**DECLASSIFIED
WITH DELETIONS**

HW-47943

This document consists
of 120 pages. Copy No. [redacted]
es. Series [redacted]

**HANFORD LABORATORIES OPERATION
MONTHLY ACTIVITIES REPORT**

HW--47943-Del.

DE92 017588

**DECLASSIFIED
WITH DELETIONS**

JANUARY 1957

Classification Cancels

By Authority of

CG-14-2
DS Lewis 4-21-92
DJ Kiser 5-11-92
PM Eck 5-11-92

Compiled By
Operation Managers

February 15, 1957

Received by 0571
JUL 1 1992
CLASSIFICATION REVIEW FOR
DECLASSIFICATION. NOT LIST
UNCHANGED

By

Date

2/13/73
U.S. AEC Division of Classification

**HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON**

Work performed under Contract No. W-31-109-Eng-52 between
the Atomic Energy Commission and General Electric Company

Route To:	P. R. No	Location	Files Route Date	Signature and Date
<i>Mr. Hot</i>				
<i>Mr. Evans</i>				

DISTRIBUTION RESTRICTED TO U.S. ONLY

**DECLASSIFIED
WITH DELETIONS**

MASTER

SEP 1992

DECLASSIFIED

HW-47943

DISTRIBUTION

COPY NUMBER

- 1 W. E. Johnson
- 2 R. H. Beaton
- 3 L. L. German
- 4 A. B. Greninger
- 5 D. M. Johnson
- 6 W. K. MacCready
- 7 H. M. Parker
- 8 F. W. Albaugh
- 9 C. A. Bennett
- 10 J. L. Boyd
- 11 V. R. Cooper
- 12 P. F. Gast
- 13 J. P. Holmes
- 14 A. R. Keene
- 15 H. A. Kornberg
- 16 T. G. Marshall
- 17 R. W. Benoliel
- 18 J. W. Healy
- 19 - 20 Atomic Energy Commission, Hanford Operations Office,
Attn: J. E. Travis
- 21 - 22 E. J. Bloch, Director, Division of Production, Washington 25, D. C.
- 23 300 File
- 24 Record Center
- 25 - 29 Extra

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

TABLE OF CONTENTS

Staff	iv
General Summary	v through vii
Reactor and Fuels Research and Development Operation	A-1 through A-25
Physics and Instrument Research and Development Operation	B-1 through B-13
Chemical Research and Development Operation	C-1 through C-28
Biology Operation	D-1 through D-9
Operations Research and Synthesis Operation	E-1 through E-6
Radiation Protection	F-1 through F-10
Laboratory Auxiliaries Operation	G-1 through G-10
Employee Relations Operation	H-1 through H-8
Financial Operation	I-1 through I-3
Invention Report	J-1

DECLASSIFIED

SECRET

HW-47943

DECLASSIFIED

STAFF

Manager, Hanford Laboratories	H. M. Parker
Manager, Biology	H. A. Kornberg
Manager, Chemical Research and Development	V. R. Cooper
Manager, Laboratories Auxiliaries	J. L. Boyd
Manager, Operations Research	C. A. Bennett
Manager, Physics and Instrument Research and Development	P. F. Gast
Manager, Radiation Protection	A. R. Keene
Manager, Reactor and Fuels Research and Development	F. W. Albaugh
Manager, Employee Relations	T. G. Marshall
Manager, Financial	J. P. Holmes

SECRET

The long-delayed analog computer arrived, and the familiarization program started.

Radiological physics concentrated on development of techniques for detection of internally deposited plutonium in the now-authorized shielded monitoring facility.

3. Chemical Research and Development

There is substantial progress in work pointing toward reduction of cycles in the Purex process.

After considerable difficulty, the first HAPO production use of titanium (in a heat exchanger bundle) now seems to be assured.

Glass bearings in lieu of graphite may greatly extend life in process pumps.

Mass spectrometry to determine U^{235} in an isotopic mixture is slow and expensive. Where the highest accuracy is not needed, a way to do this by gamma-ray counting has been developed. This will be of great benefit if Hanford reactors are to operate on various enrichments.

An improved method of predicting UO_3 convertibility to UF_4 is now in place. The same method can be applied to predicting the behavior of UO_2 in fuel element preparation.

4. Biology

A quite unexpected development arose in tests of reactor effluent on rats. Zn^{65} accumulated in bone to give comparable hazard to P^{32} . Heretofore, P^{32} has been the key isotope in all river problems.

This work is being done by long-term feeding of concentrated reactor effluent to the animals. Actual measurement in Tri-City residents may be attempted when we have the shielded personnel monitoring facility.

Technical and Other Services

Operations Research and Synthesis has accepted an important sensitive assignment that will be administratively known as Operation Pool. For some parts of this work, key phases of assistance from product departments will be needed. Technical and financial means for this are being put in place currently.

Some important developments from studies of simple economic models promoting optimization of HAPO efforts are being presented to other departments for discussion purposes.

Emission of I^{131} from process stacks was well controlled, except in one week which accounted for 18 curies. Radiiodine deposition in the environs is within a factor of two of the permissible limit. This winter has provided the best evidence to date of the realistic nature of limits applied to stack emission. Previously, it was suspected that the limits were possibly over-conservative.

DECLASSIFIED

HW-47943

One additional area was converted to the new plastic film badge, which has been well received in the first test area.

The National Committee on Radiation Protection and Measurement has prepared a preliminary statement on maximum permissible radiation exposures to man, which is to be released on February 15, 1957. The statement will be assumed to be responsive to the general disturbance created by the NAS report, especially in the area of genetics, although the revisions were previously being considered both by the ICRP and the NCRPM. With minor exceptions, it will call for no change in the HAPCO radiation protection approach. Radiation Protection Operation will assist other organizations in interpretation of this new statement after its formal release.

Supporting Functions

The force increased by one to 1175.

Thirty-five members of the Laboratories are participating in PBM courses.

The exempt salary review was completed on schedule.

One secretary in the Laboratories achieved a seven-year attendance recognition award. There was one new grievance; it was answered satisfactorily at Step I.

Medical treatment injuries showed the favorable frequency of 1.53 per 10,000 hours, and there were no disabling injuries; there were two minor fires.

The number of security violation incidents continued to be too high.

An audit of property accountability, while showing generally favorable results, led to two changes with respect to uninstalled catalogued equipment. A new physical inventory of this category will begin in March, and a new control system will be used in the technical shops.

Manager
HANFORD LABORATORIES

HM Parker:lt

TECHNICAL ACTIVITIESA. FISSIONABLE MATERIALS - 2000 PROGRAM1. METALLURGY PROGRAM

Fundamental Studies. The study of reactor induced changes in the microstructure of fissionable and non-fissionable materials is continuing in order to substantiate present hypotheses and theories of radiation damage. A capsule containing a pre-characterized metallographic specimen of uranium irradiated to an approximate burnup of 0.03 per cent has been opened and replicas of the specimen surface have been obtained. Although a detailed comparison of the surface topography before and after irradiation has not been completed, the following conclusions can be derived: (1) in accord with laboratory studies, the irradiated uranium specimen shows little, if any, evidence of attack by the NaK in which it was immersed; (2) very little evidence of microstructure changes in the precharacterized surface is discernible by optical examinations. Since it is possible that the surface may not show changes which have occurred, the specimen was etched by ionic bombardment and additional replicas were obtained for further comparisons. Preparation and analysis of these replicas by both optical and electron microscopy are in progress.

Mechanical and Physical Properties of Irradiated Materials. Post-irradiation examination was continued of Zircaloy-2 tensile specimens exposed two operating cycles in the MTR. The estimated neutron exposure of the material was 1.4×10^{20} nvt (> 1 Mev) and 7×10^{20} nvt thermal. Initially annealed samples were tested at room temperature after post-irradiation vacuum anneals of 10 and 100 hours at 250, 300, and 350 C. Values obtained for yield strength after annealing indicated no recovery of radiation damage in 100 hours at 250 C, but approximately three per cent recovery in 10 hours, and 14 per cent in 100 hours at 300 C, and 13 per cent in 10 hours, and 35 percent in 100 hours at 350 C. Additional anneals at 400 C are being performed.

Four tensile specimens of depleted (0.028 per cent U-235) uranium canned in NaK-filled Zircaloy-2 capsules were irradiated in the MTR for two operating cycles. Two of the capsules were exposed in an estimated surface flux of 2×10^{13} nv to a total exposure of 0.32×10^{20} nvt. The other two were exposed in an estimated surface flux of 2.35 to 3.35×10^{14} nv to a total exposure of approximately 3×10^{20} nvt. These exposures are 0.00052 and 0.0048 per cent total atom burnup or equivalent natural uranium exposures of 1.3×10^{18} and 1.2×10^{19} nvt. Based on examinations in the Radiometallurgy Laboratory, the two samples receiving the highest exposure were badly warped after irradiation. They were broken in tension and were brittle but no strength values could be obtained. The two lower exposure samples were tested at room temperature. Average values were: 0.2 per cent yield strength 82,000 psi, ultimate strength 110,800 psi, elongation 2.4 per cent in 1-inch gage and modulus 30.8×10^6 psi. The embrittlement is almost as severe as has been noted for natural uranium at higher burnups, although a decrease in ultimate strength was not observed. Additional samples were sent to the MTR for irradiation at the lower flux for one cycle.

DECLASSIFIED

DECLASSIFIED

A-2

HW-47943

REL

A natural uranium tensile specimen exposed at HAP0 to 0.075 per cent total atom burnup was given a post-irradiation vacuum anneal at 700 C for ten hours. The tensile properties determined from a room temperature test confirmed previous test results after beta phase annealing; there is no increase in elongation as a result of such annealing.

New Fuel Development. During the past month three 7-rod cluster fuel elements have been fabricated--one made from aluminum dummy rods and two from 0.500-inch uranium rods jacketed in 30-mil 304 stainless steel. These fuel elements will be charged into the 3865-KE through-hole facility within the next three weeks. They will be exposed to 600 MWD/T to determine their in-reactor performance and any changes in their physical characteristics at power levels of 40-50 kw/ft.

A new rear face nozzle designed to facilitate the discharge of a rupture from the KW through-hole facility was installed and a holder containing three cored insulated uranium fuel elements and a dummy was charged during the fourth week of January. These fuel elements are scheduled for irradiation to 600 MWD/T at 43 kw/ft. The uranium surface temperature is calculated to be 282 C and the maximum temperature 540 C. Additional cored insulated uranium fuel elements are being fabricated for simulated rupture testing in a flow tube.

Two charges of experimental cluster fuel elements were completed last quarter. They were originally designed for operation in a ribbed tube at the KER facility, but have now been modified to fit the ribless Zircaloy-2 KER tubes. A longitudinal leaf spring was mounted on each end-cap of the four-rod fuel element by tungsten arc spot welding. The spring material is cold rolled 304 ELC stainless steel. The annealed area adjacent to the weld is not significantly loaded during spring deflection, so that permanent deformation of the spring does not occur during charging. This spring mounted fuel element has the advantage of flexibility and 0.150-inch clearance between rods and tube wall. The rods are spaced with a rigid internal ring which, in addition to its structural function, is intended to prevent damage during handling, charging, and discharging. Two spring-mounted four-rod fuel elements are being checked for nozzle clearance and charge-discharge at 1706-KE.

A study of the fuel and cladding material requirements for organic cooled reactor application has been made and a report has been issued (On Fuel Elements for Organic Cooled Reactor Application, HW-47828 RD, T. W. Evans).

In connection with the pre-charging inspection of vacuum-canned and hot-pressed fuel elements, it was necessary to measure the end-cap and can base thickness on each individual element in order to permit machining these components to specifications. Inasmuch as the Fuels Preparation Department has abandoned the use of the x-ray fluoroscope in favor of direct indexing in the automatic facing lathes, it was necessary to procure (from Excess) and install an x-ray machine. A pneumatically actuated slug-feeding carriage was developed, and this, together with a micrometer stop-adjustment, permits speedy, accurate measurement of the components, with much less effort on the part of the operator than was formerly required on a production set-up. Continued development of the internal Frost Test for I & E fuel elements has led to further improvement of the system. It has been found possible,

by repeated passage of the same slug through this test at successively increasing power input, to distinguish between areas of subnormal heat-transfer and areas where the jacket is excessively thin, both of which conditions result in characteristically shaped melted areas on the acenaphthene-coated test strip.

Pre-irradiation evaluation of fuel elements prepared by the hot-press process for an in-reactor comparison is essentially complete. The test pieces are the best yet produced by this process. They have been subjected to tests that show the integrity of the heat transfer medium and completeness of bond, thickness of the nickel, intermetallic layers, uniformity of can wall, soundness of the weld, and uniformity of the aluminum jacket grain size. Others have been sectioned and examined metallographically to assure that non-destructive tests are valid. After an anodizing treatment, the test charges will be set up to await loading into a reactor.

The testing of approximately 300 elements produced by vacuum canning is now essentially complete. It is planned to irradiate sixty-four of these elements and compare their performance with a similar number of hot-dip canned I & E elements.

Tests were performed on the cold closure canning technique to learn the effects of various ram speeds and loadings on the resulting closure. Results from the tests indicate that loadings can be reduced by increasing the ram or closure speed.

Fabrication Development. In continuation of the development of self-supporting fuel elements, a series of fuel element autoclave rupture tests was conducted to determine the extent of damage to the process tube when a self-supporting fuel element ruptures. The results point to the requirement for supports that will collapse under the forces caused by a fuel element rupture. The best design for a collapsible support developed to date is a bridge type support with three piers in the span. This support has sufficient strength to withstand normal charging forces, but will collapse under the excessive forces caused by a fuel element rupture. The fuel element can move a total of 0.115 of an inch before excessive pressure is exerted on the process tube.

As part of the fuels development program, 20 eight-inch I & E wafer fuel elements were dip-canned and destructively examined. The examination revealed that the fuel elements contained too much lead (carried over from duplex bath) located primarily between wafers. The lead is responsible for difficulty in welding the closures. A change in the agitator cycle plus the addition of a pneumatic vibrator to the agitator will be tried to minimize lead carry-over. With the elimination of the lead problem, the process is considered ready for production of a reactor test charge.

In support of the KER loop utilization and development program, 10 tested eight-inch KER-size I & E wafer fuel elements were delivered to FPD engineering for flow testing.

Investigations of the variables involved in degassing uranium washers in the vacuum annealing furnace were conducted. The canning of non-degassed washers has resulted in I & E elements with large voids in the bonding layer along the internal tube. As would be expected, it was observed that the hydrogen content after degassing depends upon the initial content, the degassing temperature, and the degassing time.

DECLASSIFIED

DECLASSIFIED

A-4

HW-47943

100-100000

Fuel Evaluation. The irradiation of a coaxial fuel element specimen in the HAPO fuel element testing facility in the MTR was begun January 11. This first irradiation was designed as a heat transfer experiment. The specimen parameters were selected so that the central tube would operate in the gamma phase only and the outer tube in only the alpha phase, based on out-of-reactor measurements of uranium-uranium interface thermal conductances with no load. Post-irradiation examination should provide an estimate of the maximum temperature that was reached during operation.

The irradiation of an eight-inch I & E wafer fuel element in the HAPO fuel element testing facility in the MTR was completed January 7. The fuel element specimen operated at a power level of 70-75 kw/ft for five reactor cycles (fifteen weeks) without incident. The exposure at discharge was estimated at 800 MWD/T. The specimen will be returned to Hanford in February for examination in the Radio-metallurgy facilities.

Static Corrosion Tests in Organic Coolants. Studies have continued of the reaction between uranium and monoisopropyl biphenyl (MIPB). At 400 C in a closed system there is essentially no visible attack of the uranium after one day, but there is evidence of spalling and peeling after three to four days. Once the spalling starts, the reaction proceeds more rapidly, and after six days the uranium is completely converted to the monocarbide. Uranium in refluxing MIPB (300 C) has shown no spalling after 24 days in test. Tests have been started to determine whether the rate of conversion to the monocarbide is more dependent on the elapsed time of exposure in the MIPB or on the rise in gas pressure (primarily H₂) which occurs in a closed system from the thermal decomposition of the organic fluid.

A piece of uranium, 1/2 inch diameter by two inches long, was sealed in a close fitting aluminum can. A 1/16 inch diameter hole was drilled through the can exposing the uranium. This assembly was tested in MIPB at 400 C in a closed system vented every two days. In 12 days a noticeable swelling appeared at the hole. After 18 days the diameter of the piece had increased 50 per cent and the piece was bent about 100°.

These experiments suggest that the rate of reaction of uranium with organic coolants is fast enough to require the jacketing of massive uranium fuel elements. Discharge of defective fuel elements will also be necessary, but the reaction rate may be sufficiently slow that the removal can be accomplished on a scheduled rather than a "scram" basis. It is possible that the reaction rate can be slowed further by (1) continuously venting the hydrogen, and (2) using a more stable organic coolant.

