Wells - FY 1958.	\$ 49,000		\$ 49,000	4-16-58	100	0	0		4-7-58	12-31-58	5-15-58				
		USING COMPONENT								6-30-58	12-31-58	12-31-58				
REMARKS:		Chemical Research & Development														
		Construction bids were opened on June 10, 1958. The Bach Drilling Company of Coulee City, Washington was awarded the contract with a low bid of \$32,270. The Government Fair Cost Estimate was \$36,820. The contractor has not yet started construction.														

UNCLASSIFIED

H-14

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56640 MONTH June, 1958					
General Plant Projects - FY 1958 - AEC-2-23-58-L		HAFORD LABORATORIES OPERATION		AUTHORIZATION INFORMATION				PROJECT PROGRESS IN PER CENT				STARTING DATE		DIRECTIVE CCMP. DATE		ESTIMATED COMP. DATE	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AMOUNT	DATE	DESIGN SCHED.	ACTUAL	DESIGN SCHED.	ACTUAL	DESIGN	CONST.	DESIGN	CONST.	DESIGN	CONST.	DESIGN	CONST.	
CGH-796	Facilities for Isotope Study on Animals	\$ 49,800	\$ 49,800	5-22-58	0	0	0	0	5-22-58	7-27-58	7-27-58	7-15-58	6-12-58	11-1-58	11-1-58	11-1-58	11-1-58
REMARKS: Preliminary grading has been done. Excavation for footings and curtain walls is complete. Reinforcing steel and forms are in place.		J. T. Lloyd PEO ENGINEER															
CGH-803	Alterations - Building 231-Z	\$ 49,600	\$ 49,600	6-2-58	0	0	0	0	6-2-58	7-1-58*	11-15-58	11-15-58	7-1-58*	11-15-58	11-15-58	11-15-58	11-15-58
REMARKS: AEC Directive No. HW-461, dated June 2, 1958 was received. Laboratory Auxiliaries issued a Work Release Authorization, dated June 4, 1958 to Construction Engineering Operation authorizing project management and expenditure of \$43,000. Work is scheduled to start on July 1, 1958.		J. T. Lloyd PEO ENGINEER															
*Scheduled date.																	
CGH-804	Ceramic Fuels Press Enclosure - 325 Building	\$ 41,000	\$ 41,000	6-2-58	30	0	0	0	6-2-58*	10-2-58#	1-15-59	1-2-59#	6-2-58*	10-2-58#	1-15-59	1-2-59#	8-18-58#
REMARKS: AEC Directive No. HW-462 was issued June 2, 1958.		R. C. Ingersoll PEO ENGINEER															
*Actual date. #Project Proposal dates.																	

AM-7500-010 (5-58)

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UNCLASSIFIED

H-15

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56640 MONTH June, 1958	
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION		PROJECT PROGRESS IN PERCENT				STARTING DATE		DIRECTIVE COMP. DATE		ESTIMATED COMP. DATE	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		DESIGN SCHED.	ACTUAL	CONST. SCHED.	ACTUAL	DESIGN	CONST.	DESIGN	CONST.	
			AMOUNT	DATE									
IR-236	321 Building Test Pit Enclosure	\$ 19,000	\$ 19,000	2-28-58	100	100	80	3-3-58	5-12-58	8-27-58	5-6-58*	8-1-58	
		USING COMPONENT		FEO ENGINEER									
REMARKS: The CPFF Construction Contractor has completed the underground drainage system and poured the floor slab on the north end of the building. Miscellaneous repairs to the siding and roof have been made. Work is progressing on the sheet-metal work on the west side of the building. The electrical work on the lighting is essentially complete. However, the electrical and steam piping cannot be completed until receipt of the unit space heaters. Beneficial use of the building was attained on June 30, 1958.		A. W. Hervin											
*Actual date.													
IR-240	Removal of Obsolete Melt Plant Equipment - 314 Building	\$ 19,000	\$ 19,000	6-24-58	0	0	0	None	6-27-58	11-11-58	11-11-58	11-11-58	
		USING COMPONENT		FEO ENGINEER									
REMARKS: This Informal Request was approved by the Commission on June 24, 1958. The CPFF Construction Contractor started work on June 27, 1958.		A. W. Hervin											
CGH-809	Electrical Modifications - 328 Building	\$ 40,000	\$ 40,000	6-30-58	0	0	0	7-30-58	10-30-58	3-1-59	9-30-58	3-1-59	
		USING COMPONENT		FEO ENGINEER									
REMARKS: The project proposal was submitted to the AEC-HOO on June 6, 1958. It was approved by the AEC-HOO Review Board on June 27, 1958. AEC Directive HW-467, dated 6-30-58 has been received.		R. C. Ingersoll											

