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HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT

MAY, 1958

Classification Category

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PRELIMINARY REPORT

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TABLE I. HLO FORCE REPORT AND PERSONNEL STATUS CHANGES

Date May 31, 1958

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	At close of month		At beginning of month		Additions		Separations			
	Exempt	Non-Exempt	Exempt	Non-Exempt	Exempt	Non-Exempt	Exempt	Non-Exempt		
Chemical Research and Development	124	95	219	121	95	216	3	1	0	1
Reactor & Fuels Research & Development	149	102	251	147	98	245	2	5	0	1
Physics & Instrument Research & Development	62	25	87	59	25	84	3	0	0	0
Biology Operation	34	42	76	34	43	77	0	0	0	1
Operations Res. & Syn.	14	3	17	14	3	17	0	0	0	0
Radiation Protection	40	121	161	40	120	160	0	1	0	0
Laboratory Auxiliaries	44	179	223	44	180	224	0	1	0	2
Financial	16	34	50	16	34	50	0	0	0	0
Employee Relations	13	10	23	13	11	24	0	0	0	1
Programming	15	4	19	15	4	19	0	0	0	0
General	<u>1</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Totals	512	617	1129	504	615	1120	8	8	0	6
Totals excluding Internal Transfers	512	617	1129	504	615	1120	8	8	0	6

Composite Separation Rate ----- 0.5314
 Separation Rate (based on separations leaving G. E.) ----- .0026
 Controllable Separations Rate ----- :0017

SUMMARYBUDGETS AND COSTS

Fiscal year to-date costs are \$15,720,000 at the end of May or 86% of the FY 1958 Mid Year Review as adjusted to reflect changes received from the Product Departments and HOO-AEC. May costs of \$1 524,000 were practically unchanged from the April level.

Cost-budget relationships for all programs are considered satisfactory at this time. Funds for Biological Research are extremely tight. Plutonium Recycle Research and Development costs did not reach the level expected in May. Research and Development and Process Technology costs for the Product Departments were within budget limitations. A significant underrun in CPD-Process Technology is expected.

RESEARCH AND DEVELOPMENT1. Reactor and Fuels

Design of the Plutonium Recycle Test Reactor is 80% complete overall. Temporary construction is complete, the excavation for the containment shell is about 95% completed, and the Phase II PRTR bid package was forwarded to the AEC on schedule.

Design of the Plutonium Fabrication Pilot Plant is 48% complete.

A process for extracting plutonium from aluminum employing liquid bismuth extractant is being investigated for reprocessing Al-Pu alloy PRTR fuel. Plutonium is recovered from the bismuth by re-extracting with molten caustic soda and leaching with hot water. The plutonium oxide residue is then reconverted to Al-Pu alloy by the cryolite process. An over-all plutonium recovery approaching 99% appears feasible.

Injection casting of aluminum into Zircaloy-2 tubing has resulted in cast densities 90% of theoretical as compared to 96-97% when aluminum is cast into stainless steel tubes. Cause of the difference is being investigated.

Irradiation of UO_2 rod elements fabricated by swaging revealed that no warp or distortion developed in an irradiation to 400 MWD/T in the MTR.

Nuclear Metals has produced additional promising extrusions of ribbed PRTR Zircaloy-2 jacket tubing in the nominal two-inch and three-inch sizes.

Initial burst tests of PRTR Zircaloy-2 process tubing at 300 C (6000 psi; 10% higher than calculated) substantiate the design calculations for these pressure tubes.

Thermocouple instrumented cluster fuel elements of an IPR type are operating satisfactorily with core temperatures of 522 C to yield data which will permit accurate prediction of fuel temperatures.

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Self-supported slugs, designed to eliminate misalignment and subsequent hot spot failures in current production reactors have been fabricated and three tubes are currently being irradiated in B Reactor.

Uranium casting development has continued with considerable success although initial casting of uranium into zirconium jackets resulted in sporadic bonds.

Preliminary success has apparently been achieved employing a laboratory, hot water jet-impingement test to demonstrate a significantly higher erosion-pitting type attack on X-8001 aluminum alloy (the former M-388) than on standard 1245 aluminum can stock. The test will be used to clarify similar differences which appear to occur in-reactor.

Contrary to previous conclusions, new data for graphite irradiation at 30 C indicate continued expansion, though at a reduced rate, above 5000 MWD/AT in the range on out to 8400 MWD/AT.

Conceptual studies indicate the technical feasibility of conducting Hanford high-temperature graphite irradiation experiments in one or more MTR shim rods without sacrificing the control rod feature.

Experimental studies of AlSi bonding variables (conducted in a joint program with FPD) show that a tough rather than a brittle bond on Hanford production fuel elements is favored by increasing the time, increasing the temperature, or decreasing the silicon content of the duplex preheat bath.

Thermal Hydraulics tests with I and E fuel elements in a K-Reactor geometry show that the Panellit trips apparently furnish protection at all tube powers.

2. Chemical Research and Development

Although plutonium absorption capacity was unaffected, examination of Permutit SK resin removed after 60 days in the Purex anion exchange unit showed greater resin shrinkage and bead cracking to have occurred than shown by previous checks. The cracking led to difficulty in resin bed movement. A revised preparation of the resin corrects this fault.

Calcined, Purex waste containing sulfate lets the fission products leach out. On the other hand sulfate free waste releases ruthenium during calcination. Phosphate addition reduces the leachability but only partially stops ruthenium volatilization.

Detailed drawings for the Cesium Isolation and Packaging Prototype Facility are 65 percent complete. Procurement of components continued.

Preliminary experiments supported the feasibility of recovering strontium-90 from Purex 1W by precipitation as strontium nitrate with fuming nitric acid.

Feasibility was demonstrated for recovery of neptunium by anion exchange treatment of Purex backcycle wastes.

In a two phase molten system of aluminum and potassium aluminum chloride, plutonium distributes to the double salt phase and uranium to the aluminum

metal phase. At about 700° C a separation factor of 200 was measured at one equilibrium contact.

On Non-Production Fuels Reprocessing activities the Darex prototype dissolver was 90 percent completed. Pilot plant Zirflex study continued to characterize uranium losses during zirconium jacket dissolution. Construction was initiated of a laboratory scale Hastelloy F dissolver for HNO₃-HF solutions.

An enrichment of 18 percent in the plutonium content of an aluminum-plutonium alloy was achieved by the electrolytic removal of aluminum in a molten cryolite bath.

Study of radioisotopes in several samples of the effluent from an experimental reactor process tube cleaned with special cleaning compound gave valuable information with respect to probable sources of some isotopes. Na²⁴ and Zn⁶⁵ were hypothesized to form from impurities or alloy constituents in the aluminum process tubes and appear in process water as a result of corrosion.

3. Physics and Instrument Research and Development

For the improved production reactor program, measurements of the reactivity of clusters of 1/2-inch diameter rods in various lattice spacings continued.

For present reactors, work continued on the difficult experiments to determine the reactivity temperature coefficients at higher discharge levels and on the theoretical work necessary to interpret the results.

Enclosing 0.95% enriched fuel elements in iron pipe will eliminate concern about nuclear safety in shipping, handling, and storage before charging into the reactors. The pipe also provides physical protection for the elements.

Other nuclear safety experiments indicated that the reactivity of mixtures of partially dissolved and undissolved slugs is not simply predictable from measurements made on each type alone. Work on reactivities of 2% and 3% slurries continued.

In the Plutonium Recycle Program measurements of the neutron physics parameters of a nine-inch lattice were begun to improve understanding of the neutron behavior in all lattices of the PRTR type. A nuclearly safe dissolver for plutonium-aluminum fuel elements will be of rather small size, about one foot in diameter, according to calculations completed this month.

The 329 Building temporary facility for examining wounds for plutonium contamination was recalibrated following receipt of a new source. The recalibration eliminated one-half of the discrepancy between facility measurements and direct results on material removed from wounds.

The prototype radiotelemetering data station was received from the manufacturer for evaluation. The tests so far indicate that only minor changes will be required to assure satisfactory operation. Satisfactory progress was made in the development of many other radiation detection and monitoring instruments.

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4. Biology

The prostate gland in rats chronically fed Zn⁶⁵ appears to compete with the skeleton as the critical organ. If this should be true in man, it would provide an avenue for measurement of Zn⁶⁵ deposition in the body because the gland is relatively accessible.

It appears that attempts to make Sr⁹⁰ unavailable to plants by adding chemicals to the soil to form insoluble strontium compounds will be effective only for relatively short periods of time. Preliminary evidence indicates that the strontium in insoluble compounds gradually becomes increasingly available.

Somewhat similar to EDTA, DTPA should be administered within one hour after plutonium gains entrance into the body for optimum effectiveness. In rats, three-hour delays in administering DTPA after plutonium injection resulted in twice the concentration of plutonium in the rat skeleton as compared with that when therapy was given within one hour. The early administration removed or prevented deposition of about 80 to 90 percent of the plutonium which would have deposited had no DTPA been administered.

5. Programming

The value of plutonium enrichment relative to the value of U-235 enrichment was compared in a high neutron economy reactor and a low neutron economy reactor. The results indicate that plutonium enrichment is more productive to the low neutron economy reactor than to the high neutron economy reactor.

In conjunction with others, research and development proposals were prepared and transmitted to the AEC concerning work dealing with the in and ex-reactor chemical reaction between CO₂ and graphite, and on lattice physics parameters associated with gas cooled reactor geometries.

Evaluation was made of proposals submitted by concerns interested in the design, development, and construction of a plant to recover rare gases from separations plant effluents, and appropriate recommendations were forwarded to the Chemical Processing Department.

Work was completed on the preliminary engineering and economic evaluation of processes for the recovery and packaging of waste fission products as radiation sources. It was determined that the cost of large scale recovery of gross or mixed fission products may be less than one cent per curie.

Necessary arrangements were made for the first HLO Science Colloquium, for which the speaker was Dr. Hans Ussing, Danish Zoophysiolgist. The colloquium was eminently successful.

Technical and Other Services

One case of plutonium deposition resulted from a puncture wound to a process operator. Approximately 0.01 μ c (1/4 MPL) Pu was removed by a small excision of flesh. Surveys indicated about the same amount remained in the finger, apparently diffused.

Extensive work was done in connection with the evaluation of current rupture performance of I and E fuel elements, with particular emphasis on the uncertainty associated with extrapolation of prediction equations derived for standard fuel elements.

Statistical and mathematical assistance on 28 separate problems was given with HLO and to other departments and operations. A comprehensive study of the statistical properties associated with different means of estimating receipts, removals, and inventories for a given material balance area was of particular interest.

Excluding the major PRP projects, there were 21 authorized projects at month end with total authorized funds of \$5,216,500. The total estimated project cost of these authorized projects is \$9,456,300. There were no projects completed during the month. Four new projects are awaiting AEC authorization; these have a total estimated project cost of \$577,000. Proposals for four new projects are in preparation.

A major declassification review program has been underway for approximately three months. About 4,200 early Hanford documents have been reviewed. Fifteen to twenty percent have been declassified and about the same number have been sent to the AEC Declassification Branch for review.

A bibliography - abstract on uranium alloys was started. Abstracts are being prepared on ASM-SLA punch cards in accordance with ASM metallurgical literature classifications. Approximately 9,000 documents will be reviewed for possible inclusion in this collection.

Supporting Functions

A new form, which should reduce paperwork and permit ease of preparation, is being designed to replace the IBM cards used by all components in submitting weekly time distribution.

The amount of underruns on appropriation requests continue to exceed the overruns, however, of the 93 completed requests since July 1, 1957, 54 (58%) have deviated (either over or under) by more than 10% from the original estimate.

Work by the traveling auditors was about complete at the end of the month with the review of the formal report by the Manager, Hanford Laboratories and Manager, Finance pending. There were no significant exceptions indicated.

At month's end, the staff of the Hanford Laboratories Operation totalled 1129, including 512 exempt and 617 nonexempt employees. Of the total exempt employees there were 446 with college degrees, including 428 technical degrees as follows: BS 221, MS - 104, PhD - 103. There were 35 nonexempt employees with degrees.

Attitude survey follow-up discussions were completed in one Level 4 component and in one Level 5 component in the Radiation Protection Operation. Similar discussions were initiated in the Physics and Instrument Research and Development Operation.

Plans were essentially completed for the A.S.E.E. Summer Institute for Professors and AEC Radiological Physics Fellowship Programs. Both programs will convene during June.

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Tours were arranged for 40 Walla Walla College science students and 25 members of the Umatilla County Elementary Principals' Association. As part of the G.E. Community Relations Program, a tour was arranged for forty Tri-City school administrators.

Laboratories' personnel worked a total of 188,284 man-hours during the month with no disabling injuries. Since September 1, 1956, 3,962,890 man-hours have been completed with no disabling injuries. The medical treatment frequency for May was 1.81 as compared with 1.75 during April.

There were 4 security violations during the month, bringing the total for the calendar year to 23.

Norman A. Stoll, a Portland attorney, has been appointed by the Federal Mediation and Conciliation Service as arbitrator in the Maki case.

At the May Suggestion Board Meeting 12 suggestions were approved for awards totalling \$255. For the year to date 45 suggestions have been approved for awards of \$1,345 with an average award of \$29.66 and a ratio of award to savings of 10.7%.

Jack L. Poe, Engineering Assistant, Reactor and Fuels Research and Development, was the recipient of a GE scholarship. Mr. Poe has accepted and is arranging to enroll in the University of Washington in the fall.

A realignment of functional responsibilities and organizational structuring within the Technical Information Operation was completed and made effective during May.

The annual reconciliation trip scheduled during May was completed with visits being made to the following Company components:

Aircraft Nuclear Propulsion Department
Missile and Ordnance Systems Department
Flight Propulsion Laboratory Department
Knolls Atomic Power Laboratory
Research Laboratory
General Engineering Laboratory



Manager,
HANFORD LABORATORIES

HM Parker:kss

REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATIONTECHNICAL ACTIVITIESA. FISSIONABLE MATERIALS - 2000 PROGRAM1. METALLURGY PROGRAMCorrosion Studies

Aluminum Can Stock Comparisons. The new HAPO standard can material, Alcoa aluminum alloy C-64, is similar to the Aluminum Association standard 1245 aluminum alloy except for limiting the iron content to a minimum of 0.35 wt percent. Samples of alloy C-64 have been studied for resistance to rapid high temperature corrosion by autoclaving in 250 C deionized water. Materials from two vendors were compared with a sample of 1245 alloy from Alcoa. Both C-64 alloys corroded less than the 1245, though more than X-8001. The results after one month are as follows:

<u>Alloy</u>	<u>% Fe</u>	<u>Corrosion in Mils</u>
Alcoa 1245	0.30	1.30
Alcoa C-64	0.41	0.74
Hunter-Douglas (C-64)	0.35	0.50
X-8001 (former M-388)		0.37

Both C-64 alloys corroded somewhat less than the one sample of 1245 alloy. The lower corrosion rate of the Hunter-Douglas material than of the Alcoa C-64 sample may be related to a special annealing treatment of the blanks before extrusion.

Jet Impingement Tests. Preliminary success has apparently been achieved employing a laboratory, hot water, jet-impingement test to demonstrate a significantly higher erosion-pitting type attack on X-8001 aluminum alloy than on standard 1245 aluminum can stock. Following are the first data from this test:

Conditions:

Water - 300 Area Process; temp. at nozzle = 100 C;
distance from nozzle to sample - 1/8 inch;
flow - 1 liter/hr; velocity - 70 fps.

Results:

1245 aluminum - after four hours of testing there was a roughening of the surface but no pitting to a depth of more than 0.2 milli-inch.
X-8001 aluminum - after two hours of testing the sample showed an indentation of 2.5 milli-inches at the area of impingement.

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Hydriding Studies. Studies on hydriding of zirconium and Zircaloy-2 in monoisopropylbiphenyl at constant partial pressures of hydrogen showed that the extent of hydriding was dependent on the partial pressure of hydrogen and the temperature. The presence of MIPB had no effect on the extent of hydriding. No significant difference was found between zirconium and Zircaloy-2 in these tests. Similar studies with uranium showed a strong dependence on hydrogen partial pressure. The rate of uranium hydride formation in MIPB appears to follow the rate law: $\text{rate} = k (P_T - P_D)^{5/2}$, where k is the rate constant, P_T is the hydrogen partial pressure, and P_D is the decomposition pressure of UH_3 . The presence of MIPB reduces the rate of hydriding to a tenth of the rate in dry gas at the same temperature and partial pressure of hydrogen.

Radiometallurgy Laboratory Studies

Metallographic examination and hardness testing showed that the temperature monitored coaxial fuel element (GEH-4-24) had operated in the uranium gamma phase and that the thermocouple material had reacted with the uranium.

Further details of Radiometallurgy studies in support of the 2000 Program fuels development activities are reported in connection with the fuels development programs.

Basic Metallurgy Studies

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. Three tensile specimens, two irradiated to 0.031 and the third to a 0.018 a/o burnup, were tested at room temperature. One of the 0.031 a/o burnup specimens was annealed at 400 C for ten hours and the other at 600 C for 100 hours prior to testing. The first specimen exhibited an ultimate strength of 76,400 psi, a yield strength of 70,800 psi, and 1.3 percent elongation. The elongation is about a two-fold increase over the as-irradiated control but is nearly the same as that for a specimen annealed at 400 C for 100 hours. This indicates that a plateau in the recovery of residual irradiation damage occurs quite early during a 400 C anneal. The second specimen exhibited an ultimate strength of 82,500 psi, a yield strength of 48,500 psi, and 4.0 percent elongation. Elongations of 0.7 and 2.7 percent were found for the as-irradiated control and a specimen annealed at 600 C for ten hours, respectively. It appears that time beyond ten hours at 600 C has a significant effect on damage recovery. The third specimen, irradiated to 0.18 a/o burnup, was annealed at 600 C for 25 hours prior to testing. It exhibited an ultimate strength of 42,600 psi, a yield strength of 39,800 psi, and 4.6 percent elongation. The low ultimate strength of this specimen compared to others in this series indicates that failure was premature.

Thermal Annealing of Irradiated Molybdenum. The kinetics of damage recovery in irradiated molybdenum are being studied by means of x-ray diffraction.

An analysis is being carried out of the annealing mechanisms occurring between 30 C and 200 C. It has been established that the simple equation

$$\frac{dn}{dt} = -kn^\gamma = -\nu n^\gamma e^{-E/kT}$$

where n = defect concentration at time, t ,
 γ = reaction order,
 ν = frequency factor,
 E = activation energy,
 kT = product of Boltzman constant and absolute temperature,

cannot, in this case, be solved for a unique and integer value of γ over the total range of the data. Several factors must be considered as possible causes of this failure to find a fit of the annealing data to this equation. These are:

1. The exact nature of the γ 's.
2. The occurrence of successive reactions.
3. The possibility of varying frequency factors.
4. The existence of an activation energy spectrum.

Production of High-Purity Uranium. A study of methods of preparation of high-purity uranium is being conducted primarily to provide a supply of this material for use in fundamental physical metallurgy studies. Electrowinning from a molten $KCl-LiCl-UCl_3$ 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.

The cell has been operating satisfactorily for three weeks. Temperatures for the electrolysis have ranged from 400 C - 500 C, and have been maintained with little difficulty. Estimated cell production is approximately five pounds per 24 hours of operation, but actual production has been held to approximately one pound, pending development of techniques to melt the unstable dendrites obtained during electrolysis.

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. As part of a program of measuring thermocouple stability in-reactor, quartz insulated and asbestos insulated thermocouple lead wire assemblies have been subjected to a total of 912 hours of exposure in KW Reactor. Both units are still showing a resistance between leads above the upper limit of the recording bridge (10^7 ohms). There has been no significant drift in temperature measurements comparing leads out-of-reactor with those in-reactor.

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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/X-8001 (e.g., M-388), U/Zr, and U-Zr alloy/Al couples. Since fuel elements utilizing a nickel diffusion barrier would operate at temperatures above 200 C, and the intergranular corrosion rate of unalloyed aluminum in water is excessive at temperatures above 200 C, the U/Ni/Al diffusion studies have been replaced with U/Ni/X-8001 diffusion studies.

Four U/Ni/X-8001 couples have been annealed at 448 C, and four others at 403 C for 27 days. Aluminum diffused approximately 0.0004" into the nickel in the couples annealed at 403 C. The aluminum diffused completely through the 0.001" thick nickel in the couples annealed at 448 C. Apparently some U/Al or U/Ni/Al compound was formed in the uranium at the Ni₂Al₃ interface. Fingers of this compound extended 0.005" into the uranium at some points. The Ni₂Al₃ phase boundary apparently reached the U/Ni interface after about 12 days.

New Fuel Element Development

Cluster Fuel Elements. As part of the testing program to develop a fuel suitable for high temperature irradiation, four seven-rod cluster fuel elements were charged into the KE through-hole facility. These fuel elements contained uranium rods enriched to 1.3 percent and clad in, but not bonded to, stainless steel. The four fuel elements were placed into a basket and the entire assembly instrumented to record the fuel core temperature of two peripheral rods and the temperature difference across the test basket. All thermocouples operated satisfactorily during startup. At full reactor power, the fuel was operating at 119 kw/ft with the central core temperature reading 522 C. The stainless steel-uranium interface heat transfer bond coefficient was calculated to be 1300 BTU/hr/ft²/°F. The reactor has scrammed and resumed operation since the above data were taken. Upon starting up the second time, the indicated central core temperature of the test fuel is higher than previously. This could be explained by a lower bond coefficient due to jacket relaxation. Goal exposure for this irradiation is 2500 MWD/T, and the experiment will provide data on swelling of uranium under considerable restraint.

Four-Rod Cluster Fuel Elements. Six four-rod cluster fuel elements were fabricated from 1.6 percent enriched co-extruded uranium Zircaloy-2 fuel rod for charging into the KER Loop 2 on a short term irradiation test. These fuel elements are of the internal ring, external pencil clip support design, and used fuel rods 0.630" OD with 30-mil Zircaloy-2 cladding. The co-extruded rod employed has an irregular uranium-zirconium interface, and this test is intended to determine whether such irregularity has a detrimental effect on fuel rod performance.

During May nineteen four-rod stainless steel clad clusters, irradiated to 580 MWD/T in 270 C water were discharged for KER Loop 1. Examination of the elements in C basin revealed no obvious dimensional changes. The fuel rods were uniformly coated with a red iron oxide probably

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originating from the carbon steel ex-reactor piping. Two of the nineteen elements had broken support rings, with this damage undoubtedly occurring during discharge.

The distance between rod supports in cluster fuel elements which can be tolerated without excessive bowing is a critical variable. The components for two elements, one a two-foot element without intermediate supports and the other a three-foot element with one intermediate support, have been fabricated and are being autoclaved. Co-extruded Zircaloy clad natural uranium rod will be used for the test.

Co-axial Fuel Elements. Post-irradiation examination of the last two co-axial fuel elements irradiated in the MTR is nearly complete. The mass of material found in the bottom of the inner uranium piece of the thermocouple element has been found to contain about 2.5 w/o stainless steel. The stainless steel content came from the thermocouple sheathing and an alloy of this composition could have had a melting point of about 1000 C. Metallographic examination in Radiometallurgy of the cross section of the fuel element revealed that the alloy formed penetrated the inner cored uranium piece intergranularly, and at some locations filled the interface between the outer uranium sleeve and the co-axial inner piece. The inner piece had grown considerably in length (> 0.1 "), and in the process the upper end was elevated above its tapered seat. This action isolated the top end of the inner piece and appears to have insulated it sufficiently to raise the operating temperature above the melting point of uranium. Metallographic examination is being made to determine if the observed melting resulted from uranium attaining its melting point (1133 C) or whether it occurred by alloy formation with the stainless steel thermocouple sheathing (possible alloy melting range 700-1000 C). The second or bottom co-axial fuel element (no thermocouples and no possibility of low melting alloy formation) was found to be in good condition and apparently capable of attaining a higher exposure without incident. Two additional co-axial fuel elements are scheduled for loading and irradiation in the MTR starting the last week of May. One of these elements has a tantalum protected thermocouple and will be operated until the thermocouple fails. The second element will operate until 1000 MWD/T exposure is attained.

Tubular Fuel Element Testing. Three, three-foot long, co-extruded Zircaloy-2 clad uranium tubes have been machined and fitted with end caps. End closures will be formed by electron beam welding and support rails will be spot-welded into the tubes. These tubes are intended for irradiation in a KER loop.

Effect of Clad Stiffness on Corrosion Behavior. A test program to determine the effect of clad stiffness upon the corrosion of uranium in the NMI co-extruded uranium-Zircaloy-2 fuel rod was initiated. It is hoped that a ratio of jacket strength to bond strength can somehow be correlated to the amount of damage caused by exposing purposely defected fuel rods to 225 C water for a period of two to four hours. Samples have been prepared with wall thickness varying from 30 to 5 mils. Two sets,

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one beta heat treated, will be initially tested to see if the bond diffusion caused by the heat treatment effects the corrosion damage. The tests are scheduled for the first week in June.

NPR Aluminum Alloy Melting Point Determination. Melting points and phase transition temperatures for the four NPR aluminum alloys, A-1, A-2, C-1, and C-2 have been determined. Standard cooling curves were run and all data interpreted from these graphs. The average values are presented as follows with ± 1 C variation in the readings:

<u>Alloy</u>	<u>Melting Temp. °C</u>	<u>1st Phase Transition °C</u>	<u>2nd Phase Transition °C</u>	<u>Final Phase Transition °C</u>
A-1	656.4	--	--	653.2
A-2	658.4	656.5	652.1	647.6
C-1	660.0	653.4	--	643.8
C-2	653.8	650.5	648.5	642.0

Candidate NPR (Category II) Uranium Alloys. Uranium alloys which may be suitable as NPR fuel material are being prepared for corrosion testing. The alloys prepared are presently in the "as-cast" condition and are being evaluated for homogeneity of the alloying addition. If the castings are determined to be homogeneous, they will be fabricated into 1/2" diameter rods and prepared for testing. Evaluation of the suitability of these materials for NPR application will include corrosion testing of the base alloy and "Elmo" flow loop testing of aluminum clad AlSi bonded and Ni bonded fuel elements.

Brittle Bonding. Continued bake test experiments on the causes and effects of "brittle bonding" have given the following results: with respect to fracture of bond due to long-term holding at intermediate temperature (275 C), (a) regular production as of early 1958 is the most vulnerable of all types tested; (b) slugs preheated in 620 C lead covered with nine percent AlSi are next worst; (c) slugs preheated in three-inch extra deep lead layers at 606 C with a normal (approx. 11 percent Si) overlay of AlSi are most resistant, being still intact after 33 days baking, with nine cycles of cooling, Frost-test heating, air cooling, and reheating in the bake furnace.

Repeated thermal cycling (up to 26 cycles) of Ultrasonic Bond Test reject slugs caused a general increase in size of the broken bond areas. Thermal cycling also tended to develop zones of poor heat transfer in poorly bonded slugs where formerly the heat transfer was adequate. Slugs with originally sound bonds appear to be unaffected by the relatively mild thermal cycling of the Frost test.

The optical and electron microscope studies of the bonds formed in fuel elements, between M-388 Al/AlSi/U and 1245 Al/AlSi/U, are continuing. The specialized metallographic procedures used show several important features: (1) The compound layer consists of from one to five distinct bands. (2) Large primary aluminum grains are adjacent to the compound layer, and on both sides of fragmented bands which are within the AlSi

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layer; the primary grains presumably form due to Si migration and subsequent formation of the compound layers. (3) Feathering of the compound layer is associated with breakaway of layers from the main compound layer; direct reaction of primary aluminum with uranium may account for this phenomenon. (4) Large primary aluminum grains in the AlSi are adjacent to the can wall material; their presence is due to the fact that on cooling the first solid formed from the eutectic is predominantly aluminum. (5) A random cross section of fuel elements which have passed the bond test shows all variations of the bond characteristics, both good and bad.

Two samples of fragments from the bond layer were obtained by stripping jackets from slugs. These were analyzed by x-ray fluorescence techniques for all elements from titanium (At. No. 22) to uranium (At. No. 92). No elements other than uranium were detected. The results of these tests indicate that lead carryover from the duplex bath is not sufficient to materially influence the composition of the bond layer. Work is continuing to determine the silicon, aluminum, and uranium contents of these samples.

Bake Testing of Fuel Elements. Bake testing of Al clad AlSi bonded and Ni bonded fuel elements at 450 C and 1000 psi external pressure has been completed. During the first 200 hours at these conditions, voids in the AlSi layer of AlSi bonded elements became evident as indents in the aluminum cladding. After about 800 hours, the AlSi bonds start to break down as U-Al-AlSi interdiffusion effects accumulate. These effects produce thickened and cracked intermetallic layers which "ripple" the clad surface of the fuel element and reduce the thermal conductivity of the bond. The Ni bonded fuel element appears unchanged, superficially, after about 2000 hours at the test condition. Metallographic examination of the hot press Ni bonded fuel element reveals that extensive interdiffusion (U-Ni-Al) has occurred, but not with the same effect (cracking and unbonding) as observed with the AlSi bonds. Analysis of the cladding reveals that uranium does not diffuse into it to any appreciable extent at the bake conditions. Summarized data follow:

<u>Sample</u>	<u>Hours at 450 C, 1000 psi</u>	<u>Compound Layer Thickness, in.</u>	<u>Diffusion into Uranium, in.</u>
AlSi	894	0.005	0.012
AlSi	1479	0.007	0.018
H.P. Ni	2023	0.005	0.016

Self-Supported Aluminum Jacketed Fuel Elements - PT-84-A. Self-supported fuel elements are designed to accurately position fuel elements in smooth bore process tubes. This accurate positioning should help eliminate "hot spot" type failures. Eight Hanford production-tube charges have been fabricated, and three tubes are now being irradiated in B Reactor.

Insulated Fuel Element. A cored, insulated fuel element which had operated at high temperatures was sectioned longitudinally, and replicas for electron microscopy were prepared remotely. The shapes of the pores in the longitudinal section are similar to the shapes revealed in a transverse

section. No elongation parallel to the fuel element axis was detected, and no interconnection of the pores was observed.

Vacuum Melting and Casting of Uranium. The crucible assembly of the NRC vacuum melting furnace has been rebuilt and the magnesia ramming mix replaced with stabilized zirconia. Five uranium base alloys consisting of U-0.5 w/o Mo, U-0.25 w/o Cr, U-0.10 w/o Ti, U-0.10 w/o V, and U-1 w/o Nb, have been cast into small billets. Two uranium tubes were cast using vycor tubing as a mold to determine if quartz glass would impart a smooth finish on cast uranium. The method proved to be reasonably successful. Six castings were made into small diameter heavy wall Zircaloy-2 tubes to determine the amount of bonding between the uranium core and the Zircaloy jacket. Bonding appeared to be rather sporadic, and much of the Zircaloy tubing was beta-transformed by the high temperature of the molten uranium.

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) a 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 number of tests were made during the month using dingot uranium stock preheated to 550 C after coating with MoSi₂ and packing in graphite. Dies and punches were preheated to 360 C and presses were made with 200 tons on the coining punch followed by shearing the center section with a plug punch. Smooth shear surfaces were obtained, and except for bowing of the washer during removal from the die cavity, well-formed washers were obtained. With this stock the lower edge of the washer does not completely fill the die cavity, and the edges are slightly rough.