Zirconium Hydriding Under Simulated Reactor Conditions. A laboratory experiment simulating a corroding uranium core clad in aluminum in a Zircaloy-2 process tube has failed to produce significant hydriding of the zirconium. The system consisted of a small uranium plug within a tightly fitting aluminum cylinder which in turn was forced into a Zircaloy-2 outer cylinder. The system was autoclaved at 250 C until the uranium was completely oxidized. The hydrogen content of the zirconium increased only slightly, from 17 to 21 ppm. From this test it is concluded that significant hydriding of zirconium in water at temperatures below 250 C may not occur unless the uranium and zirconium are in direct contact.

Radiometallurgical Studies

KAPL Powder Metallurgy U-Mg. The examination of the fourth and fifth irradiated KAPL powder metallurgy samples (GEH-3-18) was started. The canned samples were dimensionally stable. There was no diffusion bonding between the can and core and no evidence of core melting was observed on a metallographic specimen prepared from one of the samples.

Post-Irradiation Annealing Studies of Uranium. Post-irradiation annealing studies are being conducted on irradiated uranium to obtain a correlation between annealing time, temperature, and previous exposure as determined by apparent changes in hardness, metallography, density, x-ray diffraction and scintillation scanning patterns. Temperatures being studied are in the high alpha, beta, and low gamma phase regions for uranium (600 C, 700 C, and 800 C). Results to date indicate an average hardness range after a 600 C anneal of 60 to 62.5 Rockwell A, after 700 C of 56 to 58 RA, and after 800 C of 48.5 to 51.0 RA compared with an average of 60 to 64 RA for un-annealed material with exposures from 200 to 600 MWD/T.

The Effects of Irradiation on Diffusion Bond Tensile Specimens. Pre-formed tensile specimens containing U-Ni-Al and U-NiFe-Al diffusion bonds were tested previously to determine the effects of exposure and irradiation temperature on the strength of the bonds. These specimens consisted of a 1/2-inch long plated, beta-heat-treated, uranium mid-section which was diffusion-bonded to aluminum end-pieces. During the previous tensile testing the strength of the weaker of the two bonds was obtained. A special gripping device was designed to grip the uranium so that tensile data could be obtained on the second bond. The breaking strength of the second diffusion bond on each specimen was consistently 15 to 25 per cent higher. The tensile testing results obtained show that the irradiated NiFe bonds were 10 to 25 per cent stronger than those formed with nickel as the bonding material. The average strength of the nickel bonds varied from 9000 psi at 300 MWD/T to 5200 psi at 1500 MWD/T. This compares with an average pre-irradiation strength of 10,000 psi.

Fuel Element Test Reactor

A study has been completed of tentative test conditions required to support the Hanford fuel element development program in a fuel element test reactor. The results of this study are reported in document HW-47859, "Fuel Element Test Reactor Tentative Test Conditions," N. G. Wittenbrock. The Hanford testing requirements in an FETR are estimated to be 28 to 57 test channels in the test region of the reactor where the thermal neutron flux densities in the fuel range from 5×10^{13} neutrons/cm² sec to 5×10^{14} neutrons/cm² sec, and 40 to 80 test channels in the low power driver region where the neutron flux densities in the fuel range from 3.75×10^{13} to 4.5×10^{13} neutrons/cm² sec. Test channels should be at least 10 feet long and designed to accommodate process tubes with inside diameters of 1.68 to 4.0 inches. Both horizontal and vertical test channels will be needed. A reactor to provide these facilities might have a power level of 200 to 300 MW.

Preliminary design scoping of a Hanford Fuel Element Test Reactor was started.

[REDACTED]

DECLASSIFIED

2. REACTOR PROGRAM

Coolant Systems Development

Pressurized Water Testing. A twelve-week aluminum corrosion test at pH 4.5, 300 C was completed, with observed penetration rates of 0.5 to 1.0 mil per year. Increasing the ratio of aluminum surface to water volume continues to appear promising as a means of reducing corrosion rates. Several tests to confirm this effect are under way. At 150 C very little difference in aluminum corrosion rates was detected in water at pH 3.5 and pH 4.5. After ten weeks, a rate of 0.6 mil per year was determined.

Corrosion evaluation of a candidate Rear Face decontaminant was made. A solution of Turco, a commercial aluminum cleaning compound, was found to corrode aluminum, stainless steel, and carbon steel to a very slight extent, making its use as a decontaminant quite feasible from a corrosion standpoint.

Eight simulated rupture tests at temperatures up to 280 C were conducted, including six standard size slugs for initial KER operation, one "cow slug" (1.8" O.D. KER slug), and one candidate PRPR fuel element. The ruptured standard size slugs were readily removable from the tube; however, the "cow" slug split the KER tube section after nine hours operation at 200 C. The PRPR type slug, using a 7.5 per cent uranium-aluminum alloy to simulate a plutonium-aluminum alloy piece showed no visible change after a short exposure (about one hour) at 275 C.

Organic Coolant Technology. The in-reactor organic loop was continued in operation with MIPB, the material reaching a tar content of 48 per cent. The high viscosity (about 50 times that of cold water) necessitated dilution with fresh material at this point. Satisfactory valve packing and gasket materials for use with MIPB at temperatures to 370 C have been found following a series of tests in the ORA-3, the organic component test loop. Detailed design of the distillation purification system for the KER organic conversion is essentially complete. Material procurement is on schedule and fabrication will begin early next month.

Single Pass Coolant Development. The 1706-KE in-reactor tubes operated satisfactorily at outlet temperatures between 80 and 90 C, in the experimental investigation of the pH range 6.0 to 7.0. Mock-up tests using pH 5.5 process water at 115 and 135 C showed no pitting attack on 2S aluminum after 90 days exposure. Corrosometer probes and coupon tests of carbon steel in low pH process water have been expanded. It appears that carbon steel corrosion is the primary technical limit involved in further reduction of process water pH.

Thermal and Hydraulic Studies.

Process Tube Flow Orifice Tests. Hydraulic studies were performed to identify secondary orifice configurations suitable for replacing those now in use at the fringe zones in the K Reactors. A variety of orifice configurations were tested but none were found that bettered the performance of extended barrel tubes. For Zone 3, replacing the existing secondary orifice with a long tube will provide an acceptable assembly. For Zone 4, an additional throttle (or tertiary orifice) in

the front nozzle will probably be necessary. For Zone 5, an easy solution was not found. Even with the use of a tertiary orifice system, Panellit pressure changes in response to pigtail or front nozzle cap failure could not be made large. Thus, Zone 5 must be eliminated or means found to apply throttling downstream of the front nozzle. JPD personnel are now reviewing the results of these experiments in order to plan a proper course of action.

Transient Flow Instability. An analysis was made of transient flow instability tests performed some time ago. These tests simulated instantaneous partial cone screen plugging at high tube powers with initial tube outlet temperatures of about 125 C. An understanding was secured of the mechanisms involved in the dynamic responses, and predictions were made of low pressure Panellit trip timing for the cases studied. These indicate that early low pressure Panellit trips would have occurred for all of the cases examined (40 per cent, 60 per cent, and 75 per cent step reduction in tube flow).

Pressurized Water Burnout Tests. Results of experiments with forced circulation annular flow heat transfer to boiling water at 1500 psia pressure in the horizontal electrical heated test assembly were written up in a paper (HW-47892) to be presented at an American Society of Mechanical Engineers meeting in June. The experiments comprised measurements of heater rod surface temperatures near and in the region of transition between nucleate and film boiling at heat fluxes from 100,000 to 396,000 Btu/(hr)(sq ft) and with steam qualities up to 56 per cent by weight. Apparent phase stratification led to heater rod temperatures which produced a smooth transition from the nucleate to the film boiling state.

Shielding Studies

Because the determination of neutron dose passing through the rear face shields of the existing reactors would be very helpful in designing more efficient shields for new reactors, neutron dose measurements were made at 105-H rear face during the recent rod calibration. With the dosimeter in line with tube number 2469 and one foot away a dose rate of 0.6 m rem/hr was observed. At the time of measurement the reactor was leveled off at 1 MW and maintaining shutdown water flow. Full power water flow might increase this reading by a factor of two or three. Extrapolation to full power could mean a neutron dose rate of 2 to 3 rem/hr. Plans are being made to measure the dose rate at full power.

The second of three irradiations in the DR test well to determine the attenuation characteristics of magnetite concrete has been completed. The magnetite slabs have been removed from the DR test well for their final heating. Approximately 300 measurements of the foils that were located in these slabs have been made.

Nonmetallic Materials Development

Stored Energy of Irradiated Graphite. A series of 5000 MWD/AT cold test hole graphite samples were annealed, several each to 800, 1300, and 1800 C and sent to the National Bureau of Standards for total heat of combustion measurements from which the stored energy is calculated. These data show a total stored energy of 640 cal/gm distributed uniformly over the three temperature increments. This rough distribution curve is well below the heat capacity curve, which indicates 1154 cal/gm

DECLASSIFIED

integrated heat capacity at 1800 C. These data are the first firm evidence that an uncontrolled temperature rise from stored energy is unlikely to occur in the graphite moderator in the event of a brief power excursion during high temperature operation. Measurements with higher resolution (e.g., narrower temperature increments) are being made to determine the fine structure of the stored energy curve which could conceivably nullify this conclusion.

Thermal Annealing of Irradiated Graphite. A correlation between C_0 and physical distortion changes during thermal annealing was attempted for low temperature radiation damaged samples. For graphite with irradiations of 1600 MWD/AT or less, proportional decreases were observed in each property for the same thermal treatment. For graphite with greater damage, a decrease of C_0 began prior to any change in physical length. This is understandable since physical distortion from irradiations greater than 1000 MWD/AT results from crystallite warpage as well as C_0 expansion. To predict the decrease of physical distortion accompanying a known C_0 decrease during annealing requires a knowledge of the exposure and temperature of irradiation damage. For application to reactor annealing, it is necessary to know also the flux and temperature during the annealing period to correct for the effect of irradiation annealing on each property. It is not possible at this time to determine the physical distortion of graphite in the Hanford reactors from C_0 measurements alone since this graphite has sustained radiation damage over a wide range of temperature and total exposure.

Radiation Effects on Plastics and Elastomers. Elastomers that are known to be subject to ozone cracking when they are stressed (50 per cent elongation and greater) were also found to be cracked when irradiated under stress in air, but not when irradiated in a vacuum. It is postulated that the cause of this cracking is radiation products from the air which may be ozone, free radicals, or nitrogen dioxide. Analytical work is under way to determine the specific cause or combination of causes.

Structural Materials Development.

Five 10-inch long by 7-inch diameter Zircaloy-3 billets were satisfactorily pierced January 10 by Allegheny-Ludlum Steel Corporation under Contract DDR-5. The pierced billets were extruded January 15 into 10-foot long ribbed tube blanks. The tube blanks were reported to have good interior and exterior surfaces and good metal fill at the rib areas, and are scheduled for the first tube-reducing pass approximately the first of February.

The first tube-reducing pass was successfully performed January 5 on the tube blank extruded in November. Tooling difficulties delayed further reductions, but it is anticipated that this tube will be fully tube reduced by early February. Samples from the tube blank extruded in November have been rolled and annealed to simulate procedures encountered during tube reducing of the tube blank to final tube size. Metallographic examination of longitudinal and transverse sections at various stages of reduction and in the annealed condition revealed no apparent unusual microscopic constituents that would adversely affect tube properties.

A visit to the University of California revealed good progress on Contract DDR-4 to measure creep rates of 6063 and M-257 type aluminum alloys. The creep test machines are currently loaded with samples of 6063 aluminum alloy. After these short time

DECLASSIFIED

UNCLASSIFIED

A-9

HW-47943

tests on 6063 alloy are completed. the program emphasis will shift to an investigation of the creep properties of the M-257 (Al_2O_3 -aluminum alloy), plus a few long time tests on 6063. Because M-257 may be suitable at higher temperatures (300-700 F) with organic coolants, a decision was made to eliminate the proposed creep tests at 212 F and instead substitute tests at 500 F. Therefore, the University of California will obtain creep data for M-257 at temperatures of 300, 350, 400, and 500 F. The constant-temperature glycol-water baths employed for this investigation are limited to operating temperatures below 500 F. To obtain data at 600 and 700 F, either existing facilities must be modified or new facilities must be constructed, and the preferred approach is being developed for consideration.

Zircaloy-2 Tube from H-Loop. Six sections from a discharged Zircaloy-2 process tube were received for examination to determine whether or not any metallurgical changes were caused by in-reactor operation. The tube was selected for examination because the complete fabrication and in-reactor histories are known.

The tube, which was used in the H-Loop tests for approximately one year, had been extruded in one piece. After fabrication the tube material was in a 60 per cent cold worked condition. The tube operated at temperatures up to 200 C with deionized water as the coolant. No slug ruptures occurred in the tube during operation. During removal from the reactor the tube was cut into short sections by a special guillotine cutter installed on the rear face of the reactor. As has been observed in cutting unirradiated Zircaloy tubing with this type of a cutter, the tube did not cut cleanly, but usually broke off after the knife had penetrated approximately half-way through the tube. Two sections of tubing near these breaks were examined metallographically in Radiometallurgy. The visual absence of martensitic needles is taken as evidence that no significant hydrogen sorption in the Zircaloy had occurred. Chemical analyses for H_2 and O_2 will be made, and hardness measurements and bend tests are planned on sections of this tube.

B. WEAPONS - 3000 PROGRAM

1. 234-5 WEAPONS

Two acceptable large plutonium shapes were successfully cast during the month. The success was attributed to a sounder mold design. Prior to these two castings, three unsuccessful attempts were made. Two of these previous castings failed to fill the mold because of insufficient mold and/or metal temperature. On the third attempt the mold filled but expansion of the steel bolts holding the mold together allowed the metal to overflow the mold. The flow surge carried enough metal out of the mold so that when the metal level equalized the casting was not complete.

The design and fabrication of the necessary equipment to demonstrate the fabrication of a new model on the 20" Monarch lathe is complete and ready for testing in the 272-W Shops. The radius generating equipment and the vacuum chucks are being tested by machining a stand-in material to the desired dimensions. If these accessories operate satisfactory and the machined parts meet dimensional requirements, they will be installed and used in the 231-Z Building for fabrication of the prototype commitments.

Large sized tanks have been set up in the plating laboratory to perform the necessary coatings for these shapes. Special shipping containers have been designed and fabricated to ship these assemblies upon their completion and inspection.

C. REACTOR DEVELOPMENT - 4000 PROGRAM

1. PLUTONIUM RECYCLE PROGRAM

Reactor Design

Reactor Scope. Cycle evaluation studies along with budgetary requirements have produced a reduction in the size of the PRPR. This reduction was accomplished primarily by reducing the physical size and the design power level of the reactor plant. The resulting reductions in capital equipment, D₂O inventory, and building size are expected to lower costs without serious impairments of either the experimental flexibility or cycle demonstration utility.

The major design changes are shown in the following table.

<u>Item</u>	<u>Old Value</u>	<u>New Value</u>
Design Power Level	125 MW	70 MW
No. of Tubes	151	85
Lattice Spacing (Triangular)	7 in.	8 in.
Calandria Diameter (ID)	94-1/2 in.	84 in.
No. Shim Control Tubes	24	18
No. Flux Distribution Monitor Tubes	19	13
Moderator Pressure	50 psia	Atmospheric
Moderator Flow	2000 gpm	1200 gpm
Primary Coolant Flow	16,000 gpm	10,000 gpm
Containment Volume	900,000 ft ³	680,000 ft ³
Building Floor Area, Non-containment	21,500 ft ²	13,500 ft ²

Reactor Core and Piping. The use of a water reflector is receiving primary consideration. This reflector could be either light or heavy water; the choice would depend largely on the cost of heavy water.

The reduction of the reactor size to 85 tubes on an eight-inch lattice permits about a ten-inch decrease in calandria diameter. In addition, elimination of pressurization of the moderator has greatly simplified design of the calandria. Considerable effort has been expended in evaluating the design changes which will best suit the calandria to the new concepts.

DECLASSIFIED

The decrease in the number of tubes and the increase in lattice spacing has made possible a much simpler configuration of inlet and outlet jumpers. The new configuration will relieve congestion at the reactor faces.

Document HW-47994, "Plutonium Recycle Program - Bases for Selection of Pressure Tube Design for Demonstration Reactor," by J. C. Fox, was issued January 22, 1957.

Process Piping and Equipment. Preliminary scope drawings are being revised for the primary coolant and moderator coolant systems and the heavy water treatment systems. The revisions to these drawings will reflect the combining of the moderator coolant and primary coolant systems into one coolant system and the combining of the two heavy water treatment systems into one treatment system.

It is anticipated that the following changes will be made to the recommendations in the scope specifications:

1. One 250 psi, 1000 KW steam turbine-generator will be utilized instead of two units.
2. Two primary coolant pumps with capacities of 5000 gpm each will be required, and a possible third pump will be installed as a spare unit. No throttling of the pumps will be required to obtain the desired flow rates.