AM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-16

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				HANFORD LABORATORIES OPERATION		HW - 56640	
General Plant Projects - FY 1958 - AEC-2-23-58-L						MONTH June, 1958			
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DATE	DESIGN SCHED.	CONST. SCHED.			
	Modification of the 15-Ton Canyon Crane - 327 Building	\$ 49,500	None to date	None	0	0	1*	None	3*
		USING COMPONENT			0	0	5*	None	7*
REMARKS:		Reactor & Fuels Research & Development							
		R. C. Ingersoll							

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

USING COMPONENT

FEO ENGINEER

REMARKS:

USING COMPONENT

FEO ENGINEER

REMARKS:

H-17

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects - Program Class 2900		MONTHLY PROJECT REPORT HANFORD LABORATORIES OPERATION						HW - 56640 MONTH June, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE
			AMOUNT	DATE	DESIGN SCHED.	CONST. SCHED.			
CG-661	Additional Heat Generating Facility - 189-D Building	\$ 664,000	\$ 664,000	82	0		12-6-56	10-1-58*	10-1-58
			9-18-57	70	0		1-15-59	8-31-59	8-31-59
			USING COMPONENT				FEO ENGINEER		
REMARKS: Design work on the electrical and mechanical phases of the work progressed during the month. The mechanical phase is nearing completion. The structural design for the equipment foundations and hot well removal was started. Design work is behind schedule due to the lack of vendor information, namely; wiring diagrams and the dc bus work. This information has been requested from the vendor, General Electric Company. An order for approximately 30 feet of copper bus work is being placed with the General Electric Company at a cost of approximately \$8,000. The two steam condensers were not shipped this month. It was not anticipated that delivery could be made until July.			A. W. Hervin						
*Scheduled date.									
CA-681	Hanford Equipment in the ETR	\$1,200,000	\$1,200,000	100	N.S.		9-17-56	- - -	10-1-58*
			8-12-57	95*	65		4-7-58	12-15-58	1-30-59
			USING COMPONENT				FEO ENGINEER		
REMARKS: Construction activity is being concentrated on the 3 x 3 insulation and instrumentation. Testing of the 3 x 3 loop is scheduled for early July. The removal cask design is complete and fabrication is under way. *Design of the modified 9 x 9 in-pile portion has been curtailed. This is due to recent developments making uncertain availability of the originally allocated 9 x 9 facility for HAP0's use. The Commission is attempting to resolve this and resumption of full scale design activity is currently anticipated by August 1, 1958.			H. Radow						
CG-682	High Level Cut-Off and Examination Cell - 327 Building	\$ 430,000	\$ 430,000	100	45		7-18-56	- - -	6-26-57*
			8-20-57	100	50		3-27-58	10-1-58	10-1-58
			USING COMPONENT				FEO ENGINEER		
REMARKS: All of the cell castings, including the top casting which was being replaced, have been shipped. The lead glass was shipped the last week of the month. It appears that the can sealer and the 13 service plugs will be the only major items that have not been shipped by the end of June. The CPFF Construction Contractor has cut the hole in the wet storage basin for the pipe tube. The footings for the additional cell support have been poured. Electrical work is progressing on the service panels that attach to the cell, also the electrical work on the patch panel.			A. W. Hervin						
*Actual date.									

UNCLASSIFIED

H-18

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects - Program Class 2900		MONTHLY PROJECT REPORT										HW - 56640 MONTH June, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE			
			AMOUNT	DATE	DESIGN SCHED.	ACTUAL	CONST. SCHED.						
CA-695	Radio Telemetering Network	\$ 98,000	\$ 89,000	1-10-57	100	N.S.	2-22-57	4-15-57*	5-27-57**				
		USING COMPONENT	1-10-57	100	25	7-25-57	5-15-58	1-1-59					
REMARKS: The AEC has written a letter to Instruments Laboratory Company, requesting prices for negotiation of minor deletions or additions on prototype. Fabrication of the repeater station by Motorola, Incorporated, is continuing.		Physics & Instruments Research & Development.											
		J. T. Lloyd PEO ENGINEER											
*Scheduled date. **Actual date.													
CG-785	In-Reactor Studies Equipment - 105-KW Building	\$ 440,000	\$ 15,000*	2-12-58	100	0	3-10-58	None	7-1-58				
		USING COMPONENT	2-12-58	95	0	None	None	None					
REMARKS: Rough draft copies of the revised project proposal, requesting total project funds, have been distributed for comments. It is anticipated that the project proposal will be ready for submittal by the middle of July, 1958. The final estimate for the total project has been completed and is being reviewed.		Reactor & Fuels Research & Development H. Radow PEO ENGINEER											
* For preliminary design and necessary services to submit a revised project proposal for detail design, procurement and construction funds.													
CGH-801	X-Ray Diffraction Cell - 327 Building	\$ 120,000	\$ 10,000	6-2-58	0	0	6-10-58	None	12-24-48				
		USING COMPONENT	6-2-58	1	0	None	None	7-30-59					
REMARKS: AEC Directive HW-460, dated June 2, 1958 was received on June 3, 1958. It authorized initiation of design for a new cell in the north bay of the Radiometallurgy Laboratory, 327 Building. A Work Release Authorization was issued authorizing CEO \$6,000 for design on this facility.		Reactor & Fuels Research & Development R. W. Dascenzo PEO ENGINEER											