New rod stock was prepared from ingot uranium by hot rolling to approximately 0.75" diameter, salt bath beta heat treating, machining to size, and vacuum annealing at 600 C. One test made with this stock indicated good filling of the die and smooth outer edges. This is believed to be due to the finer grain size of the ingot material.

Fabrication of Tubular Uranium Cores. A method for production of uranium tube cores, 1.78" outer diameter, 1.44" inner diameter, up to 30" in length, is being developed for fabrication of tube and rod elements. Tube sections 2.00" OD, 1.25" ID, 22" long were vacuum cast in graphite molds and machined to approximately 1.9" OD, 1.45" ID. Subsequent heat treatment and swaging are being employed to break up the cast structure and perhaps increase the density. Two tube sections have been swaged in a series of passes using a mandrel to hold the inside diameter until the outer diameter is approximately 1.83". The swaging has been done with the uranium preheated to 225 to 250 C in air with intermediate vacuum annealing at 600 C. Additional work will be required to reduce the diameter to near finish size.

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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 for 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 375 C. Effort is still being made, using wire flux monitors, to get a correlation between the uranium temperature and flux in the reactor facility to determine if the heat transfer calculations are correct. The fuel exposure has now reached approximately 900 MWD/T.

A series of NaK capsule experiments is being 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. Dimensional calculations and drawings for the capsule body components have been completed and off-site bid requests distributed for the machining of them.

ETR Piping Calculations. A method of analysis for determining the stress distributions in a pipe cycled in the plastic region by alternating pressure loading and gamma-heating was developed and programmed on the IBM 650 digital computer. Numerical calculations using this program will be made to determine the mechanical state of tubing for various pipe thicknesses under conditions which will be encountered in the ETR Fuel Element Testing Facility.

NPR Piping Calculations. A method of analysis for determining steady-state creep rates and stress distributions in pressure piping with radial temperature distributions have been formulated. A material model was evaluated with experimentally determined secondary creep rates for Zircaloy-2. The equations necessary for evaluating the secondary creep rates and stress distributions are being programmed for use of the IBM 650 digital computer. The initial calculations will be for tubing operating under the design conditions encountered in the NPR.

2. REACTOR PROGRAM

Coolant Systems Development

Effect of Radiation on Corrosion (PT-105-550-E). The experimental part of the first phase of this production test has been completed. The results have been plotted to show the effect of irradiation on total corrosion under the conditions of the experiment (reactor cooling water at 110 C). From the results, it appears that there is a direct logarithmic dependence of corrosion (and corrosion rates) on the radiation levels; that is,

$$\log k = eAf$$

where k = corrosion rate
A = constant
f = flux.

The total corrosion after three months was 0.1 mil for a zero flux level and 0.4 mil for the maximum flux level of the tube (viz., 43 kw/ft at the center of the adjacent tube). This should not be interpreted as implying that radiation always increases the corrosion rate by a factor of four. The effect may be more nearly an additive one - merely adding approximately 0.3 mil, at this flux level, to the corrosion which would occur in the absence of the radiation.

KER Loop Operation. Loops 3 and 4 operated with little or no difficulty during the month. The pigtail leak in Loop 1 was repaired and the loop was brought up to about 270 C at the first of the month. On the 15th, the loop was shut down and the four-rod clusters were discharged. After the reactor went down, the loop failed to switch to process water cooling. The apparent cause of the failure was a partial plugging of the dump valve by debris in the line. The carbon steel piping upstream of the valve was inspected and found to contain numerous soft corrosion product (rust) mounds. A study is in progress to determine what precautions should be taken before restarting the loop.

Loop KER-2 operated at a 190 C outlet temperature (limited by an abnormal flux distribution) with A-2 alloy clad elephant slugs until May 12. After a spurious indication of a rupture and the failure of one pump, the loop was discharged on May 15. Several weeks will be required to repair the pump, during which time the loop will be operated on single pass with a charge of dummy slugs in order to obtain a flux traverse.

Use of Dichromate as an Inhibitor. Both loop and gamma irradiation studies have been started to determine the suitability of dichromate as an inhibitor in reactor systems employing aluminum and/or carbon steel. The first results from the gamma irradiation were encouraging. There was some decomposition of the dichromate (to oxides of chromium), but from preliminary data the rate did not appear to be excessive.

New Aluminum Alloys. Fuel elements clad with new aluminum alloys A-1, A-2, C-1 and C-2 obtained from Hunter-Douglas have been in ELMO Loops 6 and 7 for a period of about eight weeks at 300 C. The only evidence of non-uniform corrosion is a few very shallow pits which developed soon after charging and have not changed on additional exposure. From the results of these tests it appears safe to schedule small-scale in-reactor tests with some of these alloys.

Corrosion of X-8001 Alloy in Process Water. A document has been prepared describing the test program in the six central zone tubes supplied with water from the 1706-KE Semiworks. The program is designed to give additional information on the non-uniform attack being experienced by production fuel elements clad in X-8001 alloy (formerly M-388). The conditions will be made particularly severe in an attempt to reproduce the extensive pitting attack noted by the X-8001 in some reactor tubes. Such test conditions as low dichromate, excessive flow rates, frequent purging and high surface temperatures may help initiate this pitting attack. A direct comparison of X-8001, 1245 and the newer alloys will be made.

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No pitting attack was noted in the mockup tubes either in the venturi test or in the test simulating conditions of H Reactor.

Film Studies. A visual examination of aluminum dummies discharged from KER-2 showed that the film deposited in the radiation flux zone was thicker than the film deposited on those pieces out of the flux zone. In other words, the radiation does appear to affect the form, and possibly amount, of the film. A quantitative estimate of the relative film thickness will be made from weight data.

One important question which has never been answered satisfactorily is to what extent does the corrosion product film act as a heat transfer barrier. The most direct method of measuring the temperature drop across the film is to irradiate a slug having a thermocouple placed in the aluminum jacket below the outer surface. One such slug has been fabricated and is being tested in ELMO-7. If satisfactory, it is planned that a similar piece will be made and placed in one of the KER loops.

Nonmetallic Materials Development

Radiation Damage to Graphite at 30 C. Monitoring of changes in physical properties of reactor graphites irradiated in hot and cold test hole facilities is conducted on a continuing basis to provide data valuable in establishing operating procedures as well as understanding fundamental damage mechanisms. Samples were recently discharged from cooled test holes operating at approximately 30 C with total exposures of up to 8400 MWD/AT. Contrary to previous conclusions that saturation of physical length changes at 30 C was occurring at about 5000 MWD/AT, the new samples indicate that expansion has continued in the 8400 MWD/AT samples. The percent expansion for transverse oriented CSF graphite samples increased from three percent at 5000 MWD/AT to four percent at 8400 MWD/AT. The rate of expansion decreases near 5000 MWD/AT which led to the previous assumption that saturation was occurring. Parallel CSF samples continued to contract at about the same rate. At 8400 MWD/AT this contraction was 1.0 percent. TSGEF samples irradiated to exposures of 5900 and 5400 MWD/AT indicate no changes have occurred in the previously reported rates of length change.

High Temperature Graphite Irradiations. Two alternative design concepts have been visualized which would allow the conversion of the MTR L-48 shim rod to a graphite irradiation facility but still retain the control rod feature in the L-48 position. In one plan, the already hollow shim rod entering from the top of the reactor would pass over a thimble experiment which itself would penetrate the bottom reactor plug. It appears possible to develop a suitable new shock absorber to replace the existing one which would be sacrificed in the conversion. The other plan involves incorporation of the graphite carrying assembly into an operating control rod. Leads from this type facility would be brought out the top reactor plug, and no modification to the reactor itself would be made. Because of advantages and disadvantages of both methods, both schemes will be carried through a more detailed design stage.

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Radiation Annealing. Additional calculations relevant to the hypothesis that thermal neutrons may be partially responsible for the phenomenon of radiation annealing have been performed. For graphite, one calculates a thermal enhancement of the interaction between the atoms of the lattice and neutrons (e.g., the probability for transfer of energy from the neutrons to the graphite lattice increases) up to neutron energies of approximately 0.2 ev. Thus, the cross section for interaction and the neutron flux are relatively independent of temperature for neutron energies above approximately 1 ev whereas below approximately 0.5 ev both the neutron flux and the cross section for interaction are increased with increasing temperature. Graphite samples surrounded with cadmium oxide to reduce the neutron flux below approximately 0.5 ev are being prepared for irradiation to test this hypothesis.

Radiation Curing of Silicones. It is well known that silicone rubbers undergo depolymerization when subjected to heat aging by high temperature water or air. This results from reactions of the residual peroxide catalyst which is left in the rubber after normal heat curing. The depolymerization causes a decrease in hardness and tensile strength and results in failure of O-rings, gaskets, seals and other components manufactured from the material. Experiments have been reported in recent monthly reports which described the results of curing silicones with gamma radiation. Improved materials superior in their resistance to immersion in high temperature water were produced.

One disadvantage to curing by means of gamma radiation is the rather large dose required (about 10^7 r). Recent experiments indicate that the curing dose may be significantly reduced by a short heat treatment prior to the radiation cure. The first material tested, a methyl phenyl vinyl silicone was produced with good properties by a cure of 2.25×10^7 r. Heat treatment first (65 hours at 125 C) followed by a dose of 0.90×10^7 r produced a material with the same properties. Tests extending to a wider range of heat-radiation treatments are now being conducted on a number of different silicone types.

Irradiation Damage to Plastics. Based on an assumed model for the radiation induced oxidation of polyethylene, an equation has been derived which describes the experimental results within 7% over a range of sample thickness and gamma exposure. These studies indicate that reaction sites are formed uniformly throughout the solid by ionizing radiation. The rate of oxidation is controlled by the diffusion of oxygen into the sample. By modifying the normal diffusion equation to account for the removal of oxygen in carbonyl formation and solving the differential equation, the result is an equation of the form:

$$A = kt \tanh BL/2$$

where k and B are constants, A is the optical density of the carbonyl absorption band at 1720 cm^{-1} , t is time, L is the sample thickness, and tanh stands for hyperbolic tangent.

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Structural Materials Development

NPR Zircaloy Tubing. Allegheny Ludlum Steel Corporation has been unsuccessful in producing 57-foot Zircaloy tubes of KER diameter. Cracking of the tube wall and difficulty in meeting dimensional tolerances were the principal causes of failure.

In an effort to obtain KER tubes for installation during the next scheduled shutdown, two of the five NPR tubes now being produced by Mallory-Sharon Metals Corporation will be diverted to this use. A modification to the contract (DDR-28) has been negotiated with the vendor to perform this work. The two shortest tubes are to be cut in two after the third tube reducing pass and will be further reduced to KER dimensions in one additional pass. This will provide four KER tubes of sufficient length for the loops. The material on the original contract has received its second tube reducing operation, and completion is expected by mid-June.

B-D-F Zircaloy Tubing. Allegheny Ludlum Steel Corporation is attempting, under contract DDR-6, to produce B-D-F ribbed process tubes from Zircaloy extrusions by a two-pass tube reducing operation. The first pass has been completed successfully, and tooling is now complete for the final pass.

The initial commercial order for 300 B-D-F tubes of Zircaloy is causing considerable interest to be shown throughout the tubing industry. One company has requested qualification material to demonstrate a new process. One healthy sign is the constructive interest shown by the vendors in the specifications and yields, now that Zircaloy tubing is being requested on a guaranteed yield rather than a development order basis.

Thermal Hydraulics

Reactor Flow Hazard Studies. Experimental heat transfer studies of the response of reactor process tube assemblies to imposed hazardous operating conditions were continued. The group of experiments simulating C size I & E fuel elements in a K process tube were completed after 41 transient runs with 125 C outlet water temperature at 750, 1000, and 1250 KW tube powers.

In the analysis of these experiments for reactor application, two questions are especially significant: (1) at what tube powers and over what range of flow reductions can reliance be placed on a low trip of the Panellit gage to detect a flow blockage upstream of the Panellit tap, and (2) under what conditions can reliance be placed on a Panellit high trip in case the low trip was not actuated. In answer to these questions, the data lead to the following conclusions in regards to the outlet water temperature limits as specified in "Specification A-020, Process Tube Instability Limits" (HW-51659, K. W. Hess, Secret).

1. At tube powers below 700 KW, no reliance can be placed on a high trip following a flow blockage upstream of the Panellit tap. However, at these tube powers, the flow

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which would result in boiling burnout is so low that any flow blockage which would result in damage would cause a low Panellit trip.

2. At tube powers above 700 KW, and especially at the higher powers, the reliance which can be placed on the low trip for moderate flow blockages is slightly doubtful in some cases. However, for each of these cases where a low trip is questionable a high trip can be expected, although it may occur several seconds following the flow blockage.

The extent of the conditions over which a high trip was demonstrated for these experiments simulating I & E fuel elements was greater than experienced for solid fuel elements in a K process tube. The difference may arise from the lower average metal temperature in the I & E case, or from improved experimental equipment and techniques which were established for the I & E experiments.

Hydraulic Studies. Laboratory data have been gathered to study the pressure drop across various combinations of downstream support charges which include solid aluminum dummy slugs in the B-D-F and C process tube geometries. The data, which will be reported in HW-56099, will be used by IPD in studies of pressurization as a means of preventing boiling at the top of the annulus with I & E fuel elements. Similar data had been reported previously in HW-54743 for the K Reactor geometry.

Fabrication was completed of a KER tube and a Lucite PRTR tube for addition to the hydraulics laboratory.

Laboratory experiments were conducted to determine the effect on Panellit pressure of having a front nozzle insert come loose and wash downstream to butt against the front of an I & E charge. The increase in Panellit pressure was found to be very modest when the insert had a channel drilled to allow water to flow from the annulus to the hole of the I & E charge.

High Pressure Heat Transfer Apparatus. The reassembly of the Ingersol-Rand recycle pump was completed by the manufacturer's field representative. When the repaired rotor was first installed it was found that interference existed between two of the impeller wear rings and the diffuser rings. The Ingersol-Rand Company authorized the field representative to hand fit the impeller rings to eliminate this interference. The effect of this procedure on the balance of the rotor will not be known until some time after the pump has been started up.

Heat Transfer Coefficient Studies. Both analytical and experimental studies of the heat transfer characteristics of rod cluster fuel elements were continued. Calculations of temperature distribution were nearly complete for a seven-rod cluster with UO_2 as the fuel. Initial calculations were made for the nineteen-rod Pu-Al alloy cluster.

Construction of two new seven-rod cluster test sections, to be used with the electrically heated heat transfer apparatus, was nearly complete.

Mechanical Equipment Development

Organic Cooling System Components. Four mechanical seals are being tested on the organic facility (MOTS-1). The Sealol and the Byron Jackson seals operated satisfactorily. It was necessary to remove the Durametallic seal due to excessive leakage. The John Crane seal was installed but immediately removed as the shaft packing failed to seal. No leaks developed in any of the flared or compression fittings under test.

Shielding Studies

Shielding Calculations. The VALPROD multigroup diffusion theory IBM code was used to calculate the neutron flux distributions for the K Reactor. These distributions were compared to traverses from shielding experiments to determine the possible usefulness of multigroup codes for shielding calculations. The agreement between theory and experiment was only fair, but refinement of both theory and experiment can be expected to improve the agreement considerably. This work was fully reported in "Comparison of Multigroup Diffusion Calculations with Shielding Experiments" (HW-55999, D. E. Wood, 5/9/58).

NPR Physics Calculations. The study of heat generation in the thermal shield for K Reactor and NPR was continued using the two-group diffusion theory calculation for the thermal neutron flux in NPR. This work is complete and is being written up in "Heat Generation in the NPR and K Reactor Thermal Shields" (HW-56144, D. E. Wood, to be issued 5/28/58).

Thermal Shield Studies. Shop fabrication of the foil-holder wells through the lid of the experimental nose-tank for the C Reactor test plug was completed. A filler slab for the top of the tank was also completed. The assembly was checked for water leaks, and the water flow rate through the aggregate-filled tank was 1.5 gpm at 3.0 psi pressure on the in-let line.

Construction of the ion chambers for the C Reactor shielding plug has begun.

Neutron Spectrometer. Initial operating tests on the equipment for the neutron spectrometer were completed. Minor maintenance and circuit changes have been made prior to a final test before moving the unit to the positive ion accelerator.

B. WEAPONS - 3000 PROGRAM

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

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C. GAS COOLED POWER REACTOR PROGRAM - 4000 PROGRAM

Graphite Studies

A proposal for research and development work in support of the Gas Cooled Reactor Program has been prepared at the request of the Atomic Energy Commission. The proposal outlines work needed to define and better understand the effects of carbon dioxide and other gases on the graphite moderator under the conditions of high temperature, flow, and pressure expected in any advanced gas cooled power reactor. The rate of oxidation of graphite by carbon dioxide is unknown at high pressures and temperatures above 350 C. Radiation effects including dimensional, strength, and thermal conductivity changes, and stored energy accumulation need to be evaluated for the type of graphite chosen for the moderator and under expected service conditions. Recent British experiments with impervious coatings and oxidation inhibitors suggest that with appropriate treatment, graphite may serve in a carbon dioxide atmosphere at a significantly higher temperature than is now possible.

Proposed tests would be conducted in three experimental facilities to be constructed at Hanford: (1) a capsule irradiation facility; (2) an in-reactor gas loop capable of simulating reactor conditions of flow pressure, gas composition, and temperature; (3) a similar ex-reactor loop. Funds have been authorized and work has begun on a feasibility study to define the cost and construction time of the gas loops. Preliminary planning has started on capsule experiments which would provide a relative measure of the effect of radiation on the gas-graphite reaction rate and equilibrium gas composition. It is expected that this type of experiment would be useful in bracketing conditions of interest for subsequent investigation in a flowing system and also serve as a screening test for graphites treated with oxidation inhibitors or impervious coatings.

D. CUSTOMER WORK

Corrosion Studies

Reactor Decontamination. The use of Turco 4306-B cleaning compound to decontaminate the interior piping of the Hanford production reactors leaves some of the aluminum, steel, stainless steel and copper surfaces without any protective film. In order to reform a protective coating on the metals, a chemical treatment was proposed (HW-55818, HW-55849, HW-55978), using Turcoat 4504 (manufactured by Turco Products, Inc.).

Tests were started to characterize the value of the Turcoat 4504 treatment on 6061, 7072, 1245 and X-8001 aluminum alloys; 304 stainless steel and S.A.E. 1020 mild steel. Exploratory tests on post treatment corrosion of the above metals in flowing 300 Area water (uninhibited) at 95 C indicated the treatment was mildly beneficial for mild steel, 7072 and 6061 aluminum alloys. The treatment showed little effect on 1245 and X-8001 aluminum alloys and 304 stainless steel. More extensive tests are now being conducted by autoclaving in reactor process water (inhibited) at 120 C. The production tests described in the documents mentioned above will also provide data.

Preliminary tests of galvanically coupled copper and mild steel in the Turcoat 4504 solution indicate this solution might create serious corrosion in dead-ended instrument lines and brass bellows if they are not flushed out.

Radiometallurgical Examinations

IP-80-A KE M-388 Regular Rupture (RM-224). Examination of HAPO Failure #976, a regular 8-inch, M-388 jacketed slug from IP-80-A, has been completed. Water penetrated the jacket and caused the failure after 65 operating days because of pre-irradiation mechanical damage which reduced the effective canwall thickness 80-90% and damaged the AlSi. Also, a single dent was seen near the base end of the slug which reduced the effective canwall thickness 65%.

Examination of Elephant Slug (RM-223). One of the 1.800-inch OD I & E wafer fuel elements which had undergone irradiation in the KER Test Facility was submitted for examination. Observations pertaining to the appearance and condition of the uranium wafers and AlSi bonding layer were reported last month.

A sample of canwall was obtained from the element. Though the examination is incomplete, it appears that the canwall has suffered from a pitting type of corrosion. Evidence of areas of porosity in the can wall and at the AlSi canwall juncture has been found. The examination of the can wall is continuing.

Enriched I & E Fuel Element Failures (RM-218). An enriched I & E failure was transferred to Radiometallurgy for examination. The slug was irradiated in tube 3748-KE and reached an exposure of 68.5 MWD/tube before rupturing on February 25, 1958. Visual observation revealed that a large section of jacket near the male end had become detached from the slug. This piece was seen following removal of the slug from the tube; however, it has not been recovered for examination. The exposed uranium was relatively unattacked, except around the edges of this area. Warp was measured and found to be three mils.

Examination of Corrosion Coupons Exposed in Redox 107 SX Waste Storage Tank (RM-148). Corrosion coupons exposed in the vapor phase have been cleaned and examination is 50% complete. Examination of liquid phase samples was finished this month.

Fission Product Gas. The metal train for the collection of fission product gases was leak tested on May 8. Several leaks were found and closed.

A three-inch thick steel blister has also been designed and a work order submitted for its fabrication. It will house the iodine cold trap which, it is hoped, will prevent contamination of the equipment when "green" ceramic capsules are drilled. Three additional iodine cold traps have also been ordered fabricated.

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Metallography Service

The compound layer in canned slugs which was identified last month as being associated with strong or tough bonds has been tentatively labeled as UAl_3 . The metallographic appearance of this compound is very similar to that of other samples of UAl_3 which were previously identified by x-ray diffraction techniques. In order to provide positive identification a small group of samples is being prepared for x-ray diffraction studies. With these samples for direct comparison other samples may be identified by their characteristic reaction to various etches. The etch tests have been devised, but a known standard is necessary to provide positive identification.

It is apparent from the tests thus far that a tough bond (as determined by manually stripping the aluminum jacket from the uranium slug) is produced by increasing the time, increasing the temperature or decreasing the silicon content in the duplex preheat bath. Work recently completed on slugs which were dipped in the duplex bath but not aluminum jacketed indicates that, although the character of the compound layers may be largely controlled by the conditions in the duplex bath, approximately half the thickness of the layers is formed during the canning phase if the exposure time in the duplex bath is short. When the slug is held in the duplex bath for twenty seconds or longer, the compound layer thus formed begins to approach the final thickness as canned.

Samples Processed During the Month

Total samples processed: 239

Photographs:

Micrographs	277
Macrographs	<u>63</u>
Total	340

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-56185 A2.

J. W. Woodfield

For Manager, Reactor and Fuels Research
and Development Operation

FW Woodfield:kb

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
RH Purcell	5/1	Dura-Metallic, Calamaso, Michigan	Consult on mechanical development & mechanical seal pumps	AH Miller	No
	5/2	Crane Packing Company, Morgan Grove, Ill.	"	J Theyer	No
JM Batch	5/1	Lewis Flight Propulsion Lab., Cleveland, O.	Consult on burnout status	JM Fabino	Yes
RM Fryar	5/2	3rd Regional Mtg. American Soc. of Heating & Air Cond. Engrs., Spokane, Wn.	Present paper	--	No
	5/6-7	Atomic Industrial Forum, St. Petersburg, Fla.	"	--	No
JF Fletcher H Harty	5/22-23	GE-APED, San Jose, Calif.	Discuss PRTR shim controls & activity monitor	EP Peabody & DE Peterson	No
FW Albaugh	5/8-9	AEC, Washington, DC	Briefing on Australian Atomic Energy Symposium	AJ Vander Weyden	No
SH Bush	5/1	Fenn Mfg. Co., Newington, Conn.	Discuss rolling mills	T Scattergood	No
TK Bierlein	5/1-2	GEL, Schenectady	Present talk on metallography at Company-sponsored symposium	--	No
DC Kaulitz WE Roake	5/2	Phillips Pet. Co., Idaho Falls, Ida. AEC-100, Idaho Falls, Ida.	Discuss MTR - GEH-4	R Neidner (GE liaison engr.)	Yes
SJJ Cadwell SJE Minor	5/13 5/14-16	American Bearing Corp., Indianapolis, Ind. Gatlinburg Fuel Element Conf., sponsored by ORNL, Gatlinburg, Tenn.	Consult re uranium casting developments. Attend conference.	H Lambertus --	Yes Yes
WE Roake GT Geering	5/14-16	" "	Present paper "	-- --	Yes Yes

VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
RG Wheeler	5/20-23	KAPL, Schenectady	Attend 7th Annual AEC Corrosion Symposium	CG Lindquist	Yes
AC Cooper	5/21 for AEC-100, Idaho Falls, Ida., an & Phillips Pet. Co., indefinite Idaho Falls, Ida. period		Assist with Hanford irradiations in MTR & ETR together with R Weidner, GE liaison engineer between Hanford & Phillips Pet. Co. personnel.	R Weidner (GE liaison engr.)	Yes
MK Millhollen	5/21	Oregon Metallurgical Corp., Albany, Ore.	Discuss casting design on Mark II-B end fittings & observe production processes used in producing Mark II-A seam weld cups.	W Aschoff & A Abraham	No
JE Minor	5/27-28	AEC-100, Idaho Falls, Ida.;	Discuss ETR high pressure loops & irradiation programs of GE in ETR & MTR.	R Weidner (GE liaison engr.)	Yes
DC Kaulitz		Phillips Pet. Co., and GE-ANP, Idaho Falls, Ida.		Mr. Provost	Yes
FB Quinlan	5/26	Sutton Mfg. Co., Philadelphia, Pa.	Check on equipment & specifications.	RA Bland	No
	5/27-28	Reactive Metals Conf., Buffalo, N.Y.	Attend AIMME conference	--	No
	5/29	GE Research Lab., Schenectady	Check on equipment & specifications.	JH Hollomon	No
GT Geering	5/12-14	Nuclear Metals, Inc., Cambridge, Mass.	Discuss completion of development contract to produce Zircaloy clad uranium rod.	HF Sawyer	Yes
RL Dillon	5/20-23	KAPL, Schenectady	Present papers at 7th Annual AEC Corrosion Symposium	CG Lindquist	Yes

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VISITS TO OTHER INSTALLATIONS (CONT)

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JM Davidson RE Nightingale	5/14-16	Phillips Pet. Co. (MTR), Idaho Falls, Ida.	Discuss L-48 conversion.	R Van Sise & RB Johns	Yes
RL Dillon JW Riches FW Woodfield	5/26-27	GE - APED, San Jose, Calif.	Discuss Zircaloy procurement & aluminum alloy corrosion work.	RB Richards	No
RE Nightingale	5/27-29	GE - ANP - NRIS, Idaho Falls, Ida.	Plan maximum effective use of conflicting MTR & ETR space by ANP, KAPL & HAPO.	J Provost	Yes
LD Turner	5/8	U. of Washington, Seattle, Wn.	Present talk on Radio- metallurgy.	DN Polonis	No
R Harrington	5/5	B.F. Goodrich Chem. Co., Cleveland, O.	Visit rubber & plastics companies & attend ASTM Sub-Committee business meeting.	WH Schloenbach	No
	5/6	Union Carbide Corp., New York, N.Y.		LJ Sinnott	No
	5/7-8	ASTM Meeting, Washington, D.C.		DS Ballentine	No
	5/9	DuPont Company, Wilmington, Del.		JR Perkins	No
HP Oakes	5/1	Carpenter Steel Corp., Union, N.J.	Consultation on Zr fabri- cation.	BB Burd	No
	5/2	Tube Reducing Corp., Wallington, N.J.	"	SN Randall	No
JW Riches	5/5	Tube Reducing Corp., Wallington, N.J.	"	WD Goad	No
	5/6	Allegheny Ludlum, Watervliet, N.Y.	"	RE Rohrbaugh	No
	5/7	Mallory Sharon, Niles, O.	"	CB Brown	No
	5/8	Chase Brass & Copper, Waterbury, Conn.	"	DK Crampton	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	5/15	Revere Copper & Brass, Detroit, Mich.	Consult on Zr fabrication	Mr. Tarpey	No
	5/16	New Rochelle Tool Co., New Rochelle, N.Y.	"	CA Tudbury	No
PJ Pankaskie	5/21-23	Tube Reducing Corp.,	"	SN Randall & RE Rohrbaugh of Allegheny Ludlum	NO
YB Katayama	5/1-8	New York City Branson Equip. Co., Stamford, Conn. Enthone Corp., New Haven, Conn. Udelyte Corp., Detroit, Mich.	Attend Electrochem. Soc. Mtg. Discuss ultrasonics. Discuss metal finishing problems. Discuss plating problems.	-- -- WK Murray RA Fellows	No No No No
OJ Wick	5/5	U. of Washington, Seattle, Wn.	Present talk to nuclear metallurgy class.	DH Polonis	No
RE Sharp	5/8-13	No. American Aviation, Los Angeles, Calif.	Discuss fabrication of fuel elements.	J Howe	Yes

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
A Giambusso	5/13-14	AEC - DRD Washington, D.C.	Review PRTR progress	RM Fryar	No	700, 713
S Cohen	5/5-7	Phillips Pet. Co., Idaho Falls, Ida.	Discuss MTR, ETR, high pressure test loop facilities	JJ Cadwell JE Minor DC Kaulitz	Yes	700; 300, 303H 105KE; 200E, 202A
JD Rogers	5/8-9	Phillips Electronics, Burlingame, Calif.	Service electron microscope.	TK Bierlein	No	300, 326

VISITS TO HANFORD WORKS (CONT)

Name	Dates of Visit	Company and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas & Bldgs. Visited
SH Bartz EH Davidson	5/13	Phillips Pet. Co., Idaho Falls, Ida.	Discuss MTR fuel elements.	OJ Wick TC Nelson	No	200W, 231Z
J Hodges J Ewing	5/14-15	UCRL, Livermore, Calif.	Project Whitney problems.	OJ Wick RW Stewart ID Thomas	Yes	200W, 231Z, 2704Z
J Erwin	5/20-22	ORNL, Oak Ridge, Tenn.	Discuss MTR program	OJ Wick TC Nelson	No	200W, 231Z, 2704Z
WB Tarpley	5/22	Aeroprojects, Inc., Westchester, Pa.	Discuss ultrasonics	OJ Wick ID Thomas TC Nelson	No	200W, 2704Z; 300
SH Bartz	5/22-26	Phillips Pet. Co., Idaho Falls, Ida.	Discuss MTR problems.	TC Nelson	No	200W, 231Z
J Delapena JB Bryan TJ Carrol J Ewing	5/26-27	UCRL, Livermore, Calif.	Project Whitney problems	OJ Wick ID Thomas RW Stewart	Yes	200W, 231Z, 2704Z

PLUTONIUM RECYCLE PROGRAMMONTHLY REPORT - MAY 1958REACTOR & FUELS RESEARCH & DEVELOPMENT OPERATIONPlutonium Fuels Development

MTR Capsule Irradiations. Examinations of 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 to 60 percent of the plutonium atoms in the MTR as part of the GEH-3-24 test are currently in progress in the Radio-metallurgical Laboratory. The Al-Pu core sustained a volume increase of 0.9 percent after irradiation. Hardness increased from 46 before irradiation to 101 on the Rockwell H scale after 60 percent burnup of the plutonium atoms. Metallography of this core showed no perceptible change after irradiation. Similar measurements are being performed on the Al-Si-Pu core.