Preliminary equipment and piping arrangement drawings are being made of the primary and moderator coolant system within the reactor building.

Control Systems. The reduction of the number of shim control positions from 24 to 18, will require that each shim element have proportionately greater control strength. Probably maximum strengths of about 3.5 milli k per element will be required. It is not believed that the increase in strengths of individual elements will add materially to potential reactor hazards.

A schematic piping and equipment sketch has been prepared showing an emergency ink system.

Building. The containment shell of the building has been changed to a steel cylinder 90 feet in diameter, with a hemispherical dome and a dished bottom. The net containment area has been decreased to some 680,000 cubic feet. This smaller volume is consistent with the reduced size of the reactor.

Reactor Physics

Lattice Spacing Study. Increase of lattice spacing of the PRP reactor was proposed on the following grounds:

1. Recent experiments raise the possibility that fuel temperature, and therefore resonance absorption of neutrons, may be higher than anticipated for the operating reactor. This has the effect of making the lattice more undermoderated.
2. Ring-type fuel elements appear to be achievable with more than 20 lb/ft of UO_2 . These elements, in a full loading, would unquestionably make the lattice highly undermoderated.

DECLASSIFIED

DECLASSIFIED

A-12

HW-47943

DEL

3. A decrease of tank dimensions by 10 inches has been proposed; this results in a reactivity loss of 0.014 (14 mk) due to increased radial leakage.
4. Possible use of a light-water reflector results in a further loss of several mk in radial leakage.
5. More detailed design studies have indicated that the piping for the seven-inch lattice is severely cramped.
6. A lattice spacing increase, by reducing number of tubes and power rating, results in lower total costs.

Since an increase of lattice spacing by one inch already leads to a reduction of number of tubes from 121 to 85 in the reduced (seven-foot) tank size, the testing utility and experimental flexibility of the reactor is believed likely to suffer from any further increase. It is further desired to maintain the fuel-moderator ratio at a fairly high value, for reasons discussed in earlier reports. It was therefore recommended that the lattice be increased to eight inches. A document justifying this change and the reduction of tank size will be issued shortly as HW-48119, "Basis of PRPR Core Modification Proposals," J. R. Triplett.

Fuel Jacketing Material. A preliminary investigation of the cost of replacing zirconium fuel jacketing with stainless steel in the PRPR was made this month. On an equivalent parasitic absorption basis, it was found that a given thickness of stainless steel is worth 37 times as much zirconium (i.e., a one mil SS jacket is equivalent to a 37-mil Zr jacket). The drop in thermal utilization associated with substituting an equivalent thickness stainless steel jacket was then balanced against the increase in enrichment required to maintain the same multiplication. In this way it was determined that the substitution of jacket material in one rod in the NPD 19-rod cluster results in a 6% increase in U-235 concentration in the cluster. If plutonium is the enriching material, only about 2/3 of this amount is required. Reducing the thickness of stainless steel in half requires a 4% increase in Σ , so the effect is not linear.

Lattice Studies. A comparison of lattice parameters in the seven-foot H₂O reflected tank with the NPD 19-rod cluster element was carried out for two lattice spacings. The form of diffusion theory outlined by E. Critophy in CRRP 655 was used. Although the absolute values of the lattice parameters are open to uncertainty, the changes between the two lattices should be fairly reliable. The following values are for the seven-inch and eight-inch hexagonal lattices in the PRPR assuming hot, clean, zero-power conditions (no xenon or fuel temperature correction):

	7"	8"
f	0.951	0.945
p	0.840	0.872
e	1.010	1.010
η	1.320	1.320
k_{∞}	1.065	1.099
L^2	136.9 cm ²	156.5 cm ²
τ	178.9 cm ²	162.9 cm ²
B^2	202.6	302.6
ICR	0.904	0.817
Δk_{eff}	26 mk	

D₂O moderator at 75 C and 99.8% purity was assumed.

A discussion of the temperature coefficients of various fuel elements was written as HW-47884, "Doppler Coefficient of a Dilute System of U-235," M. V. Davis. The report leads to the conclusion that there is no Doppler coefficient for dilute systems of U-235.

Reactor Hazards

Metal-Water Reaction. In the event of a disaster the metal-water reaction must be considered as possibly contributing to the energy which must be dissipated within the containment structure.

1. The percentage of reaction that may be expected depends upon droplet size of the molten metal (5% or less for droplets of ~2500 microns in diameter; 75% for particles ~100 microns in diameter).
2. Metal temperature, probably the second most important factor, must be near the melting point to precipitate violent reactions.
3. The explosive reactions between metal and water are actually metal-water reactions rather than metal-steam reactions.

In the light of these qualitative conclusions there seems small reason to be concerned with the explosive nature of the metal-water reaction in the PRPR. The design of the reactor is such that (1) the D₂O storage tank is separated from the lower reactor face in a manner which would prevent any gross leakage of molten metal into the heavy water tank should the fuel elements melt, and (2) by the time the metal in the fuel elements reaches the reaction temperature the coolant will have boiled off into steam thereby providing a protective steam blanket.

Reactor Operations

Reactor Operations Studies. Assistance in the development of PRPR design criteria continued. Efforts to reduce the construction cost by reduction of scope and simplification of the building and equipment required additional attention to the process and personnel safety aspects of design criteria.

Effort was focused on the building criteria in order to allow proceeding with detailed design of the building.

Plutonium Recycle Feasibility

An analysis of recycled plutonium as a thermal reactor fuel is under way. The study is concerned with cost reduction incentives throughout the plutonium recycle process as well as the applicability of plutonium recycle to various thermal reactor concepts. Plutonium enrichment offers an alternate source of enrichment and also a method of burning the tails from diffusion plants or other depleted uranium sources without employing U-235 enrichment.

DECLASSIFIED

Certain tentative conclusions have been drawn from the study.

1. The cost of plutonium recycling using current processes (Pu-Al alloy in rods as spike enrichment) appears to be too high to compete successfully with alternate U-235 enrichment in the United States economy. This is not necessarily so under foreign circumstances.
2. Alternative plutonium fuel processing methods appear to offer greater potential for ultimate reduction to truly competitive costs and warrant developmental investigation.

Ceramic Fuel Development

Extrusion is being investigated as an alternate method of fabricating UO_2 fuel elements. Previously, UO_2 rods with sintered densities up to 93 per cent of the theoretical have been fabricated using MCW UO_2 . During the past month Mallinckrodt Ceramic Grade UO_2 was extruded to determine some of the properties of this material. Extrusions were made with the following additions per 100 grams of UO_2 : 8 cc water, 2 cc glycerine, and 2.5 gms Carbopol 934. Green densities obtained were in the range of 53 to 55 per cent of theoretical, approximately three per cent below values obtained using MCW UO_2 . Sintered densities were as high as 92 per cent of theoretical and correspond well with densities obtained with MCW UO_2 . Drying of extruded rods required close control to prevent serious warpage and cracking effects. Bloating has thus far prevented satisfactory sintering of the rods although slow sintering rates have reduced this bloating. Further work is planned on the extruding and sintering of this material even though past results have not been as satisfactory as with MCW UO_2 . The advantages in Ceramic Grade UO_2 seem to lie in faster sintering rates, lower sintering temperatures, and higher sintered densities.

A procedure has been fixed for compacting uranium dioxide pellets 0.625 inch in diameter and approximately 0.7 inch long from ceramic grade uranium dioxide at a rate of two or three per minute. A green density of 62 per cent of the theoretical density of uranium dioxide was obtained. The density increased to 92 per cent of the theoretical density upon sintering three hours in hydrogen at 1750 C. The pellets will be used for the 19-rod cluster element for the PRPR. The powder was pressed at 45,000 psi in 5/8 inch diameter hardened steel bushings, using hardened dowel pins as punches. Pellets were readily ejected from the bushings, and had excellent green strength. A time and motion study of centerless grinding of 0.5 inch diameter UO_2 pellets and rods indicated that, with manual handling of the UO_2 , the material can be ground at a rate of 7 ft/min, removing 0.001 to 0.003 inch from the rod diameter.

Ceramic grade uranium dioxide underwent 16 per cent shrinkage when compacted into tubes to a green density of 59 per cent of the theoretical density of uranium dioxide and sintered at 1750 C to a density of 95 per cent of the theoretical density. Normal Mallinckrodt uranium dioxide shrank only 13 per cent when pressed to a green density of 65 per cent of the theoretical density of uranium dioxide before sintering to a final density of 93 per cent of the theoretical density. Separate dies have been prepared for both types of oxide, so that the elements for

[REDACTED]

[REDACTED]

the PCTR loading may be formed from either source of uranium dioxide. Tubular elements for testing in the MTR were pressed from normal Mallinckrodt uranium dioxide and sintered to densities of 92-94 per cent of the theoretical density.

A Zircaloy capsule containing sintered UO_2 has been irradiated during MTR cycle 81 to test the effect of a poor fit between UO_2 and clad. This clearance, varying between 0.001 and 0.011 inch, was estimated to cause core temperature variations between 1400 C and 2800 C when irradiated at the requested flux of 1.65×10^{14} nv. A verbal report from the MTR on the day of shutdown stated that a flux about fifty per cent greater than requested existed in the test location during the cycle, due to a core flux asymmetry. Since the capsule did not rupture at this high neutron flux, it will be sectioned and examined with considerable interest after arrival at Hanford.

Plutonium Fuels

Twelve castings of Al-1.65 w/o plutonium alloy have been made to date and each casting consists of eight rods 9/16" in diameter and 11" long. This completes the casting of the PRP elements for PCTR testing. One casting has been radiographed and on the basis of favorable results, the remainder of the castings were made on an accelerated schedule while the furnace was available. Approximately two rods from each casting were broken during removal from the graphite molds. These brittle failures are apparently caused by a grain boundary weakness resulting from the low ductility of the Pu Al_4 and/or other impurities at the boundaries of the as-cast grains. Some of the fracture cross sections had voids associated with the fracture which seem to be a combination of shrinkage and gas voids. The molds were heated to 400 C before casting; however, the molten metal at 950 C raised the mold temperature and released gas which was trapped in the castings. Some trimming to remove defects will be necessary after radiography.

Some segregation of the more dense Pu Al_4 in the aluminum rods is expected because of the slow rate of cooling of the castings. Eleven-inch long rods of a master alloy of mean eutectic composition 15 w/o Pu were found to average 13.8 w/o Pu at the top and 15.4 w/o Pu at the bottom.

The experimental end plugs and tube holding devices to aid in the development of welded end closures on the PRP-PCTR test fuel elements have been fabricated. Present plans are to test and evaluate at least three end plug designs previous to sealing the fuel elements.

Shielding

Document HW-47574, "Preliminary Analysis of the Plutonium Recycle Program Reactor Shield," has been issued. This document presents the information necessary for scoping the PRPR shield design. A tentative program has been written for tests necessary to substantiate the design. This will be rechecked when the PRPR scope document is issued, and the program will be documented.

Measurements of the activity of the Magnetite shield test blocks were taken to get an indication of the activity to be expected in iron. These measurements indicated that a "machine tolerance" of 10^6 neutrons/cm² sec is adequate for iron and will not produce

excessive activation. The flux in the blocks was determined only roughly, so some checking on the true flux (taken from foil measurements) will allow more confidence in the result. However, the latest design concept specifies 304 stainless for the nozzles and jumpers. The "machine tolerance" for stainless steel (containing two per cent manganese and 0.05 per cent or less cobalt) is about 200 times smaller than for iron. It is, therefore, necessary to use a machine tolerance of 10^4 neutron/cm² sec where stainless steel is used.

Thermal Hydraulics

Calculations pertaining to fuel element core temperatures were performed and concerned PRPR fuels as well as UO₂ element geometries slated for test in the MTR.

Mechanical PRPR Prototype Facility

A preliminary layout of the test facility for testing of the PRPR process tube and pump submitted by CEO was approved. Detailed design of the facility has begun. Materials and equipment will be ordered as rapidly as possible. The drawings and specifications for the facility test shaft are being prepared by CEO. The estimated completion date for the preparation is February 1.

Zircaloy Tubing for PRPR

Stainless steel prototype fuel-element sheathing originally promised for delivery in March and April is now scheduled for delivery by February 15. Zircaloy-3 sheath tubing of diameters from 0.375 to 1.00 inch is being fabricated by Wolverine Tube Company with delivery promised by May 1. A Zircaloy-2 ingot was delivered to Chase Brass and Copper Company to be fabricated into prototype PRP process tubes. Delivery is expected in March.

Plutonium Impregnated Graphite

While impregnating graphite samples with lead nitrate solution (to simulate plutonium nitrate), a direct correlation was found between the quantity of solution absorbed by the graphite and the graphite density. Although the range of graphite density covered was small, these results are significant because they appear to permit control of the amount of salt impregnation within the range of possible interest for PRP plutonium-bearing fuel elements. The desired concentration of salt impregnation can be achieved by selecting graphite of the correct density. Two batches of five graphite samples each were vacuum impregnated with lead nitrate solution in a new vacuum vessel which will accommodate up to 12 of the 4" long x 0.5" diameter cylindrical samples. The samples with densities from 1.61 to 1.67 g/cc absorbed from 0.20 to 0.17 ml of solution per cc of graphite. A final plutonium concentration of 0.044 g/cc can be achieved by impregnating graphite of density between 1.62 and 1.66 with a 1 M plutonium nitrate solution at 9 cm of Hg vacuum. Satisfactory distribution of the salt was observed in the graphite cylinders after they were dried.

SECRET
DECLASSIFIED

DECLASSIFIED

Preparation and Corrosion Testing of Aluminum-Uranium Alloys

Tests are under way to determine whether suitable alloying additions in a plutonium-aluminum fuel element core will prevent rapid oxidation and swelling in the event of cladding failure. At present aluminum-uranium and aluminum-cerium alloy systems are being tested as stand-ins for the more hazardous plutonium system. Two alloy systems have shown promise to date. Systems containing 1.0 per cent Ni and 0.5 per cent Fe show improved corrosion resistance with up to 1.5 per cent U. Alloys containing 12 per cent Si are promising with up to 5 per cent U. Acceptable performance requires that corrosion of the alloy after twenty-four hours at 350 C be insufficient to cause significant swelling of the fuel element.

The 12 per cent silicon system shows the most promise since the presence of even 5 per cent of uranium does not appear to greatly reduce the corrosion-resistance of the alloy. The excellent corrosion resistance of alloy 4032 (32S) composition: 12.2 per cent silicon, 0.9 per cent copper, 1.1 per cent magnesium, 0.9 per cent nickel, suggests that small additions of nickel, for example, may further improve the corrosion resistance. While alloy 4032 is classed as a wrought alloy, the ductility of the high silicon alloys is substantially lower than most wrought alloys. Preliminary experiments indicate careful hot forging (450-500 C) will be required to work the uranium-silicon alloys.

D. CUSTOMER WORK1. FUELS DEVELOPMENT SERVICE WORK

Vacuum Outgassing and Annealing. Twenty-one zirconium strips and a 15-inch length of small diameter Zircaloy-2 tubing were vacuum annealed. Approximately 4000 uranium wafers were outgassed for use in wafer slugs.

Swaging. Several unsuccessful attempts were made to reduce the O.D. of a 77-inch long section of 5/8 inch O.D. Zircaloy-2 tubing by swaging over a mandrel. Ten small diameter stainless steel tubes, nine feet in length, were reduced in O.D. by swaging.

Heat Treating. Uranium sheet, uranium slugs, zirconium tubing, and zirconium sheeting were heat treated in the 72-inch salt bath during the month of January 1957. This work required a total of ten manhours.

Rolling. One hundred square inches of 0.097-inch thick uranium sheet was produced from 0.125-inch thick starting stock by a combination of hot and cold rolling. Seventeen pieces of Zircaloy-2 bar were rolled by various amounts for formability tests. Also, zirconium and aluminum sheet were rolled to various dimensions. This work required approximately 25 hours of working time.

Forging. An attempt to forge six small experimental aluminum alloy billets from a round to a square section was not entirely successful. Five of the billets fractured internally.

2. MATERIALS DEVELOPMENT SERVICE WORK

Radiometallurgical Examinations

KE Reactor Slug Failures. The examination of fuel-element failure No. 740 from tube 4771-KE was started. The tube exposure and tube power were 664 MWD/T and 777 KW, respectively. The appearance of this rupture was quite similar to that of failure No. 739, in that it was split longitudinally and the jacket had undergone severe intergranular attack in a hot-spot area located near the cap end. The hot spot area was bisected by the slug crack. Metallographic examination has not been completed. Work was resumed on the recent failure from tube 3654-KE which caused considerable difficulty because of severe gassing. Attempts to remove the slug from its rupture can were unsuccessful.