AM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-19

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects - Program Class 2900		MONTHLY PROJECT REPORT HANFORD LABORATORIES OPERATION				NW - 56640 MONTH June, 1958												
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION			PROJECT PROGRESS IN PER CENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE								
			AMOUNT	DATE	ACTUAL	SCHED.	CONST.				DESIGN	CONST.						
CCH-805	High Temperature Tensile Testing Cell	\$ 140,000	None to date	0	0	0	0	None	None	None								
		USING COMPONENT	None	0	0	0	0	None	None	None								
REMARKS:		Reactor & Fuels Research & Development																
		The project proposal requesting \$10,000 for initiation of detailed design has been awaiting approval by the AEC Board of Review for three weeks. It was deferred for further study at the board meeting of June 19, 1958.																
		<table border="1"> <thead> <tr> <th colspan="2">USING COMPONENT</th> <th colspan="2">FEO ENGINEER</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>									USING COMPONENT		FEO ENGINEER					
USING COMPONENT		FEO ENGINEER																
REMARKS:																		
Equipment Not Included in Construction Projects - Program Class 4900																		
CG-758	Ceramic Fuels Development Press and Furnace Additions	\$ 172,000	\$ 200,000	100	100	N.S.*	40	8-22-57	2-1-58**	2-28-58								
		USING COMPONENT	8-1-57	100	100			1-20-58	10-1-58**	10-1-58								
REMARKS:		Reactor & Fuels Research & Development R. C. Ingersoll																
		Minor wiring changes have been completed. Changes in piping have been held up pending delivery of a diaphragm operated valve for the helium purging system. Revision 1 to the project proposal, requesting authorization for a change in scope to install the 300-ton press in the 325 Building, was submitted to Contract Administration May 15, 1958 and to the AEC June 16, 1958, R. J. Anicetti, HLO, accepted the press 6-20-58 after extended test runs. Press was shipped June 27, 1958.																
		*An overall construction schedule has not been established because the second phase construction (press installation) has not been scheduled.																
		**Does not include press installation, funds will be accrued to cover this work.																
		##Scheduled date.																

AM-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-20

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW - 56640	
New Construction - FY 1958		HANFORD LABORATORIES OPERATION										MONTH June, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE			
			AMOUNT	DATE	DESIGN SCHED.	CONST. SCHED.	ACTUAL				DESIGN	CONST.	
CG-731	Critical Mass Laboratory	\$1,800,000	\$175,000	5-12-58	0	0	0	5-22-58	-	-	1-1-59		
		USING COMPONENT	5-12-58	0	0	0	2-15-59	10-59			10-31-59		
		FEO ENGINEER											
REMARKS:		Physics & Instruments Research & Develop. D. S. Jackson											
<p>Upon request by the Commission a study was undertaken to determine the relative merits and costs of the facility as proposed in the project proposal and one of more conventional design. The study indicated the conventionally constructed facility to be slightly less costly in Stage I, and considerably more economical if two stages are to be built. A request to change the scope to conventional construction was initiated. In addition a survey was made to determine what Hot Semi-Works facilities could be utilized.</p>													
CA-744	Metallurgical Development Facility	\$2,600,000	\$60,000	4-28-58	0	0	0	5-12-58	-	-	12-15-58*		
		USING COMPONENT	4-28-58	0	0	0	N.S.		None		9-15-60		
		FEO ENGINEER											
REMARKS:		Reactor & Fuels Research & Development J. T. Lloyd											
<p>Preparation of the project proposal requesting total funds is in progress. A comment draft copy has been prepared. FEO has been advised by CEO, Planning & Scheduling that the target date of July 1, 1958 for its completion cannot be met. This is due to uncertainties in cost and building scope that must be resolved. They will be delayed until about July 1, 1958.</p>													
*Structure design.													
CA-749	High Level Radiochemistry Facility	\$1,070,000	\$1,070,000	4-21-58	1	0	0	6-15-58	-	-	10-30-58		
		USING COMPONENT	4-21-58	1	0	0	9-1-58	6-30-59			6-30-59		
		FEO ENGINEER											
REMARKS:		Chemical Research & Development R. W. Dascenzo											
<p>There were five bidders at the bid opening on June 12, 1958. B. D. Bohna Company of San Francisco, California was low bidder and was awarded the design-construct contract. The bids were as follows:</p>													
<p>B. D. Bohna & Company, San Francisco \$574,504</p> <p>J. P. Hopkins Company, Seattle 669,000</p> <p>Hoffman Construction Company, Portland 752,948</p> <p>Jensen-Rasmussen & Company, Sunnyside 779,000</p> <p>W. G. Clark Construction Company, Seattle 869,000</p> <p>Fair Cost Estimate 673,000</p>													