The Al - 5, 10, 15 and 20 w/o Pu and Al - 12 w/o Si - 5, 10, and 15 w/o Pu alloy cores are ready for assembly into capsules for the GEH-3-33 through GEH-3-40 tests in the MTR. Satisfactory Al - 12 w/o Si - 20 w/o Pu alloy cores have not been obtained to date. The algebraic function relating flux and specific power generation for the various capsules was received. It is being used to calculate the essential heat transfer data to establish the actual irradiation test specifications.

Al-Pu Alloy Clusters for KER Irradiation. The Al-Pu and Al-Si-Pu alloy cores for KER irradiation test as four-rod cluster fuel have been completed. An autoclave is being installed to test the Zircaloy-clad fuel rods prior to assembly into the cluster geometry. The tentative KER charging date is mid-June, 1958.

Cluster Engineering. A 19-rod cluster fuel element of a new design (Dwg. No. H-2-3558) has been fabricated. Type 304 stainless steel was used for all parts except for the dummy core which was aluminum rod. The length was shortened to 30" for ease in handling. The fabrication of a short cluster uncovers many of the unexpected difficulties which would be encountered when fabricating a full size cluster. The new wire wrapping fixture was found to have several flaws which were found while wrapping wire on the short rods. Minor corrections were made at the time and the major design changes are being made in the Technical Shops. As soon as the alterations are completed on the wire wrapping fixture, a full size 19-rod fuel element cluster will be assembled. This cluster will use the same material as the short one except two of the rods will have Zircaloy end caps, tubing and wire wrap. They will be thermally cycled in hot water (200 C), tested for pressure drop with hot water and full water flow, corrosion checked, and tested for chattering and wire tension.

Joining of Zr-2 spacing wires to end caps of PRTR type fuel elements has been accomplished by using a "Heliarc" spot-welding torch. High input current and an extremely short time cycle enable color free fusion welds to be made without additional shielding techniques. Autoclave tests of the weld specimens at 720 F and 1500 psi for five days showed no accelerated corrosion product.

Pyrometallurgical Techniques. A pyrometallurgical process for the reconstitution of irradiated Al-Pu fuels has been developed. The steps in the process are:

- Step I. Al-Pu alloy is melted with an equal volume of bismuth at 700 C (CRC-639). The bismuth phase extracts 70-80 percent of the Pu (bismuth and aluminum are immiscible liquids).
- Step II. The temperature is lowered to 450 C. The solidified aluminum phase is separated from the molten bismuth.
- Step III. The bismuth phase is fluxed with molten caustic soda at 400 C. The caustic extracts 80-90 percent of the Pu in the bismuth phase. Caustic soda and bismuth are immiscible liquids.
- Step IV. After solidification the caustic phase is leached with hot water; the insolubles, which include the plutonium, probably as a hydroxide, are collected with a filter. The bismuth is recycled to Step I.
- Step V. The residue from the filters is dried and used as feed material for making Al-Pu alloy, using the aluminum-cryolite reduction process (HW-52461).

Several experiments on Steps I - IV have been run with rather consistent results. Step V has not been attempted, but the process, using pure plutonium oxide as the feed material has been previously demonstrated.

The waste products in the process are: (1) the aluminum from Step I, (2) the leach solution from Step III, and (3) the cryolite from Step V. Using two successive extractions, the plutonium concentration in the waste aluminum has been lowered to 0.1% from an initial 2% alloy, or a 5% loss. The solubility of plutonium in the alkaline leach solution is negligible, and the plutonium loss in the cryolite has been estimated at 0.2 percent (HW-52461). Since the quantity of cryolite which would be used is small based on the original alloy weight, this loss would be approximately 1% of the original amount of plutonium in an irradiated 2% alloy. Some fission product decontamination may be accomplished by selective fluxing before Step I, or by chemical techniques following Step IV.

The analyses of the feed and products of Steps I - III of one run are shown below:

Step I - 1st bismuth extraction:

		<u>Pu Anal. (1)</u>	<u>Gm Pu</u>
IN:	701 g Pu-Al	2.28%	16.0
	<u>2504</u> g Bi	0.0	<u>0.0</u>
	3205		16.0
OUT:	744 g Al	0.53	3.9
	<u>2465</u> g Bi	0.37	<u>9.1</u>
	3209		13.0

Step I - 2nd bismuth extraction:

IN:	744 g Al	0.53	3.9
	<u>2496</u> g Bi	0.00	<u>0.0</u>
	3240		3.9
OUT:	669 g Al	0.073	0.5
	<u>2493</u> g Bi	0.05	<u>1.0</u>
	3162		1.5

Step III - Caustic extraction of Bi from 1st Bi extraction:

		<u>% Pu</u>	
IN:	Bi 2465 at	0.37	9.1
	NaOH 265	0.0	<u>0.0</u>
			9.1
OUT:	NaOH 321 at	1.8	5.8
	Bi 2343 at	0.05	<u>1.2</u>
			7.0

(1) Analyses by radioassay. Percentages are averages of four determinations, considerable scatter occurred in some analyses.

Plutonium Oxide Fuel Materials. Basic powder metallurgy experiments have recently been performed on uranium dioxide. A relation between green density, pressure, and l/d ratio (e.g., length to diameter of the die) has been established in a double acting die. The density ranged from 61.0 to 64.7 percent of theoretical as the pressure was increased from 19.7 to 39.4 tsig. A minimum density of 59.4 percent was obtained with an l/d ratio of 0.88. Densities of 62.4 and 61.8 percent were found at l/d ratios of 0.56 and 1.86, respectively. These values were obtained at a constant pressure of 26.3 tsig.

Attempts at vacuum sintering have been fairly successful. The optimum design of a high temperature molybdenum heating element for use in a resistance vacuum furnace has not yet been established. With the present element, UO₂ pellets were sintered for 6.5 hours at the maximum temperature attainable, 1325 C, and 10 microns pressure. The rate of heating was too rapid, resulting in pellet fracture and hence sintered densities are not available.

Pellets sintered in vacuo in a graphite susceptor induction furnace look more promising. One pellet fractured, but the average density of the other two increased from 62.5 to 83.0 percent of theoretical. These pieces were held at 1350 C for three hours. The temperature of the graphite surface was measured optically, and it was somewhat lower than the temperature of the pellets. Average axial, diametral and volume shrinkage values are 7.5, 10.9 and 26.7 percent, respectively. A thorough examination of these pieces will be made.

Injection Casting Development. Presently, the quality of air pressure injection cast 2S aluminum and aluminum - 2 w/o uranium alloys cast into 1/2-inch diameter Zr-2 tubing is unsatisfactory for fuel cores. Gross shrink voids occur throughout the castings resulting in aluminum core densities of 90% compared with 96 to 97% density of castings in 1/2-inch stainless steel tubing. Sixteen castings which were made into Zr-2 tubing ranged in density from 86 to 92%. Some variations of temperature and pressure obtainable with the present experimental equipment were tried. The tubing surface condition, both internal and external, has been modified to provide a diffusion barrier on the inside and a thermal barrier on the outside with no improvement in casting density.

The macro-structure of castings made into Zircaloy differs from castings made in stainless steel which might account for the difference in quality. In Zircaloy the aluminum exhibits a finer grain size and is metallurgically bonded to the tubing; however, the density was not improved in a casting in which the aluminum was prevented from bonding to the Zircaloy so the effect of the diffusion layer in accelerating the solidification rate is still in doubt. All of the air pressure injection castings which have been examined have a dendritic spongy type structure. This microporosity in castings made in stainless tubing which do not have gross voids is apparently the reason why the cast density is at best only 96% of the wrought density. An obvious method of circumventing shrinkage defects is to cast into larger diameter tubing and then reduce the composite element by drawing or swaging. This approach is being considered.

Negotiations on experimental work involving mechanical pressure die casting of PRTR type fuel elements have continued with both the B & T Machinery Company and the Kux Machine Company. A development contract describing the testing program and stating the specifications and requirements involved has been written and sent to the above companies.

UO₂ Fuel Development

Irradiation of Swaged UO₂ Cluster. As a part of an investigation of the irradiation behavior of swaged UO₂, a three-rod, stainless steel clad, natural UO₂ fuel element was irradiated in the MIR. The power generation of the assembly was approximately 39 kw/ft, and the calculated exposure was 400 MWD/T. Preliminary examination of the cluster after irradiation indicated no warping or distortion of the 11-3/8" long element or the 0.600 OD individual rods. The maximum temperature of the UO₂ during irradiation was apparently less than 1700 C, on the basis of the sintering behavior of the powder as revealed by sectioning of the assembly.

To help determine the effects of irradiation on relatively long, swaged ceramic fuel elements, a three-foot, 0.570" OD rod of UO_2 in 0.030" thick stainless steel cladding was fabricated by swaging and charged into KE Reactor for irradiation to a goal exposure of 1700 MWD/T.

Six four-rod cluster fuel elements of 1.6 w/o U-235 enriched UO_2 were cold swaged in stainless steel tubing to 83, 85, and 89 percent of the theoretical density for testing in KER-1. Each fuel element contains four 0.626" OD rods eighteen inches long. The end fittings were developed by the Fuel Element Design Operation. The six elements were autoclaved at 350 C, helium leak tested, and delivered to KER.

Tubular Fuel Closures. To provide maximum possible protection against fission gas leakage from nested tubular fuel element fuel tubes, a double closure was devised. This closure consists of (1) a 0.030" wall hemitoroidal cup which slips down between the inner and outer cladding tubes of a fuel tube and is seam welded to the cladding tubing, and (2) a solid section of Zircaloy which fits into the hemitoroidal cup and is fusion welded to the cladding tubing. Cups have been successfully formed from Zircaloy strip stock by a hot forming process. It has now been demonstrated, however, that a simpler, less costly cup can be machined directly from Zircaloy bar stock. Sciaky Bros., Inc., has undertaken the development of the seam welding process and has produced adequate welds. Further experimental welding will be undertaken, utilizing both the hot formed and the machined seam weld cups.

Fabrication of UO_2 for Fuel Assembly Studies. UO_2 core pieces, 2.997" OD x 2.222" ID, were fabricated for use in testing assembly techniques for an eight-foot tubular fuel element. The assembly will also be used for mechanical stability tests in high temperature autoclaves.

Irradiation of Fuel Elements Containing Unsintered UO_2 . The second irradiation test in the MTR of two UO_2 powder elements was concluded after approximately 760 MWD/T, because of fission gas release due to a cladding defect. The irradiation had been routine up to the time of the fission break, with an indicated power generation of approximately 30 kw/ft. The elements will be returned to HAPO for radiometallurgical examination.

Sintering of UO_2 . Conventional sintering techniques and a high temperature microscope are being used to study the effects of various additives upon the sintering behavior of UO_2 . It has been demonstrated that the addition of TiO_2 or Nb_2O_5 is beneficial in attaining high density sintered UO_2 at relatively low temperatures, although each of these additives behaves quite differently during the sintering process. Studies with a high temperature microscope reveal that a liquid phase is initially present at a temperature of approximately 1400 C with Nb_2O_5 as an additive; with TiO_2 , phase changes are not evident below approximately 1600 C. Untreated PWR grade UO_2 with 0.1 w/o TiO_2 at 1600 C and activated PWR grade with 0.4 w/o Nb_2O_5 at 1500 C produce elements of densities comparable to those obtained by sintering pure UO_2 at 1700 C.

Thermal Conductivity of UO₂. BMI has reported that thermal conductivity studies with the first of a number of HAP0 UO₂ specimens are nearly complete. After studies employing unirradiated UO₂ rods, BMI will determine the conductivity of UO₂ rods which were charged into HAP0 reactors this month for irradiation to a variety of exposures.

Coolant System Studies

Hydraulic Testing of PRTR Fuel Assemblies. The pressure drop of the Mark I 19-rod cluster fuel element was measured for water and calculated to be 6.1 psi at a volume flow rate of 123 gpm in 478 F D₂O. The Mark II-A assembly had a calculated drop of 18.5 psi at the same conditions, while the pressure drop of the Mark II-B assembly is about half as great as for the Mark II-A. Apparatus has been set up for the determination of the pressure drop through Hammel-Dahl and Edwards PRTR control valves.

The Plutonium Metallurgy designed Mark I Lucite model will be employed along with a polariscope and bentonite clay suspensions for visual studies of flow patterns through the unit.

Corrosion Studies

Corrosion of Aluminum Powder Metallurgy Products. Ten-day corrosion data for APED aluminum cermet products have been compiled for static tests at 250, 300, and 360 C and a dynamic test at 200 C, all in deionized water. For all tests the corrosion rates of the cermets were somewhat higher than for wrought alloys, although the cermets exhibit higher hot strengths than the wrought aluminum alloys. The following table is a partial listing of the results after ten days of the scheduled one month test:

<u>Alloy</u>	<u>Condition</u>	<u>T°C</u>	<u>Flow, ft/sec</u>	<u>Corrosion in Mils.</u>
M-54	As extruded	200	10	0.41
M-82	As extruded	200	10	0.58
X-8001	Wrought	200	25	0.30
M-54	As extruded	250	Static	0.50
M-82	As extruded	250	Static	0.57
X-8001	Wrought	250	Static	0.14
M-54	As extruded	300	Static	0.62
M-82	As extruded	300	Static	0.99
X-8001	Wrought	300	Static	0.23
M-54	As extruded	360	Static	0.85 (some failures)
M-82	As extruded	360	Static	(all failed)
X-8001	Wrought	360	Static	0.45

Aluminum Alloy Development. Laboratory melts of an aluminum alloy containing 2.1% Fe and 0.63% Ni have been fabricated. This type of alloy was designated as alloy E₃ by H. Coriou of France who found it to have good corrosion resistance. The first laboratory melt of this alloy made at HAP0 has been in test at 360 C for one month and shows a highly desirable logarithmic corrosion rate rather than the usual parabolic rate. A photomicrograph of this material reveals an extremely fine dispersion of the second phase material on the surface of the sheet. Two later attempts to duplicate this material have failed due to cracking of the metal during working.

A series of X-8001 alloy melts in which the liquid holding time, liquid holding temperature, cooling rate, and percent cold work were varied has now been in test at 360 C for two months. There is still no noticeable effect of any of these variations except for the slowest-cooled alloy which failed rapidly.

Zircaloy Tubing

Zircaloy Tubing Fabrication. Four each of the 2.968" and 1.818" ID ribbed jacket tubes for the PRTR fuel elements were extruded for Nuclear Metals at the Detroit plant of Revere Copper and Brass Company. All the tubes extruded satisfactorily. Those that have been dejacketed show excellent surfaces. Work is now under way to size the tubes accurately and to straighten them.

A satisfactory end closure has been designed permitting high temperature burst testing of large diameter pressure tubing. In an initial test a length of PRTR process tubing required 6000 psi pressure to burst at 300 C. For a tube of these dimensions this represents a circumferential stress of about 60,000 psi. The material in this tube had been cold worked about 14%, and from the results of previous work would be expected to have a tensile strength of about 54,000 psi at the test temperature.

Thermal Hydraulics

PRTR Hazard Calculations. Calculations pertaining to water loss rates from the PRTR in event of piping failure have been completed. Water loss as a function of time has been considered for a ruptured top or bottom tube jumper and a ruptured top or bottom fourteen-inch header. The case of the top fourteen-inch header proved to be the most severe piping failure, with complete depressurization of the entire reactor piping reached in about nine seconds. The initial water loss from such an occurrence is predicted to be at a rate of 42,000 gpm.

Time-temperature transients in the PRTR fuel elements were also calculated for the most severe water loss incident. Considering both heat from the fission product decay and the zirconium steam reaction, a time of 200 seconds after scram was calculated for the jacket of a Mark II-B element in the central zone to melt. Similar calculations for a 19-rod Pu-Al element indicate the fuel would start melting at 44 seconds after scram and would be completely melted in about 120 seconds. Assuming that the Zr-2 jackets did not fail, it was calculated that they would reach their melting point at about 290 seconds after scram.

PRTR Jumper Freeze Test. Experiments were conducted to analyze the feasibility of freezing the primary coolant in the inlet jumper as a method to completely shut off the flow during a reactor shutdown. Should such a method be convenient, it could result in the elimination of the valves necessary in each jumper to shut off the 3 gpm thermal convection flow.

The experiments were conducted with a full scale mockup of the inlet jumper submerged in a cold bath. Using dry ice and methanol as the cold bath (-110 F), it was found that stagnant water would freeze in about six minutes. However, with a driving force sufficient to cause a normal flow of 3 gpm, equilibrium was reached without enough freezing to cause an appreciable decrease in flow. When liquid nitrogen was used as the cold bath (-321 F), it was found that a flow rate of 0.95 gpm could be stopped in about five minutes, but, again, equilibrium was reached with a flow rate of 3 gpm without noticeable flow decrease.

Mechanical Equipment Development

Design Test PR-20 - Calandria Characteristics. The calandria mockup dump chamber was extensively modified during the month to increase the dump rate. The weir was lowered three inches and the baffle plate was extended from a 90° arc to a 180° arc. A fourth gas line has been added. A new series of dump tests has begun and results will be available shortly.

Design Test PR-24 - Shroud Tube Bellows. Orders were placed with the Parts Engineering Company and the Master Products Company for additional bellows. The two bellows that are currently being corrosion tested in hot steam have shown no signs of corrosion or other failures. Aluminum ends have been cast on a simulated bellows. This assembly will be tested for leaks and corrosion. An examination of the original bellows which failed the corrosion tests revealed that the failure was caused by chloride stress corrosion.

Design Test PR-50 - Reactor Piping Seal Testing. The flared process tube inlet fitting has been reworked and is currently awaiting installation on ELMO-7. Both joints have been equipped with leakage collectors to measure any leakage. The flanged process tube inlet fittings and inlet gas seal assembly were hydrostatically tested. Preliminary tests indicated a gas leakage rate of 0.026 cu ft/hr. Thermocycle tests on this assembly will begin shortly.

Nozzle cap assembly "A" was reworked to permit the installation of a "skinner" seal. Hydrostatic testing and four cycles on the thermocycling apparatus have proven that this seal will not be acceptable.

The fabrication of process tube assembly "A" was completed and thermocycling tests started. To date, 80 cycles from 150 to 535 F have been completed without incident. This complete assembly will be tested on ELMO-7 following 500 successful cycles on the static thermocycling facility.

Two gas packing tests were conducted during the month; a combination of John Crane No. 177 packing and John Crane No. 4 packing, and a Garlock packing of asbestos with inconel wire. Neither packing was acceptable.

Design Test PR-51 - Reactor Piping Structural Integrity. The simulated inlet jumper has undergone 30,000 flexing cycles of one-inch vertical travel and 1/2-inch horizontal travel while at a pressure of 1500 to 2000 psi. The maximum stress in the jumper remained at approximately 17,400 psi. The jumper will be stretched 1/4-inch and the flexing test continued. Construction of the upper reactor face mockup less piping and nozzles was completed. A jig for checking the shape of the inlet header jumper was also completed.

Design Test PR-63 - Process Channel Leak Detection Facility. Preliminary calibration tests were completed during the month. The facility is currently undergoing minor changes. Testing will resume upon the completion of repairs to one of the dewcell instruments.

Single Tube Prototype Facility. Construction of the facility was approximately 67% completed from a financial standpoint. Delivery of the 14-inch PRTR gate valve from the William Powell Company is expected to be somewhat delayed due to a strike which started May 1.

Shielding Studies

PRTR Instrumentation. Static tests for the two prototypical flowmeters for PRTR were completed. One unit was satisfactory and the second failed on an over-pressure test. This unit, which had previously developed an oil leak, was returned to the vendor for replacement of the transducer. It has been returned and recalibrated. Both units have been set up for a time of response test on a 1050 psi cold water loop.

Tests were begun on prototypical resistance temperature detectors for PRTR. The results to date show a change in ohmic insulation resistance at high temperatures that may limit the use of a detector of this construction. The test cycle on these units will be continued until the test is completed or the units have failed completely.

Test facilities are being doubled to accommodate other resistance temperature detectors on order.

PRTR Design Development

Design and Construction Schedule. The Temporary Construction contract for the PRTR was completed on schedule during May. The Phase I PRTR contractor is about 2% completed; excavation for the containment shell is about 95% completed.

The Phase II PRTR bid package was forwarded to the AEC on schedule; about eighty bid packages have been mailed for prospective bidders' consideration. The Phase III PRTR design is about 73% completed. Total design is estimated at 80% completion.

Building and Outside Facilities. The revised scope for the steam condensing facility to replace the previously scoped river structure was essentially completed during the month. On the basis of the cost estimate comparisons, the condenser facility will be located near the reactor immediately north of the viewing stand rather than at the river. A river pump facility will be provided

to supply water to the condenser and to the PRTR service building. The process sewer will discharge through a submerged line which will be buried in the river bottom and extend approximately 250 feet out into the river at high water conditions and approximately 100 feet during low water conditions. The new steam condensing facility will increase project costs about \$250,000.

Detailed design was started on the below grade concrete for the fuel element load-out facility.

Reactor Piping. The outlet nozzle design is being revised to provide two features: ability to change flow restriction orifices without disturbing the fuel in the tube, and ability to remove a process tube and the top lead oxide shield plug without removing the tube centering flange, in event the plug becomes stuck to the tube. This latter feature permits the centering flange to be welded to the shield and eliminates a gasketed seal.

Core Components. The bid package for the calandria, top and bottom primary shields, and the moderator storage tank was completed and has been placed for bids.

Process Piping. Three bids for fabrication of the PRTR boiler blowdown flash tank were received for evaluation during the month.

Seven bids for the main heat exchanger were received and the proposals are being analyzed to determine whether the engineering and materials specifications meet PRTR requirements.

The composition of PRTR boiler water was studied to determine whether any unusual or unforeseen chemical treatment might be required. The total solids will be within the range permitted by the Standards of the American Boiler Manufacturer's Association and probably will not greatly exceed the usual limit for central stations (1500 ppm). The pH may have a tendency to run high (calculated value 12.3) as a consequence of sodium ion exchange treatment of feedwater and the conversion of bicarbonate and carbonate to hydroxide and CO₂ under boiler operating conditions. The use of acid phosphates may be required to achieve optimum pH values between 10 and 12.

Instrumentation and Control. GE-APED has submitted a preliminary layout of their proposed shim control assembly design. This design incorporates a ball chain drive with the driving sprocket geared directly to the motor; the non-lubricated lower gearbox and flexible shafting shown in the scope drawings have been eliminated, and the lead shielding plug has been increased in length to 20 inches. The schedule of APED calls for completion of the prototype assemblies by November.

GE-APED has been requested, under Section 10 of the HAP0 prime contract, to conduct a survey of methods of detecting fuel element failures and to recommend the system best suited to the PRTR.

The proposed method of making up D₂O losses in the primary coolant system by transfer from the moderator system will result in considerable increase in the tritium inventory of the primary system. This effect is due to the greater tritium buildup in the moderator. For the case of leakage from the primary

system at a rate of 4500 pounds D_2O per year, saturation activity will be 7.5 millicuries per gram D_2O if makeup is by transfer from the moderator, as compared with 0.4 millicurie per gram if fresh D_2O is used for makeup. The calculations of tritium buildup will be issued as a report.

The design and procurement of the PRTR automatic controller and allied reactor radiation instrumentation on a cost plus fixed fee contract basis has been approved by the AEC. Bid invitations are expected to be forwarded to appropriate companies during June.

Analog results of control system studies are currently being evaluated.

Helium Gas System. The gasometer design and specifications were completed and have been placed for bid.

Fueling Vehicle. Scope change 102-1 is being processed to permit: (1) changing bridge and carriage drive speeds to two-motor systems with a single high speed and a variable slow speed range, (2) restatement of cooling requirements so that a vehicle-mounted cooling system can be used, and (3) restatement of the floor clearance requirement so the cask can be shimmed to suit the as-built building. The drive system alteration is in accordance with a General Mills recommendation after considering several alternatives.

Fuel Element Examination Pit. A rough draft of a scope document has been written describing the scope of operations to be carried out on fuel elements and process tubes in the fuel element examination pit. Included in the document are descriptions of the cell and of the proposed equipment for viewing, manipulating, and cooling the fuel elements and process tubes.

PRTR Physics. Neutron flux distributions and critical loading configurations in the PRTR with both H_2O and D_2O reflectors are under investigation. Calculations have been carried out using a three-group model with the VALPROD IBM-650 code. Cell flux traverses have been calculated for the Mark II-B UO_2 fuel element and for the Mark I Pu-Al spike element. Values of k_{eff} yielded by VALPROD agree well with previous experimental and calculated results for these cells and were used as a basis for group constants required for subsequent whole-reactor calculations.

VALPROD was then utilized to obtain flux and power distributions for spike enrichment. A slight modification to the code allowed the calculation of k_{eff} for each multi-fuel loading. In all cases a central fuel zone of 19 UO_2 tubes was maintained to correspond to a previously calculated flattening pattern which allowed 70 MW operation without exceeding 1200 KW tube power. It was found that a critical loading, meeting tube power restrictions, is extremely sensitive to radial position of plutonium enrichment. With the H_2O reflector, a minimum of 18 spike columns adjacent to the central UO_2 zone or a maximum of 42 spike tubes loaded at the outer edge of the core gave acceptable critical loadings. The results for the D_2O reflector have not been completed, but preliminary evaluation indicates that substantially fewer spike tubes will be required.

Plutonium Fabrication Pilot Plant

Phase I Construction. All work was completed by the contractor on May 29, on schedule. This phase included underground piping and temporary construction facilities.

Phase II Design. The complete Phase II design package, which includes the building and its utilities, was transmitted to HOO-AEC on May 8, as scheduled.

The building door alarm system design was rejected by HOO-AEC as failing to meet their security requirements. Four drawings and a specification are being revised.

Phase III Design. Draft scope interpretations were prepared covering the degrease-decontamination system, the radiographic system, the preparation portion of the oxide fuel line, and the hydraulic press. During the study of the radiographic facility, it was discovered that the darkroom processing load of this facility is considerably in excess of previous scope, and major revisions to the darkroom equipment were required. Revisions to the walls of the room for increased shielding of the facility are also being undertaken. These revisions will be included in the Phase II contract, but the changes in equipment will be shifted to Phase III.

Scope interpretation for the finishing portion of the oxide fuel line will be delayed until June 10 for new information expected from the Heald Corporation at that time.

Scope information on the hydrogen sintering furnaces was recognized as a bottleneck in meeting schedules. It was decided to negotiate two design-development contracts, one with Pacific Scientific for a vertical furnace, one with Harper Electric for a horizontal furnace. Since a partial prototype will be required for the vertical unit to determine whether its thermal gradients will fall within process requirements, this contract will be regarded as a research and development item. The horizontal furnace is a more conventional type and requires only design development to establish in-hood maintainability features.

Procurement. To avoid delays caused by serial approvals in Purchasing and Inspection, a revised procedure has been instituted. Corrected comment issue drawings for vendor equipment will be circulated prior to routing of the final drawings.

The autoclave procurement package was delayed for revisions to the specifications. The revisions were required to conform with an interpretation of the Comptroller-General's ruling which apparently prohibits functional specifications with bid invitations, and possibly prohibits a requirement that engineering data be submitted with a bid.

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

Work continued on a study of the reactivity of water flooded arrays of slightly enriched (0.95%) uranium fuel elements encased in iron pipe. The goal is the determination of the thickness of iron pipe required to make an infinite array of such elements safe. Buckling measurements were made this month which indicated that a thickness of about 0.06 inches will reduce k_{∞} to unity. This result agrees with theoretical predictions. Applying a proper safety factor, an iron pipe thickness of 1/8 inch around individual columns will ensure a system that is subcritical for all masses of fuel elements. A final report will be issued on this work.

REACTORSTUDIES RELATED TO PRESENT PRODUCTION REACTORS

Analysis of PCTR data on the metal temperature coefficient of natural uranium in a 7-1/2 inch graphite lattice was completed. The final result is

$$\frac{1}{k_{\infty}} \frac{dk_{\infty}}{dT} = -(2.65 \pm 0.10) \times 10^{-5} \text{ per degree C.}$$

This result is in good agreement with a dry metal temperature coefficient obtained from KW Pile start-up measurements.

Data interpretation continued aimed at obtaining total temperature coefficients for natural and simulated 1000 MWD/T and 2000 MWD/T uranium.

Analytical work was completed on a simplified model of the flux distribution problem in a medium with a temperature discontinuity. The model is the same heavy-gas one-dimensional one discussed previously. The advance made this month was in the evaluation of a large enough number of constants to guess the asymptotic form of an infinite sequence solution.

Work continues on obtaining a solution of the above problem by numerical analysis techniques. An OMNICODE program has been written for this work and is being debugged.

Progress on an experiment to measure "neutron temperatures" in a lattice was confined to the normalization of the fission foils which will be used in the experiment.

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STUDIES RELATED TO FUTURE PRODUCTION REACTORS

Buckling measurements continued on seven-rod clusters of 0.5-inch-diameter natural uranium rods in graphite. Experimental work was done this month on a 6 3/16-inch lattice with and without water coolant. The data have been analyzed for this lattice plus a 5 3/16-inch lattice which was measured last month.

Theoretical work continued aimed at obtaining a method of specifying neutron temperature as a function of radial position in a reactor fuel rod.

A machine program was prepared for processing foil data resulting from PCTR irradiations. With this program, raw experimental data is being analyzed and returned to the experimenter within thirty hours. Previously, several days of calculation have been required for analysis.

Instrumentation

Tests were conducted on the sample magnetic core storage elements for the investigation of storage devices. The tests indicated that the samples were satisfactory, and a purchase requisition was placed for seven memory frames each containing a 16 by 16 matrix. These storage devices will be used in investigations of data storage, handling, and presentation techniques.

STUDIES RELATED TO SEPARATIONS PLANTS

PCTR experimental work was completed for the determination of k_{∞} of enriched uranyl nitrate-water mixtures. Three enrichments were studied this month using two hydrogen-to-uranium ratios. Detailed calculations remain to be done on these data and the data taken last month. A tentative maximum always-safe enrichment for this type mixture appears to be about 2.1 percent.

Equipment for subcritical multiplication measurements on water moderated fuel assemblies was installed in the TR room of 305-B Building. This gear will be used to determine nuclear safety criteria for handling and dissolving low-enrichment power reactor fuels. The three percent enriched uranium which is to be used in these measurements was in transit to Hanford this month. Three rod sizes will be used.

Preparations are nearing completion for the determination of the maximum k_{∞} of a homogeneous three percent enriched $UO_3 - H_2O$ system. The experimental work will be done in the PCTR. This work is to determine nuclear safety criteria for handling solutions of low enrichment uranium such as will result from processing spent power reactor fuels.

Authorization was received (AEC Directive HW-455 dated May 12, 1958) to proceed with the design of a plutonium critical mass laboratory. Several studies requested by the AEC relating to this facility have been initiated with Construction Engineering Operation. The purpose of the studies is to compare the economics of the currently proposed facility with comparable facilities employing the type of construction used in the Oak Ridge Critical Mass Laboratory.

Buckling measurements were made on a lattice of 1.007 percent enriched uranium with water moderation. Rods of two diameters (0.925 inch and 1.66 inches) were alternated in the lattice. This mixed lattice measurement is a continuation of previous work aimed at providing nuclear safety information on the effect of mixing partially dissolved slugs with fresh slugs in a dissolver. The results indicate that the mixed lattices are less reactive than unmixed lattices except at small water-to-uranium ratios.