Beta Phase Transformation of Cored Enriched Slugs. The examination of the last of three four-inch, cored, enriched slugs (irradiated under PT 105-607-A57-MT) to determine the degree of beta phase transformation was started. This slug was discharged from tube 2063-C after an exposure of 663 MWD/T. Transverse wafers were taken from the center and end of the slug. Initial metallographic examination of the end wafer has revealed an aluminum-uranium compound layer between the aluminum end plug and the uranium interface, indicating that diffusion occurred during irradiation. Neither of the wafers have been etched to determine the extent of beta phase transformation.

Metallography Service

A large number of canned and autoclaved slugs recently exhibited what appeared to be corrosion at the base and up the wall of the aluminum can for about 1-1/2 inches causing them to be rejected for reactor use. Metallographic examinations made on a number of unused cans, representative of several lots from the supplier, disclosed numerous laps in the metal at the base of the cans. It is concluded that the aluminum blanks prior to impact extruding to form the cans had been heavily etched, leaving deep pits in the surface. Upon extruding the cans, these pits formed laps in the metal. Any foreign material in the pits was probably occluded in the laps as well. Corrosion as well as the opening of the laps during autoclaving were the primary causes for the poor surface conditions of the cans, thus resulting in the high rejection rate of slugs. When presented with the data collected by the Fuels Preparation Department, which included the results of the metallographic examinations, the supplier agreed to replace the entire order of about 100,000 cans.

Samples Processed During the Month:

Total Samples Processed	253
Photographs:	
(a) Micrographs	146
(b) Macrographs	95
Total	241

DECLASSIFIED

DECLASSIFIED3. REACTOR ENGINEERING DEVELOPMENT SERVICE WORKThermal and Hydraulics Studies

Two batches of special orifice plates for production test tubes were calibrated. Miscellaneous process calculations were performed dealing with skin and uranium temperatures in I & E slugs.

J. W. Albright

Manager, Reactor and Fuels Research
and Development

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JF Fletcher RM Fryar H Harty PR McMurray JR Triplett	1/7-9/57	Atomic Energy of Canada, Limited Chalk River, Ont.	Discussion of heavy water technology and re-actors.	WB Lewis	Yes
JF Fletcher RM Fryar H Harty PR McMurray JR Triplett	1/9-11/57	Canadian G.E. Peterborough, Ont.	Discussion of heavy water technology and re-actors.	IN McKay	Yes
JW Lingafelter	1/7/57	GE - APED San Jose, Calif.	To make housing arrangements in connection with transfer to APED.	--	No
DE Johnson	1/21-22/57	Allegheny-Ludlum Albany, N. Y.	Consultation on zirconium orders	R Rohrbaugh	No
	1/23/57	Chase Brass	"	KD Crampton	No
	1/24/57	Waterbury, Conn. Auto-Swage Products	"	BE Hall	No
	1/25/57	Shelton, Conn. Wellington Steel Corp.	"	DH Wiese	No
	1/28/57	Wellington Steel Corp. Carpenter Steel Co.	"	B Morrison	No
	1/29/57	Union, N. J. Superior Steel Co.	"	J Carroll	No
	1/30/57	Carnegie, Pa. The Beryllium Corp. Reading, Pa.	"	Mr. Paskaly	No
	1/31/57	Superior Tube Co. Morristown, Pa.	"	HW Cooper	No

DECLASSIFIED

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
AB Burgess	1/22/57	Univ. of Calif. Berkeley, Calif.	Consultation on aluminum creep testing program-DDR-4.	JE Dorn	No
JA Ayres	1/23/57	ALCOA Pittsburgh, Pa.	Attend Aluminum Task Force Mtg.	WW Binger	No
	1/24/57	GERL, Schenectady	Consultation on corrosion problems	WE Tragert	No
	1/25/57	KAPL, Schenectady	" "	RM Haag DH Altmann	Yes
JW Riches	1/22/57	Univ. of Calif. Berkeley, Calif.	Consultation on zirconium fabrication & testing.	JE Dorn	No
	1/23/57	Sciaky Bros. Los Angeles, Calif.	" "	CA Carlson	No
	1/23/57	Tube Sales Los Angeles, Calif.	" "	JH VanUden	No
	1/24/57	NTR Products El Cajon, Calif.	" "	W Miller	No
JW Lingafelter	1/23/57	Sciaky Bros. Los Angeles, Calif. Pacific Tube Los Angeles, Calif. Tube Sales Los Angeles, Calif. NTR Products El Cajon, Calif.	Metallurgical consultations with fabricators of Zircaloy tubing	CA Carlson WP Armstrong HP Curtis	No No No
	1/24/57	Los Angeles, Calif. NTR Products El Cajon, Calif.	" "		
	1/26/57	Tube Reducing Corp. Rutherford, N. J. New Rochelle Tool Co. New Rochelle, N. Y. Penn Mfg. Co. Newington, Conn. Wolverine Tube Detroit, Mich.	" "	RW Stewart WP Rudd AT Scattergood AL Kaspark	No No No No
	1/28/57				
	1/29/57				
	1/30/57				

DECLASSIFIED

A-22

HW-47943

DEL

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JM Davidson	1/28-31/57	Phillips Petroleum Idaho Falls, Ida.	To observe dis-assembly of MTR experiment.	HT Watanabe	Yes
RJ Lobsinger	1/23/57	ALCOA Pittsburgh, Pa.	Attend Aluminum Task Force Mtg.	WW Binger	No
LP Bupp	1/24-25/57	Div. of Reactor Dev., AEC Washington, D.C.	Conferences on reactor develop-ment.	K Davis S White	Yes
WP Wallace GS Allison	1/5-10/57	duPont Savannah River	Mtg. of working comm. on uranium, consultation on fuel assembly methods	TC Evans	Yes
	1/11/57	Sylvania Electric Hicksville, N.Y.		SB Roboff	Yes
HW Newkirk	1/9/57	Harwood Eng. Co. Walpole, Mass.	Observe demon-stration of solar furnace	EB Keeler D Newhall	No
	1/10/57	Arthur D. Little Co. Cambridge, Mass.	Attend confer-ence on barricade design for hydro-static pressing equipment	P Glaser	No
	1/11/57	GE, Philadelphia	Discuss ceramic fuels	L McCreight	No
SH Bush	1/11/57	ASM Meeting Victoria, B.C.	Present paper at ASM meeting	--	No
JJ Cadwell	1/14-17/57	AEC, Washington, D. C.	Present paper at AEC sponsored Metallurgy Infor-mation Meeting	W Munster	Yes

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
MK Millhollen WE Foust	1/20-24/57	Hydraulic Press Mfg. Columbus, Ohio	Conduct tests on cold closure technique	F Sebring	No
EA Evans	1/21-22/57	Association for Applied Solar Energy Phoenix, Arizona	Attend symposium on solar furnace technology	--	No

DECLASSIFIED

VISITS TO HARD WORKS

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Bldgs. Visited
CL Lindekin and JJ Balanda	1/9-10/57	UCRL, Livermore, Calif.	Study radiation protection techniques at HW.	OJ Wick ID Thomas	Yes	200W: 231, 234-5
RP Stein and M Markels, Jr	1/17-18/57	Columbia University New York, N. Y.	To discuss reactor heat transfer & fluid flow problems including transient testing.	LP Bupp LH McEwen	Yes	300: XXX 100-D: 189-D 100-K: 105-KE
LF Epstein	1/22-24/57	KAPL, Schenectady	Employment candidate	RM Fryar FW Albaugh FW Woodfield DR deHallas	Yes	700: XXX 300: 303 100K: 105KE
J Young	1/29/57	GE - Eng. Services Schenectady	Consultant	FW Albaugh	Yes	300: XXX
PE Pade	1/16-18/57	Sciaky Brothers Los Angeles, Calif.	Check welding equip. & discuss welding problems	WP Wallace	No	300:306
J Mead	1/31/57	No.Amer.Phillips Mt. Vernon, N.Y.	Repair electron microscope	TK Bierlein	No	300:XXX

A-24

TOP SECRET

HW-47943

VISITS TO HANFORD WORKS

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Bldgs. Visited
CL Lindekin and JJ Balanda	1/9-10/57	UCRL, Livermore, Calif.	Study radiation protection techniques at HW.	OJ Wick ID Thomas	Yes	200W: 231, 234-5
RP Stein and M Markels, Jr	1/17-18/57	Columbia University New York, N. Y.	To discuss reactor heat transfer & fluid flow problems including transient testing.	LP Bupp LH McEwen	Yes	300: XXX 100-D: 189-D 100-K: 105-KE
LF Epstein	1/22-24/57	KAPL, Schenectady	Employment candidate	RM Fryar FW Albaugh FW Woodfield DR deHalas	Yes	700: XXX 300: 303 100K: 105KE
J Young	1/29/57	GE - Eng. Services Schenectady	Consultant	FW Albaugh	Yes	300: XXX
PE Pade	1/16-18/57	Sciaky Brothers Los Angeles, Calif.	Check welding equip. & discuss welding problems	WP Wallace	No	300:306
J Mead	1/31/57	No.Amer.Phillips Mt. Vernon, N.Y.	Repair electron microscope	TK Bierlein	No	300:XXX

A-25

HW-47943

DECLASSIFIED

PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENTMONTHLY REPORTJANUARY 1957FISSIONABLE MATERIALS - 2000 PROGRAMMETALLURGYVacuum Welding of Zirconium

Investigations have been performed on the feasibility of vacuum welding zirconium. Several electron gun systems were investigated. Feasibility of the method was determined when sample spot welds were successfully made joining zirconium end caps to 0.500" diameter zirconium cans containing dummy slugs.

Fuel Element Test Reactor

Contributions were made to a preliminary study conducted by Advance Engineering and aimed at determining the test conditions for a fuel element test reactor at HAPO. A detailed study is now being made of these test conditions by the taking into consideration of potential test requirements of other AEC sites. A preliminary scope of the FETR is being made jointly with members of the Advance Engineering Operation.

Instrumentation

In the Optical Shop, fabrication was continued on the Underwater Borescope. To test the feasibility of photography through the borescope, a series of photographs indicate that this depth of focus is insufficient to record all of the detail seen by the eye.

REACTORSTUDIES RELATED TO PRESENT PRODUCTION PILESVariation of Graphite Diffusion Length with Temperature

A series of measurements are being taken to determine the variation of graphite diffusion length with temperature change; the information is of value for calculating the temperature coefficient of reactivity of a graphite-uranium lattice. Measurements have been completed at temperatures up to 400° C; the highest temperature at which measurements will be taken is 600° C.

A small water-cooled, BF₃ counter is being used for neutron detection with supplementary data being obtained at several temperatures with In foils and Au foils to serve as a check on the BF₃ results.

The preliminary values for the variation of diffusion length with temperature change are in good agreement with an assumed 1/v absorption cross section for graphite. A comparison between the calculated, and measured, diffusion lengths is given in the following table. The calculated values were obtained by assum-

ing the $1/v$ law; corrections were made for the decrease in density and for the change in the nitrogen content of the graphite. The calculated value was normalized to the measured value at room temperature. As seen from the table, the calculated variation of diffusion length agrees very well with that established from measurement.

GRAPHITE DIFFUSION LENGTH VARIATION WITH TEMPERATURE

<u>Temp.</u>	<u>Diffusion Length</u>	
	<u>Experimental</u>	<u>Calculated</u>
24° C	52.3 cm.	52.3 cm.
100	55.6	55.5
150	57.3	57.4
200	59.0	59.2
250	60.8	60.8
300	62.2	62.2
350	64.0	63.6
400	65.2	65.0
500	-	67.4
600	-	69.6

Enriched Uranium, Graphite Lattices

Buckling measurements were continued in the small ($\sim 4' \times 4' \times 6'$) graphite exponential piles with enriched-uranium loadings. The uranium enrichment was 1.44% by weight U-235. I and E fuel elements of the following dimensions were used: 1.37" O.D., 0.48" I.D.; the canned dimensions were 1.47" O.D., 0.37" I.D. The buckling values measured this month are given below.

Buckling of 1.44% Enriched Uranium (1.37" O.D., 0.48" I.D., I and E Elements)

<u>Lattice Spacing</u> (inches)	<u>Al/U</u>	<u>C/U</u>	<u>Cooling Annuli</u> <u>Condition</u>	<u>H₂O/U</u>	<u>Buckling</u> (10^{-6} cm^{-2})
6-3/16	0.598	52.0	Dry	-	566
			Wet	0.351	711
7-3/16	0.598	71.4	Dry	-	615
			Wet	0.351	664

The above ratios are the atom ratios for the cell. The lattice spacings measured thus far include 5-3/16", 6-3/16", 7-3/16", 8-3/8", and 10-3/8". An additional measurement will be taken for a lattice spacing of 9-3/16" to more firmly establish the lattice spacing for which the wet and dry bucklings are of equal value (cross-over point).

STUDIES RELATED TO FUTURE PRODUCTION PILES

K_∞ Studies Using 1.68" Cored Fuel Elements

Measurements have been made in the PCSTR of the multiplication factor (k_{∞}) for graphite lattices with natural uranium, cored fuel elements. These elements were 1.68" O.D., 0.75" I.D. and were jacketed with 0.040" thick aluminum. The fuel elements were positioned in a 2.00" I.D., aluminum process tube which provided for a 0.12" thick cooling annulus between the canned element and the process tube; the central hole was kept dry throughout the measurements.

For each lattice, k_{∞} was determined as a function of the number of rods in the buffer region surrounding the central cell. From the measurements completed thus far, it is possible to specify a lower limit to the value of k_{∞} , i. e., to specify that value of k_{∞} which is less than, or equal to, the true value.

A listing of the lower limit values for k_{∞} are given in the following table. These values were determined from the measured mass of copper required to poison the central cell to a multiplication of unity, and by using a disadvantage factor for the fuel element of 1.225 which was calculated by the P_3 approximation to the transport theory.

Minimum k_{∞} for Cored Slugs

Measured Mass of Cu to make $k_{\infty} = 1.000$ and Calculated k_{∞}

Lattice Spacing	Air Cooling		Light Water Cooling		MIPB Cooling	
	Mass of Cu (in gm.)	k_{∞}	Mass of Cu (in gm.)	k_{∞}	Mass of Cu (in gm.)	k_{∞}
6½"	-123	0.962	-4	0.999		
7½"	65	1.020	79	1.026	73	1.026
8-3/8"			90	1.029		

The correct values of k_{∞} and the limits of error are to be evaluated on the basis of cadmium ratio measurements now in progress.

Lattice Parameters for Large Diameter Slugs and Cluster Elements

From irradiations in the PCSTR, preliminary values of ϵ , f , p , and CR (conversion ratio) have been determined for a solid 1.93" diameter fuel element in an 8-3/8" graphite lattice under the following test conditions.

	ϵ	f	p	CR
a) No coolant -- dry	1.0565	0.9373	0.7565	1.098
b) Water coolant	1.0502	0.8992	0.7960	1.007
c) MIPB coolant	1.0480	0.9075	0.7860	1.029

The amount of water or MIPB in the external coolant channel was 5.5 cm³/cm of process tube length.

P₃ Programs on the Digital Computers

An "n" region P₃ program for the 650 computer has been received from Dr. John Weil and is presently in operation on the 650. The program will solve the transport equation by the P₃ approximation for the thermal flux through "n" concentric cylindrical regions. Isotropic scattering in the center of mass system has been assumed in the solution. The limiting condition is that Σ_a and Σ_t (macroscopic absorption and total macroscopic cross section for thermal neutrons) cannot be equal to zero.

A P₃ program for the 702 computer is presently being "debugged." This program permits any region of the system to be a void (Σ_a and Σ_t equals zero) but is limited to a maximum of five regions. Isotropic scattering in the center of mass system has been assumed.

Routine buckling calculations for the exponential pile have begun and are approximately 15% to 20% completed.

Interpretation of PCTR Experiments

Approximate expressions for the thermal flux in the PCTR have been developed as reported in the Physics Research Quarterly Report for October-December, 1956. Errors have been found and corrected in two terms of the critical determinants.

Work continued on the transport aspects of the problem of the thermal neutron distribution in the neighborhood of a temperature discontinuity in a polycrystalline modulator. Particular emphasis has been on determining the relevant boundary conditions.

Test Reactor Operations

Thermal Test Reactor

The graphite in the core was rearranged and additional graphite added. This eliminated the voids that were around the top of the fuel tubes.

The reactivities of several materials that are proposed to be used in the TTR and PCTR were measured.

One unscheduled scram by Channel 3 period trip occurred.

Physical Constants Testing Reactor

Operation of the PCTR continued routinely during the month. Three unscheduled shutdowns occurred; two were caused by faulty operation and one by instrument failure. The measurements on the seven-element cluster fuel rod were completed during the month.

Reactor improvement items included: The installation of a panel containing all the power level and pile period indicating meters. Work was started on the installation of the control room partitions.

DECLASSIFIED

HW-47943

Angular Distribution of Neutrons in a Scatterer

The problem of multiple scattering in a foil for $\cos^k \theta$ entrant angular distribution has been carried through a second scattering. A report is being written.