AM-7300-010 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-21

BUDGET CLASSIFICATION New Construction - FY 1958		MONTHLY PROJECT REPORT HANFORD LABORATORIES OPERATION				HW - 56640 MONTH June, 1958							
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE		DIRECTIVE COMP. DATE		ESTIMATED COMP. DATE	
			AMOUNT	DATE	SCHED.	ACTUAL	SCHED.	ACTUAL	DESIGN	CONST.	DESIGN	CONST.	DESIGN
CGH-790	High Level Radioactive Receiving and Storage Addition	\$ 325,000	\$ 325,000	6-25-58	0	0	0	6-23-58	2-1-59	- - -	2-1-60	12-1-58	2-1-60
		USING COMPONENT	FEO ENGINEER										
REMARKS:		<p>Reactor & Fuels Research & Development</p> <p>AEC Directive HW-464, dated June 17, 1958 was issued authorizing \$21,000 for design. Design work was started on June 23, 1958. Design emphasis will be initially placed on writing the Specification and Purchase Requisition for the overhead traveling bridge crane.</p> <p>AEC Directive HW-464, Modification 1, dated June 25, 1958 was issued authorizing the total project funds of \$325,000.</p>											
		USING COMPONENT	FEO ENGINEER										
REMARKS:													
		USING COMPONENT	FEO ENGINEER										
REMARKS:													

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
W. T. Short	6-12-58	General Electric Co.	Tour of Facilities	O. W. Priebe	No	300, 328, 325
Guy Hughes	5-29-58	Leo Daley Co. A-E Seattle, Washington	Contractor to view work site for bid.	R. W. Dascenzo	No	329, 326 300, 325
Jack Rasmussen	5-29-58	Jensen-Rasmussen Const. Co. Sunnyside, Wash.	"	"	No	300, 325
Mr. Benz	5-29-58	Pacific Car & Foundry Seattle, Washington	"	"	No	700, 703
H. Salinger	6-9-58	Brinck, Salinger, McDaniel & Assoc. Seattle, Washington	"	"	No	300, 325
B.D. Bohna & J. Turner	6-10-58	B.D. Bohna Company San Francisco, Calif.	"	"	No	700, 703
Herschel Smith	6-10-58	Bovay Company Seattle, Washington	"	"	No	700, 703

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
D. S. Jackson	6-2-58	Todd Shipyards Seattle, Washington	Inspect and discuss fabrication of steel cell for Project CA-658	Messrs. Nesser, McClean, Long & Porter. G. Ackerman of Lewis Hopkins	No
H. Radov	6-16 to 6-19-58 6-20-58	National Cylinder Gas Co. Chicago, Ill.	ASME Convention Detroit, Michigan Information for Special valve for Project CG-785	---	No
R. E. Rostenbach	6-16 & 6-17-58	Portland, Ore.	Attend Northwest Regional ACS Meeting	---	No

UNCLASSIFIED

H-23

HW-56640 H

VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company Visited and Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
C. O. Finney	6-12 & 6-13-58	Portland, Ore.	Attend Pacific Northwest Instrument Show	--	No
W. Holmgren	6-26-58	Campbell Industrial Supply - Seattle, Wash.	Attend demonstration of grinding equipment	--	No
Maryde F. Orr	6-8 to 6-12-58	Argonne National Laboratory Lemont, Ill.	Confer with librarians	Dr.H.D. Young	No
J. L. Boyd	6-23 to 6-26-58	Portland, Ore.	Attend ASCE Meeting	--	No

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EMPLOYEE RELATIONS OPERATION MONTHLY REPORTGENERAL

At month's end, the staff of the Hanford Laboratories Operation totalled 1132, including 520 exempt and 612 nonexempt employees. Of the total exempt employees, there were 454 with college degrees, including 436 technical degrees as follows: BS - 225, MS - 106, PhD - 105. There were 35 nonexempt employees with degrees.