Nuclear safety recommendations were made on containers for handling plutonium fluoride, and on a liquid de-entrainment trap proposed for installation in Recuplex. A design for an ion exchange column was reviewed for nuclear safety.

An evaluation was made of the errors in positioning the neutron source and detector foils in the neutron age measurement.

The mechanical portions of the mass spectrometer for plutonium analyses are complete except for finishing work on the cabinet and frame. Electrical work has been delayed by late delivery of some commercial components. Two commercially built amplifiers did not meet specifications and were returned. Substitute amplifiers have been ordered.

REACTOR DEVELOPMENT - 4000 PROGRAM

PLUTONIUM RECYCLE PROGRAM

Measurements of k_{∞} and f are being made in the PCTR on 19-rod cluster UO_2 fuel elements in a nine-inch spacing heavy water lattice.

Calculated values of resonance capture probability were compared with experimental values deduced from exponential pile measurements. The calculated values were consistently about 70 percent of the experimental values. This was interpreted to mean that the eighteen resonances used in the theoretical calculation account for 70 percent of the total epithermal neutron captures in natural uranium.

Further work was done on the formulation of resonance escape probability for an infinite lattice of supercells. Approximate expressions were developed to evaluate the ratio of the resonance capture probability for neutrons in neighboring fuel elements to resonance capture probability in the originating fuel elements. The elements were assumed to be all of the same type.

A theoretical study was made of the nuclear safety criteria for dissolution of plutonium-aluminum alloy PRTR fuel elements. Nuclear safety in processing these elements in large dissolvers will depend on the presence of three moles of nitrate per mole of aluminum. A plutonium-aluminum water solution of the enrichment studied can be made critical in the absence of nitrate in the solution. The diameter of a cylindrical dissolver which is safe by geometry cannot exceed 12 inches. The always safe slab thickness cannot exceed six inches.

Studies at GERL continued on electron irradiation damage to copper. Current experimental work on the variation of damage with total irradiation flux indicates a nonsaturable damage. No flux rate dependence of the damage was observed.

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A theoretical study of the outward flow (leakage) of neutrons from lattice-type reactors has led to an improved understanding of the effect of the various lattice components in impeding this flow. Improved formulas for computing the diffusion coefficients of lattices resulted.

CROSS SECTION MEASUREMENTS PROGRAM

More data were taken on the subthreshold fission of Np^{237} and Am^{241} to improve the statistical precision of the low resolution data previously reported.

Two single beryllium crystals were received for possible use as monochromating crystals. Both gave multiple reflection of neutrons. Investigation to date shows that each crystal is of roughly comparable quality to our present beryllium crystal and gives intensities about an order of magnitude less than an optimum crystal.

The defective beam shutter mechanism for the KE spectrometer has not been replaced as yet. Operation of the spectrometer awaits this, plus completion of associated instrumentation.

Improvements in the vernier chronotron and in the neutron detectors used with it resulted in the lower limit on neutron energy range being pushed from about 800 kev down to 200 to 300 kev.

A survey run was made on the angular distribution of $\text{Be}^9(d,n)$ neutrons.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

Two field experiments were attempted during the month. A Wahluke Slope diffusion and transport experiment was aborted shortly after its initiation due to a radical wind shift and loss of wind speed. A successful experiment involving the use of the Portable Mast was completed. The latter experiment was designed to measure particle erosion and translocation. Analyses of the data were in progress at month's end.

A summary of pertinent wind measurements from the Wahluke Slope and the reactor areas and the results of Atmospheric Physics' diffusion experiments was presented to the ACRS in Washington, D. C., on May 9. A more complete discussion of the effects of terrain on the dispersion of airborne materials originating in the 100 Areas has also been completed for presentation to the ACRS at Hanford on June 5.

A five-year summary of wind data from the wind station network was completed. This summary embraces the years 1952 through 1956. Presentation of these data in a formal report was initiated.

The zinc sulfide particle counter was received from Instrument Research and Development, and was undergoing field tests at month's end.

Efforts were continued in developing more accurate and versatile empirical equations capable of representing the variance of crosswind distributions of material as a function of time after emission or distance from the source. Functions capable of representing this variance correctly have been found, but no general uniqueness has been demonstrated.

DOSIMETRY

A new plutonium source was obtained to serve as a standard for X-ray counting. Its strength was checked by alpha counting. It indicated that our previous standard was only 80% as many microcuries as we had believed. For this reason, plutonium depositions reported earlier were actually 25% greater than reported. This new standard accounts for only one-half the discrepancy found between X-ray counting and alpha analysis of excised tissue.

A plutonium puncture case described last month was re-examined after the wound from the excision had healed. 0.002 microcurie remained at the wound site. This was 34% of the amount measured just after surgery.

A new plutonium puncture case was studied. Since alpha contamination had been found at the puncture, surgery was performed before the subject was brought in for X-ray counting. X-ray counting showed 0.011 microcurie in the finger and another 0.011 in the excised tissue. The next day more flesh was removed. 0.0088 microcurie was left in the finger and 0.0011 found in the excised tissue. Three days later an attempt was made to locate the plutonium remaining in the finger. It was found that a region of about 1.5 cm² was uniformly active. In this case, the plutonium probably entered the wound as the nitrate and diffused fairly rapidly because of its solubility. In other cases seen recently, the plutonium was present as the metal or the oxide and diffusion was small. On this third day, there was 0.0071 microcurie in the finger; on the seventeenth day there was 0.0040 microcurie.

Another possible plutonium contamination case was examined, under poor conditions, and found to have less than 0.0002 microcurie in a wound.

Most of the problems in using a large multiple-wire proportional counter for X-ray counting were worked out. The available gas multiplication and the resolution were quite good when the counter was filled to three atmospheres with argon.

Samples of the outer three inches of steel for the body monitor were received and counted. It was estimated that they contained less than 10⁻⁴ curies/gram of radioactivity. This was acceptable.

The Van de Graaff operated satisfactorily during the month although it became apparent that the beam was out of alignment.

One week of accelerator time was used by Radiological Development Operation to study the moderator plus slow neutron pencil method of area monitoring. One week was spent by Instrument Development Operation in studying a spherical moderator plus slow neutron detector instrument. One week was spent by Nuclear Physics Operation studying the Be⁹(d,n)B¹⁰ reaction by double moderator techniques, testing a new high sensitivity tube for the long counter, and studying

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the Hurst dosimeter borrowed from Oak Ridge.

A study was made of our data on the use of the long counter as the basis for our fast neutron measurements. Standard calibration constants and methods of use were chosen. A report on the subject was prepared for use of others using the Van de Graaff.

A great deal of trouble was encountered in trying to make the Hurst dosimeter we borrowed from Oak Ridge work. On the basis of evidence of relative pulse heights that could be observed, it was decided that the counter was subject to a slow leak. It was returned to Oak Ridge.

INSTRUMENTATION

Circuitry development, all transistorized, is about completed for the scintillation alpha beta, gamma Hand and Shoe Counter to replace, in one instrument half the size of a Five-Fold, both the Five and Four-Fold instruments. Fabrication has started on the probes and circuitry necessary. The detector probes are of ZnS for alpha detection and strips of terphenyl in polystyrene for beta-gamma detection.

The vacuum tube model alpha, beta, gamma Hand and Shoe Counter replacement for the Four and Five-Fold instruments has been in general building use in the 329 Bldg. for 14 weeks now with a total "downtime" of 15 minutes for calibration adjustments. This instrument will be eventually superseded by the all-transistorized scintillation model.

An investigation was started on devices and methods for detecting neutrons and analyzing them for energy distribution.

Investigations were completed on the ten-inch diameter spherical moderator for the scintillation transistorized fast neutron dose-rate meter. This instrument, which uses a ZnS-B¹⁰ crystal, is used without the moderator for a very sensitive slow neutron detector. With a small layer of wax moderator, it performs as a slow neutron dose-rate meter, and then, using the 10-inch diameter wax moderator, it performs satisfactorily as a fast neutron dose-rate meter. As a fast neutron dose-rate meter, it is isotropic and has a sensitivity of about 10,000 c/m/mrad/hr and is energy-independent to $\pm 20\%$ from 0.2 Mev to about 2.5 Mev. This compares favorably with the heavier and larger double-shell moderator BF₃ fast neutron dose-rate meter developed by Radiological Physics Operation. With the proper application of wax moderator, the instrument can be made quite sensitive in essentially one direction only; this feature is valuable for neutron "beam" locating. The sensitivity, both for slow and fast neutrons, is actually much better than required for field work.

The two prototype portable scintillation transistorized gamma-energy analyzers have been "de-bugged" and are about ready for evaluation tests. These instruments will determine the gamma photopeak energies from 100 Kev to 1.5 Mev in the "standard" model. A tested variant of the above has worked down to the 17-Kev photopeak for Pu²³⁹ using a thin NaI crystal.

Another robot monitoring sensing device was investigated. This device, trans-

istorized, uses a 15 KC audio signal which is transmitted and the echo from the object is received, amplified, and indicated. This system has been successful to 60 cm distances for relatively nonabsorbent materials. The read-out voltage indicated has a linear relation to distance up to 60 cm.

The experimental, sensitive alpha air monitoring system has worked successfully during May. It will alarm on a 60 mpc level of airborne plutonium in 20 minutes. Fabrication was started on a prototype model for use at Biology. A built-in variable frequency calibration device was fabricated for it.

One prototype Radiotelemetering Data Station, fabricated to our specifications, has been received from Instrument Laboratories in Seattle. The system has been temperature-tested and de-bugged except for the Radiation Integration Amplifier. A manual for adjustment and calibration procedures for the remaining 19 data stations is being prepared.

The testing and investigation of methods of using film for photographing oscilloscope tracings for pulse-height analysis was continued. Several types of film emulsions were investigated, and the photocell-type detector for the densitometer was found to be inadequate. A photomultiplier system was suggested and is now being investigated to obtain better response speed and better resolution.

The newly developed single transistor high-voltage supply has worked quite successfully. The input is 3.0 to 3.75 volts at 15 milliamps with an output of 4900 to 1000 v pc at 25 microamperes. The supply is two-thirds the size of the original model and can be used for any portable scintillation or GM instrument.

The zinc sulfide particle detector for the Atmospheric Physics Operation was tested satisfactorily during May and is ready for delivery. Linear particle detection range is from 100 to 19,000 particles per filter paper.

The Dog Counter System for Biology was delivered and tested successfully at Biology. We are now waiting for the Biology Operation to supply the proper room for final installation. The system will be used for in vivo detection of Pu²³⁹, Sr⁹⁰-Y⁹⁰, Ru¹⁰³, Ru¹⁰⁶ and Cs¹³⁷ isotopes. The system can be used to determine what isotope is present and its location in the animal.

Evaluation tests were successfully completed on the portable scintillation transistorized slow and fast neutron detector and dose-rate meter.

Evaluation of the newly-developed single transistor high-voltage supply was successfully completed.

Evaluation work was started on a DuPont developed strip-filter, impactor-type, alpha or beta-gamma (depending on detector used) Particulate Air Monitor. The device seems to be limited, in life, by the inadequate air-moving system.

Evaluation tests were completed on a modified 110 VAC-operated transistorized high-voltage supply. The original supply was modified with a better regulator and more adequate filtering.

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WASHINGTON DESIGNATED PROGRAMS

The construction of the mass spectrometer for this program proceeded simultaneously with the construction of the mass spectrometer for plutonium analyses.

CUSTOMER WORKAnalog Computing

Additional runs were made on the PRTR Hazard Study at the request of the customer. Because of the wide range of power to be covered, 70 to 20,000 and 200 to 50,000 megawatts, the limited range of the computer makes it necessary to repeat runs at the low values to insure accurate results.

Authorization was received from IPD to proceed with a study on transient heat flow through a canned slug, its gas annulus and the surrounding graphite. Initial runs have been made and indicate a satisfactory solution with the computer.

Weather Forecasting and Meteorology Service

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	93	83.6
24-Hour General	62	85.5
Special	148	87.2

The average temperature of 68.1 was the fourth highest for May in 47 years of record for the Hanford Area. Precipitation amounting to 0.74 inch was nearly twice the normal. Nearly all of it occurred during an all-day rain on the 11th and during an intense shower lasting less than one hour on the 24th.

Consultation services were provided in connection with an assessment of real and potential hazards due to oxides of nitrogen which are or may be emitted from the 321 Building.

A statistical summary and analysis of relative humidity data for the months of June, July, and August, and the years 1943 through 1957 was completed in collaboration with Operation Research and Synthesis personnel. The primary question asked in this analysis was, "Has there been a significant increase in relative humidity during this period?" The answer obtained was a definite "No." There has been considerable variability of relative humidity but no trend either towards higher or lower values. The data were taken from observations made routinely at the Meteorology Tower, and the results must, of course, be restricted to this open country site.

Instrumentation

The single probe alpha, beta, gamma detection and aural-indicating instrument was fabricated and successfully tested for the Calibrations Operation. This instrument will provide simultaneous radiation checking of all incoming (from the field) portable instruments for alpha, beta, and gamma contamination.

The probe uses alternate strips of ZnS and plastic phosphors for the detection. The pulses of different heights are electronically separated for readout via two speaker systems. The device will successfully detect beta particles as low as 100 Kev. Previously-used systems were limited to 500 Kev or above for beta detection. The system will also detect 50 d/m alpha contamination spots.

Fabrication is continuing on a dual alpha air monitor for use in the Purex Facility. The instrument employs two high-level alpha air monitors with a differential indication for high sensitivity.

An authorization was received from the Regional Monitoring Operation for the development of transistorized circuitry for the portable scintillation detector. The new circuitry will provide high reliability and will eliminate the need for heavy automotive-type batteries.

An authorization was received for the development of a medium-level alpha air monitor for use by the Biology Operation of HLO. The design of this instrument will be based on recent developed techniques in the Radiation Protection Instrumentation Operation.

Optical Service

A binocular magnifier has been designed to locate pinholes in weld beads on fuel elements fabricated by FPD. The unit consists of a circline fluorescent lamp, a magnifier and a special circular reflector which permits viewing both the top and the side of the weld at one glance.

Installation of the periscopes at Purex has begun and assistance is being given in establishing the order of assembly and identifying the parts to be assembled.

A work authorization of \$1,000 was received for the scoping of the wide angle and 5X viewers for the PRTR examination pit.

The major routine Optical Shop work included the fabrication of collimated light sources for testing methods and the repair of two Redox crane periscope heads.

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	Buildings Visited
Z. D. Sheldon	5/1	General Eng'g Lab. Schenectady, N. Y.	Discuss FIRDO programs and GEL programs.	GR Hilst AE Tucker JL Carter	Yes	300: 329 326
A. Gianbusso	5/14	Div. of Reactor Dev. US-AEC Washington, D. C.	Plutonium Recycle Program.	PF Cast	Yes	300: 328
D. G. Egan	5/23	Convair, Nuclear Lab. Dept. 6-8, Box 748, Fort Worth, Texas	Discuss Instruments.	RA Harvey	No	300: 329
H.J.G. Kouts K. W. Downes E. V. Weinstock R. Sher J. P. Phelps	5/29	Brookhaven Nat'l Lab. Upton, Long Island, New York	Discuss graphite reactor physics.	PF Gast JE Faulkner ED Clayton RE Heineman	Yes	300: 326 328 305-B 100-KE: 105

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
I. T. Myers	5/1-2	Univ. of Washington Seattle, Wash.	Instruct AEC Fellows.	--	No
E. J. Seppi	5/1-3 5/5-7	Am. Physical Soc. Washington, D. C. Chalk River Project Ontario, Canada	Present paper. Discuss neutron cross section measurements.	-- BN Brockhouse	No No
J. E. Faulkner	5/1-3	Am. Physical Soc. Washington, D. C.	Ph.D. Recruiting.	--	No

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VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
A. E. Tucker W. D. Cameron	5/6-8	General Eng'g Lab. Schenectady, N. Y.	Attend Simulation Symposium.	JK Delson	No
G. R. Hillst	5/8-9	U. S. Atomic Energy Commission Washington, D. C.	Present data to ACRS.	CR McCullugh	Yes
W. C. Roesch	5/8-9	Univ. of Washington Seattle, Wash.	Instruct AEC Fellows.	--	No
H. V. Larson	5/15-16	" "	" "	--	No
D. G. Foster J. T. Russell	5/15-16 5/19	Los Alamos Scientific Lab., Los Alamos, N.M. Radiation Laboratory Univ. of California Livermore, Calif.	Discuss neutron time-of-flight. " "	L. Cranburg J. Benveniste	No No
	5/20	Univ. of California Berkeley, Calif.	" "	DA Mack	No
	5/21	Lockheed Aircraft Corp. Palo Alto, Calif.	" "	Mr. Moffett	No
H. W. Lefevre	5/15-16	Los Alamos Scientific Lab., Los Alamos, N.M.	Discuss neutron time-of-flight.	L. Cranburg	No
	5/21	Tektronix Portland, Oreg.	Fast Pulse Techniques.	Clifford Moulton	No
H. A. Fowler	5/16	Idaho Test Station Idaho Falls, Idaho	Interview.	JD Provost AR Crocker RM Chatter	Yes
W. C. Roesch	5/22-23	Univ. of Washington Seattle, Wash.	Instruct AEC Fellows.	--	No
I. T. Myers	5/29	" "	" "	--	No
D. S. Selengut	5/31-6/3	Los Angeles, Calif.	Attend Meeting of American Nuclear Society.	--	No

Chemical Research & Development

ORGANIZATION AND PERSONNEL

Richard E. Ewing, Chemist I, was transferred in from Chemical Processing Department and assigned to Chemical Research Operation.

H. Dale Warren, Engineer II, was transferred in from Relations and Utilities and assigned to Chemical Development Operation.

Norman P. Wilburn, Engineer I, was hired and assigned to Chemical Development Operation.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Decontamination of Mild Steel Reactor Components

Studies to date have concerned only removal of activated corrosion products from surfaces exposed to hot water in an in-pile recirculating loop. Equipment is under construction to permit exposure of steel surfaces to UO_2 and fission product as would occur in the event of a fuel element rupture. Removal of such contamination will then be studied also.

The removal of activated corrosion products from oxidized (in hot water) carbon and stainless steel surfaces by a number of proprietary cleaning compounds as well as locally prepared solutions has been studied. General conclusions are (1) stainless steel is more difficult to decontaminate than carbon steels, (2) different types of carbon steel (A212, 1051, and 1052 were studied) vary in their ease of decontamination, (3) coupons, even when stored in deoxygenated water at room temperature, become increasingly difficult to decontaminate as they age (in the present case coupons aged a few days are compared with coupons aged as much as 40 days), and (4) most of the decontamination observed occurs in the first one or two hours exposure to the cleaning solutions--little further decontamination is obtained on continued exposure up to 12 hours.

Automatic Analyzing Monitor

The automatic analyzing monitor, undergoing tests on reactor effluent water at 100-F-Area, was operated with minor interruptions during the month. Improvement in the inherent instability of the gamma ray energy channels was sought, however, this still limits the reproducibility of the instrument to a greater degree than anticipated. As a consequence, calibrations with separated isotopes continued to show variations exceeding expectations.

Reactor Effluent

Analysis of the effluent from six 105-KE experimental process tubes indicated that the concentration of As^{76} increases by about 80 per cent if the pH of the

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cooling water is lowered from 7 to 6. This further substantiates previous data which indicated that sulfuric acid is one of the main sources of the parent isotope.

Uranium Oxidation Experiments

Experiments on oxidation of uranium in air showed that the oxidation rate is dependent upon time, temperature and air flow rate. Below 500 C, these data correlate well with the available literature information. However, above 500 C comparisons cannot be made because no data are available in this temperature range. In order to determine the reproducibility of results, 5 runs were made at identical conditions. A standard deviation of 5.15 per cent (68 per cent confidence level) was indicated. This is excellent in view of the many variables involved.

SEPARATIONS PROCESSES

Feed Preparation

Continuous Dissolution. Experimental work on the five-inch continuous dissolver has been concluded with a run of thirty hours duration. Aluminum-clad metallic uranium slugs (1.34-inch OD by 8.32 inches long) were dissolved at a rate of 20 pounds of uranium per hour per cubic foot of superficial tower volume (1.0 ton U per day per ton of heel) while producing an effluent stream containing 1.5 M and 0.5 M HNO_3 . Hydrogen in the post-condenser off-gas averaged 1.6 per cent.

Dissolution of Dingo Metal. Further instantaneous dissolution rate studies confirmed previously reported acceleration of the dissolving rate of Dingo uranium by ammonium fluosilicate. The studies covered fluosilicate concentrations from 0.005 to 0.05 M in dissolving media containing 1 M UNH and HNO_3 ranging from 0.25 to 6.0 M. It is particularly interesting that the acceleration was observed at low HNO_3 and fluosilicate concentrations. Integral dissolution tests (complete dissolution of a test piece in an amount of dissolvent comparable to process conditions) also show acceleration of the dissolution rate by fluosilicate but are difficult to interpret in terms of shortened dissolving time cycle. Further tests are in progress.

Solvent Extraction

Coated Pulsed Column Plates. The coalescence of an organic phase by stainless steel sieve plates "whirlclad" (coated in a fluidized bed) with linear polyethylene and hot pressed at 1500 psi and 108 C for 2.5 minutes between two Teflon covered heated platens of a laboratory press was found to be essentially identical to coalescence produced by solid linear polyethylene sieve plates. It is worthy of note that these are the first coated plates tested which have had such characteristics.

"Sandwich" C-Column Cartridges. Experimental testing of a "sandwich" cartridge under Purex Phase II flowsheet conditions indicated that the cartridge was inferior (capacity-wise) to a standard plant cartridge under 1/2-inch pulse amplitude conditions. However, the sandwich was superior to a plant cartridge in both capacity and efficiency characteristics under 1-inch pulse amplitude conditions.

The "sandwich" employed in these tests contained four linear polyethylene sieve plates (18 per cent free area, 1/8-inch holes) on 1/16-inch spacing, with a nozzle plate of 23 per cent free area spaced 1/4-inch above the plastic plates with nozzles up and a similar nozzle plate 3/4-inch below the plastic plates with nozzles down. Sandwiches were separated by a standard sieve plate spaced midway (3 inches) between successive sandwiches.

Production of U(IV). About 50 per cent reduction of U(VI) to U(IV) in six hours of irradiation was obtained under the best conditions found to date for the photochemically activated reduction by formaldehyde of uranium in nitrate solution. The solution was initially 2M in HNO₃, 0.2 M in UNH, and 0.2 M in HCHO. It was maintained at 20 C and irradiated with a G.E. R.S. Sunlamp during the run. The product solution is unstable toward reoxidation of uranium unless a holding reductant such as sulfamic acid is added following irradiation. However, the presence of holding reductants (H₂NSO₃H, N₂H₄, or H₂NCONH₂) during irradiation reduced the rate of reduction. Methanol may be used as the reducing agent in place of formaldehyde but the initial reduction rate is somewhat lower under comparable conditions.

Purex

Laboratory studies indicate that a preliminary extraction with TTA in benzene preceding a Purex cycle is effective in improving zirconium-niobium decontamination. An aqueous feed was subjected to exhaustive extraction with TTA-benzene which removed about 99 per cent of the zirconium activity. The treated feed was then processed through a simulated Purex HA column comprising a batch extraction with 30 per cent TBP in Soltrol followed by five batch scrubs. The overall zirconium-niobium decontamination factor through these operations was 2×10^6 , or greater by a factor of about 100 than would have been obtained in the absence of the TTA extraction step. The activities due to zirconium and niobium in the final organic product were essentially equal, implying a decontamination factor in the simulated Purex HA column about 100-fold greater for niobium than for zirconium. Thus it appears that the TTA extraction, in addition to removing about 99 per cent of the zirconium, was effective in removing those niobium species which are difficult to separate in the TBP system.

Continued studies of the effect of "aging" TBP extracts on fission product scrubbing indicate that "aging" is beneficial for ruthenium but not for zirconium-niobium. Distribution ratios (organic/aqueous) for ruthenium ranging from 0.12 in the first scrub to 4.0 in the fifth scrub were observed when a fresh organic extract was subjected to five consecutive batch scrubs. When the organic extract was "aged" for 96 hours at room temperature before application of the scrubbing operations, distribution ratios for ruthenium ranged from 0.09 in the first scrub to 0.47 in the fifth scrub. Distribution ratios for zirconium-niobium were not significantly altered by the "aging" process, however.

Redox

The desirability of improving ruthenium decontamination in the solvent extraction cycles in Redox (thereby permitting the head-end ruthenium volatilization step to

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be eliminated) has prompted studies of the effect on product extraction and fission product decontamination of diluting hexone with an inert organic material. Diluents which have been tested include paraffinic hydrocarbons, methylcyclohexane, and aromatic hydrocarbons. Paraffinic hydrocarbons were rejected because they resulted in formation of a third phase at high uranium concentration. Methyl cyclohexane was chosen over aromatics for the experimental work because of its higher flash point, greater chemical stability, and lower density.

The distribution coefficient for uranium into diluted hexone decreases rapidly as the hexone concentration is reduced. For example, the distribution coefficients for uranium out of 0.2 M U, 1.5 M ANN, - 0.2 M HNO₃ were 2.5, 1.2, 0.6, and 0.14 for, respectively, pure hexone, and 70, 60, and 50 volume per cent hexone in methylcyclohexane. Thus a hexone concentration of about 70 volume per cent would be required in conjunction with 1.5 M ANN to obtain the same product concentration as is presently obtained in the Redox plant.

No significant improvement in ruthenium decontamination was noted in a batch extraction-scrub study in which 80 volume per cent hexone was compared with pure hexone. With 1.5 M ANN, - 0.2 M HNO₃ in the aqueous phase in both cases, ruthenium decontamination factors through a batch extraction and three batch scrubs were 1500 for pure hexone and 1800 for 80 volume per cent hexone. A two-fold improvement in ruthenium decontamination in the extraction step was observed with the diluted hexone but this advantage was lost because of slower scrubbing of ruthenium out of the diluted hexone.

These data indicate that little improvement in ruthenium decontamination can be expected through dilution of the hexone solvent, particularly when it is noted that the foregoing comparison was made with 1.5 M ANN, which represents a considerable excess in salting strength over that necessary to obtain adequate product recovery with pure hexone.

Flurex Process

Continuous operation of an electro dialysis cell under simulated Flurex conditions at a membrane current density of two amps/in.² resulted in serious deterioration of both Permutit 3142 (anion) and Permutit 3148 (cation) membranes within 96 hours. Damage was evidenced by excessive uranium in the anolyte, coating of anolyte side of the Permutit 3142 with diuranate precipitates, and blistering and pinholes in both membranes. These same membranes show no evidence of damage after 200 hours of operation at one amp/in.².

Preliminary data indicate only slight decontamination from ruthenium, zirconium, and niobium when NH₄UF₅ is precipitated from catholytes containing these fission products. Ruthenium decontamination appeared to be dependent on HF concentration; it was slightly better at 1 M HF than at 0.1 M HF. Spectroscopic analysis of NH₄UF₅ precipitated in a trench-cell Flurex catholyte did not detect any mercury contamination.

A procedure for estimating the total electrical resistance of a Flurex cell having a trench cathode has been devised. Estimated resistances are within 20 per cent of actual resistances measured for laboratory cells.

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Anion Exchange Processes

Laboratory examination of a sample of Permutit SK removed from the Purex facility after 60 days "hot" operation showed this resin had lost none of its original plutonium absorption capacity. The resin shrinkage on absorption of plutonium was about 50 per cent greater than for new resin, however.

Microscopic examination of this resin showed it to contain a large proportion of broken resin beads, which probably accounts for the increased pressures required to move this resin in the continuous contactor. Almost all the fragments appear to be from beads in the upper 25 per cent of the particle size range. Microscopic examination of a sample of resin obtained at the time this batch of resin was charged into the Purex contactor showed that a large proportion of the larger beads had surface cracks but very few fragments were present.

Laboratory investigations prompted by these observations disclosed that the techniques which have heretofore been used to convert the resin from the as-received chloride form to the nitrate form result in formation of surface cracks (generally along equatorial planes) in the larger beads. In order to avoid this cracking it is necessary to use dilute nitric acid (one molar or less) to effect the conversion from chloride to nitrate form. However, once converted to the nitrate form in this fashion the resin can be cycled between 0.5 M HNO_3 and 7 M HNO_3 and can be loaded with plutonium and eluted without appreciable cracking. Cycling between water and 7 M HNO_3 does produce cracking, however. Rates of absorption of plutonium are somewhat lower for resin having no surface cracks, but elution rates are apparently not significantly altered.

Application of one cycle of anion exchange to Purex plant LBP obtained during the recent operation on the "poor man's" two-cycle flowsheet yielded a product containing 50 g Pu/l, 4.3×10^5 $\gamma/\text{m,ml}$ Zr-Nb, and 8.2×10^4 $\gamma/\text{m,ml}$ Ru. This corresponds to a γ/AT ratio of 5.5×10^{-11} microcuries γ per alpha count, or about three-fold greater than the current plant product but within the accepted limit of 6×10^{-11} .

Resin Movement, Higgins Contactor. Additional resin profile studies employing a uranyl sulfate complex as the transferring ion corroborate the findings of resin channeling reported last month. The evidence, to date, definitely indicates that the resin moves with the parabolic-type velocity gradient characteristic of fluids flowing in circular conduits. The flow pattern lengthens a "plug" of tracer resin to approximately twice its initial length during its movement from the resin reservoir to the resin sampling point just above the XAF feedpoint.

The results of the fluid profile studies have been somewhat inconclusive, with some data indicating marked channeling and others indicating essentially piston flow.

Pyrochemical Processing

Aluminum-Potassium Aluminum Chloride System. The distribution of uranium between molten aluminum and potassium aluminum chloride was decreased by a factor of over 25 in an experiment in which the temperature was changed from 700 C to 825 C and

an excess of potassium chloride was used. It is believed that the effect stems not from the temperature change, but from the excess chloride which complexes the uranium trichloride thereby reducing its activity and inhibiting the reduction process. This finding points out the possibility of controlling the uranium distribution by modification of the solvent.

Scouting experiments to determine whether the presence of zinc would displace the uranium distribution toward the metal phase of the Al-KAlCl₄ system were attempted, but no apparent beneficial effect was observed. This approach was motivated by the possibility of forming U₂Zn₁₇ which has been reported to form as a very stable intermetallic compound.

The behavior of plutonium in the aluminum-potassium chloride system was studied in a series of experiments under the same conditions that resulted in 88 per cent of the uranium appearing in the metal phase. The equilibrium was approached from both sides resulting in about 95 per cent of the plutonium in the salt phase. Uranium apparently has no effect on the plutonium distribution up to 15 weight per cent. Separation factors (uranium to plutonium) of 200 for a single contact were measured. In a single experiment in which the metal phase was re-contacted with fresh KAlCl₄, only 0.9 per cent of the plutonium remained in the metal. The calculated separation factor for the two stage operation was greater than 40,000.

An equilibration of aluminum-potassium aluminum chloride to which yttrium-90 traced Y₂O₃ had been added resulted in essentially all of the activity in the salt phase. No significant beta count was detected in a dissolved sample of the metal phase.