Cross Sections and Nuclear Parameters

Calculations have been completed on the experimental determinations of the normalizations of the slow neutron fission cross sections of Pu-239 and Pu-241 following the results of mass spectroscopic analyses of the plutonium samples by KAPL. The measurements were made with a 0.10 ev neutron beam with the crystal spectrometer relative to a boron chamber calibrated with the Au-197 capture cross sections. The values determined were:

<u>Nucleus</u>	<u>Neutron Energy</u>	
	<u>0.10 ev</u>	<u>2200 m/s (from shape of curve)</u>
Pu-239	431 ± 14 barns	680 barns
Pu-241	539 ± 19	905
U-235	238 ± 3	552 (previously reported)

The ratios of these cross sections are consistent with the ratios of presently accepted values. All the values are about five percent lower than accepted values which depend primarily on the measured values of $(1 + \alpha)$ for U-235 from reactor irradiations.

The absolute spontaneous fission half-lives for Pu-240 and Pu-242 have also been determined from these plutonium samples. The values obtained are shown compared with other recently reported values.

<u>Nucleus</u>	<u>Spontaneous Fission Half-Life</u>	
	<u>This Experiment</u>	<u>Other Recent Values</u>
Pu-240	$(1.235 \pm 0.028) \times 10^{11}$ yrs.	$(1.225 \pm 0.030) \times 10^{11}$ yrs. $(1.196 \pm 0.030) \times 10^{11}$ yrs.
Pu-242	$(7.06 \pm 0.28) \times 10^{10}$ yrs.	$(7.06 \pm 0.19) \times 10^{10}$ yrs. $(6.64 \pm 0.10) \times 10^{10}$ yrs.

The new neutron beam cutoff and collimation system has been installed on the crystal spectrometer at 105-DR during the Project CG-558 outage. The system was designed for higher energy resolution to extend fission cross-section measurements into the 1-10 ev neutron energy region.

Millimicrosecond Time Analyzer

Characteristic operating curves were obtained for the secondary emission pentodes which drive the time analyzer loops. The characteristic curves were found to be significantly different for the special conditions imposed in the loop operation. With this knowledge, stable operation and control of the loop were achieved.

SEPARATIONS

STUDIES RELATED TO CHEMICAL SEPARATIONS

Criticality Experiment for Enriched Uranium Salts

The necessary material has been assembled for the initial phase of the "criticality experiment" designed to determine the maximum always-safe enrichments of uranium salts in water. Sixteen small tanks (including buffer tanks) have been received from CR and D; these were filled with $\text{UO}_3 \cdot 2\text{H}_2\text{O}$ with the uranium enrichment varying from 1.00% to 2.00%. In the first phase of the experiment those two enrichments will be determined which bracket $k_{\infty} = 1$; about four days of PCTR time will be required for the initial phase of the experiment, which will be started in the week of February 4.

Critical Mass Facility

Preliminary scoping of the Critical Mass Laboratory has been carried on jointly with design personnel of CEO. Problems which are being initially considered include the building floor plan, burst containment, and provisions for ready decontamination. A study for the preparation of detailed criteria for the critical assemblies, with primary attention being focused on instrumentation, control systems, and reactor tanks, is in progress.

Work has continued on adapting the design and modifying the detailed drawings of the Idaho Processing Plant (NRTS) mass spectrometer to a plutonium isotopic analyzer for the proposed critical mass laboratory.

Plutonium Mass Spectrometer Consultation

Further consultation has been contributed to the Chemical Instrumentation's project of converting a gas analyzing mass spectrometer for use as a plutonium analyzer.

Magnetic Balance

The electronic system for the balance has been completed but has not been fully tested.

Neutron Age Measurements

A program has been planned for the measurement of the neutron age in water and in other hydrogenous materials which would be expected to aid in the understanding of the age measurements in water. A water tank has been constructed; lead has been obtained for shielding; and the preparation of Na-Be neutron sources has been started.

INSTRUMENTATION

The Goodyear Aircraft Corporation A-14 Analog Computer was delivered to Hanford on January 3, 1957. As expressed in a letter to Mr. F. J. Hughes dated December 28, 1956, Goodyear Aircraft has made delivery with the understanding that many items

of a minor nature were not included and are scheduled for earliest possible delivery. Also, that certain components are sub-standard and will be replaced or reworked as soon as possible.

None of the above items will prevent the operation of the computer or retard the familiarization program now in progress.

REACTOR DEVELOPMENT - 4000 PROGRAM

STUDIES RELATED TO THE PLUTONIUM RECYCLE PROGRAM

PCTR Core

Design has been completed and construction has been started on the aluminum tanks which will contain the heavy water test cores for PCTR measurements on UO_2 and Pu-Al fuel systems. A requisition for 1700 lbs. of D_2O has been initiated for these measurements.

Thermal Neutron Flux Distribution in a Nineteen-Rod Cluster

The thermal neutron flux distribution has been calculated for a nineteen-rod cluster of 0.5" diameter UO_2 rods in a 7" lattice by means of the P_3 program for the 650 digital computer; this type fuel element is being considered for use in the PRP reactor.

For the calculation, the uranium oxide and aluminum cladding were homogenized into three concentric cylindrical regions with heavy water separating the fuel regions. A comparison of the average calculated neutron flux in each fuel region to flux measurements which were made in a nineteen-rod cluster at Chalk River shows this method of calculation to be satisfactory (within the uncertainties of the approximations used). The thermal utilizations of the UO_2 , D_2O , and aluminum are 0.898, 0.006, and 0.095, respectively.

BIOLOGY AND MEDICINE - 6000 PROGRAM

BIOPHYSICS RESEARCH

Atmospheric Physics

Detailed analyses of the experimental data available for diffusion in stable atmospheres were directed toward interrelations between the apparent distribution of concentration with respect to an observer fixed with regard to the ground and meteorological parameters. The most significant of these parameters were found to be the wave length and magnitude of the large-scale horizontal oscillations of wind direction. The dependence of the concentration upon the downwind distance from the source was found to be almost entirely dependent upon the wave length of these wind direction oscillations as compared with the distance over which the observations were made. In the presence of wave lengths which were long compared with the range of observations (600 meters), the variance of the horizontal cross-wind distribution of concentration increased as the square of the distance, irrespective of the magnitude of the wind direction oscillations. This result was in conformity with the predictions derived from the Hanford model for diffusion in

DECLASSIFIED

HW-47943

stable atmospheres.

A strong relationship between the average visual width of smoke plumes emitted into stable atmospheres and the average wind direction shear over the height of the plume was also found. This result provided strong qualitative support for the need for including wind shear in any realistic model of atmospheric diffusion but was not sufficiently quantitative to differentiate between the distortion of the plume and the enhanced dilution of the smoke due to persistent wind direction shear with height.

Observations of the vertical distribution of concentration in stable atmospheres failed to verify a normal error law for this distribution according to the χ^2 test for normality. However, when a normal error law was assumed it was found that the predicted concentrations agreed, on the average, to within $\pm 25\%$ of the observed concentrations, a very useful accuracy in the present state of knowledge in this problem area.

An extensive revision of the "bookkeeping" system for data from the wind station network was undertaken to facilitate summarization of these data by arbitrary time intervals. The new system was designed to facilitate the processing of selected data for special problems.

Consulting services on a potential atmospheric pollution problem in the Purex Tank Farm was provided to Chemical Effluents Technology Operation. Estimates of airborne concentrations and ground depositions for the situation postulated were provided.

The Meteorology Tower facilities were toured by the AFSWP officers on January 9 and a one-hour training lecture entitled "Meteorology as Related to Waste Disposal and Weapons Tests," was given before this group by J. J. Fuquay on January 15, 1957.

DOSIMETRY

A study was begun of the possibility of using coincidence counting methods with scintillation counters for plutonium detection in the Body Monitor. The first counter made for this purpose showed considerable promise in that large reductions in background counting rate were possible. The optical coupling of the two photomultipliers to the crystal was so poor, however, that operation in the thermal noise region was necessary and even the use of the coincidence technique could not prevent a rather high background. Tests indicated the optical coupling could be improved. The coincidence counter was used to measure the absorption of rays from Pu^{239} and Am^{241} in a water phantom. In connection with experiments with plutonium X-rays, the lack of linearity of response of NaI to low energy photons was measured to confirm reports in the literature, and the potential of the shield in the photomultiplier tube for minimum noise production was found to equal that of the first dynode.

A 330-cubic inch plastic scintillator and a 14-inch photomultiplier were prepared for use to see if they could be applied in certain Body Monitor measurements.

A new ion source was received and installed in the Van de Graaff; the mass-one

yield improved and the machine has been in steady use through the month. Considerable time was spent with Facilities Engineering Operation in planning an enlargement of the Van de Graaff facilities.

It was found that measurements with the double moderator neutron flux-dose-energy meter were being affected by scattered neutrons. This was noticed as a change in the ratio of the dose to the flux with distance from the target. It was found that to a good approximation the number of scattered neutrons was independent of position in the laboratory. When corrected for the scattered neutron contribution the dose to flux ratio was independent of position when beyond 80 cm from the target.

When a graphite ion chamber was exposed to 34 Kev X-rays to complete a study of chamber-size effects, it was found that the measured current was 30% higher than that expected theoretically. In earlier work, the currents in aluminum and copper chambers were found to be 15% higher than expected, and this was attributed to an incorrect value for the absorption coefficient of air at this energy. As a result of what turned out to be a good guess, nitrogen was substituted for air as the gas in the chamber. After flushing the chamber several times, the measured current (corrected for the change in W and the stopping power of the gas) was found to be only 15% higher than expected. If this is attributed to the same cause as for the aluminum and copper chambers, this is the best agreement that can be expected. Apparently the nitrogen displaces argon from the surface of the graphite; a small amount of argon could significantly affect the current in a graphite chamber because its photoelectric emission is much higher than that of graphite.

The electron calorimeter vacuum chamber was found to leak badly. It was repaired and is now satisfactory. Wiring of the system was completed.

First experience with personnel using the new calibration wells indicated the adequacy of their shielding. Film badge readings were 3% of the average values before use of the wells. During the changes in procedure accompanying use of the new facilities, it was found that there seems to be a few percent difference between the large and small radium sources; this is being investigated.

INSTRUMENTATION

Experimental work on air alpha contamination detection using two filters was started. The two filters are arranged in series in the air stream with the initial or upstream filter collecting airborne plutonium particle contaminant plus a portion of the radon-thoron natural background. The second filter collects only natural background contaminant in an amount giving a constant 1:2 ratio with the first filter. Such differences in collection are then electronically subtracted giving a resultant net plutonium alpha contamination value for the air.

The modifications on the alpha air filter checker for 4" x 4" filters was completed and the instrument sent to the field. Specifications were completed for a combined alpha, beta, gamma air filter checker for both 4" x 4" and 4" x 8" filters.

DECLASSIFIED

HW-47943

USE

Experimental work concerning a Dust Meter was started. The Dust Meter utilizes dust particle electronic charge transference to a wire mounted across an orifice. Deposited charge forms voltage pulses which are easily amplified and counted. The next phase is the determination of possible particle size to pulse height relationships.

Investigations of circuitry for reversible and preset counters were carried out in conjunction with the Radioisotope Analyzer.

Experimental work concerning small area dose-rate detectors and fast neutron detectors was carried out. Zinc sulfide powder dispersed in Dow-Corning #200 silicone fluid appears more promising than zinc sulfide in lucite as a fast neutron detector. Response varies directly with fast neutron energy.

Experimental work concerning a portable Scintillation Exposure-Rate Meter was completed. The optimum detector was found to be a one-millimeter thick NaI crystal covered by a 0.030-inch thick tantalum absorption shield. The energy response curve, instrument reading to true dose rate, is approximately + 20 percent from 40 Kev to 5.0 Mev gamma energies. Sensitivity maximum is 0.5 mr/hr full-scale first range.

Evaluation tests were completed for a Samson dose-rate meter and a Nemo slow and fast neutron detector. Calibration tests were completed on one sample, of seventeen total, dose totalizer used for setting radiation zone personnel time limits.

Group meetings were held with supervisors and personnel from I.P.D., C.P.D., and H.L.O. for purposes of disseminating information concerning instrumentation at other plants and to determine field instrumentation needs.

CUSTOMER WORK

PROCESS TECHNOLOGY

Current Nuclear Safety Problems

The nuclear safety study of the 234-5 development laboratories continuous Task I and II facilities has been completed. The Recuplex dissolver hood revision has been approved for nuclear safety. A document, HW-48035, entitled "Addendum to RC Can Criticality Study-Hood No. 5, 234-5 Building" and dated 1-28-57, is being issued. Additional design prints for continuous Task I and II production facilities continue to be reviewed, with comments, for nuclear safety.

Certain phases of criticality problems involved in processing and handling enriched uranium were discussed with three representatives of Mallinckrodt Chemical Works, Uranium Division, who were visiting Hanford in connection with a study, requested by the AEC, of the feasibility of conversion of Mallinckrodt's natural uranium facilities to enriched uranium processing.

~~SECRET~~

HW-47943

□

OTHER

Weather Forecasting

<u>Type of Forecast</u>	<u>Number Made</u>	<u>% Reliability</u>
8-Hour Production	93	78.7
24-Hour General	62	81.4
Special	102	80.4

Summary of the Weather

The average temperature of 16.5° F was the sixth lowest monthly average in 45 years of record for the Hanford Area. There were 12 days with a minimum of zero or below--all of which occurred during the latter half of the month. The extreme low was -22° on the 26th.

All measurable precipitation during January was in the form of snow and totaled 0.48 inches, which was only about 60 percent of the normal. Wind speeds during the month average only 3.7 mile per hour as compared to 1945-1956 average of 6.3 miles per hour.

Optical Shop

Routine work included the repair of the 105-D corner periscope, the repair of the 105-DR discharge area periscope and the fabrication of microscope accessory mounts.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

PF Gast:mcs

DECLASSIFIED

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 and Buildings Visited</u>
John Balanda Carl Lindeken	Jan. 9	Univ. of Calif. Radiation Lab. Livermore, Calif.	Discuss atmospheric pollution studies and Tracer techniques.	GR Hilst JJ Fuquay	Yes	200-W: 622
E.R. Gaerttner	Jan. 10-11	Knolls Atomic Power Lab., Schenectady	Discuss KAPL Assistance to Hanford Program.	PF Gast	Yes	300: 328, 326 305-B, 3760
L. L. Lindekin J. J. Balanda	Jan. 11	Univ. of Calif. Radiation Lab. Livermore, Calif.	Health Chemistry & Instrumentation.	RA Harvey GD Linsey LV Zuerner	No	300: 329
J.E. Carothers W. N. Roth	Jan. 17-18	Univ. of Calif. Radiation Lab. Livermore, Calif.	Discuss production of highly irradiated plutonium.	JE Faulkner	Yes	300: 303 200-W: 2704-Z, 231, 234-5,

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>
R.E. Heineman	Jan. 7-9	Atomic Energy of Canada, Chalk River	Discuss heavy water technology and reactors.	WB Lewis	Yes
G.W. Stuart	Jan. 28	ANP Dept. G-E Co. Evandale, Ohio	Discuss reactor theory.	F Mezger	Yes
D. J. Donahue	Jan. 28	ANL, Lemont, Ill.	Discuss reactor and lattice physics	BI Spinrad	Yes
G. W. Stuart	Jan. 29	AEC Computing Center NYU, New York, NY	Discuss machine calculations of reactor parameters.	R Van Norton	Yes

DECLASSIFIED

HW-47943

VISITS TO OTHER INSTALLATIONS (CONT'D)

<u>Name</u>	<u>Dates of Visits</u>	<u>Company Visited and Address</u>	<u>Reason for Visits</u>	<u>Personnel Contacted</u>	<u>Access to Restricted Data</u>
D. J. Donahue	Jan. 30-31	APS Meeting New York	Recruiting technical personnel.		No
G. W. Stuart	Jan. 30-31	APS Meeting New York	Present a paper and re- cruit technical per- sonnel.		No

DECLASSIFIED

ORGANIZATION AND PERSONNEL

Dr. G. B. Barton, Senior Scientist, transferred to APED at San Jose, California.

Mr. Frank L. Mourich transferred to Purchasing Operation in Relations and Utilities Operation.

Dr. Duane Barney, Dr. Robert Schuman and Mr. James Coddling of KAPL were interviewed for possible transfer to HAPO.

TECHNICAL ACTIVITIES2000 PROGRAM - PRODUCTION OF FISSIONABLE MATERIALREACTOR

Determination of the plutonium conversion ratios for a channel of I and E slugs and a control channel of solid slugs is underway. Dissolution was accomplished in the Redox Plant. The coulometric titration method is being explored for chemical plutonium determination. That method will reduce the radiation hazard.