Approximately one-half of the employees in the Physics and Instrument Research and Development Operation have been covered by attitude survey follow-up discussions. An analysis of their comments is being made.

AEC-SPONSORED TRAINING PROGRAMS

The 1958 AEC Radiological Physics Fellowship Program started June 16, 1958. A total of 15 Fellows are participating; 9 from the University of Washington and 6 from the University of Kansas.

The Chemical Processing portion of the 1958 Summer Institute of Nuclear Energy started on June 23, 1958. Ten college professors and one AEC employee from Savannah River will take part in this eight-week program.

TRAINING

Thirty-six employees attended a one-hour presentation on "Nuclear Industry Standards" and 8 employees attended the R & U-conducted "Management Orientation". Three PBM-1 classes completed their course work during the month.

HEALTH, SAFETY AND SECURITY

Laboratories personnel worked a total of 182,035 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,145,225 man-hours have been completed with no disabling injuries. The medical treatment frequency for June was 1.86 as compared with 1.81 during May.

There were 2 security violations during the month, bringing the total for the calendar year to 25.

TECHNICAL PERSONNEL PLACEMENT

During the month, 13 PhD candidates visited Richland for employment interviews. Eight offers were extended and there were no acceptances, so the total for the recruiting year beginning September 1, 1958 remains at 13 acceptances.

The recruiting of experienced BS/MS personnel continues at a minimum level.

UNION RELATIONS

Negotiations with Regional Monitors have been temporarily suspended pending further discussions within the HAMTC.

The Maki arbitration case is tentatively scheduled for the week of October 6.

One grievance was received during June and was answered satisfactorily at Step I. Grievances processed since January 1, 1958 now total 16, including 2 non-unit grievances; 12 of these were processed prior to April 1 with 4 having been received during the last 3 months.

EMPLOYMENT

Nine requisitions were received during the month and 5 were filled. Transfers are pending for the remaining 4 vacancies.

Oral notices of force reduction were given to 19 nonexempt employees and 3 exempt employees in Radiation Protection Operation. Placement of these individuals in other assignments is progressing satisfactorily.

SUGGESTIONS

At the June Suggestion Board meeting 5 suggestions were approved for awards totalling \$65. For the year to date, 49 suggestions have been approved for awards totalling \$1,405, bringing our average award to \$28.67 and our ratio of awards to savings to 11%.

BENEFIT PLANS

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

<u>1958</u>	<u>Insurance</u>	<u>Pension Plan</u>	<u>Savings & Stock Bonus</u>	<u>Savings Plan</u>
Jan.	99.6	98.4	60.6	7.5
Feb.	99.7	98.5	61.3	8.2
Mar.	99.7	98.6	61.9	8.7
Apr.	99.7	98.6	61.3	7.9
May	99.7	98.6	61.3	7.6
June	99.7	98.9	61.4	7.6

SALARY AND WAGE ADMINISTRATION

The necessary work in revising the Employee Relations Operation to include those functions which were transferred from Relations and Utilities effective July 1 were completed during the month.

The pay differential study correlating the salary of first-line supervisors to those personnel being supervised was completed. A complete report will be forwarded to HLO managers and supervisors in the near future.

A HAPO-wide Nonexempt Compensation Study Task Force was formed during the month to critically evaluate all phases of the existing Nonexempt Wage Plan, practices, procedures and policies. Representatives from each of the six components met for a two-week period with W. R. Jacobson, HAPO's Field Consultant from Employee Compensation Services, New York, to discuss and outline broad objectives, plans and goals which will serve as guides for the work to be accomplished in the coming months.

Manager
Employee Relations

TABLE II. EMPLOYMENT - TECHNICAL PERSONNEL STATUS

I. Employment

<u>Non-exempt Employment Status</u>	<u>May</u>	<u>June</u>	<u>Non-exempt Transfer Requests</u>	<u>May</u>	<u>June</u>
Requisitions			Transfer Requests		
At end of month	10	11	Active cases at end of mo.	54	53
Cancelled	2	1	Cancelled	0	0
Received during month	10	9	New during month	5	0
Filled during month	8	5	Transfers effected	0	1
Candidates Considered			Planned Transfers		
Total applications	12	46	Effective during month	0	1
Total transfer requests from other at HAPO	7	5			
Total Interviewed	0	0			