Examination of the literature has disclosed data related to the free energies of solution of various salts in the KCl-LiCl eutectic. The dissolution of AlCl₃ is associated with the greatest negative free energy change of all the salts examined. This is further evidence that the solution of AlCl₃ provides the driving force for the reduction of uranium by aluminum.

The activity coefficient of uranium in aluminum was determined by an analysis of data by Rough (BMI-1066). At a uranium mole fraction of 0.015 and a temperature of 950 C, the activity coefficient was found to be about 0.97.

Analytical Services

A gamma absorptiometer was placed in laboratory operation for measuring uranium in solution. Corrections for interferences (nitric acid, sulfuric acid, hydrochloric acid, and aluminum nitrate) and extended uranium calibrations are being completed. The instrument is more compact, more stable and covers a larger range of uranium concentration than the X-ray photometer.

Pyrolysis replaced pyrohydrolysis for measuring fluoride in heavy metal fluorides. Advantages are: more compact system, no need for a cumbersome steam generator, and lower blank. Quality of results and time for analysis are comparable.

Assaying nitrate in the amine-plutonium system was aided by reduction to ammonia. It was distilled and titrated with hydrochloric acid. Reducing agent was Devarda's alloy.

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256-channel energy analysers continue to give higher quality data and to save time. Six to 70 Kev gamma radiation is being measured with a 1 mm crystal. One hour per sample is being saved since transferring to the 256--the measurement of Cs^{137} occurring with Cs^{134} .

Observation Wells

Monitoring wells provided in Projects CA-764 and CA-773 are about one-third completed. One of the two wells to be furnished with well screen under Project CA-764 was completed and soil samples were subjected to mechanical analysis to permit specification of screen size. A well drilled 50 feet southeast of the 216-BC-5 crib penetrated a zone of contamination extending from 15 to 205 foot depths. The contaminated zone at this location extends 85 feet deeper than is apparent from scintillation probe logs of a well just 5 feet from the crib. The greater depth of penetration of contaminated liquids at the site of the new well is probably the result of movement down the dip of bedding planes.

Improved sensitivity of analysis for Sr^{90} in routine ground water samples (from 2×10^{-7} $\mu\text{c/ml}$ to 7×10^{-8} $\mu\text{c/ml}$) resulted in its detection in an additional monitoring well near the abandoned 216-S-1 and 2 cribs. No other monitoring wells showed positive Sr^{90} results using the improved analytical method.

Scintillation probe logs of a monitoring well near the new Purex tank condensate crib were obtained before and after the crib was placed in service. Prior readings were less than 1000 c/m for the entire depth of the well, while three weeks after crib discharge was initiated greater than 10,000 c/m were obtained to depths of 100 feet.

Special Geological Studies

Drilling by the Corps of Engineers at the Ben Franklin dam site was terminated when the first of three proposed test holes penetrated 90 feet of sand and gravelly sand, then only two thin beds of silt and clay interstratified with more sand to a depth of 97.2 feet. The stratigraphic sequence was as predicted from data at the 300 Area, 300 North, and along the White Bluffs; no basalt was encountered.

Bid packages for well drilling project CAH-794 (CET 1958 drilling) were prepared. Bid opening is planned for June 10, 1958, with a notice to proceed to follow prior to June 30.

Disposal To The Ground

Data on the life expectancy of the Redox 216-S-7 process condensate crib were communicated to the Chemical Processing Department. The data confirmed earlier findings that the crib has a minimum remaining life of 2-1/2 years. As a result of this information, construction of the replacement crib will probably be deferred by CPD to FY-1960.

First steps were taken to establish waste evaluation tests on a routine basis in the CPD Analytical Laboratory, 222-S Laboratory. Standard column tests will be

██████████ duplicated in both laboratories for a brief period to assure reproducibility of the results. Initial tests are being performed on Purex tank condensate wastes and UO_3 condensate wastes.

Further testing of Redox D-2 waste with standard soil columns indicated a capacity of greater than 10 column volumes for the 216-S-7 crib. Soil column tests of Purex condensate wastes were performed using condensates neutralized with limestone as is now practiced, neutralized with sodium hydroxide, and unneutralized. The breakthrough of radiostrontium was found to occur after the passage of 1.2 column volumes of lime neutralized waste and of 3.4 column volumes of unneutralized waste. Condensate neutralized with caustic showed no limiting breakthrough after passage of 66 column volumes.

WASTE TREATMENT

Calcination of Purex Waste

Studies were continued on the volatility and leachability of fission products when Purex LWV is calcined. It had been hypothesized that the sulfate in LWV was responsible for the large, non-selective fission product leaching previously observed and for the decrease in leachability of material calcined at temperatures above 700 C (where sulfate is decomposed). This has now been confirmed. For a sulfate free LWV, only about two per cent of the gross fission products were leached from solids calcined at 400 C, or above. However, ruthenium evolution during calcination was much increased (very nearly quantitative), suggesting that the sulfate in normal LWV inhibits the evolution of ruthenium. Replacing the sulfate with phosphate further decreased leachability, and produced a glassy melt at 900 C, but was only partially effective in reducing ruthenium volatilization.

Apparatus has been set up to test spray calcination ("atomized suspension" calcination) on a small scale. This is being done by collimating spray droplets from a high-pressure atomizing nozzle through an orifice at the end of a vertically mounted four foot tube externally heated with laboratory furnaces.

Nitrate Destruction

Design and construction of pilot plant equipment for investigation of the nitric acid-formaldehyde reaction have begun. Potential areas of application of this process include: nitrate removal from Purex-type high level radioactive wastes, feed preparation steps for a fission product recovery plant, and adjustment of the nitrate content of dissolver effluents.

The primary reaction vessels (a four-gallon stainless steel pot and surmounted absorption tower) of the pilot plant will be housed in an empty 30,000 gallon underground storage tank to confine the reaction products in the event that excessive pressures are developed during exploratory studies.

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TRANSURANIC ELEMENT AND FISSION PRODUCT RECOVERYCesium Isolation and Packaging Facility

The preparation of detailed drawings for the prototype is approximately 65 per cent complete. Some drawings are expected to be placed into shop for fabrication during the month of June. The procurement of instruments and hard-to-get materials (such as Hastelloy B) has been initiated.

A conceptual design has been completed of the hydrolyzer. As currently visualized, the hydrolyzer will be an inductively heated ball mill. The cesium zinc ferrocyanide slurry will be fed directly into the hydrolyzer where it is converted to the oxide, dried and milled.

A model of the cesium isolation and packaging facility has been essentially completed. It has proved helpful in detecting congested areas during layout studies. It is also proving helpful in designing remote operation and maintenance facilities for the cell.

Strontium Recovery

Preliminary experiments support the feasibility of recovering strontium-90 from Purex LWW by precipitation as strontium nitrate with fuming nitric acid. Due to the low concentration of strontium, simple addition of nitric acid is not effective due to the accompanying dilution. However, generation of nitric acid in solution by passing nitrogen dioxide and oxygen into cooled LWW followed by a minor butt of fuming (95 per cent) acid shows promise. Approximately 80 per cent of the strontium can be recovered in this way.

Neptunium Recovery

The Purex plant was operated on the new two cycle-back cycle flowsheet during April and most of May (until shutdown). During that period, the bulk of the neptunium fed to the plant reached the 2DF, partitioned into the 2DW, and was back-cycled to HA via 3WB. No neptunium followed the plutonium, and very little appeared in the uranium product. Of particular interest was the partial reflux of the neptunium in the 2DF, 2DW, and 3WB plant streams to a concentration about three times normal (except for periods of operational upset due to re-work of off standard waste or addition of nitrite to 3WB.)

The feasibility of neptunium recovery from either concentrated 2DW or from 3WB by anion exchange (with gassing) was demonstrated, and the effect of recycle uranium was investigated. With 3WB containing 0.05 M U, corresponding to a one per cent back-cycle, the capacity on Dowex 1, X-4 (50 - 100 mesh) resin was 630 column volumes at a high flow rate of 5 ml/min/cm². With 0.25 M U, this was reduced to a still satisfactory value of about 130 column volumes for the same terminal instantaneous loss of 25 per cent. While recovery from either 3WB or evaporated 2DW is equally feasible chemically, the latter is preferable since it avoids plutonium criticality problems and permits use of a larger diameter column and lower flow rates.

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ANALYTICAL AND INSTRUMENTAL CHEMISTRYX-Ray Analysis

Continued work on the application of X-ray fluorescence to the measurement of the thickness of aluminum cladding on MTR type fuel plates disclosed that a thickness of 0.020 inch could be measured to 0.00025 inch with counting times of 1.6 and 4.7 minutes for apertures of 1.6 and 0.32 square centimeters, respectively.

This method is quite satisfactory for aluminum thicknesses to 0.045 inch with a 50 KV X-ray source. However, for determination of stainless steel or zirconium cladding thickness, a 150 KV source would be required. For 60 KV X-rays a thickness of 0.005 inch of stainless steel or zirconium is equivalent to 0.108 and 0.191 inch of aluminum, respectively. The thickness of these materials that can be measured accurately is, therefore, considerably less than 0.005 inch.

100 Channel Analyzer

A slow, D. H. Wilkinson type 100 channel analyzer employing beam switching tubes has been constructed using a circuit developed at Los Alamos. Input circuitry was added to permit spreading any fraction from 10 to 100 per cent of the pulse spectrum over the 100 channels. In addition, a live-time scaler was added to permit compensation for coincidence losses which would be about ten per cent at a counting rate of one per second with the basic circuit. The completed instrument is capable of analyzing pulses from conventional radiation detectors at rates up to about 10 cps per channel and 30 cps total.

Direct Oxidation Potential Measurements

The standard oxidation potential of the Fe(II/III) couple and the formal oxidation potentials of the Pu(III/IV) couple in various media have been re-determined using a controlled potential coulometer. The standard potential of the Fe(II/III) couple was determined by extrapolation of potentials observed at several ionic strengths to zero ionic strength, at which point activities are unity, and the observed potential becomes the standard potential. The Pu(III/IV) formal potentials were those obtained for given systems in which the two oxidation states were equal in concentration and not corrected to unit activity. These potentials were determined and compared to values reported in the literature in order to test the coulometer technique. The use of the coulometer is advantageous because of the easily known concentration ratios of the oxidation states, easily determined potentials, and the ability to "titrate" directly with electrons.

The standard potential for the Fe(II/III) couple was within five millivolts of the value reported by Latimer. The formal potentials of the Pu(III/IV) couple for 0.004 M to 0.02 M Pu in 1 M HCl, HClO₄, and HNO₃ were within ten millivolts of the values reported by Kraus. These differences are probably due to junction potentials.

EQUIPMENT AND MATERIALSProduct Concentrator Feed Inlet Lines

Laboratory studies indicate that the frequent corrosion failures of Redox and Purex Plant product concentrator feed inlet lines are due to a solution concentration cell existing at the feed inlet point. Differences between the feed composition and the concentration of solution circulating in the concentrator loop create the cell. In laboratory equipment simulating the feed inlet point, a bar of 308-L welding rod was exposed to 0.5 M HNO_3 on one end and, simultaneously, to 5 M HNO_3 on the other end. Localized attack at the junction of the two solutions was observed. A design modification to the concentrator feed inlet line to avoid the failures has been suggested.

Equipment for Chlorination of PuO_2

Samples of gold, platinum, Baker-413 (a palladium-platinum-gold alloy), Hastelloy B, Hastelloy C, and Haynes 25 were exposed to phosgene gas at 600 C for 72 hours. Corrosion rates observed were 14.9, 16.0, 39.4, 8.1, 7.3, and 36.8 mils/mo. in the order given. Exposure of the same materials at 400 C is in progress. Other chlorinating agents to be studied are HCl and CCl_4 .

PROCESS CONTROL DEVELOPMENTAssistance to Chemical Processing Department on Process Control Instrumentation

Gamma scintillation monitors on the Redox HCP, and LCU streams were placed in service this month. Tests are planned, on modified startup procedures, which may minimize fission product carryover in the columns upstream of these monitors. Tests were completed with the Purex prototype 100 (G-5) sampling system in the 321 Building. Plant system difficulties are probably due to air leakage in the wall connector.

Alarm System for Hot Semiworks

A system to continuously monitor temperature, liquid level, and pressure at 15 locations in the Hot Semiworks has been developed. A predetermined phone number will be called upon indication of any off-standard condition. In addition, a check to determine if an "alarm condition" exists can be made by dialing a Hot Semiworks number.

Light Photometer

A dual filter photometer was installed on the LCU stream of an experimental extraction column in the 321 facility. Preliminary results indicate that the unit aids in evaluating the performances of the column, as well as life testing of the photometer components.

Neutron Detector

The experimental pipeline neutron monitor on the 234-5 task I supernate recycle line, showed a 30-fold decrease in background activity over the previous unit.

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However, the plutonium concentration in the transfer line is too low to be quantitatively detected by the monitor. The unit was removed and will be tested on a stream having a higher plutonium concentration.

Alpha Phosphors

A facility for testing phosphors has been set up in the laboratory. A single dot zinc sulfide phosphor with a 3.8 cm² area, such as used in the 234-5 prototype exhibits a short life compared to one of the same area but distributed in the form of many dots. The short life of the single dot unit appears to be due to lack of bonding of the Teflon protective coating to the back-up disc in the area of the phosphor.

NON-PRODUCTION FUELS REPROCESSING

Mechanical Processing

The scope design of a mechanical processing "cold" test installation for size reduction of spent non-production reactor fuels is about 60 per cent complete. Major cell equipment includes a cut-off saw (hardware removal only), shear, feed mechanisms, crane, and manipulator. In designing the installation it has been assumed that the sheared product drops either directly into a dissolver or a suitable catch bin.

Design and procurement of components for a 40-ton hydraulic shear are underway. Simulated and prototype fuel elements will be chopped to evaluate the suitability of the product for core leaching in a dissolver.

Studies were made to determine the effect partial tubing closure (as a result of shearing) might have on dissolution rates of sheared pieces. Dissolution rates on both stainless steel jacketed and unjacketed samples of UO₂ in 10 M HNO₃ were determined. Studies indicated that the UO₂ dissolution rate of expected shear product (say one inch long tube segments) would be less than a factor of two slower than unjacketed UO₂.

Feed Preparation

Darex. Shop fabrication of the major equipment pieces was completed during the month. The overall installation is now about 90 per cent complete.

A glass lined, titanium float, rotameter designed for aqua regia service has been checked out, calibrated and is being installed with the other Darex equipment. The Kates flow regulator has operated in excess of 1000 hours, controlling within ±0.01 GPM over the range 0.02 to 0.2 GPM. At steady or slowly changing line pressures the regulator controls to ±0.004 GPM.

The installation of the Darex equipment in the 321 Building has offered numerous opportunities to develop techniques for field welding titanium. Although radiographs of some of the welds revealed defects in terms of code interpretation, the general quality was acceptable since the primary function of the titanium was corrosion resistance rather than strength. Experience was gained which will be useful in future applications.

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A paper entitled, "Titanium for Chemical Processing Equipment" was written for the AIChE symposium, "Chemical Engineering Principles in Nuclear Applications" to be held at Salt Lake City, Utah in September 1958.

Zirflex. Pilot plant exposure of sintered uranium dioxide to a zirconium-free boiling solution of 5.5 M ammonium fluoride and 0.75 M ammonium nitrate for 6.5 hours resulted in loss of 3.3 per cent of the uranium. The loss was distributed in approximately equal amounts to the solution and UF_4 precipitate. Only 0.6 per cent of the original uranium was lost in simulated cladding removal solution after cooling, storage, and centrifugation.

Further laboratory work has confirmed that the rate of reaction of sintered uranium dioxide with the Zirflex decladding medium (6 M NH_4F , 0.5 M NH_4NO_3) decreases significantly after the solution becomes saturated with uranium(IV). For example, in one experiment 3.2 grams of uranium was converted to fluoride during a 3.25 hour exposure to boiling 6 M NH_4F , 0.5 M NH_4NO_3 during which the solution became saturated with uranium(IV). Exposure of the uranium dioxide to the saturated solution for an additional 2.75 hours then resulted in conversion of only 0.2 grams of uranium into fluoride.

Sintered uranium dioxide (1/2-inch thick pieces) remaining after Zircaloy decladding operations completely dissolved in 10 M HNO_3 and 0.2 M $Al(NO_3)_3$ in 7-1/2 to 12 hours.

Nitric-Hydrofluoric Acid Dissolution. The preferential attack of vacuum melted Hastelloy F weld metal in HNO_3 -HF solutions may be prevented by a solution heat treatment at 2150 F. Rapid cooling following heat treatment is essential. Base metal corrosion resistance to HNO_3 -HF solutions is essentially unaffected by this heat treatment.

Severe preferential attack of weld metal occurred when low-carbon Hastelloy F welded with Haynes 25 filler rod was exposed to HNO_3 -HF solution in the "as welded" condition. In earlier studies Haynes 25 weld metal (reported by manufacturer to be "as welded") was not preferentially attacked by HNO_3 -HF solutions.

Gold and platinum have good corrosion resistance to boiling 1 M HNO_3 - 2 M HF. However, Hastelloy F, when it is coupled to gold, is severely attacked by this solution.

A Hastelloy F laboratory-scale dissolver is being constructed. When completed, it will be solution heat treated. It is intended for use in studies of process variables in the HNO_3 -HF dissolution of non-production fuels.

Redox Feed Preparation

Studies with synthetic feeds simulating those which would be prepared by total dissolution of stainless steel clad fuels in HNO_3 -HF mixtures indicate that addition of aluminum nitrate to the extent of 0.33 moles aluminum per mole of fluoride will suffice to yield normal extraction coefficients for uranium(VI) and plutonium(VI) with hexone.

Addition of excess aluminum nitrate is necessary to obtain reasonable rates of oxidation of plutonium(IV) to plutonium(VI) in these feeds.

REACTOR DEVELOPMENT - 4000 PROGRAM

Pyrochemical Processing

An enrichment of 18 per cent in the plutonium content of an aluminum-plutonium alloy was achieved by the electrolytic removal of aluminum in a molten cryolite bath. The plutonium content of the alloy (anode) was changed from 1.54 to 1.82 w/o. About 4.5 per cent of the plutonium and 22.2 per cent of the aluminum in the original alloy were removed from the anode. A current efficiency of about 70 per cent was calculated on the basis of the anode reaction.

Non-Rigid Fuel Cores

In an effort to elucidate the role of magnesium in the UO_2 -Bi system prepared by the magnesium gettering technique, samples of a 20 w/o uranium sample which had been held at 600 C for 92 hours before cooling were analyzed for U/Mg ratio. The ratio was substantially constant at 2.5, an indication that the magnesia is either somehow attached to the UO_2 in the slurry or, since there was little segregation of uranium, is uniformly distributed throughout the bismuth, a less credible explanation.

An improvement in the stability of the slurry was achieved by modifying the density of the metal phase by the addition of sodium. The addition of 0.83 w/o sodium resulted in a calculated density of 8.86 at 600 C. With sodium present, no segregation occurred in a system which under the same conditions segregated badly with sodium absent. This finding is of considerable significance since it means that slurries should be capable of preparation in which segregation is minimized or eliminated.

Reprocessing of PRP Fuels by Amine Extraction

The maximum plutonium concentrations which can be attained without two organic phases forming were determined for ten volume per cent tri-n-octylamine-xylene and ten volume per cent trilaurylamine - two volume per cent n-octyl alcohol-Amsco. These were 8.9 grams Pu/liter organic for the former and 4.2 for the latter. Other diluents and additives are being investigated in an attempt to increase the plutonium solubility.

Analytical Services

A flame photometer is being used for measuring low magnesium in a uranium dioxide-bismuth matrix. Error is about 10 per cent. Interference is eliminated by making standards in the same matrix.

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6000 PROGRAM - BIOLOGY AND MEDICINE

Reactor Radioisotopes

Reactor film material removed from a process tube by a "Turco" purge operation was radioisotopically analyzed for ten isotopes. If this single tube is assumed to be representative of this reactor, a five minute "Turco" purge removes as much Na^{24} , P^{32} , Sc^{46} , Cr^{51} , Co^{60} , Cu^{64} , Zn^{65} , As^{76} , La^{140} , and Np^{239} as are released into reactor effluent water in 0.3, 25, 85, 9, 100, 5, 70, 8, 50, and 2.5 days of normal operation, respectively. Using the same assumption this purge releases eight times as much Na^{24} , 20 times as much Cu^{64} , and 60 times as much P^{32} , Zn^{65} , and As^{76} as the one hour diatomaceous earth purges previously used. A series of radioisotopic analyses made on samples taken at different times during the purge showed that the radioisotope concentration drops sharply after the second minute of the purge except for Na^{24} and to a lesser extent Zn^{65} . This lends support to the hypothesis some of the Na^{24} and Zn^{65} originate in the aluminum and appear in the reactor effluent water following corrosion.

A spectrophotometric procedure was developed and applied to the determination of uranium in Columbia River water, reactor process water, and effluent water. In samples taken during April and May the Columbia River contained 25 $\mu\text{g/liter}$, process water contained 8.3 $\mu\text{g/liter}$, and effluent water contained 5.3 $\mu\text{g/liter}$. These data will be helpful in determining the origin of Np^{239} and fission products in reactor effluent water.

A preliminary study was completed of the efficiencies of removal of P^{32} and As^{76} from reactor effluent water by columns of adsorbents. Columns of 24ST aluminum turnings, and two iron-containing minerals (limonite and magnetite) proved to be the most efficient of the materials tested. After 600 - 1000 liters of reactor effluent water were passed through 15 cm^2 area, 10 - 30 cm long columns of these materials, 60 percent of the P^{32} and 20 - 90 percent of the As^{76} were still being removed. Limonite had the greater efficiency and will be tested further.

Twenty tissues from a steer butchered March 24 which had lived its life (two years) on land irrigated with Columbia River water below the Hanford Project were analyzed for Zn^{65} content. Steak, bone and fat contained 10.7×10^{-6} , 13.4×10^{-6} , and 2.22×10^{-6} $\mu\text{c Zn}^{65}/\text{g}$, respectively, which is about twice that of an animal butchered last year which was also raised on this pasture.

Geology and Hydrology

Logs of eight wells recently completed or in process of drilling immediately east of the Columbia River are providing additional detailed data on the changes in, character of, and attitude of the Ringold formation and basalts there. These are useful in the interpretation of the observed geologic conditions in those rock units on the Hanford Works.

Assuming the Ringold formation to be tectonically deformed with the basalt, the basalt surface contour map was used to predict the depth of the Ringold blue clay zone at a proposed well location south of 200-East Area. The predicted depth of the zone was 440 feet and subsequent drilling logs indicated

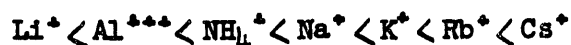
that the formation was actually encountered at 431 feet. This information provided further substantiation of the Ringold conformable deformation with the basalt.

The equilibrium moisture content of samples of Touchet sediments subjected to 1000 gravities in a centrifuge for 65 and 72 hours was determined to be 8.5% and 8.36% by weight respectively. These results conform well with data previously obtained for shorter drainage under centrifuge conditions.

Soil Chemistry and Geochemistry

The rate of removal of strontium from phosphate solutions by the calcite replacement reaction was shown to be strongly affected by temperature. More than 99% of the strontium in a test system of calcite-phosphate solution was removed in one hour at 65°C, while only 53% was removed from an identical system maintained at 15°C. The effect is believed to be the result of lower concentrations of dissolved CO₂ at the higher temperature.

Further tests confirmed the specific removal of cesium from solution by the natural zeolite clinoptilolite. Measurements of the Cs removal capacity of this mineral was 105 meq/100g from 0.05 M Cs solutions. The same system revealed a Cs removal capacity of less than one meq/100g for the IRC-50 cation exchange resin. Cation removal by clinoptilolite was found to follow the general replacement series:



The specificity of clinoptilolite for Cs removal was demonstrated by equilibrium distribution coefficients for Cs in the presence of various concentrations of several cations. The Cs-137 K_d of the mineral was found to be greater than 700, even in 1.0 M Na⁺ solutions.

Ground Waste Investigations

Equilibrium distribution coefficients for Sr⁹⁰ were determined for the standard soil used in development work on soil column techniques. The tests were performed at 18° C and at 83° C and with a variety of accompanying cations. The results indicated a temperature effect consistent with that observed during soil column tests, i. e., the equilibrium exchange reaction is dependent on the relative ionic hydration of the exchanging and exchanged ions at a given temperature. These data will be required in the application of the Hiester-Vermeulen equations for treating exchanger column data.

The study of the influence of column length and column diameter on soil column tests neared completion. Preliminary results indicated no significant diameter effect, thus demonstrating negligible influence of the column wall on packing or flow characteristics. No significant difference was found in breakthrough curves obtained from columns 10, 20, and 40 cm in length, however 120 cm columns revealed a significantly greater number of column volumes to achieve breakthrough than did the shorter columns. Quantitative interpretation of the data must await completion of the remaining tests.

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Field Apparatus Development

Since the velocity of water flow through a porous medium is a function of the permeability of the soil, a valid measurement of permeability may permit ground-water velocities to be determined. Laboratory permeameters were further studied using uniform grain size sand to evaluate the applicability of empirical equations relating permeability to the properties of the medium. Permeability as measured with the laboratory equipment was higher by a factor of 1.6 to 3.3 than predicted by the equations. Further refinement in evaluating the grain size may give improved agreement.

A recently acquired deep well pump performed satisfactorily. A pumping rate of 450 gpm from a depth of 140 feet was recorded.

Recent tests pointed up the poor condition of perforations in older observation wells. The jet perforator was employed to re-perforate casings, thus permitting improved well draw-down data. Attempts to perforate recently placed Kaiwell casing resulted in apparent fracture of the casing, suggesting the necessity of fewer simultaneously fired shaped charges.

The two-thermistor ground-water velocity element was incorporated into a probe for in-well measurements. Calibration curves determined by moving the element at a known rate through a stagnant tank were more reproducible than those obtained from former methods due to reduction of thermal eddies and bubble formation on the elements. Velocities of the order of a cm. or two per minute were detectable.

Analytical Services

Neutron activation was used to form Y^{90} (with practically no Y^{91}) from highly purified yttrium oxide and to confirm its purity. Forty millicuries of Y^{90} was produced from 37 mg Y_2O_3 . The Y^{91} restriction was met. High oxide purity was confirmed by a 64.4 hour half-life compared to the 64.0 hour literature value for Y^{90} . Incidentally, the 1650°C sintered Y_2O_3 dissolved readily in nitric - or hydrochloric acid.

W. H. Leas (for L. 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
E. J. Frederick W. G. Stockdale	5/2/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Discuss Hot Cell Design	RL Moore KH Hammill	No
T. Ward	5/1-7/	Corps of Engineers Seattle, Washington	Supervise drilling of test hole at Ben Franklin dam site and discuss geologic conditions there, also follow bucket-auger work at 100-F Area.	RE Brown	No
C. F. Konzak	5/8/	Washington State College Pullman, Washington	Discuss radiation of seeds.	LL Burger	No
Z. D. Sheldon	5/6/	GEL Schenectady, New York	Discuss chemistry programs.	LP Bupp OF Hill WH Reas	No
A. Gianbusso	5/14/	Washington AEC Washington, D.C.	PRP Program discussions.	LP Bupp	No
G. W. Watt	5/19-23/	University of Texas Austin, Texas	Technical consultations.	LP Bupp WH Reas EE Voiland RJ Brouns MT Walling RE Burns OF Hill	Yes
W. Tsang	5/16/	Applied Research Lab. Glendale, California	Service & adjust spectrograph source unit.	FM Smith	No
J. L. Agee	5/20-23/	Oregon Board of Health	To obtain information pertinent to Radiochemical Analysis.	FE Holt	No

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restrict- ed Data
W. B. Tarpley	5/23/	Aeroprojects, Inc. West Chester, Pa.	Discuss application of ultrasonics in research and development activities.	RL Moore WH Reas WL Lyon HT Bahrn WR DeHollander	No
G. D. DeBuchananne R. M. Richardson R. C. Newcomb	5/26/	U.S. Geological Survey of Washington, D.C., Oak Ridge, Tennessee & Portland, Oregon, respectively.	Examine waste handling facilities.	RE Brown DW Pearce JF Honstead WH Bierschenk	No
J. F. Stickel	5/25/	Dames and Moore Los Angeles, Calif.	Discuss proposed geo-physical seismic program.	RE Brown	No
R. E. Alvord	5/28/	Jarrell Ash Company Newtonville, Mass.	Discuss spectrochemical equipment.	FM Smith	No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visits	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
C. L. Pleasance	5/2/	Seattle Section of Institute of Radio Engineers Seattle, Washington	Presented Paper	--	No
R. E. Connally	5/2/	" "	Attend meeting	--	No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
L. L. Burger	5/19-20/	Oak Ridge National Laboratory Oak Ridge, Tennessee	Discuss new solvents for chemical processing.	FL Culler	Yes
	5/21/	Savannah River Aiken, South Carolina	" " "	TH Siddall	Yes
	5/22-23/	University of Texas Austin, Texas	Discuss preparation of organic compounds.	PD Gardner	No
D. W. Pearce	5/6-7/	Purdue University W Lafayette, Indiana	Present paper at annual Purdue Conference.	DE Bloodgood	No
	5/8-9/	Division of Reactor Development - AEC Germantown, Md.	Meeting of Committee 24, 1958 Geneva Conference	JA Leiberman	No
	5/12/	Standard Oil Co. (NJ) Tulsa, Oklahoma	Listen to technical program on specialities of the laboratory; inspect.	CD Russel	No
	5/13/	Magnolia Field Research Laboratory Dallas, Texas	" " "	CI Alexander	No
	5/14/	Humble Oil & Refining Houston, Texas	" " "	M. Williams	No
R. E. Brown W. H. Bierschenk	5/18-23/	US Geological Survey Boise, Idaho	Attend conference on Hydrology of Volcanic Rocks, and to make field trip.	MJ Mundorff	No

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restrict- ed Data
J. F. Honstead	5/14/	Humble Oil Research Houston, Texas	Study waste disposal	API Committee	No
	5/15/	Texas Co. Research Houston, Texas	Study waste disposal application of research activities.	"	No
	5/16/	Schlumberger Well Logging Company Houston, Texas	"	"	No
	5/18-23/	East Texas Salt Water Disposal Company Kilgore, Texas	"	"	No

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BIOLOGY OPERATION

A. Organization and Personnel

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

B. TECHNICAL ACTIVITIES

FISSIONABLE MATERIALS - 2000 PROGRAM

BIOLOGICAL MONITORING

Atmospheric Contamination

Concentrations of I¹³¹ in thyroid glands of jack rabbits were about the same as one year ago. Values were as follow:

<u>Collection Site</u>	<u>µc/g thyroid</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Four Miles S.W. of Hedox	2×10^{-3}	3×10^{-3}	- 5
Wahluke Slope	1×10^{-3}	4×10^{-3}	-10
Prosser Barricade	1×10^{-3}	2×10^{-3}	- 7

Fission products were present in tissues of rabbits in the following amounts which were slightly higher than one year ago.