In support of organic pile coolant studies, tars are being determined by low temperature-reduced pressure distillation. Further decomposition during analysis is avoided. Pile coolant use of MIPB (mono isopropyl bi-phenyl) yields enough Cl-38 to cause radiation hazard to operators. Subsequent to MIPB experimental irradiations, Cl-38 measurements are being made to assist in defining the amount of hazard. New isotopes were found in the 105-KE organic test loop--P-32 and S-35 at the 0.02 $\mu\text{c/ml}$ and 0.15 $\mu\text{c/ml}$ levels.

Over the last year gross beta particle activity doubled for C, D, H, and KW reactor effluent water. Increase was linear throughout the year by discounting spring run-off.

Experimental pile coolant water is being routinely evaluated for metallic impurities by an emission spectrographic method. Impurities are measured with ± 14 per cent precision, 95 per cent C.L. The following detection limits show general improvement over those of colorimetric methods.

<u>Metal</u>	<u>Emission Spec. Detection Limit</u>	<u>Colorimetric Detection Limit</u>
Aluminum	2 parts per billion	30 parts per billion
Calcium	10	100
Copper	2	2
Iron	5	5
Magnesium	2	30
Manganese	1	10
Nickel	20	2
Chromium	1	2
Lead	5	Not determined
Cobalt	5	Not determined
Zinc	10	Not determined
Zirconium	1	Not determined

DECLASSIFIED

The emission spectrographic method cuts by a factor of four the time required for those measurements. The other metals if required can be measured with very little additional effort.

Reactor Effluent Studies

Analytical results were made available on the November experiment at 105-KE where NaH_2PO_4 was added to the cooling water of a single process tube to determine the effect this corrosion inhibitor would have on the P^{32} output rate in the effluent, compared to a control tube without the additional phosphate. The effluent concentration of P^{32} in the experimental tube was greater by a factor of about twenty at reactor equilibrium conditions. It now appears that this method of treating water to reduce corrosion of aluminum components of HAPD reactors is impractical, unless a recirculating system is used, because of the resultant increase in the activity density (due mostly to P^{32}) in the flesh of Columbia River whitefish.

Evaluation is underway on the possible use of Turco 4306-B, a chemical that may be added to the reactor cooling water to reduce discharge area personnel exposure rates in the discharge area through internal cleaning of pile piping systems. Current plans for testing this method include adding the reagent at a concentration of one ounce per gallon of cooling water during a reactor outage when the flow has been reduced. Estimates are being made of the following disposal consequences of such a test: toxicological effects of reagent in downstream reactor sanitary water systems; physical and chemical effects the reagent might have on downstream water treatment processes; and radiological effects of river contamination due to the sudden removal of radioactive material from the reactor piping system.

Continuous Analyzing Monitor

A safety circuit was designed and assembled which prevents the simultaneous inadvertent operation of two cup positioning mechanisms which could cause damage to the equipment. The gamma detector shield assemblies were received and mounted on the table structure. The second control chassis, which controls beta counting, pipetting, some of the gamma counting control functions, and the Streeter-Amet printer read-in functions, was wired and tested. Improvements in timing accuracy for certain cycles were incorporated into the programmer. The Cu^{64} coincidence channel was modified to permit its output to drive the printer directly.

Complete removal of isotopes other than P^{32} in the P^{32} stream continued to be a problem of concern. It was determined that I^{133} with a 20.1 hour half-life was a primary contaminant. Preliminary efforts to volatilize this isotope by boiling to dryness with nitric acid were not successful. Efforts of Analytical Chemistry were requested to improve the P^{32} procedure.

Further testing of the Dowex-50 columns with reactor effluent showed that at least four weeks of operation at the design sampling flow rate could be realized with insignificant breakthrough. Reproducibility of column performance was demonstrated by operating six columns in parallel flow. Equal efficiencies for cation removal from reactor effluent basins were found. The CuS bed was shown to have a useful life of greater than one week, the anticipated servicing period.

A Skinner solenoid valve was internally coated with Kel-F and a thin rubber diaphragm was supported between valve seat and armature valve stem as an apparently successful design to permit improved resistance to hydrochloric acid corrosion.

The 100-channel analyzer was shipped by the vendor near month end.

SEPARATIONS PROCESSES

Redox

Ca(NO₃)₂ as Salting Agent

Investigation of reducing agents which could be used in combination with Ca(NO₃)₂ as salting agents in the Redox process concerned U(IV). An IBX solution containing U(IV) can be prepared conveniently by reduction of UNH in 1.5 M Al(NO₃)₃ with finely divided aluminum in the presence of a holding reductant. Sulfamic acid, hydroxylamine or semicarbazide can be used as the holding reductant. U(IV) yields of about 95 per cent are obtained. Oxidation to U(VI) on standing is slow, e.g., one solution containing initially 95 per cent U(IV) contained 72 per cent after five days.

Batch contacts of simulated IAP and IBX solutions show plutonium reduction and stripping rates with U(IV) comparable to those obtained with ferrous ion. Distribution ratios for U(IV) into hexone are less than those for U(VI) by a factor of about ten under IB scrub conditions. Batch contacts show that adequate separation of U(IV) from plutonium in the IB scrub section is obtained by four or five scrub contacts without excessive loss of plutonium to the organic phase.

Purex

HA Column Studies

A program was undertaken to develop a cartridge for the Purex HA Column which would provide efficient operation at a capacity factor of four with the organic phase continuous. The experimentation was carried out in a three-inch-diameter glass pulse column utilizing Purex Plant Flowsheet IIA.

Extraction Section. Capacity tests on a nozzle plate extraction cartridge using plates identical to those in the Purex Plant 2D Column indicated satisfactory operation at a pulse frequency of 60 cycles per minute, a pulse amplitude of 1.1 in., and a capacity factor of six.

Scrub Section. Previous studies had indicated that scrub section contacting was generally inefficient with the organic phase continuous unless an alternate phase inversion ("zebra effect") was achieved. Such an effect was obtained for the 2D Column by alternate pairs of stainless steel and fluorothene sieve plates. Principal emphasis in the present study was directed toward obtaining a "zebra effect" without using a plastic material. Various configurations of sieve plates, nozzle plates, louver plates, screened plates, Raschig ring packing, and voids were tested. It was found that with the controlled interface at the bottom of the column an inversion

from the organic phase to the aqueous phase continuous could be achieved in a number of ways, one of the best being two to four 1/8-inch-thick standard sieve plates (23 per cent free area, 0.125-inch-diameter holes) on one-inch spacing. Once an aqueous phase continuous condition has been obtained, however, it has not yet been possible to cause a reinversion to organic phase continuous without the use of plastic.

Bottom Interface Control

Three instruments for bottom interface control of an organic continuous HA Column are under development on test columns in the 321 Building.

A Foxboro 13-A type differential pressure cell controls well but requires daily contact maintenance. The standard silicone oil filled diaphragm and an unirradiated dextrose-filled diaphragm performed equally well.

At the suggestion of the Purex Technology group, a float-type instrument is being evaluated for bottom interface control. The device, as now set up for installation on a test column, consists of a stainless steel float with attached armature which is the core of a position detecting differential transformer. For plant application, the device would be installed on a jumper similar to the way that dip tubes are installed. Preliminary tests with a float, float cage, and armature operating in a 3-foot pulsed column showed that the float followed the interface within 1/32 of an inch at pulse frequencies greater than 40 cycles per minute and within 1/8 of an inch below 40 cycles a minute. Additional tests with this device are underway.

A capacitance probe insulated with aluminum oxide failed to respond to the interface level in actual column operation because, under these conditions, the surface was preferentially wet by the aqueous phase. Experiments are underway to determine if a pretreatment of the alumina might render it organophilic.

Mini Runs

Results in recent mini runs indicate that the unusually high decontamination factors of four to ten observed on occasion in batch stripping steps following runs at 60 C in the "A" unit probably arise from solvent "aging" effects. Stripped solvent from such a mini run exhibited a value for $E_Q(U)$ in the "C" contact test of 0.091. This value dropped to 0.007 after the solvent was given a carbonate wash. It is of interest to note that the plutonium loss in this stripping operation was only 0.007 per cent, however.

A recent run employing ten mini extraction stages and an extended scrub section comprising 27 mini scrub stages all operated at 60 C resulted in a gross gamma decontamination factor of 4.8×10^5 through the "A" unit and an exhaustive batch stripping operation simulating a "C" column. A "low-acid" single scrub flowsheet was used in this run with 0.067 molar Versene added to the scrub (yielding 0.027 molar Versene in the aqueous waste). The gross gamma decontamination factor through this stripping operation was high in this run also, a value of 7.4. Analysis for dibutyl phosphate in the stripped organic (HCW) from this run showed 0.040 grams DBP per liter. The plutonium loss in this stripping operation was only 0.08 per cent, however.

DECLASSIFIED

"Aging" of 30 per cent TBP in Soltrol 170 by exposure at 60 C to aqueous solutions similar to those encountered in the mini "A" unit caused the distribution coefficient (organic/aqueous) for zirconium into this solvent to be increased. Exposure for 100 minutes, approximately the total solvent hold-up in a mini "A" unit with an extended scrub section, resulted in doubling the zirconium distribution coefficient at the low uranium end of a sequence of batch operations simulating a "C" column.

Profile Column Runs

An additional run with bottom interface, organic-continuous operation of the profile column confirmed the results reported in the last progress report, i.e., the scrub section HTU for zirconium tracer increases as the uranium concentration in the organic phase increases. With organic-continuous operation scrub section HTU values for zirconium were 2.3 feet at a uranium product concentration of 72 grams uranium per liter, 3.4 feet at a product concentration of 92 g/l, and 6.5 feet at a product concentration of 99 g/l. This effect is similar to effects observed with aqueous-continuous operation.

Ion Exchange Studies

The moving-bed ion-exchange contactor was operated continuously for two weeks circulating Dowex 50W(8X)-50 to 100-mesh resin to test mechanical stability of the resin. Microscopic examination of the resin after the test revealed no significant increase in broken particles.

After laboratory testing, the Purex Plant prototype resin reservoir containing twenty-four conductivity probes has been installed on the 321 Building unit for test prior to shipment to the Purex Plant. During the test, efficiency runs will be made on Dowex 50(8X)-20 to 50-mesh resin.

The C-Column conductivity bridge was received and adjusted to cover the following ranges of nitric acid concentrations:

0.1 to 1.0 grams/liter
1.0 to 10.0 grams/liter
10.0 to 100.0 grams/liter

The control function on the bridge can be set to operate the slip water valves at any point within the above spans. This bridge is being tested on the 321 Building column before installation in the Purex prototype.

WASTE TREATMENT AND FISSION PRODUCT RECOVERY

Cesium Recovery from Purex Waste

Further work has been done to evaluate calcination followed by water leaching as an alternative to the already demonstrated calcination-chlorination and wet chemical flowsheets for converting cesium zinc ferrocyanide to a product suitable for fabrication into a stable radiation source. It was found that calcination in air at either 550 or 650 C followed by leaching with water removed all of the cesium and that none

DECLASSIFIED

was volatilized. It was also found that no appreciable fraction of the zinc or iron was solubilized by this treatment. It is, therefore, possible to recover pure cesium chloride simply by acidifying the leach solution with hydrochloric acid and evaporating to dryness. The complete results are shown in Table I.

TABLE I

CALCINATION-LEACHING OF CESIUM ZINC
FERROCYANIDE - EFFECT OF TEMPERATURE AND ATMOSPHERE

<u>Calcination Temp.</u> <u>°C</u>	<u>Atmosphere</u>	<u>% Cesium in</u> <u>Water Leach</u>	<u>% Cesium</u> <u>Volatilized</u>
350	Air	45	0
450	Air	75	0
450	Oxygen	95	0
550	Air	100	0
650	Air	100	0
700	Air	95	5

A temperature of about 550 C appears to be optimum.

Removal of Cesium from Redox Waste

The experimental work on this problem has been completed, and a summary report is being prepared.

Americium Recovery

Calculations have been made of the amount of americium-241 which is introduced into the Purex process via the feed. It is found that for 600 MWD/T uranium, the americium concentration will range from about 0.1 to 0.4 grams/ton U for 90 to 200 day irradiation times and 120 day cooling. Since americium-241 is a daughter of plutonium-241, the amount present in the Purex feed is larger the longer the cooling time prior to processing and the longer the irradiation period, i.e., the lower the specific pile power. At present processing rates, the above concentrations correspond to a production rate of about 45 to 180 grams Am²⁴¹/month. The present trend toward higher pile power levels and shorter cooling times would favor the lower value.

From a consideration of the chemistry of americium, it is believed that essentially all of this material is going into the IWW stream. Work is underway to verify this and to develop recovery processes.

Neptunium Recovery

An intensive effort has been carried out with pile produced neptunium-239 tracer to determine the extraction behavior of the various neptunium valence states into tributyl phosphate, to resolve discrepancies in the extraction data reported by various sites, and to determine the kinetics of oxidation and reduction in nitrate systems.

The results obtained for the distribution of neptunium(IV) into 30 per cent TBP - Shell 2342 as a function of nitric acid are shown in Table II, and the effect of uranium saturation on this extraction is shown in Table III, each number representing the mean of several determinations. The nitric acid data is in good agreement with some work reported by the Canadians. The uranium saturation data, on the other hand, differs considerably from that reported by Oak Ridge, their extraction coefficients being much smaller than ours and relatively unaffected by uranium saturation. It would appear that the Oak Ridge solutions contained a large fraction of the neptunium in the relatively inextractable(V) state. From the data in Table III, one can compute a minus two order dependence on free TBP concentration, in agreement with British investigators.

TABLE II

EFFECT OF NITRIC ACID ON
NEPTUNIUM(IV) EXTRACTION

Organic: 30% TBP in Shell E-2342
Aqueous: 0.1 M ferrous sulfamate, indicated
nitric acid.

<u>M HNO₃</u>	<u>Np(IV) E_a^o</u>
1	0.3
1.5	0.8
2	1.5
3	2.6
4	4.2

TABLE III

EFFECT OF URANIUM SATURATION ON
NEPTUNIUM(IV) EXTRACTION

Conditions similar to Table II

<u>U Saturation Per Cent</u>	<u>Np(IV) E_a^o</u>	
	<u>1.5 M HNO₃</u>	<u>2 M HNO₃</u>
0	0.8	1.5
10	0.75	1.35
20	0.65	1.1
35	--	0.9
40	0.4	--
50	0.3	0.5
60	0.2	0.3
70	0.1	0.2

SECRET

~~SECRET~~

C-8

HW-47943 ~~SECRET~~

The Oak Ridge reported reduction of neptunium(VI) in the organic (TEP-hydrocarbon) phase was confirmed. However, it is found that the reduction product is (V), rather than (IV), and that the half time of reduction is two to three minutes. In general, the results of the current investigation have confirmed that the stable neptunium oxidation state in nitrate solutions, particularly in the presence of nitrite, is (V). It has also been found, as expected, that the (IV) - (V) transition is generally much slower than the (V) - (VI). The extractability of the (V) is accordingly being investigated. Preliminary results indicate that the extraction coefficients are very small at low aqueous nitric acid concentrations but that the neptunium(V) extraction has a very high acid dependence and that the extractability from 3 to 4 M acid may be high enough for practical recovery. Further experiments are being done to verify these findings, and flowsheets for mini scale mixer settler testing are being prepared.

The possibilities of analyzing mixtures of Np-237 and Pu-239 by gamma and x-ray counting were explored. Since Np-237 emits many more gamma and x-rays per alpha disintegration than Pu-239, the ratio of gamma and x-ray counts to alpha counts may be used to analyze mixtures of these isotopes. A gamma spectrometer was adjusted for integral counting above 5 kev with both a gas filled proportional detector and a 2 mm NaI(Tl) scintillation detector. The following results were obtained.

GAMMA TO ALPHA COUNT RATIO

	<u>2 mm NaI(Tl)</u>	<u>Gas Proportional</u>
Pu-239	0.003	0.007
Am-241	0.17	0.04
Np-237	0.35	0.44
46% Np-237 plus 54% Pu-239	----	0.23

The interference of fission products would be severe although some discrimination could probably be obtained by differential gamma counting techniques or alpha-gamma coincidence counting. Although this method may be useful for certain applications, the alpha energy analysis method for Np-237 analysis is preferred.

WASTE TREATMENT, FISSION PRODUCT RECOVERY

Disposal to Ground

An investigation was started to estimate the removal by soil of uranium from UO₃ plant uranium wastes. This information was required to establish realistic limits for the ground disposal of UO₃ plant wastes that currently are rerouted to the Uranium Recovery Plant for processing. After shutdown of the URP an alternate disposal method will be required. A sample of C-2 waste was determined to be at pH 1.6. The addition of sodium hydroxide to the waste resulted in precipitate formation beginning at approximately pH 4.5 and continuing well into the alkaline range. A measurement was made of the concentration of uranium remaining in the supernate after adjusting the system to the basic region. Approximately 99 per cent of the uranium was carried down with the precipitate. These results suggest that pH adjustment and retention of the precipitate in a catch tank to be a possible means of treatment.