II. Technical Personnel Placement

Ph.D. Recruiting - HLO - 9/1/57 to date

	<u>Cases Con-</u> <u>sidered</u>	<u>VISITS TO RICHLAND</u>				<u>OFFERS*</u>			<u>On</u> <u>The</u> <u>Roll</u>
		<u>Extended</u>	<u>Visited</u>	<u>To</u> <u>Visit</u>	<u>Open</u> <u>Invite.</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	
Engineering:									
Chemical	58	24	10	1	1	7	3	-	3
Electrical	29	5	2	1	-	3	-	1	-
Mechanical	32	12	3	1	3	2	-	-	-
Met-Ceramics	60	29	11	4	2	8	-	2	1
Other	6	2	2	-	-	-	-	-	-
Science:									
Chemistry	262	38	22	1	-	14	7	2	4
Physics	245	102	35	7	10	18	2	3	3
Math-Stat.	37	3	-	-	-	-	-	-	1
Other	51	7	4	-	-	2	1	-	2
TOTAL	780	222	89	15	16	54	13	8	14

*Offer totals include 14 Ph.D. open offers as of 9/1/57.

BS/MS Experienced Recruiting - HLO - 9/1/57 to date

	<u>Cases Con-</u> <u>sidered</u>	<u>VISITS TO RICHLAND</u>				<u>OFFERS</u>			<u>On</u> <u>The</u> <u>Roll</u>
		<u>Extended</u>	<u>Visited</u>	<u>To</u> <u>Visit</u>	<u>Open</u> <u>Invite.</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>	
Engineering:									
Chemical	6	2	1	-	-	1	-	-	-
Electrical	9	2	2	-	-	-	-	-	-
Mechanical	13	6	5	-	-	2	-	-	-
Met-Ceramics	10	1	1	-	-	2	1	1	1
Other	17	-	-	-	-	2	1	-	1
Science:									
Chemistry	11	-	-	-	-	-	-	-	2
Physics	9	4	4	-	-	4	1	1	-
Math-Stat.	4	1	1	-	-	1	1	-	1
Other	19	1	1	-	-	1	1	-	-
TOTAL	98	17	15	0	0	13	5	2	5

TABLE III. Exempt Transfer Cases

	<u>June</u>	<u>May</u>	<u>Total</u>
Active cases at <u>beginning</u> of month	28	28	
New cases: Initiated by employee			5
Initiated by management*	1	1	14
Cases reactivated			
	<u>29</u>	<u>29</u>	
Cases closed: Transfers: Within HLO			2
Within HAPO		1	1
Other G.E.			0
Withdrawn		1	4
Terminated	<u>3</u>		<u>9</u>
	<u>26</u>	<u>28</u>	<u>16</u>
Active cases at <u>end</u> of month	26		<u>26</u>
Total cases - January 1, 1958 to date (includes 23 cases initiated prior to and active on 1/1/58)			42
Initiated by employee	15		
Initiated by management*	27		

*Includes ROF's, transfers proposed by employee's management, and requests from other G.E. departments.

TABLE IV. Union RelationsGrievances Processed - January 1, 1958 to date

Total processed 16 (includes 2 non-unit grievances)

Step I

Answered satisfactorily* 7

Step II

Pending Step II discussion 2

Answered

Satisfactorily** 6

Pending time limit 1

Applied for arbitration 1

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step I.

** Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Date of Visit</u>	<u>Company Visited</u>
T. G. Marshall	6/16 and 6/17	American Soc. for Eng's Education at Berkeley, California

VISITORS TO HAPO

<u>Name</u>	<u>Date of Visit</u>	<u>Company Represented</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>	<u>Areas & Bldgs. Visited</u>
W. R. Jacobson	6/9	General Electric Employee Compensation Services, N. Y.	Nonexempt compensation study	HA Paulsen TG Marshall	None	700 - 703
W. S. Hill	6/23	General Electric Engineering Recruitment	HAPO recruitment	TG Marshall	None	700 - 705 300 - 3760

FINANCIAL OPERATION MONTHLY REPORTPersonnel

The Specialist - Procedures was transferred to IPD on a promotional basis.

ActivitiesGeneral Accounting Operation

Utilization of FY 1958 budgets for Attendance at Meetings and Off-Site Courses and amounts approved for FY 1959 for HLO are as follows:

	<u>Estimated FY 1958</u>	<u>Approved FY 1959</u>
Attendance at Meetings of Professional and Trade Societies	\$23,000	\$27,000
Attendance at Off-Site Courses and Seminars	\$ 2,900	\$ 3,000

Preparations were completed and a procedure distributed for the physical inventory of uninstalled cataloged equipment in the custody of Radiation Protection Operation. The inventory will begin July 7, 1958 with an anticipated completion date of July 18, 1958 for all field work. A 100 percent verification of equipment will be made by a Financial representative with the exception of portable radiation monitoring instruments. The inventory of these instruments will be accomplished by Calibration Operation furnishing Financial with a detailed IBM listing, certified by the custodian that all instruments listed were inventoried. This listing will be spot-checked by Financial personnel.