<u>Sample Type</u>	<u>µc/g tissue</u>	<u>Trend Factor</u>
	<u>Average</u>	
Bone	6×10^{-5}	- 7
Muscle	4×10^{-5}	-
Feces	3×10^{-5}	- 17
Liver	2×10^{-5}	- 2

Columbia River Contamination

Contamination levels for beta emitters were as follow:

<u>Sample Type</u>	<u>Collection Site</u>	<u>µc/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

A concentration of four per cent effluent from the 100-F reactor caused a slight increase in mortality among young Chinook salmon over that of controls. Varying the concentration from 3 to 6.2 per cent to simulate the magnitude of fluctuation which may result from power production at Priest Rapids Dam produced virtually the same effect as the continuous addition of four per cent effluent. This test will be terminated early next month since the fish are ready to migrate to the ocean.

Exposure of young Chinook salmon to four per cent strength effluent from the KE reactor and from special Tube No. 4963 has shown this concentration to be slightly toxic in each case. The sensitivity of the test has been impaired because of a supersaturation of nitrogen in the raw river water which has caused a "gas bubble" disease in the fish.

BIOLOGY AND MEDICINE - 6000 PROGRAM

METABOLISM, TOXICITY, AND TRANSFER OF RADIOACTIVE MATERIALS

Phosphorus

The feeding of P^{32} at the rate of $0.006 \mu\text{c/g}$ of body weight per day to trout was completed at the end of the month. The fish had been maintained on this lowest level diet for several weeks beyond the conclusion of other phases of the test in hopes that some indication of damage to sex products might be obtained. Eggs were obtained from only two females which had been chronically fed the radio-phosphorus. The viability of the eggs obtained was within the normal range for this strain of trout and because of the small number of eggs available, it will not be possible to use this as a parameter of radiation damage.

Methods are under development to determine the effect of temperature on the uptake of P^{32} by trout and the effect of P^{32} on the survival of eggs of sunfish.

Zinc

Male rats sacrificed after 200 days chronic feeding of Zn^{65} show highest concentrations of Zn^{65} in the hair. Following in order of decreasing Zn^{65} concentration are femur, prostate, liver, kidney, pancreas and testes. The concentration of Zn^{65} in the total prostate is slightly less than that in the femur, the major fraction of prostate Zn^{65} is present in the dorso-lateral portion of the gland, which constitutes a small fraction of the total prostate mass.

Strontium

The experiment to determine the effect of dietary calcium level on the retention of a single intraperitoneal dose of Sr^{90} and Ca^{45} continued with animals sacrificed 1, 2, 4 and 8 days following radioisotope administration. Results are not yet available.

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The experiment studying the effect of dietary calcium on chronic deposition and retention of Sr^{90} and Ca^{45} was completed with the sacrifice of animals fed the radioisotope for a period of 100 days. Results from the 100-day sacrifice are not yet available. Further analysis of the data obtained through 50 days of chronic feeding indicates that the accumulation of Ca^{45} in bone can be reasonably explained on the assumption that bone deposition is directly proportional to the specific activity of Ca^{45} in the blood, and that the specific activity of Ca^{45} in the blood is determined by dilution of dietary calcium with calcium recycled to the blood from bone. In the case of Sr^{90} , deposition in bone is similarly proportionally to concentration in blood. However, the concentration of Sr^{90} in blood is not simply related to dietary Sr^{90} or stable calcium intake.

The first of a series of experiments designed to reveal the nature of isotope transfer from the lumen of different segments of the pig intestine into the general circulation was completed.

Skeletal deposition of Sr^{90} orally administered to pigs was found to range from 1 to 6 per cent for adults and 25 to 32 per cent for the young.

Relatively insoluble compounds of strontium are taken up by plants grown with the Neubauer technique 1/20th as readily as are soluble compounds in first growth on contaminated soil. In a second cropping of the same soil the insoluble compounds were taken up 1/10th as readily. These data suggest that the compounds are slowly dissolving and moving onto the soil complex where they are more readily available to plants. No further croppings are possible on this soil, but comparable tests are in progress using pot culture techniques in the greenhouse.

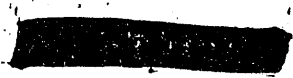
Data obtained by Neubauer tests, as previously reported, showed depression of Sr^{90} uptake by barley when sulfate was added to the soil. A comparable test carried out by pot culture with larger volumes of soil in the greenhouse failed to show a depression due to sulfate treatment. Up to a 25 per cent depression was noted in cultures to which gypsum or $Ca(NO_3)_2$ were added. This effect of calcium was not observed in the previous Neubauer tests. The cause of the disagreement between the two tests is not clear at the present time. It was interesting to note that the concentration of Sr^{90} in plants grown in the larger soil volumes was greater than in plants grown by the Neubauer technique.

Iodine

Sheep on 0.5 μc I^{131} /day for three years and longer seem to have decreased thyroid function when compared to sheep on 0.15 μc /day. Thyroids of pigs on full-feed continue to be more active than those on 70 per cent of full feed.

Cesium

The concentration of Cs^{137} in tissues of frogs from cesium spiked pond was essentially the same as for samples taken one month ago when the frogs had just emerged from hibernation. Muscle contained ten times the concentration that was found in any other tissue. Liver, skin, gut and bone had about the same contamination levels.



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Tungsten

Twenty-four hours after intragastric feeding of W^{185} , as the tungstate, 75 per cent of the dose was recovered in the excreta, 12 per cent remained in the gastrointestinal tract and 1.5% was recovered in various tissues of the female rat; a total of 88 per cent of the administered dose being accounted for. Of the W^{185} excreted, 55 per cent was present in urine, indicating extensive gastrointestinal absorption and rapid elimination. The highest concentration of W^{185} in tissues was present in the kidney, followed, in order of decreasing concentration, by spleen, skeleton, liver and ovaries. The concentration in the ovaries was a factor of 14 lower than that in the kidney.

Plutonium

Over the dose range from 500 mg/kg to 2500 mg/kg there was no significant difference in the effectiveness of $CaNa_3DPTA$ in preventing deposition of plutonium in the bones of rats. There was a significant effect of time of administration. Animals treated at the 2000 mg/kg level one hour after plutonium injection retained 0.71 per cent of the plutonium dose per gram femur, while animals treated $3\frac{1}{2}$ hours after plutonium injection retained 1.5 per cent per gram femur. Control animals receiving no treatment retained 6.2 per cent of injected plutonium per gram femur.

Radioactive Particles

The results of experiments now in progress indicate that inhaled plutonium oxide may be more toxic than when it is injected directly into the lung. Only 30 per cent of 50 mice inhaling plutonium oxide (about 0.9 μc total body burden) are surviving after seven months. The survival in another group of mice having initial body burdens of 0.4 μc is 96 per cent and 100 per cent in two groups given 0.2 μc . No mortality was observed for a period of 13 months after intratracheal injection of 0.8 μc $Pu^{239}O_2$ in mice. The cause of death in the group showing high mortality is not known. The mice show loss of weight, dehydration, lack of adipose tissue, and low white cell counts.

Preparations are almost complete for exposing dogs to plutonium oxide aerosol. In addition to toxicity, deposition, retention, distribution and excretion of plutonium will be studied.

Fallout

The first samples of natural biota were taken from the Rock Lake station for analyses.

Gastrointestinal Radiation Injury

Experiments were performed to determine the effect on intestinal DNA synthesis of partial shielding of the exteriorized intestine during x-irradiation. The shielding had no effect on the reduction in DNA synthesis during the first day

following exposure. Three days following exposure there was a significantly increased synthesis of DNA in the shielded, as compared with unshielded, animals which had received 1200 or 1500 r. These results suggest that the previously demonstrated protective effect of partial shielding of the intestine may be due to a more rapid recovery of the DNA synthetic ability.

Relative Biological Effectiveness

The RBE for betas from S^{35} relative to those from tritium is the same when measured with chlorella growing photosynthetically in a salt substrate as for chlorella, yeast, or bacteria grown in media containing glucose as a source of energy. From this it appears that the presence of 2 per cent glucose does not alter radiation sensitivity of organisms grown in nutrient solution.

Procedures have been worked out for obtaining thin sections of yeast suitable for study with the electron microscope and by autoradiography. Such sectioned material will be used to identify the location of Po^{210} as well as to study other cytological changes associated with radiation sensitivity and damage.

Genetic Effects of Metabolized Isotopes

In an experiment to test for transmutation effects from P^{32} , yeast containing metabolized P^{32} showed a higher mutation rate than did yeast exposed to a comparable concentration of P^{32} in the suspending medium. Since absorbed dose may well differ in the two cases, the rate of loss of viability was compared as a rough evaluation of dose. Viability also dropped more rapidly in cells containing P^{32} , but by only a factor of three or less as compared to cultures with P^{32} outside the cells. Mutation rate differed by a factor of seven suggesting that transmutation is more effective in causing mutation than in causing loss of viability. On the other hand, the differences may not be significant since it was not possible to determine the reliability of the average differences.

Population Dynamics

Histories of 305 Canada goose nests in the Hanford reservation were completed. Fifty-one per cent of the nests were destroyed by predators or deserted as compared with thirty per cent last year. The 142 successful nests produced 713 goslings, a decline of 15 per cent from last year. Ninety-eight per cent of the eggs were fertile which is consistent with previous years. The number of unhatched fertile eggs was one per cent greater than for the past five years.

HA Kornberg
Manager
BIOLOGY OPERATION

HA Kornberg:es

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C. Offsite Visits and HLO Visitors

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
M. Spence	5/2/58	Wash. State Game Dept., Seattle, Wash.	Pick up bass for Game Department.	PA Olson	No	100-F, 146-FR
Umatilla Educators (30)	5/5/58	Umatilla, Oregon	Tour facilities.	RF Foster WJ Clarke	No	100-F, 146-FR 141-M
Mrs. V. Johnson and GR Spencer	5/8/58	Veterinary College, WSC, Pullman, Wash.	Discuss large animal experiments.	WJ Clarke	No	100-F, 141-M
Tri-City Educators	5/14	Tri-City Public Schools	Tour facilities	Clarke, Foster	No	100-F, 141-M, 146-FR
Dr. Paul C. Tompkins	5/12	USNRDL, San Francisco	Tour facilities and discuss fallout	RC Thompson	No	100-F, 108-F, 146-FR, 141-M
Prof. Hans Ussing	5/15	U. of Denmark	Tour facilities and discuss current research	FP Hungate	No	100-F, 108-F, 146-FR, 141-M
J. M. Woodbury	5/16	U. of Utah, Salt Lake	Confer on mutual scientific studies.	JJ Davis	No	100-F, 141-M
R. Daubenmire	5/21	WSC, Pullman, Wash.	Discuss ecology	RC Pendleton WC Hanson	No	108-F, 146-FR 100-F, 146-FR
Mr. Mathews	5/20	AEC Health and Safety, Albuquerque, N.M.	Tour facilities	RC Pendleton Foster, Clarke, Kornberg	No	100-F, 108-F 141-M, 146-FR

VISITS TO OPH R INSTALLATIONS

RF Foster	5/2	Industrial Wastes Committee, C-ympis Rochester, N.Y.	Attend meeting	Vint Bacon	No	-
WJ Bair	5/14-15	Rochester, N.Y.	Attend NAS meeting. Interview applicants.	JN Stannard WC Dewey, M Schulman A Cassarett, R Thomas TR Koszalka	No	-
HA Kornberg	5/12-16	Rochester and New York City	Attend AEC Bio-Med. Directors Mtg. and NAS Meeting.	JN Stannard	Yes	-
JJ Davis	5/26-30/58	Las Vegas, Nevada	Discuss Sr work with UN Scientific Committee.	Dr. Hermann Lisco	-	-
HA Kornberg	5/31	Yakima, Wash.	Consult on ecology program. Address 6th Annual Scientific Session of Wash. Academy of General Practice.	Dr. John Wolfe	Yes	-

[REDACTED]

D. Lectures

a. Papers presented at meetings

Kornberg, H. A., "Radiation Biology at Hanford", 6th Annual Scientific Session of Washington Academy of General Practice, Yakima, Wash. May 31, 1958.

b. Seminars

W. J. Clarke and L. A. George, "Radiotoxicology", a series of three lectures to Veterinary classes at Washington State College, Pullman, May 3, 10, 17, 1958.

R. Borasky, "Electron Microscopy," Royal Society of Richland, May 6.

R. C. Pendleton, 5-7-58, "Absorption of Cs¹³⁷ by Components of an Aquatic Community," Biology seminar.

L. A. Temple, 5-7-58, "Tumorigenesis of Lung Deposited Radioactive Particles," Biology seminar.

D. E. Warner, 5-8-58, "Radiochemistry at HAPO", Columbia High School Chemistry Classes, Richland.

W. L. Dockum, 5-28-58, "Application of Film Techniques in the Localization of Radioelements in Tissue," Biology seminar.

D. H. Willard, 5-28-58, "Metabolism of Inhaled Radioactive Particles," Biology seminar.

E. Publications

a. HW Publications

None

b. Open Literature

Barnes, C.M. and L. K. Bustad, "Thyroidal I¹³¹ Uptake in Fetal Sheep," Endocrinol. 62:684 (1958)...

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[REDACTED]

OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT

May, 1958

ORGANIZATION AND PERSONNEL

There were no changes in personnel during May.

OPERATIONS RESEARCH ACTIVITYEconomic Studies

One meeting of the task force for the evaluation of long range capital expenditure programs was held during May. Appropriate production forecasts associated with these programs were discussed and agreed upon, and the translation of these production statistics into operating statistics and costs for all parts of the production cycle is underway.

Work in connection with the input-output response simulation model was concentrated on the development of adequate statistical tools for testing the applicability and reliability of potential models on the basis of past performance data.

CPD Control Study

Data and information accumulated to date in the study of the CPD control system were summarized in an interim report. Recommendations were made that materials accounting be more closely integrated with process characteristics and process control. This involves changes in material balance account areas, improvement in reliability of source data, changes in methods of numerical analysis, and changes in interpretation of data. Rough draft copies of this report were given to CPD Research and Engineering and to SS Accountability for comment.

A comprehensive study is being made to determine the statistical properties associated with different estimates of the receipts, removals, and inventories in a given material balance area.

Other

Further work on the problem of operator coverage at electrical substations was concerned primarily with the evaluation of the reliability of supervisory control equipment as opposed to operator coverage. It is expected that this study will be completed early in June.

Preliminary discussions were held with interested Irradiation Processing Department personnel concerning possible assistance in the area of spare parts procurement and inventories. It was agreed that a more detailed investigation would be made of the applicability of available techniques and the possibility of utilizing more formal procedures than have been used in the past.

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STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS

2000 Program - Metallurgy

Data from a recent pilot study of certain physical properties of annealed zircaloy as a function of temperature and hydrogen content are being analyzed. The primary concern is with the possibility of expressing the general behavior of the metal in terms of fewer fundamental characteristics.

2000 Program - Reactor

Discussions were continued with personnel of Fuels Design Operation concerning an NPR design experimental program to investigate uranium fuel element swelling as a function of fuel element physical characteristics and reactor operational variables.

2000 Program - Separations

Work continued for the Critical Mass Physics Operation on the computation of confidence interval estimates of parameters which occur in buckling studies.

6000 Program - Biology and Medicine

A discussion was held with members of the Biology Operation concerning methods of analysis and interpretation of data from experiments to determine radio-strontium-calcium relationships in plants and animals. A deterministic system of differential equations was derived, as a model for these relationships, and is currently being solved.

At the request of the Pharmacology Operation an investigation was initiated of possible sampling methods for location of malignant tumors in the lungs of mice which have been experimentally administered a carcinogenic agent.

Mathematical effort continued on the migration model depicting the transfer of radioactive tracer particles from region to region within a biological system.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

Process Control - Fuels Preparation Department

The possibility of obtaining meaningful estimates of the degree of non-wetting in certain lots of fuel elements was discussed with appropriate personnel. The primary question to be resolved was the relative importance of different types of non-wetting.

Pre-irradiation warp data were analyzed to determine the probable success of recovery operations on excessively warped slugs.

Controls established on aluminum components should provide data which will enable the eventual determination of the relative effect of canning variables and component variation on inclusion rejects.

Process Experimentation - Fuels Preparation Department

Experimental data are being analyzed to determine how lead temperatures and silicon content affect the bond test reject rate. Unfortunately these data, although quite voluminous, result from an experiment in which the presence of nuisance variables tends to obscure results to a considerable extent.

General - Fuels Preparation Department

An improved method of absenteeism control suggested by Employee Relations personnel was reviewed.

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

Dimensional data from production tests IP-44-A and IP-45-A were analyzed in order to evaluate vacuum canned and hot pressed I and E slugs with respect to warp and diameter change. The data were extremely sketchy, with most of the data from the control slugs missing. However, comparisons could be made with data from other production tests which ran more or less concurrently.

Thirty-two tubes were irradiated at C reactor under production test 105-634-A in order to compare resistance to rupture of purposely cocked slugs with slugs known to be uncocked when initially charged. Although charged primarily in order to evaluate rupture performance, interesting results followed from an analysis of the warp data. All tubes involved had appreciably less warp than expected for tubes charged under similar conditions. Since all slugs were hand charged to insure against inadvertent cocking, it was suggested that the hand charging might have been responsible for the reduced warp.

A recommendation that a statistic representing the tube filling capacity of an irradiated slug be used in addition to average warp and diameter change in evaluating dimensional stability in irradiated slugs has been accepted and the necessary changes have been incorporated in calculations.

Rupture Analyses - Irradiation Processing Department

In connection with attempts to evaluate current rupture performance of I and E fuel elements, the equations derived for solid slugs expressing the side failure rate as a function of exposure, power and temperature have been used. After adjusting the reactor variables to apply to I and E slugs, the predicted rupture rates at a given exposure were compared with I and E slug performance. In addition, the amount of uncertainty introduced by extrapolation of the prediction equation was examined. It is indicated that by adjusting the results of the run-to-rupture tests involving I and E slugs for differences in power and temperature, possible gross changes in interpretation can result. Further work is being done in this direction.

A frequency distribution of rupture removal times was submitted in order to determine what distribution function would adequately describe the data for purposes of predicting removal times in the future. The exponential distribution provided an adequate fit for the 275 cases submitted.

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Other work in connection with fuel element failures consisted of (1) analyzing results of the production test concerned with evaluating hand seating as opposed to flow seating with respect to rupture resistance, (2) investigating the effect of tube wall thicknesses on failure rates, and (3) determining sample sizes necessary to detect a given improvement in the incidence of hot spots.

General - Chemical Processing Department

Preliminary analyses have been performed on corrosion data from stainless steel produced by different suppliers in a variety of shapes. Of primary interest is the investigation of the effects of carbon content on corrosion. Further work will be done with the intention of ultimately arriving at practical purchase specifications.

Recent data have been analyzed to obtain good estimates of the measurement error associated with determining the plutonium content of the final product. It is anticipated that these estimates will be used to establish acceptance limits for individual parts in contrast to the present method of accepting or rejecting parts for a whole quarter based on a tolerance statement.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

Activities within HLO

A statistical evaluation of key-punch and verifier operators' error rates was completed and a report issued.

Work was continued on a mathematical model for the prediction of soil column breakthrough ratios. A simple model for an experimental laboratory soil column was discussed and the assumptions underlying the model were pointed out. One outcome of the discussion was a more realistic set of assumptions governing the physical system in question. The resulting model, derivable from these assumptions, is expressible as a second order quasi-linear partial differential equation. Current efforts are directed toward the solution of the equation.

Evaluation continued of routine standard and referee data for the General Chemical Analysis Operation. A simple method of estimating the precision of nitrate titrations was derived. Current efforts are directed toward extending the method to fluorimetric uranium estimations.

A statistical analysis of a Chemical Development Operations' experiment to investigate anodic dissolution of platinum in an alkaline medium was completed and the results reported.

A statistical analysis was performed on data from an experiment to determine the effect of heat treatment on the corrosion resistance of zircaloy which was reported on page 39 of the Bettis Technical Review, WATD-VT-6, Reactor Metallurgy. The results of the analysis point out facets of the problem ostensibly not recognized by the experimenters.

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HW-56185

The statistical analysis of Hanford Reservation relative humidity readings for the past decade was completed this month and a report issued.

Data on a recent experiment to study the relative sensitivities of duPont and Eastman personnel monitoring film were analyzed. The resulting detection limit information and the precision of estimation in the 0 to 100 mr. range were reported.

OFFSITE VISITS AND VISITORS

John L. Jaech presented a paper at the AEC Contractor Materials Management Meeting in Washington, D.C., May 19-22.

L. G. Waters visited the Bonneville Power Administration in Portland and the California-Oregon Power Company in Medford, Oregon on May 27-28, to obtain data on and discuss the reliability of supervisory control equipment for electrical substations.

C. A. Bennett (1) attended the Sixth Annual Meeting of the Operations Research Society of America at Boston, Massachusetts on May 15 and 16, (2) visited GE Research Laboratory for consultation on information and communication theory on May 19, (3) visited Princeton University for PhD recruiting on May 20, (4) attended a special meeting of Operations Research & Synthesis Managers in Washington, D.C. on May 21 and 22, (5) discussed various aspects of special programs with AEC personnel in Washington, D.C. on May 22 and 23.



Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

PROGRAMMING OPERATION
MAY 1958

A. FISSIONABLE MATERIALS - 2000 PROGRAM

1. CHEMICAL PROCESSING PROGRAMS

Evaluation was made of proposals submitted by concerns interested in the design, development, and construction of a plant to recover rare gases from separations plant effluents. Of the proposals submitted, some were of considerable merit, and appropriate recommendations were forwarded to the Chemical Processing Department.

The economic study of alternate processes for power reactor fuels was continued with emphasis on the cost of Darex head end and transfer facilities from 221-U Building to the 202-S Redox plant.

2. RADIOLOGICAL AND WASTE DISPOSAL PROGRAMS

To assist the Chemical Processing Department in a program of study on the use of waste fission products as radiation sources, work on preliminary engineering and economic evaluation of recovery and packaging processes was completed. This work provided additional information to be transmitted to the Arthur D. Little Company to aid in an investigation of market potential. It is also closely related to studies on ultimate high level waste disposal since calcination and packaging of highly radioactive material is involved in both studies. Although it was shown that costs for large scale production of mixed fission products (essentially packaged separations plant high level wastes) may be as low as two or three mils per curie the shipping cost would be the same as for smaller scale production. Even so, the delivered costs for routine, large-scale recovery of gross or mixed fission products may be less than one per cent per curie.

Material was prepared for, and a presentation made to the Advisory Committee on Reactor Safeguards (ACRS) in Washington, D.C., on May 9. This information is to be used by the ACRS in preparation for a meeting concerning the Wahluke Slope to be held at Hanford on June 5 and 6.

B. REACTOR DEVELOPMENT - 4000 PROGRAM

1. PLUTONIUM RECYCLE PROGRAM

Plutonium Recycle Analysis

The value of plutonium enrichment relative to the value of U-235 enrichment was compared in a "high" neutron economy reactor and a "low" neutron economy reactor. The results indicate that plutonium recycle is more productive to the "low" neutron economy reactor than to the "high" neutron economy reactor. It appears that the increased absorption cross sections

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of plutonium leads to a greater relative increase in fuel exposure for the lower neutron economy reactor. The market value of plutonium for the various cases was prepared as a function of the incremental processing cost of plutonium bearing uranium fuel elements employed for recycle over non-plutonium bearing fuel elements as employed for U-235 enrichment. When it costs \$10/# uranium extra to process plutonium bearing fuel, the market value of plutonium for the "high" neutron economy reactor appears to be \$6.25/gram of Pu-239 and 241 contained and is \$10.50/gram of Pu-239 and 241 for the "low" neutron economy reactor.

Within $\pm 10\%$ the study values can be represented by simple slope intercept equations regardless of the absolute fuel processing costs, at least up to \$60/# uranium which is the maximum value studied.

Pu value in \$/gram = A - (B) (Pu fuel processing cost - uranium fuel processing cost)

for the high neutron economy reactor:

$$A = \$11.50 \text{ and } B = .625$$

for the low neutron economy reactor:

$$A = \$15.50 \text{ and } B = .497$$

If the losses during processing are less than 5 per cent the separations, core fabricating, and jacketing costs can be added directly to establish the fuel processing cost.

It should be kept in mind that the "high" neutron economy reactor has the lowest fuel costs for comparable fuel processing costs. For example, for self-sustaining plutonium recycle with a total fuel element fabricating and jacketing cost of \$25/# uranium, the "high" neutron economy reactor shows a fuel cost of ~ 2 mills/kwh as compared to ~ 4 mills/kwh for the "low" neutron economy reactor.

The following table lists the nuclear characteristics (as operated using U-235 enrichment) of the "high" and "low" neutron economy reactors used in this analysis:

<u>Arbitrary Neutron Economy</u>	<u>"Low"</u>	<u>"High"</u>
Average Moderator Temperature	400 C	200 C
k_{∞} / ϵ	1.15	1.10
p	.75	.92
f	.84	.95
Specific Power - mw/ton	10.0	10.0

It should be understood that these reactors do not represent specific designs and furthermore, that somewhat idealized highly thermalized neutron spectrums are employed to simplify fuel exposure calculations.

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The latter assumption appears satisfactory for purposes of initially surveying the value of plutonium and work is planned to ascertain the limitations of these methods. It should also be noted that high neutron economy reactors generally cost more to build than low neutron economy reactors and no correction is made in these analyses for such differences as would be necessary if the total cost of electrical power from a reactor were being determined.

A substantial portion of the greater fuel cost for the low neutron economy reactor is due to the higher average uranium-235 enrichment which is billed at 12%/year of the salvage value as a non-depreciating asset and 15%/year for the depreciating components. Many analyses are currently made with the "use" charge of 4%/year for the uranium inventory as provided by the Atomic Energy Act of 1954. Under these circumstances there is less spread between the fuel costs for "poor" and "high" neutron economy reactors but it also follows that plutonium would also have a lower value under these circumstances since U-235 enrichment costs less at the lower interest rate.

One other preliminary conclusion from this study is that the operator of a "high" neutron economy reactor may find it most profitable to sell plutonium to operators of low neutron economy reactors who would also benefit from such an arrangement. Self-sustaining plutonium recycle using natural uranium fuel may nevertheless be selected by reactor operators who wish to be as independent as possible of outside sources of fissile material supply. It may also prove possible to exploit the effects of neutron economy on plutonium value by using reactors with multi-region cores with different neutron economy in each region.

The second-order continued-fraction approximation to the function $\tan^{-1} k/k$ proposed by Carlson and Goldstein (IA-1943, p. 34) leads to a form of diffusion theory possessing several advantages from the numerical standpoint. This form is being analyzed by the methods outlined in the paper "Generalized Diffusion Theory Methods for Reactor Survey Applications" submitted for the Geneva Conference. Results are as yet incomplete.

In order to relate the spectral index r and epithermal coefficient s to specific fuel and lattice configurations, an IBM 650 computation of the quantity

$$\Lambda = - \frac{\ln p(r, s)}{\sum_k N_k (I_{ak} - v_k \epsilon I_{fk})} = \frac{(\phi v)_{\text{fuel}}}{(\xi \sum_s v \phi)_{\text{mod}}}$$

has been coded and debugged. Here I_{ak} and I_{fk} are effective resonance integrals obtained from the s -factors for absorption and fission in isotope k respectively, and other symbols have their usual meanings. The quantity Λ will supply a needed frame of reference for the survey studies of plutonium behavior and value in single-pass fuel cycles, and for the evaluation of the use of high-exposure material from other reactors in the PRTR.

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HW-56185

Disposition within the core of spike fuel elements for the H₂O-reflected PRTR has been studied with the 3-group VALPROD code by Reactor Engineering Development and Programming personnel. Initial results indicate an extremely sensitive dependence of power distribution on position of enrichment, as would be expected in a high-leakage reactor. Results indicate that approximately 35 plutonium elements (averaging 25% burnup for the reactor load) will be required with this reflector. Difficulties with the 650 computer have delayed progress of this study somewhat, so the optimum disposition of the fuel has not been fully determined as yet.

An examination of the relative advantages of H₂O and D₂O as reflector materials is being undertaken, with a summary report in preparation at this time. An unconditional recommendation for either alternative during the first two years of operation cannot be made on technical grounds, although the D₂O reflector is regarded as essential for later phases of the program, and highly desirable for early phases of the program.

Detailed charge-discharge schedules are being prepared for the first two years of PRTR operation. Provisions are made in the schedules to meet the needs of both the physics and fuel testing functions of the reactor. The schedules call for one fuel element to be replaced at each shutdown, alternating plutonium and uranium fuel elements at successive shutdowns. Elements may be recharged after inspection until a steady state in the reactor is reached. Thereafter, new elements will replace irradiated ones of the same type as they reach goal exposure. Plutonium fuel elements may be taken to about 50 per cent reduction of heat generation rate and uranium fuel elements to about 5000 MWD/T. These schedules are tentative and are being circulated for comment.

PRTR Fuel Processing

A study was begun to evaluate alternate facilities which are available or which can be provided for metallurgical inspection and sampling of fuel elements or sections of elements. This study includes the survey of possible off-site facilities which may be suitable.

2. GAS COOLED REACTOR PROGRAM

Proposals to the AEC for gas cooled reactor research and development work were prepared in conjunction with others. It is proposed that Materials Development Operation undertake a study of gas-graphite interactions under reactor simulated conditions. In- and ex-reactor loops would be constructed in which to perform some of the investigations. Also proposed is a group of PCTR measurements applicable to gas cooled reactor types to be performed by the Nuclear Physics Research Operation. Studies are proposed to continue into FY-1963 with a level of effort of about ten or eleven men dropping to about six in 1963.

C. OTHER ACTIVITIESSINE Program

The lectures, plant trips, and problem assignment schedules for the "Summer Institute on Nuclear Energy - Chemical Processing" program have been completed. The lectures and problem assignments portion of the program have been substantially expanded over last year's effort. Attendance is expected to comprise 10 college professors.

Science Colloquia

Necessary arrangements were made for the first HLO Science Colloquium, for which the speaker was Han Ussing, Danish Zoophysicologist. The Colloquium was eminently successful.

Arrangements were also made concerning a second colloquium to be held on June 19, and which will feature Major William E. Mayer, U.S. Army Psychiatrist.



Manager - Programming Operation

LH McEwen:dl

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VISITS TO HAPO

Name	Dates of Visit	Company Represented and Address	Reason for Visit	HAPO	Access to Restricted Data	Bldgs. & Areas Visited
				Personnel Contacted		

None

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
E. A. Eschbach J. R. Triplett	5/5/58 5/6/58	General Electric Co. (APED) San Jose, California Vallecitos Atomic Lab. Pleasanton, California	Discussions on plutonium recycle physics calculations.	R.B. Richards W.K. Woods	No
L. H. McEwen	5/15/58	Washington State College Pullman, Washington	To give a talk on "Influence of Research and Development on Business".	Dudley Brown	No
E. T. Merrill	5/14-17	Idaho Chemical Processing Company, Idaho Falls, Idaho	Consultations on off-gas processing and hear discussions presented by the Air Reduction Company.	F.M. Warzell J. Stevens	No
J. W. Healy	5/8-9	Division of International Affairs, AEC Washington, D.C.	Write report on Atoms for Peace mission to New Zealand.	R.L. Kirk A. S. Rupp C. Zabel R.C. Anderson	Yes
	5/9/58	Advisory Committee on Reactor Safeguards Washington, D.C.	Discuss Wahluke Slope.	C.R. McCullough C.L. Beck	Yes

VISITS TO OTHER INSTALLATIONS (CONT.)