~~SECRET~~
DECLASSIFIED

A review of the disposal of uranium-containing wastes in the 300 Area was made to determine the ratio of river concentration to pond concentration and to ground water concentration. Ground water in the wells near the river has approximately the same concentration as that in the ponds; river concentrations ranged from 1/100 to about 1/10,000 of that in the ground water, suggesting appreciable dilution from such a shoreline discharge. Further work was scheduled to permit improved river concentration measurements. The work bears not only on the question of 300 Area operations but also on the fundamental problem of river dilution of materials admitted from a line source at the shore and this in turn to the whole question of possible separations plant contributions to the contamination pattern of the river.

An evaluation was made of the radiological consequences of releasing three million gallons of high level Purex wastes from tanks and unrestricted emission of 50,000 pounds per hour of boiling tank condensate. Serious ground contamination would result from the aerosol and vapors from the condensate. Dose rates would result up to hundreds of mrad/hr., measured at three feet from the ground. Air concentrations up to 80 times MPC would occur at points 10 meters from the discharge stack and 4 times MPC would be experienced at points 50 meters from the stack. The seriousness of loss to the ground of large volumes of high level wastes was determined within the hypothesis that all waste except that retained through specific retention would eventually reach ground water. A leak of small dimensions was assumed for conservatism. Under the assumption of negligible adsorption by the soil and radioactive decay during transit to the Columbia River, it was determined that the entry of one-half gallon of waste per day to the River would produce a concentration equal to the off-plant limit for drinking water. Assuming that soil decontamination might give a reduction in concentration of 1000, an entry rate of 500 gallons per day would produce the same concentration, a concentration which if exceeded might call for the drastic measure of limiting or withdrawing the Columbia River from public use. Lead rates of such magnitude could conceivably be postulated. Although somewhat improbable assumptions were made, the limited knowledge of soil adsorption of high activity Purex wastes, travel time to the Columbia River, type of tank failure postulated, and shoreline discharge dilution factors, as well as the magnitude of the consequences justify a continued conservative approach.

Special Geological Studies

Water table gradient changes in the vicinity of 200 East Area show a clear-cut and direct relationship to the detailed stratigraphy of the area. Flat gradients occur in beds that are clearly highly permeable and steeper gradients in those beds obviously less so. The flattest gradient under natural conditions has been in a bed of sand and gravel up to about 100 feet thick in the lowest part of the Ringold formation. This particular bed pinches out toward the east and the north and is replaced by the clays which become predominant in the section and inhibit the movement of the groundwaters. Study of the groundwater in the more permeable sand and gravel should provide data on the potentially most rapid movement of the groundwaters and any contained contaminants.

Observation Wells

A ground water depth sampling device was used in a well in the 200 East Area to study the relationship between the geologic stratigraphy and the movement of contaminated

DECLASSIFIED

DECLASSIFIED

C-10

HW-47943

ground water. Well No. 299-E28-2 was tested with a "delayed action" sampling device that collected samples from five different levels of the ground water. Sediment samples and the drilling log from this well indicated a probable low permeability of the sediments near the surface of the water table compared to that of the sediments at 20 feet below the water table. During a series of sixteen daily samplings of the well low-level contamination appeared in some of the samples. The contamination was detected in samples from the 20-foot depth eight days prior to its appearance in samples obtained from one foot below the water table. Sample data for the sixteen sets of samples are shown in the following.

TEST WELL 299-E28-2 DEPTH SAMPLING DATA
UNITS OF 10^{-8} uc/cc

Depth Below Water Table (ft.)	CONSECUTIVE SAMPLE NUMBER															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	0	5	2	0	5	5	5	10	1	0	9	20	20	10	5
5	4	3	7	5	6	3	2	6	10	5	7	7	20	20	10	10
10	2	5	10	5	4	6	5	6	1	7	7	20	20	20	20	9
15	4	10	20	4	0	0	10	6	8	1	6	10	30	10	30	7
20	8	20	50	10	6	30	10	10	20	6	10	50	40	30	90	40

An apparent periodicity in these data may be the result of batch-wise waste disposal to the scavenged waste cribs.

The gamma scintillation well probe showed the presence of contamination at a depth of 190 feet beneath the BC crib site. The probe was unable to analyze the gamma radiation for specific isotopes because of malfunction of some of the components.

Influence of Cooling Water Swamps on the Water Table

The disposal of cooling water to the various disposal sites at the present time is estimated to be:

Purex swamp	- - - - -	7×10^6 gal/day
T-Plant swamp	- - - - -	1×10^3 gal/day
222-S swamp	- - - - -	1.5×10^4 gal/day
U-Plant swamp	- - - - -	4.5×10^6 gal/day
S-Plant caverns	- - - - -	1.5×10^6 gal/day

Anticipated changes in these totals include: discharge rate to the Purex swamp is expected to increase to at least 1.2×10^7 gal/day but the timing is uncertain; T-Plant swamp discharge rate to decrease soon to 700 gal/day; after March 1, 1957, the U-Plant swamp discharge rate to drop to less than 2×10^6 gal/day; about 85 per cent of the flow to the Redox caverns to be diverted to a new swamp. The 200 East Area ground water mound is expected to increase no more than about one foot in height during the next year if the present discharge rate is maintained during that period.

The 200 West Area ground water mound will be somewhat altered during the next year, with a gradual increase in the southwest to northeast gradient beneath the area. This will produce an increased rate of movement toward the northeast of ground water contaminants beneath the T-Plant.

In Well Measurements

Testing of the scintillation probe for operational procedure appraisal showed certain instrument malfunctions. Instability of the base line and poor resolution were found to be due to failure of circuit components.

The deep well submersible pump was prepared for pumping tests as soon as weather permits. Preliminary tests will be with shallow wells.

The development of an in-well casing perforator was considered; time and cost requirements indicated that the present perforation method would have to be continued for at least the next year. It is planned to obtain estimates for getting this work done by concerns employing shaped charge and ballistics perforators.

Cobalt⁶⁰ in Scavenged Metal Recovery Plant Wastes

The continued presence of Co⁶⁰ in TBP scavenged supernates above the recommended cribbable limit of 4×10^{-5} uc/cc necessitated recommending tank storage or ground disposal on a specific retention basis of all TBP waste scavenged during January. To date 9.5 million gallons of high Co⁶⁰ waste have been disposed on a specific retention basis at the BC trenchsite. It is estimated that 1 to 1-1/2 million gallons of scavenged waste will be produced before the TBP building scavenging program is terminated. Co⁶⁰ concentrations in the last three batches of scavenged waste averaged 3×10^{-4} uc/cc, or 7.5 times the present recommended cribbing limit. Plans for a "use test" disposal of Co⁶⁰ materials progressed toward exact formulation.

Process Development

An investigation of the mechanism of the reactions of ruthenium with silica and alumina surfaces was considered to be important to the interpretation of the adsorption of ruthenium on silicate surfaces from process wastes, and the development of possible methods for the removal of ruthenium from wastes. The investigation of the adsorption of ruthenium tetroxide was continued in an effort to define the mechanism of the adsorption process. Pure ruthenium tetroxide was prepared and samples in carbon tetrachloride were equilibrated with 400 mesh silica powder which had been outgassed at 300 C and then cooled. The amount of ruthenium tetroxide adsorbed by the silica was determined and the resulting adsorption isotherm indicated the formation of a monolayer on the silica by a physical adsorption process. Plans were made to measure the heat of adsorption and to perform rate studies to better define the adsorption mechanism.

DECLASSIFIED

Fission Product Chemistry

It was reported last month that boiling with urea or sulfamic acid or boiling at reduced acidity was effective in decreasing the solvent extractability of a labelled ruthenium nitrosyl preparation. Since the sodium nitrate solution employed was not buffered, it was not clear whether the results with the nitrite suppressors were due to destruction of the NO group or simply to reduction of acidity through hydrolysis. Further experiments with aluminum nitrate - nitric acid solutions, in which the 1.5 M ANN exerts a buffer action, show that the nitrite suppressors did indeed have a specific effect. Boiling for one hour with one gram per liter of urea or sulfamic acid reduced the extraction coefficient from 1.75 to values of 0.21 and 0.24, respectively. It thus appears that nitrite destruction and decreased acidity produce similar effects. In other experiments, it was found that an anion exchange resin (Dowex-1) tended to preferentially adsorb the solvent extractable ruthenium species.

CHEMICAL INSTRUMENTATION - PROCESS CONTROL

Determination of Plutonium in First Cycle Waste

The ion exchange method (Dowex 1) previously described for separating plutonium in wastes from americium and fission products has been evaluated more completely. A miniature laboratory column has been used repeatedly through many cycles to recover 95 per cent of the plutonium from HAW samples at concentrations equivalent to 0.2 to 50 per cent waste losses for 900 MWD/T feed. The complete cycle including column regeneration can be done in 20 minutes. Americium separation is essentially complete and gamma and beta decontamination factors are 5×10^2 and 1×10^3 , respectively.

Determination of Uranium at Low Levels

For some process streams, polarography is unattractive as a method for low level uranium monitoring. Accordingly, alternate methods such as colorimetry and titrimetry must be considered. A coulometric titration method for uranium, described in an Idaho Falls research report, appears to be sufficiently sensitive and adaptable to automatic control. In this method, the uranium is reduced by electrolysis over a mercury pool with controlled cathode potential. Interfering elements are first removed by electrolysis at a lower cathode potential. An apparatus similar to that described in the referenced report has been assembled, and exploratory work is being carried out. The method appears capable of readily detecting two micrograms of uranium.

Plutonium Dioxide Studies

A study of the reliability of standardizing plutonium solutions by ignition to PuO_2 has been completed and a topical report is being prepared. A ten gram sample of pure plutonium metal was cleaned of oxide and dissolved to make up a solution of accurately known concentration. Several aliquots of this solution were analyzed by ignition to constant weight of PuO_2 at 1050 to 1100 C. The recovery of plutonium was 100 per cent within a precision (σ) of ± 0.04 to ± 0.06 per cent.

[REDACTED]

DECLASSIFIED

DECLASSIFIED

Determination of U-235 by Gamma Counting

The research on the gamma counting method for U-235 as applied to enriched uranium-aluminum alloys has been completed, and a topical report is being prepared. The study established the optimum sample preparation and counting methods and included an evaluation of possible interferences by other gamma emitters. It was found that the interference of U-234 is negligible within the counting precision obtainable (± 0.2 per cent relative) and if an initial growth period of about 12 days is allowed for the first U-235 daughter, no significant errors are incurred from further daughter growth after uranium purification.

Contact Alpha Counter

A Task I supernate sample containing 5.8 g/l of plutonium was cycled through the contact alpha counter now operating in the 222-S Laboratory. With the cell in use, the counting rate exceeded the range of the instrument until the discriminator voltage was increased. This means that the surface area of the phosphor must be decreased for this level of plutonium. Results from this laboratory run indicate that with an open center cell and with a small phosphor area the instrument will be satisfactory for monitoring the Task I supernate. A suitable cell for plant installation was designed and is being fabricated.

Uranium and Dichromate Photometers

The demonstration of the Project CG-686 uranium photometers was satisfactorily completed. The final demonstrations were carried out in a simulated Purex Plant sampling system with uranium concentrations ranging up to 350 g/l.

Basic development information furnished by the Chemical Research Operation indicates that a dual-filter photometer is satisfactory for monitoring the dichromate concentration in the Redox HAIS and 2DF streams. On the basis of this information, development has started on a plant-type, dual-filter, self-degassing dichromate photometer. Results to date indicate that a high-impedance recorder will satisfactorily handle the relatively dilute HAIS solution, while a standard Brown recorder coupled with a Beckman micro-microammeter is necessary for the more concentrated 2DF stream.

Purex Iodine Monitor

The gamma scintillation iodine monitor located on the C-Dissolver at Purex is detecting a 0.52 mev. gamma activity during dissolutions. This corresponds to the ruthenium-106 gamma, but the 0.62 ruthenium gamma does not appear. This, together with the observation that there is no evidence of ruthenium at the end of the dissolution period, leads to a review of the possible gamma contributors other than ruthenium. The most likely gamma emitter at this energy is krypton-85 with a 10-year half-life. To aid in collecting data for this study, a recorder was converted to provide an automatic base line drive for the differential analyzer on the iodine monitor. With this added recorder, the monitor can be used as a recording gamma spectrometer. Studies on both the dejacketing and dissolving cycles will be carried out with this equipment.

Purex Gamma Absorptometer

The Purex L-Cell absorptometer reached the end of the compensating amplifier adjustment for decreased source intensity. This was not unexpected since the thulium-170 gamma source is now about one year old and has gone through somewhat over two half-lives. The instrument was reset to place the "empty cell" reading at 50 per cent of scale and the output of the Beckman amplifier changed from 50 to 100 millivolts. It is hoped that this measure will permit continued use of the absorptometer until such time as the instrument can be installed on the resin bed with the americium-241 source.

EQUIPMENT DEVELOPMENT

Pumps

The Johnston splined-shaft deepwell turbine pump, with Pyrex (Corning #7740) glass bearings and liquid throttle bushings was inspected after 569.9 hours of smooth operation pumping 60 per cent nitric acid at 170 gpm against a head of 86.2 feet. Wear of the bearings varied from a maximum of 1.7 mils on the second bowl bearing down to zero on the others. The hardened 17-4 PH stainless steel journals were not measurably worn or scored. For comparison, the CSGBF pile graphite vapor throttle bushings were worn 4.5 mils.

A titanium Chempump, Model SF, failed after 2428 hours pumping nitric acid (9.5 gpm, 65.5 feet of head) when the titanium shaft lugs used for securing the impeller sheared. Measurements showed that the Carbolube AP-80 bearings wore 5.6 mils on the end opposite the impeller but less than 1 mil at the impeller end. The Teflon thrust faces were scored an estimated 2 to 3 mils but increased in thickness up to 4.3 mils, indicating that some swelling of the material had occurred. On the other hand, the titanium shaft was unworn and remained in excellent condition. A redesigned shaft is being fabricated.

Titanium Tube Heat Exchanger Prototype

Fabrication of the new titanium-tube prototype product concentrator for the Purex L-cell was completed using titanium welding techniques which produced ductile weld metal as demonstrated by bend tests. The fusion welds joining the tubes to the tube sheet facings on the heat exchanger were bright and silvery, indicating good inert gas shielding during the welding operation. Dye penetrant tests have revealed no cracking of weld metal to date. Until the tube bundle is placed into service, periodic dye checks are planned to see if delayed cracking will occur; also, the unit is to be tested under simulated service conditions.

Materials of Construction

Flexure Tests of Irradiated Plastics

Super Dylan (Koppers Company), a high density, linear polyethylene is being flexure-tested at various levels of exposure to gamma radiation. Preliminary results indicate

DECLASSIFIED

that flexure life is little affected by exposure to 10^7 R, is doubled by exposure to 10^8 R, and is increased ten times by exposure to 10^9 R. There is a slight increase (10-15 per cent) in modulus of elasticity with increased exposure.

Chemical Compatibility

Homalite 141 and CR-39 (Homalite Corporation), both clear plastic sheet materials, were tested by static immersion at room temperature. The results listed below indicate that the CR-39 is, from chemical requirements, suitable for replacing Lucite in Recuplex hoods.

<u>Solution</u>	<u>Homalite 141 (65 Days Exposure)</u>	<u>CR-39 (56 Days Exposure)</u>
60% Nitric Acid	Failed - three days	Failed - 19 days
50% Caustic Soda	No appreciable change	Clouded slightly
Carbon tetrachloride	Swelled 0.65%, softened	No visible effect
Recuplex CAX	Yellowed, softened, little loss of transparency	Yellowed slightly, no other effect
Purex HAX	Yellowed slightly, softened slightly	No visible effect
Hexone	Failed - 10 days	No visible effect
Distilled Water	Swelled 0.1%, softened, clouded	Swelled slightly, softened slightly

Carbon-graphite materials of various grades were tested in a simulated LAFS (Redox) solution at its boiling point for a period of 31 days. The results tabulated below show that dimensional changes occur which may contribute to the failure of graphite bearing-equipped Redox pumps.

<u>Material</u>	<u>% Change</u>		
	<u>Weight</u>	<u>Hardness</u>	<u>Linear Dimension</u>
AP-80 (Carbolube)	- 0.86	-2	+ 0.13
TS-GBF (Pile Graphite)	- 2.28	-4	+ 0.34
CS-GBF (Pile Graphite)	- 0.89	-8	+ 0.27
CS-312 (Nat'l Carbon)	- 1.13	-5	+ 0.21

Corrosion Studies

Corrosion rates observed for sensitized 347 stainless steel under heat transfer conditions ranged from 0.0001 to 0.0200 ipm at a surface temperature of 120 C and nitric acid concentrations from five to 70 per cent. At a surface temperature of 145 C., corrosion rates varied from 0.0007 to 0.1000 ipm over the same range in nitric acid concentrations. Thus, the corrosion rate doubles, approximately, for each 10 degrees rise in surface temperature.