In connection with the physical inventory of the 321 Building, Cold Separation Laboratory, new installed records are currently being prepared. Upon completion, a duplicate copy of the records will be furnished custodial personnel for control and a report issued.

Arrangements were completed for the regular quarterly inventory of other special materials as of June 30, 1958 to be conducted by custodial personnel. Financial personnel will not witness the count but will reconcile the results to Property Accounting records. A report of results will be issued upon completion of reconciliation.

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

	<u>No. of AR's</u>	<u>Authorized Funds</u>	<u>Actual Cost</u>	<u>(Over) Under-Run</u>	<u>%</u>
<u>Over-Run</u>					
By more than 10%					
Supplement Required	24	\$113,588	\$154,886	\$(41,298)	36.0
By less than 10%	20	157,830	164,398	(6,508)	4.1

<u>Under-Run</u>	<u>No. of AR's</u>	<u>Authorized Funds</u>	<u>Actual Cost</u>	<u>(Over)- Under-Run</u>	<u>%</u>
By more than 10%	34	\$185 285	\$119,529	\$65,756	35.5
By less than 10%	22	140,944	137,078	3,866	3.4

Federal income tax will no longer be withheld from reimbursements or allowances paid to new employees to cover expenses incurred in relocating at the place of new employment. Such payments will, however, represent gross income and are reportable on Form 1099 if the total of all payments of income (including wages) to the individual amounts to \$600 or more in the calendar year. While this ruling is effective January 1, 1958 no retroactive adjustments are planned for HLO employees.

A recapitulation of appropriation requests processed in FY 1958 by Level Three component is shown below:

	<u>Appropriation Requests</u>		<u>Supplements</u>		<u>Less Cancellations</u>		<u>Net Totals Approved</u>	
	<u>No.</u>	<u>Value</u>	<u>No.</u>	<u>Value</u>	<u>No.</u>	<u>Value</u>	<u>No.</u>	<u>Value</u>
Reactor & Fuels	51	\$ 606,440	11	\$51,875	5	\$33,200	57	\$ 625,115
Chemical R&D	30	170,115	4	2,408	2	24,400	32	148,123
Physics & Instrument	10	220,000	1	700	1	14,000	10	206,700
Radiation Protection	12	71,010	1	500	2	21,000	11	50,510
Laboratory Auxiliaries	5	32,800	1	257	-	-	6	33,057
Biology	6	31,735	2	1,162	-	-	8	32,897
	<u>114</u>	<u>\$1,132,100</u>	<u>20</u>	<u>\$56,902</u>	<u>10</u>	<u>\$92,600</u>	<u>124</u>	<u>\$1,096,402</u>

In addition several appropriation requests submitted late in the fiscal year were held due to lack of funds. These requests will be returned to the initiating component for review and determination of priority status for FY 1959.

We have been requested by Contract Accounting to submit, with the monthly travel report, a memo of costs incurred by participation in the Second International Conference on the Peaceful Uses of Atomic Energy to be held in Geneva, Switzerland in September 1958. This information has been requested by the Commission.

Cost Accounting

Hanford Laboratories received an additional allocation from the Chemical Processing Department in June for Research and Development as follows:

	<u>Previous Authorization</u>	<u>Additional Allocation</u>	<u>New Authorization</u>
2000 Program Separations Development	\$1 476 000	\$63 000	\$1 539 000
Nuclear Materials Management	29 000	4 000	33 000

Work on the FY 1959 budget is being deferred pending further information on "target" budgets and AEC Financial Plan.

FY 1958 accrual policies have been determined and preliminary work is being conducted necessary for year end purchase order accruals. Arrangements have been made by letters to vendors and through HOO-AEC to procure June's costs on outstanding Procurement Directives. Accrual entries have been prepared for services rendered but not billed on GE contracts (excluding Zirconium). The administrator of each

contract was contacted to determine extent of liability. Accounts payable operation was also contacted to insure against our making an accrual and also receiving an actual charge.

One new "Cost purposes only" code, 7391, has been established for purposes of accumulating Buildings & Utilities Operating Costs. The purpose of this code is to identify, by building, unusual costs such as shade screens, new roof, etc. A new report format, for reporting type of cost by building, has been designed which will provide the additional information desired by Laboratory Auxiliaries Operation management.

Arrangements have been essentially completed for converting the Radiometallurgy Laboratory Operation to the work order system. Work Order series A-99001 - A-99899 has been given to the RLO to use in identifying examination requests and for accumulating cost associated with the employees whose effort is devoted to the development of new equipment.