<u>Name</u>	<u>Dates of Visit</u>	<u>Company Visited & Address</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
J. W. Healy	5/12-13	Rochester, New York	Bio-Med Directors meeting.	R.G. Thomas Dr. Hodges	
	5/14-15	Inhalation Hazards Sub-Committee (NAS) Rochester, New York	Attended NAS meeting.		
	5/16-17	Ad Hoc Committee (AIBS) Washington, D. C.	Ad Hoc Committee on whole body counters.		

RADIATION PROTECTION OPERATION
MONTHLY REPORT-MAY, 1958

A. ORGANIZATION AND PERSONNEL

Janis G. Campbell transferred into the Operation on May 12, 1958.

<u>Force Summary</u>	<u>4-30-58</u>	<u>5-31-58</u>
Exempt	40	40
Nonexempt	<u>120</u>	<u>121</u>
Total	160	161

B. ACTIVITIES

One case of plutonium deposition was confirmed as a result of bioassay sampling following a puncture wound on a process operator. Excision of a small skin area showed about 0.01 μc Pu in the excised flesh and about 0.01 μc still remaining in the finger. The remaining plutonium in the finger was apparently diffused and made further excision inadvisable.

Five radiation incidents which exceeded the permissible limits occurred. Three were localized overexposures to the skin of which the maximum estimated dose was 9.3 rads. One incident occurred during rupture removal work on the rear face of the 105-DR reactor during which one employee received 590 mrad including 320 mr in a seven-day period. In the remaining incident, six employees received planned emergency exposures exceeding the weekly limit to the eyes during boroscope operations at the 105-H reactor. The maximum estimated dose was less than 600 mr.

The new bioassay sample boxes were placed in service and the old boxes were excessed to salvage. Programming bioassay records was essentially completed.

The average emission rate of I^{131} from separations stacks was below the weekly working limit. The average deposition of I^{131} on vegetation outside the plant perimeter was below the detection limit of 1.5×10^{-6} $\mu\text{c}/\text{gram}$. The deposition of nuclear bomb debris on environs and vegetation was substantially reduced from April. Plutonium contamination released during a fire at the Purex burial ground was confined to the burial ground radiation zone. The maximum ground contamination was about 10,000 d/m plutonium.

Concentrations of radioactive materials in the Columbia River water at 100-F area and Pasco reflected the increased river flow rate and were normal for this time of the year.

Detailed design and drafting was initiated on the feed system for the film-badge processing machine. Necessary action for capitalizing the existing prototype equipment was completed. The studies of Eastman Type II Personal Monitoring Film were extended to include the determination of detection limits and to allow comparisons with currently used du Pont film.

Equipment was provided to industrial medical personnel for possible use in monitoring contaminated wounds. The instrument consists of a modified BF-51 brain probe combined with a GM meter. Evaluation of the continuous impactor air sampler continued. The unit was operated in parallel with other air monitoring equipment to

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evaluate other operating characteristics and determine monitoring efficiency of current contaminants. Materials were received for adaptation of the air sampling unit for continuous beta-gamma monitoring in addition to monitoring for air-borne alpha contaminants.

The national civil defense exercise, Operation Alert 1958, occurred on May 6 and 7. According to plan the Technical Defense Organization evaluated the effects on Hanford of the simulated nuclear weapon attack on the Pacific Northwest. The Hanford district was neither hit directly nor significantly affected by fallout. Plans were laid for substantial revision of the Plotting Room facilities and techniques to permit rapid evaluation of radiological disasters.

Consultation was provided to the Task Force which is preparing a report on the effects of public navigation on the Columbia River through the Hanford project.

Radiation Monitoring and Calibrations services were provided for customers without incident.

C. EMPLOYEE RELATIONS

Follow-up investigations on the Attitude Survey were conducted by Employee Relations in the Calibrations and the Exposure Evaluation and Records Operations.

Negotiations with the regional monitors did not progress significantly. The HAMTC negotiating committee informally requested the Federal Mediation and Conciliation Service to review the Company's offer and the HAMTC reaction. The outcome of this informal action is not known.

The program of the level 3 manager informally meeting with employees in the bioassay laboratory continued. This program was started early in the year to improve the working atmosphere in the laboratory.

There were two medical treatment injuries for a frequency of 0.77. No security violations occurred during the month.

Three suggestions were submitted by Radiation Protection Operation personnel. Three suggestions were received for evaluation. Three Radiation Protection Operation suggestions received awards of \$25.00 and represented an estimated tangible savings of \$130.00.

D. SIGNIFICANT REPORT

HW-55550--"Waste Disposal Monitoring Activities Summary, March 1958" by R. M. Bernard

HW-55858--"Waste Disposal Monitoring Activities Summary, April 1958" by R. M. Bernard

HW-55925--"Regional Monitoring Activities, April 1958" by Regional Monitoring Personnel

HW-56205--"Monthly Report-May 1958, Radiation Monitoring Operation" by A. J. Stevens.

Glossary - Radiological Waste Disposal, Terms and Expressions was prepared for the Joint Committee on Atomic Energy Public Hearings on Radioactive Waste Disposal.

CONFIDENTIAL

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Buildings Data	Areas and Buildings
R.K. Betts F.G. Boyle C.D. Williams	5/19/58	ANP, Cincinnati, Ohio	Relative to the merits and faults of various glove box and hood designs	HJ Paas	No	3706:300
J.L. Agee	5/20/58	Oregon State Board of Health, Portland, Ore.	River sampling and analysis	BV Andersen MW McConiga RC Dozer	No	329:300
E.R. Mathews	5/21/58	Health & Safety Div. AEC, Albuquerque, N.M.	Tour of Regional Monitoring	BV Andersen	No	329:300
D. Guyer	5/21/58	AEC, Albuquerque, N.M.	Discuss radiation monitoring procedures	AJ Stevens RW Meisinger	No	3746:300 3745:300
D.G. Egan	5/22/58	Convaair, Fort Worth, Texas	Discuss radiation monitoring systems, data processing, and badge & badge processing	AR Keene RL Junkins	Yes	3746:300 3706:300
F.G. Tabb	5/28/58	ANP, Idaho Falls, Idaho	Discuss radiation protection procedures and organization	AR Keene HA Meloeny RL Junkins AJ Stevens	No	3746:300 3705:300 3706:300 3746:300

VISITS TO OTHER INSTALLATIONS

None

REGIONAL MONITORING - RESULTS (April 20 - May 25)

<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	1.0	% MPC _{GI}	--
Separations Areas	Total Beta	2.0×10^{-7}	$\mu\text{c}/\text{cc}$	-3
Pasco	Isotopic	0.3	% MPC _{GI}	--
Kennewick	Isotopic	0.6	% MPC _{GI}	--
Richland	Total Beta	3.0×10^{-8}	$\mu\text{c}/\text{cc}$	--
<u>Columbia River Water</u>				
Above 100-B Area	Total Beta	$< 3.0 \times 10^{-8}$	$\mu\text{c}/\text{cc}$	--
100-F Area	Isotopic	5.2	% MPC _{GI}	-2
Hanford Ferry	Total Beta	2.7×10^{-5}	$\mu\text{c}/\text{cc}$	-2
Pasco	Isotopic	1.4	% MPC _{GI}	--
McNary Dam	Total Beta	9.7×10^{-7}	$\mu\text{c}/\text{cc}$	--
Vancouver, Washington	Total Beta	2.6×10^{-7}	$\mu\text{c}/\text{cc}$	--
<u>Waste Water</u>				
Outlying Test Wells	Total Beta	$< 2.0 \times 10^{-7}$ (max)	$\mu\text{c}/\text{cc}$	--
Basins to River	Total Beta	32,700	curies/day	--
<u>Atmosphere</u>				
Gross Dose Rate -				
Separations Areas	Beta-gamma	0.9	mrad/day	--
Residential Areas	Beta-gamma	1.8	mrad/day	--
I-131 Separations Areas	I-131	6.2×10^{-13}	$\mu\text{c}/\text{cc}$	--
Separations Stacks	I-131	7.2	curies/week	--
Active Particles - Project	--	5.1	ptle/100 m ³	--
Active Particles - Environs	--	7.9	ptle/100 m ³	--
<u>Vegetation</u>				
Separations	I-131	4.3×10^{-6}	$\mu\text{c}/\text{gm}$	-4
Residential	I-131	$< 1.5 \times 10^{-6}$	$\mu\text{c}/\text{gm}$	-4
Eastern Washington and Oregon	I-131	$< 1.5 \times 10^{-6}$	$\mu\text{c}/\text{gm}$	-10
Fission Products less I-131 - Wash. and Ore.	Beta	6.8×10^{-5}	$\mu\text{c}/\text{gm}$	-4

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

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

<u>RADIATION MONITORING</u>	<u>Hanford Laboratories</u>	<u>Minor & Major Construction</u>	<u>Others</u>	<u>May</u>	<u>1958 to Date</u>
Special Work Permits	1,463	105	421	1,989	9,872
Routine and Special Surveys	1,488	110	287	1,885	8,074
Air Samples	2,426	1	185	2,612	11,965
Skin Contaminations	9	1	0	10	31
*Class II Radiation Incidents	0	0	0	0	0
**Class II Radiation Incidents	0	0	5	5	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>
May	38,580	35	2	2
1958 to Date	232,122	193	26	16

Beta-Gamma Film Badges

	<u>Badges Processed</u>	<u>Readings 100-300 mrad</u>	<u>Readings 300-500 mrad</u>	<u>Readings Over 500 mrad</u>	<u>Lost Readings</u>	<u>Average Dose Per Film Packet mrad(ov)</u>	<u>mr(s)</u>
May	21,156	820	16	3	33	2.80	9.92
1958 to Date	108,952	4,161	120	33	217	3.17	9.62

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>
May	3,766	38	4	1
1958 to Date	19,952	243	69	7

Fast Neutron Film Badges

	<u>Badges Processed</u>	<u>Readings Above 50 mrem</u>	<u>Lost Readings</u>
May	1,047	3	1
1958 to Date	5,875	11	5

Bioassay

	<u>May</u>	<u>1958 to Date</u>
Plutonium: Samples Assayed	1,330	6,618
Results above 2.2×10^{-8} $\mu\text{c/sample}$	54	212
Fission Product: Samples Assayed	1,367	6,866
Results above 3.1×10^{-5} $\mu\text{c FP/sample}$	5	16
Uranium: Samples Assayed	316	1,611
Confirmed Plutonium Deposition Cases	1	11 *

*HLO Radiation Monitoring Customers

**Other Plant Components

*Bringing all-time HAPO total to 223

<u>Sample Description</u>	<u>Following Exposure</u> Units of 10^{-9} μ c U/cc			<u>Following Period of No Exposure</u> Units of 10^{-9} μ c U/cc		
	<u>Maximum</u>	<u>Average</u>	<u>Number</u>	<u>Maximum</u>	<u>Average</u>	<u>Number</u>
			<u>Samples</u>			<u>Samples</u>
Fuels Preparation	12.1	4.9	25	8.3	4.3	21
Hanford Laboratories	61.2	12.9	24	15.0	4.4	18
Chemical Processing	35.4	5.6	85	19.5	4.4	63
Chemical Processing*	24.6	7.9	24	11.2	3.5	21
Special Incidents	0	0	0	0	0	0
Random	4.6	1.6	35	0	0	0

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

<u>Thyroid Checks</u>	<u>May</u>	<u>1958 to Date</u>
Checks Taken	6	17
Checks Indicating >0.01 μ c	0	0
<u>Hand Checks</u>		
Checks Taken - Alpha	47,492	235,036
- Beta-Gamma	38,678	192,845

CALIBRATIONS

<u>Portable Instruments</u>	<u>Number of Units Calibrated</u>	
	<u>May</u>	<u>1958 to Date</u>
CP Meter	1,004	4,848
Juno	332	1,620
GM	1,367	6,611
Other	223	1,111
Total	2,926	14,190
<u>Personnel Meters</u>		
Badge Film	936	5,704
Pencils	4,848	21,603
Other	404	1,658
Total	6,188	28,965
Miscellaneous Special Services	785	4,980
Total Number of Calibrations	9,899	48,135

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

ARK:kc

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - MAY, 1958

GENERAL

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 4.92 per cent which is considered high.

The absenteeism rate was 3.24 per cent, which is about average experience.

There was one security violation charged to the Operation.

TECHNICAL SHOPS OPERATION

Total productive time for the month was 13,030 hours. The total shop work backlog is 19,448 hours of which 75% is required in the current month, with the remainder distributed over a three month period. Overtime worked during the month was 4.3% (748 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
Fuels Preparation Department	2873	22.0
Irradiation Processing Department	960	7.4
Chemical Processing Department	870	6.6
Hanford Laboratories Operation	7957	61.1
Construction Engineering Operation	242	1.9
Miscellaneous	128	1.0

The total backlog of work decreased from the previous month and now stands at one and one-half crew months. Optimum backlog for this shop is considered to be approximately one crew month. Requests for emergency service increased sharply resulting in a higher than normal overtime rate.

RADIOGRAPHIC TESTING OPERATION

Activity for the Radiographic Testing Operation continued at a high level for the past month. New gains continued to be made in the number of tests performed which now are approaching 6000 per month. A total of 5849 tests were made, of which 1486 were radiographic exposures (including X-ray and gamma) and 4363 were supplementary tests. The supplementary test work included penetrant, magnetic particle, ultrasonic (thickness measurements and flaw detection), eddy current, boroscope, dimensional measurements (micrometric and air gage), and densitometry. While the feet of material examined was only approximately one-half of that for last month - 6162 feet, the number of pieces examined was up three times that of last month - 3135 pieces. Work was done for 14 different organizational components representing most of the operating departments and service organizations. A total of 16 reports were issued detailing test findings with conclusions and recommended action. Radiographic Testing Operation was consulted on 32 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in part II.

Considerable planning activity engaged Radiographic Testing Operation in connection with several projects.

Radiographic liaison will be provided by Radiographic Testing Operation for Hanford Laboratory Operation on the construction phase of the PRTR containment vessel. Work will be integrated with the contractor on procedures, techniques, and records.

For the Plutonium Fabrication Laboratory designs were made for a radiographic testing room that will accommodate the wide variety of work anticipated for this facility.

Preliminary scoping is being done on testing facilities in the planned 306 building expansion. This work consists mainly of updating previous criteria established for such a facility.

Work is well along on the design for the mobile laboratory for testing field work. A complete body with a special interior arrangement is being designed to fit on a standard 4 x 4 chassis.

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. Construction Engineering Operation	99	81-1/2	57	S.S. welders coupons, S.S. recir. gas loop, Project AEC-160. Gamma graph Test drill hole. Test reactor nozzle & cap assembly.
B. Fuel Preparation Department	16	20	2	Weld repair on steam autoclave pressure vessel.
C. Hanford Laboratories Operation	5547	5996	3073	Welds on: Al, Ti, 303, 304, 316 S.S. Swaged T.J. radioactive graphite rods, cast Pu-al blocks, rolled Pu-al fuel plates, PRTR venturi assem., Zr-BDF ribbed, PRTR tubing, etc. Density scan on fuel plates.
D. Irradiation Processing Department	187	64-1/2	3	C.S. He storage tanks. #2 stage brass impeller, pump 181 KW. Fatigue Test for crack in 12 pump shaft.
	<u>5849</u>	<u>6162</u>	<u>3135</u>	

FACILITIES ENGINEERING OPERATIONProjects

Following is a summary of project activity:

Number of Authorized Projects at End of Month.....	21
Number of Projects Authorized During Month.....	6*
Number of Projects Completed During Month.....	0
Project Proposals Submitted to the AEC During the Month.....	6**
Number of Projects Awaiting AEC Approval.....	4***
Total Authorized Project Funds.....	\$5,216,500
Total Estimated Cost of Authorized Projects.....	\$9,456,300
Project Proposals in Preparation.....	4****
Service Engineering During the Month.....	\$ 4,500

* CG-731, Critical Mass Laboratory
 CG-779, Rev.1, Additions to the Separations Development Facilities,
 321 Building
 CGH-796, Facilities for Isotope Study on Animals
 CGH-801, X-ray Diffraction Cell, 327 Building
 CGH-803, Alterations - Building 231-Z
 CGH-804, Ceramic Fuels Press Enclosure - 325 Building

** CG-779, Rev.1 Additions to the Separations Development Facilities,
 321 Building
 CGH-801, X-ray Diffraction Cell, 327 Building
 CGH-803, Alterations - Building 231-Z
 CGH-804, Ceramic Fuels Press Enclosure - 325 Building
 CGH-805, High Temperature Tensile Testing Cell - 327 Building
 IR-240, Removal of Obsolete Melt Plant Equipment - 314 Building

*** CG-760, Expansion of 3745-B Facility
 CGH-790, High Level Radioactive Material Receiving and Storage Addition,
 327 Building
 CGH-805, High Temperature Tensile Testing Cell - 327 Building
 IR-240, Removal of Obsolete Melt Plant Equipment - 314 Building

**** Increase Electrical Capacity - 328 Building
 Crane Improvements - 327 Building
 Biology Facility Addition - 108-F Building
 300 Area Waste Disposal Facilities Expansion

Project Activity

The attached report summarizes project activity and status.

Both the attached detailed reports present activity and status of projects.

Engineering ServicesTitleStatus

Modification of Elevator, 327 Building.

Work in progress.

Alterations to Room 313, 3706 Building.

Work in progress. Scheduled for completion in June.

Acid System & Acid Dispenser Installation, Bioassay Laboratory 747 Building.

Field work has started and safety shower installation is complete.

Install Intercom System - 326 Building.

System installed and operating. Work completed.

Resistance Seam Welder - 325 Building.

Work proceeding.

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

Work scheduled for completion in early June.

Move Army Hutment and Install Near 100-F Area.

A site plan and scope have been prepared. A Work Order for \$7,790 has been written. The building will be located between the 108-F Building and the boat house, adjacent to train shed.

Electrical Addition - Basement 325 Building.

Job complete except for installation of circuit breaker.

Install Hot Water Heater - 327 Building.

Heater has been shipped and Work Order is being issued for installation.

Clean Up West End of 314 Building.

Work is progressing.

Service and Outlets - 141-H Building.

Work complete. Overhead service connected by R&U.

Greenhouse - Roof of 108-F Building.

Availability of steam and electrical service in 108-F Building has been verified. Estimates are being prepared.

Development Plan for Biology Operation.

Study is approximately 90% complete.

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

A supplement to ER-90099 has been issued for design and fabrication funds.

Fabricate and Install XY Manipulator in Metallographic Cell.

In progress.

<u>Title</u>	<u>Status</u>
Pig farrowing House - 100-F Animal Farm.	Approximately 25% complete.
Lawn Sprinkling System for Aquatic Biology Building - 100-F Area.	Design work is nearing completion.
Extend Annunciator System - 1706-KE Building.	Installation drawings are complete and will be submitted for approval.
Canopy and Lean-to - 141-H Building.	Approximately 25% complete.
Heating and Ventilating Study - 325 Building.	Study approximately 75% complete.
Inspect and make recommendations for Safe Operability of Truck, HO 68-B-8195.	Work in progress.
Air Exhaust from Instrument Cabinets, Room 4-A, 326 Building.	Job approximately 50% complete.
Investigate Ventilation System of the 321 Building.	Investigation complete and recommendations made.
Specifications for Storm Windows and Shade Screens - 328 Building.	Complete.
Provide Operating and Safety Improvements at 340 Building Tank Pit.	Requested safety improvements have been received and methods of performance are being studied.
Heating & Cooling Study - 3760 Building.	Study is approximately 90% complete.

Drafting Services

Major designs completed or in progress:

<u>Title</u>	<u>Status</u>
Cesium Recovery.	The Cesium Recovery job is scheduled for completion July 15, 1958.
Scope plans for discharge of HAPO 3" x 3" facility in the ETR reactor.	100% complete.
Induced Radiation Test Facility for 347 stainless steel.	Work in progress.
Non-Production Fuels Processing Facility - Mechanical Process cell.	Detail design scheduled to start on the prototype 1-15-59.
Three-ton liquid waste handling cask, (4 liter capacity).	Work in progress.

<u>Title</u>	<u>Status</u>
Injection Casting for Al-Pu mixture.	Drawing 90% complete.
Project CG-660 - Remotize Metallograph.	This phase being prepared on work sheets. Eighteen work sheets have been completed to date. Design is 65% complete.

Maintenance and Building Engineering Services

3707-C Building	Work remaining includes heating and ventilating system, partitioning, and revision of water heater system.
3760 Building	Library stacks are nearly complete. Partitioning and lighting work in altered space is underway. Modifications have been made to exterior drive on north side.
325 Building	Improvements have been made to exterior walks and drives.
326 Building	Improvements have been made to exterior walks and drives. Work is progressing on an enclosure around the building entrance at southwest corner.
147-F Pump House	Study work is underway to improve this structure.

General

Storm windows and shade screens have been recommended for 325, 327, 328, and 3760 Building. Also, shade screens have been recommended for 3702 and 3707-C Buildings.

"As-Built" program is underway - seven structures are complete.

The initial office equipment physical survey is complete.

Miscellaneous

Work on engineering survey of code vessels is progressing at a reduced rate because of work load. All field data has been compiled. Engineering work remains prior to summary report.

Twelve vessels were inspected by third party inspector during the month.

The study on liquid helium requirements for HLO has been revised to include liquid hydrogen.

A more proficient method of determining and controlling expenditures on project purchased equipment has been initiated.

Eight requisitions totaling approximately \$10,000 were processed during the month.

Approximately 16,000 square feet of prints were produced during the month.

About 100 drawings were produced in the Drafting Operation. This includes sketches, work sheets, graphic illustrations, and formal drawings.

TECHNICAL INFORMATION OPERATION

Certain functions in the Technical Information Operation were realigned this month. The library's reference and cataloging functions were combined with Reports Reference and Publication to create a centralized reference-cataloging group. The library's clerical staff and branch libraries were also combined into a single group. The changes are intended to increase the efficiency of the Operation and provide a better and more unified technical information service.

A program has been completed which will permit us to learn the number of documents charged to any component on a given date. The program involves keypunching the component suffix in the name cards behind which the document charges are filed. It is expected that the expense of obtaining the information (by taking the charge-out cards to Data Processing and having them listed) will be borne by the requesting component.

Revisions to "Confidentially Yours", the Files manual on the preparation and care of classified documents, were announced by means of a "For Your Technical Information" release. As a result, 296 requests for revisions were received, and 76 requests for completed manuals.

AEC has required that classified Research and Development reports be circulated from the Classified Files in accordance with a system which translates the access categories in use at HAPO (100-U, 200-U, 100-L, 200-L and combinations of these) into Standard Distribution List categories, ie certain categories in the Standard Distribution List will not be available to persons holding a 100-U, 200-L clearance, for example. Some inconsistencies in the list of exclusions have been called to Security's attention, and a meeting to resolve the inconsistencies is planned soon.

Plans have been completed for the review and restamping of all documents which are marked Atomic Weapon Data. These changes are necessary to conform to AEC Manual Chapter 2108, which makes a clear distinction between Atomic Weapon Data reports and Atomic Weapon Data documents. According to the chapter, AWD reports will be categorized as Sigma 1, Sigma 2 or Sigma 3, depending on the degree of sensitivity. A special category for production and stock pile information is also provided. AWD reports will be distributed only to those persons who have been authorized, and access lists of HAPO persons eligible to see AWD reports are now being used in the Classified Files. The program for reviewing all documents marked Atomic Weapon Data will consist of (1) deciding on the proper category for AWD reports, and stamping them accordingly, and (2) removing the AWD marking from AWD documents. The program will not be started until the manual chapter is officially transmitted to General Electric. As a result of the program, (1) the number of AWD items to be inventoried annually will be reduced by about 75%, and (2) incoming documents will no longer be reviewed and marked AWD at HAPO. Instead, the marking of the originating installation will determine local handling.

HAPO has been asked to contribute to the preparation of topics on Hanford financial data for the Proposed Hanford Classification Guide. R&J's Contract Accounting Operation is integrating the preliminary phase of this work done by the financial components and the HOO Finance Division. The recommendations of the HOO Finance Division will be reviewed by the HOO Classification Committee prior to forwarding to Washington for incorporation in the proposed Guide.

A major declassification review program has been under way for approximately three months now. About 4,200 early Hanford documents have been reviewed. Between 15 and 20 per cent were declassified or downgraded locally, and another 15-20 per cent are being sent to the Declassification Branch for review.

The literature created during the past five years is being surveyed to collect and organize information on the metallurgy of uranium alloys. The results of this survey will be used in preparing the uranium alloys chapter of the Fuel Element Design Handbook. Abstracts of this literature are being typed on ASM-SLA punch cards, and punching will be in accordance with ASM-SLA metallurgical literature classifications. Only a few new headings will have to be added to accommodate such subjects as burnup, fuel elements, nuclear cross sections, and pyrophoricity. Approximately nine thousand documents and thirty journal articles will be reviewed for possible inclusion in this collection.

Work Volume Statistics

April

May

Document Distribution and Files

Documents routed and discharged (copies)	18,376	13,828
Documents issued (copies)	9,139	6,586
Documents sent offsite (copies)	8,974	2,975
Document reserves filled (copies)	1,110	772

Document Accountability

Holders of classified documents whose files were inventoried	563	327
Documents inventoried in Files (copies)	36,433	54,362
Documents destroyed or retired (copies)	10,222	7,241
Documents revised (copies)	1,034	1,044
Documents pulled and documents filed (copies)	11,615	8,779
Documents reclassified	1,174	403
Accountable copies of SECRET and DOCUMENTED CONFIDENTIAL documents on site	211,000	204,107

Reference and Publication

Books cataloged (new titles)	74	105
Books added to the collection (volumes)	251	321
Literature searches by professional staff	29	122
Reports abstracted (titles)	192	196
Formal reports prepared (titles)	8	12
Reports released to CAP (titles)	29	21

Library Acquisitions and Circulation

Books ordered (volumes)	297	177
Periodicals ordered	144	424
Books circulated (volumes)	2,737	2,384
Periodicals circulated (issues)	4,934	4,794

	<u>April</u>	<u>May</u>
<u>Classification and Declassification</u>		
Documents, including drawings and photographs, reviewed for downgrading or declassification.	91	29
Documents submitted to Declassification Branch, Oak Ridge.	182	87
Documents and papers (intended for oral presentation or publication) reviewed for appropriate classification.	50	23

LABORATORIES ADMINISTRATION

Timely revisions were issued to five Organization and Policy Guides. One new Organization Guide was issued.

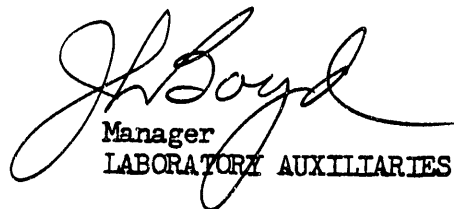
A draft of a manual, Authorization and Performance of Work, was completed and submitted for review. This manual brings together fourteen Organization and Policy Guides related to subject.

A renewal of Consultant Agreement, CA-195 with Professor G. W. Watt was approved for signing by General Manager - HAPO.

Contract DDR-39 for the development and fabrication of a bellows assembly by Solar Aircraft Company was considered for approval.

Four Assistance to Hanford assignments have been considered. Letter of authorization, ATH-HLO-1-58-D, was issued to Atomic Power Equipment Department for a study of Fuel Element Failure Detection.

Four special requests for automotive and heavy equipment were prepared. Three were approved and submitted to Transportation and Maintenance for a motor scooter, station wagon, and a boat. Radiation Protection Operation is cooperating in the examination and reporting of radioactive contamination of vehicles assigned to Hanford Laboratories Operation.


Manager
LABORATORY AUXILIARIES

JL Boyd:rjcw

UNCLASSIFIED

H-11

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT									
General Plant Projects - FY 1958 - AEC-2-23-58-L		EST. TOTAL PROJECT COST		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT		STARTING DATE		DIRECTIVE COMP. DATE	
PROJECT NUMBER	TITLE	AMOUNT	DATE	DESIGN SCHED.	ACTUAL	DESIGN SCHED.	ACTUAL	DESIGN CONST.	DATE	DESIGN CONST.	ESTIMATED COMP. DATE
CG-760	Expansion of the 3745-B Facility	\$ 193,000	None to date	0	0	0	0	1*	None	None	6*
REMARKS:		Physics & Instruments Research & Develop. R. C. Ingersoll The project proposal was resubmitted to the AEC-HOO March 13, 1958. This project is still under study by AEC-HOO.									
*Months after authorization.											
CA-765	Additions to the 314 Building	\$ 46,000	\$ 46,000	100	100	5	5	10-14-57	11-15-58	3-7-58**	
REMARKS:		Reactor & Fuels Research & Development A. W. Herwin The Contractor started work on May 14, 1958. During the course of the excavation several concrete slabs, which were not shown on the contract drawings, were uncovered. It has been decided that instead of removing one of the large slabs, asphalt tile will be laid throughout the building addition. The total cost of extras to date is \$792. The contractor has poured the footings for the building addition. Excavation work for the water line which runs inside the existing building is progressing.									
*Date CPFF Construction Contractor started work. ** Actual date.											
CA-769	Additions to the 622 Building	\$ 80,000	None to date	0	0	0	0	None	None	None	None
REMARKS:		Using component personnel are continuing their study of other possible alternates. J. T. Lloyd Physics & Instruments Research & Develop.									

UNCLASSIFIED

H-12

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				HANFORD LABORATORIES OPERATION		HW-56185		MONTH May, 1958	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT		STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATED COMP. DATE	DESIGN	CONST.
			AMOUNT	DATE	DESIGN SCHED.	CONST. SCHED.					
CA-778	Expansion of the 305-B Building	\$ 55,000	\$ 55,000	12-11-57	N.S.	0	4-4-58	5-15-58	5-7-58*		
		USING COMPONENT	100			0	6-16-58#	10-15-58	10-1-58#		
REMARKS: The AEC-HOO, Contract Branch is preparing the bid package for the fixed price contract. The bid package will be issued about June 2, 1958.											
#Actual date. # A-E scheduled dates.											
CG-779	Additions to Separations Development Facilities - 321 Building	\$ 27,900	\$ 27,900	5-22-58	0	0	5-26-58	- - -	6-15-58		
		USING COMPONENT	20			0	6-15-58	1-31-59	12-1-58		
REMARKS: Directive HW-456 dated May 22, 1958 has been received from the AEC. CEO has been issued a work order to complete a design drawing from a previous study. A Purchase Requisition for the rectifier is being processed. The Work Authority is being prepared. Preliminary data on the rectifier indicates that it will be larger than was anticipated. To keep within required safety shower distances, the outside structure will be increased about four feet in width.											
CAH-794	Geological and Hydrological Wells - FY 1958	\$ 49,000	\$ 49,000	4-16-58	100	0	4-7-58	- - -	5-15-58*		
		USING COMPONENT	100			0	6-23-58	12-31-58	12-31-58		
REMARKS: Specifications were prepared and transmitted to the Commission on May 15, 1958. Bid Assemblies were sent out to prospective bidders on May 22, 1958. Bid opening is scheduled for June 10, 1958.											

#Actual date.

A14-7300-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H-13

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW -56185		
General Plant Projects - FY 1958 - AEC-2-23-58-L		HANFORD LABORATORIES OPERATION										MONTH May, 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.	DESIGN	CONST.	DESIGN	CONST.
CGH-803	Alterations - Building 231-Z	\$ 49,600	None to date	None	0	0	0	0	None	None	None	None	8-1-58	
REMARKS:		The project proposal was approved by the AEC-HOO Board of Review on May 22, 1958. The Directive has not yet been received.												
CGH-804	Ceramic Fuels Press Enclosure - 325 Building	\$ 41,000	None to date	None	0	0	0	0	None	None	None	None	None	None
REMARKS:		The project proposal was approved by the AEC-HOO Board of Review on May 22, 1958. The Directive has not yet been received.												
IR-236	321 Building Test Pit Enclosure	\$ 19,000	\$ 19,000	2-28-58	100	100	50	60	3-3-58	5-12-58	8-27-58	8-27-58	5-6-58*	8-1-58
REMARKS:		The Army Mess Hall was released to the General Electric Company by the Commission on May 7, 1958. The CPFF Construction Contractor started work on May 12, 1958. All foundation walls were poured on May 22 and 23. The mess hall was moved to the 300 Area and placed on the foundation walls May 26 and 27. Work was started on fabrication of the underground drainage system.												

*Actual date.
AM-7300-019 (5-58)

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H-14

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW -56185	
General Plant Projects - FY 1958 - AEC-2-23-58-I		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.		DESIGN CONST.		DESIGN CONST.		DESIGN CONST.		
			AMOUNT	DATE	SCHED.	ACTUAL	ACTUAL	ACTUAL	DATE	COMP. DATE	COMP. DATE	COMP. DATE	
IR-240	Removal of Obsolete Melt Plant Equipment - 314 Building	\$ 19,000	None to date	0	0	0	0	N. S.	None	None	None	None	
REMARKS: The Informal Request has been submitted to the AEC-HOO and is awaiting approval.		USING COMPONENT		0		0		5*		None		20*	
Weeks after authorization.		Laboratory Auxiliaries		None to date		0		1		None		3*	
REMARKS: The project proposal is being routed through HLO for signatures.		USING COMPONENT		None		0		4*		None		7 1/2*	
Months after authorization.		Modification of the 15-Ton Canyon Crane - 327 Building		None to date		0		1		None		3*	
REMARKS: The project proposal is being routed through HLO for signatures.		USING COMPONENT		None		0		5*		None		7*	
		Reactor & Fuels Research & Development		None to date		0		FEO ENGINEER		R. C. Ingersoll			

UNCLASSIFIED

H-15

PROJECT NUMBER	TITLE	BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT		HANFORD LABORATORIES OPERATION		MONTH May, 1958	
		Equipment Not Included in Construction Projects - Program Class 2900		EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION AMOUNT DATE	PROJECT PROGRESS IN PER CENT DESIGN SCHED. ACTUAL	STARTING DATE DESIGN CONST.	DIRECTIVE COMP. DATE DESIGN CONST.	ESTIMATED COMP. DATE DESIGN CONST.
CG-661	Additional Heat Generation Facility - 189-D Building			\$ 664,000	\$ 664,000 9-18-57	56 47 0 0	12-6-56 10-1-58*	10-1-58* 8-31-59	10-1-58 8-31-59
REMARKS: Design work is progressing on both the electrical and mechanical phases. The vendor, The General Electric Company, has submitted drawings for approval on the saturable reactor. The drawings for the transformers and rectifiers are expected momentarily. The shell and tube heat exchanger has been received from the Whitlock Manufacturing Company. Efforts are being made to expedite the two steam condensers so that payment can be made in June; however, it is anticipated that delivery will not be made until July.								A. W. Herwin PEO ENGINEER	
*Scheduled date.									
CA-681	Hanford Equipment in the ETR			\$ 1,200,000	\$ 1,200,000 8-12-57	95 94 N.S. 45	9-17-56 4-7-58	12-15-58	7-1-58 1-30-59
REMARKS: Installation of the 3 x 3 loop and common components is progressing favorably. Instrumentation changes to conform to Phillips' Plant Standards are being made, per Phillips' design, from construction funds. The 9 x 9 loop design change is somewhat behind schedule, but completion by July 1, 1958 is still possible. The removal cask design has not yet been completed because of problems that need to be resolved. An HLO representative is at Arco for this purpose.								H. Radow PEO ENGINEER	
CI-682	High Level Cut-Off and Examination Cell - 327 Building			\$ 430,000	\$ 430,000 8-20-57	100 100 25 30	7-18-56 3-27-58	- - - 10-1-58	6-26-57* 10-1-58
REMARKS: The vendor started shipment of cell castings on May 27, 1958. It is anticipated that delivery will be made before June 15, 1958 on all but the top casting which is being replaced. The replacement casting required extensive repair; however, it should be shipped by June 6, 1958. The cut-off saw, 14-ton cask, and slug anvil have been received. All plug assemblies, except the 13 service plug assemblies, have been shipped. The 14-ton cask cart is being expedited so that delivery is now scheduled for June. Some of the lead glass viewer plug assemblies have been received. The lead brick cell has been dismantled. Work is progressing on cutting the hole in the wet storage basin for the pipe tube. Installation of conduit runs and miscellaneous work in connection with the patch panel is progressing. The hot crib line and service lines in the basement have been relocated.								A. W. Herwin PEO ENGINEER	

UNCLASSIFIED

H-16

PROJECT NUMBER	TITLE	BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT				HANFORD LABORATORIES OPERATION			
		Equipment Not Included in Construction Projects - Program Class 2900		EST. TOTAL PROJECT COST	INFORMATION AMOUNT DATE	PROJECT PROGRESS IN PERCENT DESIGN SCHED. ACTUAL	CONST. SCHED. ACTUAL	STARTING DATE	DIRECTIVE COMP. DATE	ESTIMATE COMP. DATE	
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	22.5	7-25-57	5-15-58	1-1-59

REMARKS: Physics & Instruments Research and Development have completed testing the prototype. Only minor corrections need be made in design and assembly. Modifications will be discussed with the vendor (Instrument Lab., Inc.) when he is here on June 2, 1958. Radio equipment information was sent to Motorola, who is the vendor for the Repeater Station.

Physics & Instruments Research & Develop. J. T. Lloyd

PEO ENGINEER

*Scheduled date. **Actual date.

CG-758	Ceramic Fuels Development Press and Furnace Additions			\$ 172,000**	\$ 200,000	8-1-57	100	N.S.*	8-22-57	2-1-58##	2-28-58#
				USING COMPONENT	8-1-57		100	40	1-20-58	10-1-58##	10-1-58

REMARKS: Minor changes in wiring and piping on the sintering furnace are being made by the Lump Sum Contractor. Design revisions are under way to install the 300-Ton press in the 325 Building. 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 on May 15, 1958.

*An overall construction schedule has not been established because the second phase construction (press installation) has not been scheduled. **Based on latest cost information. ##Scheduled date.

#Does not include press installation, funds will be accrued to cover this work. Housing for the press will be provided by CGH-804. #Actual date.

CG-785	In-Reactor Studies Equipment - 105-KW Building			\$ 440,000	\$ 15,000*	2-12-58	65	0	3-10-58	None	6-13-58
				USING COMPONENT	2-12-58		75	0	None	None	None

REMARKS: Drawings for comment have been completed. The estimate and write-up are being prepared for the revised project proposal requesting total project funds.

#For preliminary design and necessary services to submit a revised project proposal for detailed design, procurement, and construction funds.

UNCLASSIFIED

H 17

PROJECT NUMBER	TITLE	BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT										HW 56185		
		Equipment Not Included in Construction Projects - Program Class 2900		HANFORD LABORATORIES OPERATION		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PERCENT		STARTING DATE		COMPLETION DATE		MONTH		MAY, 1958
		EST. TOTAL PROJECT COST	AMOUNT DATE	DESIGN SCHED.	ACTUAL	DESIGN SCHED.	ACTUAL	DESIGN CONST.	DATE	DESIGN CONST.	DESIGN CONST.	DATE	DESIGN CONST.	DESIGN CONST.	DESIGN CONST.	DESIGN CONST.
CGH-801	X-Ray Diffraction Cell .. 327 Building	\$ 120,000	None to date None	0	0	0	0	None	None	None	None	None	None	None	None	None
REMARKS:		Reactor & Fuels Research & Development R. W. Dascenzo														
A project proposal for \$10,000 partial design money was submitted to the Commission on May 12, 1958. It was approved by the AEC-HOO Board of Review on May 22, 1958. A directive has not yet been received from the AEC.																
CGH-805	High Temperature Tensile Testing Cell	\$ 140,000	None to date None	0	0	0	0	None	None	None	None	None	None	None	None	None
REMARKS:		Reactor & Fuels Research & Development R. W. Dascenzo														
A project proposal for \$10,000 partial design money was submitted to Contract Administration on May 14, 1958.																
REMARKS:		USING COMPONENT FEO ENGINEER														

UNCLASSIFIED

BUDGET CLASSIFICATION

New Construction - FY 1958

H 18

MONTHLY PROJECT REPORT

HANFORD LABORATORIES OPERATION

HW -56185
MONTH May, 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	DESIGN SCHED.	CONST. SCHED.	ACTUAL	DESIGN	CONST.	DESIGN	CONST.	DESIGN	CONST.	DESIGN	CONST.	

CG-731	Critical Mass Laboratory	\$1,800,000	\$ 175,000	5-12-58	0	0	0	0	5-22-58	10-59	10-59	1-1-59	1-1-59
		USING COMPONENT							FEO ENGINEER				

REMARKS: Physics & Instruments Research & Develop. R. W. Dascenzo
 Directive HW-455, dated May 12, 1958 was received on this project. A Work Release Authorization, dated May 21, 1958 was written authorizing FEO management of this project and assigning \$128,200 to CEO for performance of design studies and detailed design. Detailed design is limited to Stage I scope, but will include consideration for possible expansion if required. D. S. Jackson was appointed Project Engineer.

CA-744	Metallurgical Development Facility	\$2,600,000	\$ 60,000	4-28-58	0	0	0	0	5-12-58	None	None	12-15-58*	9-15-60
		USING COMPONENT							FEO ENGINEER				

REMARKS: Reactor & Fuels Research & Development R. W. Dascenzo
 A Work Release Authorization dated May 27, 1958 was written to CEO authorizing their management of General Electric Company work and services for this project. Of the authorized funds, \$30,000 was delegated to CEO for preparation of detailed design for a building structure and related work. A number of meetings were held clarifying the scope of work, and delineating the responsibilities of the various components involved.

*Structure design.

CA-749	High Level Radiochemistry Cell	\$1,070,000	\$1,070,000	4-21-58	0*	0	0	0	7-1-58	6-30-59	6-30-59	10-30-58	6-30-59
		USING COMPONENT							FEO ENGINEER				

REMARKS: Chemical Research & Development R. W. Dascenzo
 The bid package for completion of design and performance of construction was issued on May 1, 1958. Bid opening has been set for June 12, 1958. An addendum to the bid package was prepared on May 29, 1958. Various prospective bidders have been shown the site and had their inquiries answered.

*Does not include scoping, preliminary design and bid package by G. E.

AM-7800-019 (5-58)

UNCLASSIFIED

UNCLASSIFIED

H 19

BUDGET CLASSIFICATION		MONTHLY PROJECT REPORT											
NEW Construction - FY 1958		EST. TOTAL PROJECT COST		AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT				STARTING DATE		MONTH	
PROJECT NUMBER	TITLE	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION	DATE	DESIGN SCHED.	ACTUAL	CONST. SCHED.	ACTUAL	DESIGN	CONST.	STARTING DATE	MONTH	ESTIMATED COMP. DATE
CGH-790	High Level Radioactive Receiving and Storage Addition	\$ 325,000	None to date	None	0	0	0	0	1*	None	5-22-58	May, 1958	6*
REMARKS:		Reactor & Fuels Research & Development											
		A. W. Hervin											
		The project proposal is awaiting AEC-Washington approval.											
*Months after authorization.													
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	5-22-58	7-27-58	7-15-58
REMARKS:		Biology											
		J. T. Lloyd											
		The project was approved by the AEC-HOO Review Board on May 15, 1958. AEC Directive HW-457, dated May 22, 1958 has been received. Construction Operation has been given the scope and requested to submit a fixed price for the work. Authority to remove the hutments has not yet been received.											
REMARKS:		USING COMPONENT											
		FEO ENGINEER											

VISITS TO HANFORD WORKS

<u>Name</u>	<u>Dates of Visits</u>	<u>Company or Organization Represented & Address</u>	<u>Reason for Visit</u>	<u>H. W. Personnel contacted</u>	<u>Access to Restricted Data</u>	<u>Areas & Buildings Visited</u>
Bryant Moore	4-28-58	Aeroject Corporation Los Angeles, Calif.	Inspect site for bld on CA-749 project	R. W. Dascenzo	No	325, 300
Mickey Cochrane	5-20-58	Hoffman Constr. Co. Portland, Oregon	"	"	No	"
R. Biggs, W. Pauley, H. D. Smith	5-19-58 & 5-20-58	H. E. Bovay Consulting Engineers, Spokane, Wn.	"	"	No	"
Mr. Putman	5-22-58	Hill & Ingaham Consulting Engineers Seattle, Wash.	"	"	No	"
Mr. Vaughn H. D. Smith	5-26-58 & 5-27-58	H. E. Bovay Consulting Engineers, Spokane, Wn.	"	"	No	"
Principals	5-5-58	Umatilla County Ele- mentary Schools	Learn about Tech Info. Facilities	C. G. Stevenson	No	3760, 300
Principals and members of the School Boards	5-14-58	Tri City Schools	"	C. G. Stevenson	No	"

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>
Joseph J. Hauth	5-12-58 to 5-19	Rochester and New York City	National Academy of Sciences Committee Meeting	J. K. Scott J. N. Stannard, C. I. Campbell	No
R. E. Rostenbach	5-2-58	Pollution Control Commission Offices, Olympia, Wash.	Industrial Wastes Committee meeting, Pacific Northwest Sewage and Indust- rial Wastes Assoc.	V. W. Bacon, Chairman	No

EMPLOYEE RELATIONS OPERATION MONTHLY REPORTGENERAL

At month's end, the staff of the Hanford Laboratories Operation totalled 1129, including 512 exempt and 617 nonexempt employees. Of the total exempt employees there were 446 with college degrees, including 428 technical degrees as follows: BS - 221, MS - 104, PhD - 103. There were 35 nonexempt employees with degrees.

Attitude survey follow-up discussions were completed in one level 4 component and in one level 5 component in the Radiation Protection Operation. Similar discussions were initiated in the Physics and Instrument Research and Development Operation.

AEC-SPONSORED TRAINING PROGRAMS

Plans were essentially completed for the A.S.E.E. Summer Institute for Professors and A.E.C. Radiological Physics Fellowship Programs. Both Programs will convene during June.

PERSONNEL DEVELOPMENT

At month's end, 15 Technical Graduates and 9 Technician Trainees were on assignment within the Laboratories.

TRAINING

Eight HLO employees completed Conference Leading; 5 attended Data Processing; 12 completed Understanding People; and 16 completed the Statistics Concept course.

COMMUNICATIONS

Tours were arranged for 40 Walla Walla College science students and 25 members of the Umatilla County Elementary Principals Association. As part of the G.E. Community Relations Program, a tour was arranged for 40 Tri-City school administrators.

Two management luncheons for exempt employees and one for nonexempt employees were held during the month.

Thirty-three signed articles, technical papers and speeches were processed for clearance.

HEALTH, SAFETY AND SECURITY

Laboratories personnel worked a total of 188,284 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 3,962,890 man-hours have been completed with no disabling injuries. The medical treatment frequency for May was 1.81 as compared with 1.75 during April.

There were 4 security violations during the month, bringing the total for the calendar year to 23.

EMPLOYMENT

Eight nonexempt vacancies were filled during the month, including 4 temporary openings to be completed late in the summer. There are currently 7 open

requisitions with an additional 3 on a temporary hold basis.

Oral reduction of force notices were given to 4 General Clerks whose jobs are scheduled for elimination. It is expected that all Clerks will be reassigned within the Laboratories.

TECHNICAL PERSONNEL PLACEMENT

Nine PhD candidates visited Richland for interview during May. Three offers were extended and one was accepted, bringing our total PhD acceptances to 13 for the recruiting year beginning September 1, 1957. The recruiting of experienced BS/MS personnel continues at a minimum level.

UNION RELATIONS

Negotiations with the Regional Monitors are continuing with a meeting being held on May 12th with the HAMTC and Mr. Walter Ziman of the Federal Mediation and Conciliation Service. No further meetings have been scheduled since that date.

Norman A. Stoll, a Portland attorney, has been appointed by the Federal Mediation and Conciliation Service as arbitrator in the Maki case.

Two grievances were received during May. Both were filed by Boilermakers claiming misassignment of work in the 328 Building. Both are scheduled for Step II discussion.

SUGGESTIONS

At the May Suggestion Board Meeting 12 suggestions were approved for awards totalling \$255. For the year to date, 45 suggestions have been approved for awards of \$1,345 with an average award of \$29.66 and a ratio of awards to savings of 10.7%.

BENEFIT PLANS PARTICIPATION

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

EDUCATIONAL ASSISTANCE

Jack L. Poe, Engineering Assistant, Reactor & Fuels Research & Development, was the recipient of a G.E. scholarship. Mr. Poe has accepted and is arranging to enroll in the University of Washington in the fall.

SALARY AND WAGE ADMINISTRATION

A realignment of functional responsibilities and organizational structuring within the Technical Information Operation was completed and made effective during May.

The annual reconciliation trip scheduled during May was completed with visits being made to the following Company components:

Aircraft Nuclear Propulsion Department
Missile & Ordnance Systems Department
Flight Propulsion Laboratory Department
Knolls Atomic Power Laboratory
Research Laboratory
General Engineering Laboratory.



Manager
Employee Relations

TG Marshall:tr

VISITS TO OTHER INSTALLATIONS

<u>Name</u>	<u>Date of Visit</u>	<u>Company Visited</u>	<u>Reason for Visit</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
R.D. Tillson	5/12 and 13	Aircraft Nuclear Propulsion Dept.	Salary Reconciliation	R.L. Coons R.L. Gartner	None
R.D. Tillson	5/14	Flight Propulsion Laboratory Dept.	Salary Reconciliation	O.J. Krasner G.F. Devereaux D.R. Lester	None
R.D. Tillson	5/15 and 16	Missile & Ordnance Systems Dept.	Salary Reconciliation	T.A. Capriotti C.B. Dates R.L. Eddy	None
R.D. Tillson	5/19	Knolls Atomic Power Laboratory	Salary Reconciliation	D. Kerr	None
R.D. Tillson	5/20	Research Laboratory	Salary Reconciliation	L.W. Steele	None
R.D. Tillson	5/21 and 22	General Engineering Laboratory	Salary Reconciliation	F.J. Moles D.K.W. Wilson P.C. Bogiages A.P. Goetes	None
H.A. Paulsen	5/23	Employee Compensation Services	Consultation with Services Personnel	M.H. Blesh H.H. Hutchinson W.R. Jacobson	None

TABLE II. EMPLOYMENT - TECHNICAL PERSONNEL STATUS

I. Employment

<u>Non-Exempt Employment Status</u>	<u>April</u>	<u>May</u>	<u>Non-Exempt Transfer Requests</u>	<u>April</u>	<u>May</u>
Requisitions					
At end of month	10	10	Transfer Requests		
Cancelled	1	2	Active cases at end of month	49	54
Received during month	7	10	Cancelled	2	0
Filled during month	7	8	New during month	6	5
Candidates Considered			Transfers effected	1	0
Total applications	13	12	Planned Transfers	0	0
Total transfer requests			Effective during month	1	0
from other at HAPO	6	7			
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 Open</u> <u>Visit Invite.</u>	<u>Extended</u>	<u>Accepted</u>	<u>Open</u>		
Engineering:									
Chemical	57	23	10	-	1	7	3	1	3
Electrical	29	5	1	2	-	2	-	-	-
Mechanical	32	11	3	3	2	2	-	-	-
Met-Ceramics	57	26	10	2	2	6	-	1	1
Other	6	2	1	1	-	-	-	-	-
Science:									
Chemistry	252	37	19	2	1	11	6	1	4
Physics	240	95	29	8	14	16	2	4	3
Math-Stat.	37	3	-	1	-	-	-	-	1
Other	47	7	3	2	-	2	2	-	2
TOTAL	757	209	76	21	20	46	13	7	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 Open</u> <u>Visit 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	7	2	1	1	-	2	-	-	-
Math-Stat.	4	1	1	-	-	1	1	-	1
Other	17	1	1	-	-	-	-	-	-
TOTAL	94	15	12	1	0	10	3	1	5

TABLE III. Exempt Transfer Cases

	<u>May</u>	<u>April</u>	<u>Total</u>
Active cases at <u>beginning</u> of month	28	31	
New cases: Initiated by employee			5
Initiated by management*	1	1	13
Cases reactivated			
	<u>29</u>	<u>32</u>	
Cases closed: Transfers: Within HLO			2
Within HAPO		1	1
Other G. E.			0
Withdrawn	1	1	4
Terminated		<u>2</u>	<u>6</u>
	<u>28</u>	<u>28</u>	<u>13</u>
Active cases at <u>end</u> of month	28		<u>28</u>
Total cases - January 1, 1958 to date (includes 23 cases initiated prior to and active on 1/1/58)			41
Initiated by employee	15		
Initiated by management*	26		

*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	15 (includes 2 non-unit grievances)
<u>Step I</u>	
Answered satisfactorily*	6
<u>Step II</u>	
Pending Step II discussion	2
Pending Step II answer	0
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.

FINANCIAL OPERATION MONTHLY REPORTPersonnel

There were no personnel changes in the Financial Operation during May.

General Accounting Operation

Information required in support of forecasts of diversions of nuclear materials Outside production channels was received from SS material custodians and transmitted to SS Accountability Operation.

In response to a request from the SS Accounting Operation, material custodians were requested to submit information necessary to schedule HOO-AEC Survey 15, Part IV. Upon receipt, this information will be consolidated and forwarded to SS Accountability.

Considerable study has been devoted to the re-evaluation of SS materials on Hanford Laboratories books. Prior to the end of this fiscal year an adjustment will be made to bring unit values in line with Plant averages. The value of SS materials in custody of HLO has been overstated since before July 1, 1957. Prior to that date no mechanism existed to recognize material losses incurred as a result of research programs. Procedures adopted July 1, 1957 have prevented additional build-up of these differences, but an over-all adjustment is necessary, the total amount of which is expected to exceed \$2,000,000.

During the month Manager - General Accounting attended the 1958 Nuclear Materials Management Conference at AEC Headquarters in Germantown, Maryland.

The running analysis of estimating accuracy on FY 1957 and FY 1958 closed appropriation requests 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	22	\$104,788	\$143,883	\$(39,095)	37.3
By less than 10%	17	144,030	150,221	(6,191)	4.3
<u>Under-Run</u>					
By more than 10%	32	155,385	103,979	51,406	33.1
By less than 10%	<u>22</u>	<u>140,944</u>	<u>137,078</u>	<u>3,866</u>	<u>2.7</u>
	<u>93</u>	<u>\$545,147</u>	<u>\$535,161</u>	<u>\$ 9,986</u>	<u>1.8</u>

We have been informed by Contract Accounting of a proposal to change the form for reporting travel and living expenses to the Commission. The new report form, to be effective with July business, will eliminate the classification of expenses by type of travel (Business Conferences, Transfer of Employees, etc.) and the various expense categories (Transportation, Taxi and Limousine, etc.). However, variation figures will be included on the report submitted to the Commission. As a result of these changes, we have developed a summary page of travel and living expenses to be distributed to HLO management.

A schedule of HLO's physical inventory program for FY 1959 was prepared and distributed to interested personnel. A physical inventory of all uninstalled cataloged equipment, plant and equipment held for future use, reactor and special materials, and installed plant and equipment to the extent practicable, will be taken and completed during FY 1959. In taking the inventories, the standard procedure with necessary modifications will be followed. Inventories will be taken by the respective custodial organization under the direction of Property Accounting.

Quarterly IBM listings of assigned equipment were furnished each property control custodian or representative for their use and to aid in the control of equipment. In addition, listings of all HLO uninstalled equipment (9,081 items) in HEW number sequence were furnished each HAPO property group to minimize the possibility of their dropping or adding to record items which are on our records.

A Property Management Manual for use by HLO personnel is currently being prepared by Property Accounting. The purpose of this Manual is to present in one publication the property management policies, procedures, and requirements of Hanford Laboratories Operation which will replace existing HLO Property Management OPG's. Distribution of this Manual will be the same as that used for HLO Property Management OPG's.

Cost Accounting

During the month Hanford Laboratories received a direct authorization of \$25,000 for work on a 4000 Program Research and Development activity, Gas Cooled Reactor Studies. The allocation within Hanford Laboratories for FY 1958 consists of \$18,000 to Reactor & Fuels R&D Operation, \$2,000 to Physics & Instrument R&D Operation and \$5,000 for General Overhead. Other adjustments made during the month to funds previously authorized to provide a better balance between HLO components are as follows:

- (1) transfer of Plutonium Recycle R&D funds of \$40,000 from Physics & Instrument R&D Operation and \$10,000 from Chemical R&D Operation to Reactor & Fuels R&D.
- (2) transfer of FPD Research & Development funds of \$12,000 for Category I and \$12,000 for Category II from Chemical R&D Operation to Reactor & Fuels R&D Operation.
- (3) miscellaneous adjustments between Level 4 and Level 5 components within Reactor & Fuels R&D Operation.
- (4) a letter has been submitted to Contract Accounting requesting a transfer of \$13,000 from the Instrumentation Sub-Program of the Biology & Medicine Program to the Dosimetry Sub-Program. Approval by HOO-AEC is required for fund transfers of this nature. As no difficulty is foreseen in obtaining this approval, the transfer will be reflected in operating cost statements for May. Physics & Instrument R&D Operation is the only component affected by this transfer.

In connection with the Budget Review by the General Manager - HAPO, the decision was made that the FY 1959 Revised Budget and FY 1960 Annual Budget would be revised before submission to HOO-AEC for two items: (1) reduction to conform with HOO-AEC Program Production Assumptions received in March (document dated 2-28-58) and (2) limitations of the average salary rate escalation to 3% per fiscal year over the

previous year. Due to the shortage of time available to make the changes, the General Manager - HAPO requested that these be calculated for each HAPO Level Two component by Contract Accounting. As a result Hanford Laboratories budget submission was reduced \$457,000 in FY 1959 and \$867,000 in FY 1960 in salaries and continuity of service. The full impact of this reduction on Hanford Laboratories is not known at this time due to the uncertainty of (1) the allocation of the reduction to HLO components and (2) the type of financial controls which will be placed on the HLO component during FY 1959.

A new form has been designed to replace the "TDR" IBM card for use by the components in submitting weekly time distribution information for each employee. Use of this form will reduce the volume of paper processed by the cost clerk involved from approximately 550 IBM cards to approximately 50 sheets of 8 1/2 x 11 paper per week. The new form will also eliminate the necessity of the cost clerk summarizing the information by organization (except to the extent of add-checking the figures submitted). Time saved as a result of adoption is estimated to be one day per week by the cost clerk plus the time saved by each component in filling out one sheet of paper for the entire group as compared to filling out a separate card for each employee. It is currently planned to place the new form in use in late June or early July to provide time for appropriate explanations to individual components prior to usage.

Personnel Accounting Operation

A Tax Accounting Service Bulletin on moving expenses to newly-hired employees was received which indicated that effective January 1, 1958, employers were no longer required to withhold taxes from reimbursements or allowances paid to new employees to cover expenses incurred in relocating at place of new employment. However, such payments are still subject to Federal Income Tax.

Forms on the General Electric Savings and Stock Bonus Plan, the General Electric Pension Plan, and the Insurance Plan have been prepared and will be delivered to employees on June 6.

Procedures

A study was initiated of the total keypunching and verifying workload now performed for HLO Financial Operation by Data Processing. Evaluation will be made of the data to determine the current feasibility of operating this IBM equipment in the field. Procedural studies continued on (1) control of cataloged equipment, (2) budgets and budget planning, and (3) cost accounting.

Auditing

The traveling auditors were assisted by one representative from HLO Financial during the month.

Measurements

Hanford Laboratories library data were compiled to allow their comparison with one off-site library from which cost information has been received. Work continued on the report on possible employee indicators and the compilation of unit cost data for Bio-Assay.

Payroll StatisticsNumber of HLO Employees
Changes During Month

	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on Payroll at Beginning of Month	1 119	504	615
Additions and Transfers In	16	8	8
Removals and Transfers Out	<u>6</u>	<u>-0-</u>	<u>6</u>
Employees on Payroll at End of Month	<u>1 129</u>	<u>512</u>	<u>617</u>

Overtime Payments During Month

	<u>May</u>	<u>April</u>
Exempt	\$ 1 698	\$ 5 298
Non-Exempt (Five weeks during May)	<u>10 862</u>	<u>5 466</u>
	<u>\$12 560</u>	<u>\$10 764</u>

Gross Payroll Paid During Month

Exempt	\$399 521	\$395 783
Non-Exempt (Five weeks during May)	<u>341 439</u>	<u>260 345</u>
	<u>\$740 960</u>	<u>\$656 128</u>

Participation in Employee Benefit
Plans at Month End

	<u>No. Participating</u>		<u>% Participating</u>	
	<u>May</u>	<u>April</u>	<u>May</u>	<u>April</u>
Pension Plan	1 122	1 127	98.6	98.6
Insurance Plan				
Personal Coverage	1 170	1 164	99.7	99.7
Dependent Coverage	742	740		
U.S. Savings Bonds				
Stock Bonus Plan	692	686	61.3	61.3
Savings Plan	86	88	7.6	7.9

Insurance Claims

	<u>May</u>		<u>April</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee Benefits				
Life Insurance	-	\$ -	-	\$ -
Weekly Sickness & Accident	12	937	17	946
Comprehensive Medical	26	6 317	61	4 841
Dependent Benefits				
Comprehensive Medical	<u>39</u>	<u>4 187</u>	<u>89</u>	<u>5 849</u>
Total	<u>77</u>	<u>\$11 441</u>	<u>167</u>	<u>\$11 636</u>

Good Neighbor Fund

	<u>May</u>	<u>April</u>
Number Participating	713	709
Percent Participating	63.2	63.4

INVENTIONS OR DISCOVERIES

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

INVENTOR

TITLE OF INVENTION OR DISCOVERY

E. A. Evans and H. C. Bowen

A Fuel Element Wafer Concept

R. L. Brandt

The Radiation Exposure Integrator

C. A. Rohrmann

A Simplified Type of Liquid Metal Reactor

W. G. Spear

A Single Transistor High-Voltage Supply

W. G. Spear

A Linear Transistorized Pulse Amplifier

R. H. Moore

A Pyrochemical Method for Separation of Uranium and Plutonium (HW-55967)



END

**DATE
FILMED**

5 / 5 / 93