Personnel Accounting Operation

A report of the 1957 Corporate Alumnus Program was received and distributed to all college graduates on the Hanford Laboratories Operation payroll.

As a result of Contract Accounting's letter on the subject "Salary Review Data - Midpoint Control", a report was prepared to indicate the number of employees over midpoint, number at midpoint and under, based on salary structure as of 12/1/57, and based on salary structure as of 12/1/57 plus 2%.

A Writ of Garnishment was served on one of our former non-exempt employees. The only monies due employee at the time of serving was a Pension Plan refund. Mr. D. P. Templeton suggested we answer the Writ in the negative and contact the Pension Trust relative to issuance of a pension check. This matter is unresolved at the month's end.

Effective July 1, HLO employees may authorize the Company to mail their salary checks on each regularly established pay day to any bank in which they have an account. Salary checks will be mailed regularly by Personnel Accounting to the designated bank as indicated on the authorization for deposit by the bank to the employee's account.

Beginning June 24, Salary Administration began pulling from their personnel files all documents other than appraisal forms. These documents are being turned over to Personnel Accounting in groups of 25 to 50 employees and if the original document is in the Personnel Accounting folder, the Salary Administration copy is destroyed. A study is being made to determine the procedures to be used and the records to be maintained in the combination of Personnel Practices personnel folders and records with those of Personnel Accounting.

Auditing

The special assignment with the Traveling Auditors was completed in June. Internal audit work since that time has consisted of continuation of those portions of the Property Accounting audit which do not duplicate work done by the Traveling Auditors. The work papers of the Traveling Auditors are being reviewed to mesh their coverage with the internal audit program remaining for the year ended July 31, 1958.

Measurements

The study of existing data on Personnel Accounting costs has been completed. Meetings continued with managers to enlist their constructive criticism of the measurements program and to get more information on their related needs. A study was completed for Technical Information.

Payroll StatisticsNumber of HLO Employees

<u>Changes During Month</u>	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on Payroll at Beginning of Month	1 129	512	617
Additions and Transfers in	18	13	5
Removals and Transfers Out	(14)	(6)	(8)
Employees on Payroll at End of Month	<u>1 133</u>	<u>519</u>	<u>614</u>

Overtime Payments During Month

	<u>June</u>	<u>May</u>
Exempt	\$ 5 648	\$ 1 698
Non-Exempt (Five weeks during May)	10 921	10 862
	<u>\$16 569</u>	<u>\$12 560</u>

Gross Payroll Paid During Month

Exempt	\$415 858	\$399 521
Non-Exempt (Five weeks during May)	269 174	341 439
	<u>\$685 032</u>	<u>\$740 960</u>

Participation in Employee Benefit Plans at Month End

	<u>No. Participating</u>		<u>% Participating</u>	
	<u>June</u>	<u>May</u>	<u>June</u>	<u>May</u>
Pension Plan	1 120	1 122	98.9	98.6
Insurance Plan				
Personal Coverage	1 162	1 170	99.7	99.7
Dependent Coverage	745	742		
U. S. Savings Bonds				
Stock Bonus Plan	696	692	61.4	61.3
Savings Plan	86	86	7.6	7.6

Insurance Claims

	<u>June</u>		<u>May</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee Benefits				
Life Insurance	-	\$ -	-	-
Weekly Sickness & Accident	19	1 450	12	937
Comprehensive Medical	33	5 742	26	6 317
Dependent Benefits				
Comprehensive Medical	55	4 245	39	4 187
Total	<u>107</u>	<u>\$11 437</u>	<u>77</u>	<u>\$11 441</u>

Good Neighbor Fund

	<u>June</u>	<u>May</u>
Number Participating	716	713
Percent Participating	63.2	63.2

W. Sale
7/15/58

INVENTIONS OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief no inventions or discoveries were made in the course of their work during the period covered by this report except as listed below. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

INVENTORTITLE OF INVENTION OR DISCOVERY

D. W. Shannon

An Improved Solution for Rinsing Zirconium and Zircaloy after Etching

L. L. Ames, D. W. Rhodes,
and J. R. McHenryThe Removal of Strontium from Solution by
a Calcite Phosphate Reaction

L. L. Ames

The Removal of Cesium from Solution by
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The Use of Molten Ammonium-Hydrogen
Fluorides in the Processing of Zirconium
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Radiation Reaction Catalyst-Hydrocarbon
Refining (May 16, 1958 - HW-56283)R. E. Ewing
H. H. Van TuylRecovery of Radioactive Strontium from
Nitric Acid Solution of Fission Products
(June 17, 1958 - HW-56425)

H. T. Hahn

The Stabilization of Liquid Metal Slurries
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