Further studies of the crevice corrosion around gaskets observed with nitric acid alone in laboratory heat transfer equipment have eliminated sodium, sulfate, and ferric ions as crevice corrosion inhibitors. Since crevice corrosion was not observed

CLASSIFIED

DECLASSIFIED

C-16

HW-47943 CBI

in this equipment when synthetic Purex 2WW waste was studied, it was thought some constituent of this waste served to inhibit such corrosion. Changes in gasket geometry so far tried have also not decreased the crevice corrosion with nitric acid.

Many analyses for Cr(VI) in nitric acid previously made for the Corrosion laboratory have been in error due to slow reduction of Cr(VI) to Cr(III) in the samples prior to analysis. Previous determinations of the critical level of Cr(III) for corrosion acceleration (K. L. Sanborn-1954) are being re-examined. It appears, from preliminary data, that accelerated corrosion previously ascribed to Cr(III) is in reality due to Cr(VI) which reduced to Cr(III) prior to analysis.

Mr. W. E. F. Smith of Savannah River discussed corrosion problems here during the past month. It is interesting to note that the Savannah River Plant has experienced several corrosion failures of 309 SCb equipment due to preferential attack in and around welds. This coincides with Hanford experience and supports the contention that 304L stainless steel, although inferior to 309 SCb on the basis of base metal corrosion, is a better candidate for applications involving nitric acid corrosion since it is not as subject to preferential attack at welds.

UO₃ CONVERSION

UO₃ Studies

Further analysis of the effect of reduction temperature on the surface area of the resulting uranium dioxide has suggested a correlation which may be valid for predicting the reaction characteristic of the starting material. The surface area of UO₂ produced from UO₃ or U₃O₈ decreases with increasing temperature of reduction because of sintering, which occurs during the reaction. Uranium trioxide produced by pot calcination shows a smaller surface area variation with reduction temperature than continuously calcined UO₃, thus indicating less sintering takes place. The change in UO₂ surface area for reduction at two temperatures is, therefore, a measure of the sinterability of the powder. In addition, it has been generally observed, that reaction rates increase with increasing surface area, other parameters being constant. These relationships of surface area, sintering and reaction characteristics have been utilized in defining a "Reliability Index" (R.I.):

$$R.I. = \frac{\text{Surface Area of UO}_2 \text{ reduced at 800 C.}}{S.I.}, \text{ where}$$

$$S.I. = \text{Sintering Index} = \text{Surface Area of UO}_2 \text{ reduced at 700 C} - \text{Surface Area of UO}_2 \text{ reduced at 800 C.}$$

A high value of R.I., of course, indicates a desirable type of UO₃ powder. Preliminary application of the Reliability Index to a variety of powders gave values ranging from 3.2 for activated continuous powder (reduction-oxidation-reduction cycle), to 0.8 for composite Car 3 continuously calcined powder. The value for HAP0 standard pot powder was 1.3. Surface area data on UO₂ obtained from the reduction at 870 C was similarly treated giving reliability index values quite consistent with their

reaction characteristics. Continuous powders ranged from 0.4 to 1; pot powders from 1.3 to 2.3 depending upon their origin. Further correlations will be made to check the validity of this testing method. It is believed to be more than an empirical method since it is based upon factors fundamental to the reaction behavior of these powders.

Further investigation of the reduction-oxidation cycle for activating UO_3 powders has disclosed the best conditions for this procedure to be:

1. Reduction of UO_3 at 550-600 C.
2. Oxidation at 500-550 C.
3. Hydrogen partial pressure is not important.

Following this treatment reduction may be done at any temperature up to 1000 C.

X-ray diffraction analysis of partially reduced continuously calcined UO_3 samples disclosed the presence of the following coexisting species: Type III UO_3 , U_3O_8 and UO_2 . Thus, U_3O_8 is an intermediate in the reduction process.

X-ray diffraction analyses of samples from various drums of continuously calcined UO_3 showed remarkably consistent crystalline compositions, although low and high temperature reactivity ratio measurements on the same material fluctuated quite markedly. This is again indicative that crystal habit rather than crystal composition is the important factor in reaction behavior.

Unmilled continuously calcined UO_3 was converted to $\text{UO}_4 \cdot 2\text{H}_2\text{O}$ by treatment with 20 per cent excess hydrogen peroxide. There was apparently no change in particle size during the reaction and filtering characteristics were excellent. When calcined at 400 C for 2 hours, 100 per cent amorphous UO_3 was obtained.

Pressurized Feed System - Continuous Calciner

Further studies of the pressure-temperature relationship in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 3.1\text{H}_2\text{O}$ were conducted in the temperature range 60-157 C. The following information was developed:

1. In the two phase region above 149 C,

$$\log p = \frac{-2160}{T} + 8.211.$$

2. In the three phase region consisting of dihydrate, solution and vapor which is stable between 113 C and 149 C,

$$\log p = \frac{-1291}{T} + 6.152$$

DECLASSIFIED

DECLASSIFIED

3. In the three phase region consisting of trihydrate, solution and vapor, which is stable between 60 C and 113 C,

$$\log p = \frac{-1043}{T} + 5.507.$$

These findings indicate a higher value for the vapor pressure than reported by Wedolkowski and Kirslis (K-1086). For example, for the system $\text{UO}_2(\text{NO}_3)_2 \cdot 3.1 \text{ H}_2\text{O}$ at 76 C, K-1086 reports a vapor pressure of 135 mm Hg while this study gives a value of 328 mm Hg.

NEW PROCESSES

Anion Exchange Process

The effect of elevated temperature on capacity, breakthrough characteristics, and fission product decontamination was studied. A 45 cm column of Dowex 1 X-4 (50-100 mesh) was loaded at 60 C using a 7.2 M HNO_3 feed solution prepared from Purex IBP. The loading flow rate was 15 ml/min/cm². The loading band was much sharper than at 25 C with 190 column volumes required to bring the visible front of the band to the bottom of the column. This corresponds to an average capacity to visible breakthrough of 105 g Pu/l resin which is approximately twice that attainable at 25 C under similar conditions. The column was further loaded by passing on additional 35 column volumes of feed through in a manner similar to that employed in series column operation. The resin which had undergone about 25 per cent shrinkage during the plutonium loading was then washed at 60 C with twelve column volumes of 7.2 M HNO_3 at a flow rate of 3.5 ml/min/cm². The fission product (Zr-Nb and Ru-Rh) wash-off from the resin was followed and did not measurably differ from that obtained at 25 C at the same flow rate.

Elution was carried out at 60 C with 0.25 M HNO_3 at a flow rate of 0.5 ml/min/cm². The elution was very sharp with the product concentration rising very rapidly to 60 g/l and remaining practically constant until the plutonium band had left the column. It appears that under these conditions the elution is controlled by equilibrium rather than kinetics so that faster elution flow rates can probably be used without affecting the product concentration. A small amount of the plutonium remained on the column, and it was necessary to allow the resin to stand several days in 7.2 M HNO_3 before this could be eluted completely. It has not yet been established why this retention occurred. Fission product decontamination was excellent, a decontamination factor of 4100 for Zr-Nb and greater than 5000 for Ru-Rh being obtained.

Dissolution of IPR Fuel Elements

Work on this problem during the report period has been concentrated on exploring the possibilities of substituting for fluoride, other agents capable of forming stable complexes with zirconium, hoping, thereby, to reduce the concentrations of fluoride required to effect dissolution of zircalloy jackets. Systems which have been studied (all at their boiling points) include mixtures of hydrofluoric acid or potassium fluoride with oxalic acid, tartaric acid, ammonium fluoride, ammonium hydroxide, ammonium thiocyanate, and ammonium oxalate.

Addition of oxalic acid enhances the rate of dissolution of zircalloy in hydrofluoric acid systems. Thus, the rate of dissolution* was 32 mg/min, cm² into a solution 0.9 molar in oxalic acid, one molar in hydrofluoric acid, and 0.23 molar in zirconium as compared with 14 mg/min, cm² in a solution one molar in hydrofluoric acid and 0.21 molar in zirconium. Increasing the oxalic acid concentration also reduces the rate at which the dissolution rate diminishes with increasing zirconium concentration. Dissolution rates were 6, 3.3, and 2 mg/min, cm² for dissolution into a solution 4.5 molar in oxalic acid, 0.1 molar in potassium fluoride and containing, respectively, 0.1, 0.2, and 0.3 molar zirconium. By comparison, dissolution rates were 5.3 and 1.7 mg/min, cm² for dissolution into 0.9 molar oxalic acid, 0.1 molar potassium fluoride containing, respectively 0.1 and 0.2 molar zirconium.

The dissolution rate is still quite sensitive to fluoride concentration in mixtures of oxalic acid and fluoride. With 0.9 or one molar oxalic acid solutions measured dissolution rates were in the region of 15 to 30 mg/min, cm² with one molar fluoride, as compared with 1.5 to 6 mg/min, cm² for 0.1 molar fluoride, and about 0.1 mg/min, cm² for 0.01 molar fluoride.

Measurable dissolution rates in the range 1.1 to 0.5 mg/min, cm² were obtained with 4.5 molar tartaric acid containing 0.1 molar potassium fluoride for zirconium concentrations ranging from 0.02 molar to 0.09 molar. The dissolution rate into 4.5 molar acetic acid, 0.1 molar potassium fluoride decreased very rapidly with increasing zirconium concentration.

Of special interest are the experiments employing a mixture of ammonium fluoride and ammonium hydroxide. A mixture one molar in ammonium fluoride and two molar in ammonium hydroxide yielded a "dissolution" rate of 2.3 mg/min, cm² at a zirconium "concentration" of 0.05 molar and 1.1 mg/min, cm² at a zirconium "concentration" of 0.17 molar. By contrast, a solution one molar in potassium fluoride did not attack zircalloy-2.

The rate of attack of uranium by a number of these reagents has also been examined, but results to date are incomplete and inconclusive.

Flurex Development

A three-compartment electrolytic cell was used for study of current efficiency and water transport under possible Flurex operating conditions. With Rohm and Hass cation and anion membranes, current efficiency for uranium transport was essentially constant as HNO₃ concentration in the anolyte was varied from 0.5 to 4.0 M, indicating negligible back-transfer of hydrogen ion from the anode to the feed compartment for this acidity range. Current efficiency increased about four per cent for each ten degree increase in feed temperature in the range 30 to 50 C. Transport of water into the anode and cathode compartments appears independent of operating conditions and amounts to about 0.5 and 3.5 ml/g U for anode and cathode compartments, respectively.

*Dissolution rates are averages over the dissolution period. Zirconium concentrations are terminal - all were zero at initiation of dissolution.

DECLASSIFIED

DECLASSIFIED

Further studies on the anodic corrosion of platinum show that the corrosion rate decreases with nitric acid concentration in the range 0.15 to 1.0 M. These results indicate the desirability of operating the anode compartment at as high acidity as permitted by back-transfer of hydrogen ion into the feed compartment.

Conductivity measurements have been made on nitrate-form Permutit Anion Membrane 3148 equilibrated with nitric acid solutions ranging from zero to 4.0 M. Specific conductivities ranged from 0.941×10^{-3} to 7.11×10^{-3} ohm⁻¹ cm⁻¹, corresponding to a maximum resistance (0 M HNO₃) of 24 ohms/cm² for the commercially available film (0.009 inch thick). Similar measurements will be made for other commercially available films to provide design data for a pilot plant.

To gain experience with operating a Flurex cell, several runs were made with the laboratory-scale unit to produce KUF₅, NaUF₅ and NH₄UF₅. Current efficiencies for reduction ranged from 91 to 100 per cent. In all of these runs, the catholyte (including non-settled solids) was recycled back to the cell. In preparation for tests, of other cathode materials (in lieu of mercury), a run was made in which solid was removed from the catholyte by a solid bowl centrifuge before recycle to the cell. Reduction current efficiency was only 58 per cent in this run. Explanation for the loss in efficiency is being sought.

HOT SEMIWORKS MAINTENANCE

The coil on the service waste concentrator (TK-55) in A Cell was tested and found leaking in two spots. Instead of installing a replacement coil, the concentrator is being modified to include a new boiling chamber and a remotely removable tube bundle. The cost of coil replacement approximates the estimated cost of the new remote bundle design.

Approximately 50 to 55 per cent of the scheduled A Cell maintenance work has been completed. During the month major A Cell emphasis has been placed upon floor work, cell piping, and regasketing. During the month the concrete chipping for the floor-to-wall adapter plates was essentially completed and several of the plates were installed (25 per cent of plate installation work completed). Regasketing is approximately 75 per cent complete.

In B Cell, pulser work and general piping work has continued. The overall B Cell maintenance program is 80 per cent completed.

MISCELLANEOUS

Hydration of UO₃ (for PCTR Criticality Experiment)

Approximately 125 pounds of UO₃·2H₂O representing U-235 enrichment levels from 0.65 to 2.0 per cent have been prepared, packaged, and delivered to Reactor Lattice Physics personnel for use in criticality experiments. The dihydrate was obtained readily by slurry treatment of enriched UO₃ from Oak Ridge. However, the monohydrate was obtained by the same treatment of HAPo pot calcined powder (depleted) used in making the enrichment blends. Water was added to the monohydrate to produce an U/H

ratio of four (dihydrate). While this procedure appears satisfactory for the relatively small quantities of blends so far produced, it cannot be recommended for the large quantities required for later phases of the criticality experiment. Variables in the slurry treatment studied in unsuccessful attempts to prepare dihydrate from Sanford pot powder include hydration temperature and time, pH of aqueous phase, $\text{UO}_3/\text{H}_2\text{O}$ ratio, degree of agitation, and drying temperature. Similar studies on hydration of HAPO continuously calcined powder are in progress.

Critical Mass - Applicability

The benefits which could accrue in 200 Area capacities and economics resulting from data to be obtained from the proposed critical mass laboratory were reviewed. A rough draft report was prepared. Five to ten tons/day capacity increase may be possible in Redox and five to seventeen in Purex by increasing the critical mass limit by 10 to 30 per cent. Additional dissolution and extraction equipment would be necessary. Cost savings from \$150,000 to \$200,000 may be possible by the use of revised plutonium processing equipment to achieve these capacity gains. Greater gains, both in equipment and processing costs, could result when processing enriched metal. For a new separations plant, savings of \$200,000 to \$400,000 in construction costs may be possible with a 50 per cent increase in critical mass limit.

4000 PROGRAM - REACTOR DEVELOPMENT

Enrichment of D_2O in Heavy Water

In support of the Plutonium Recycle Program, experiments were undertaken to evaluate the use of triethylamine for regenerating heavy water slightly contaminated with H_2O . The basis for the method is the difference in solubility of H_2O and D_2O solubilities in this reagent at 20 C are 0.70 mole fraction and 0.42 mole fraction, respectively.

Initial reliable experiments indicate essentially no isotopic separation. Contacting water initially 3.17 ± 0.05 per cent in HDO for 25 minutes at 18 C with triethylamine resulted in aqueous phase and organic phase HDO contents of 3.18 ± 0.07 per cent and 3.19 ± 0.05 per cent, respectively. The separation factor was 1.00 ± 0.03 per cent.

UO_2 -Bi Fuel - Appraisal

Consideration of the UO_2 -in-molten-bismuth slurry, graphite-moderated reactor from the chemical engineering standpoint was continued. The high pressures required in the molten metal circulating system for the original concept encouraged review of potential modifications which would minimize these pressures. Increase of the diameter of the slurry channels in the graphite to about one inch would bring pumping pressures in the range of 200 pounds per square inch. The feasibility, compensations and limits of such a change require physics calculations, which were proposed.

From a separations standpoint, these molten bismuth reactor concepts are attractive in that the normal high temperatures suggest simple methods for fuel clean-up. The volatile fission products, including the xenon poison (also I, Br, Kr), are assumed to be continuously removed as gases. Sufficient clean-up of the rare earth poisons

SECRET

C-22

DECLASSIFIED

HW-47943

SECRET

from recycled fuel is assumed to be achievable by a simple fused salt extraction. Separation of a UO_2 -rich fraction from the melt would be preferred for final recovery of plutonium for recycle, with application of the usual dissolution and solvent extraction techniques. The absence of fuel element fabrication and disintegration for processing is obviously attractive. The features of this reactor concept were reviewed with Chemical Processing Department management.

PRPR - Engineering Support

Pre-scope details for the plutonium recovery and refabrication facilities for the Plutonium Recycle Program Reactor were being assembled. Processing rates for the various fuel materials were estimated and proposed methods for plutonium recovery were outlined. Sufficient detail is being presented to permit preliminary estimation for construction and operating costs for alternate locations.

Pre-scope details of the evaporation and electrolytic method alternates for heavy water processing were outlined and submitted for estimating. With such estimates, the justification for the methods will be established.

6000 PROGRAM - BIOLOGY AND MEDICINE

The I^{131} in three vegetation samples was determined both by multichannel spectrometry and by the Radiological Chemical Analysis Laboratory procedure for direct comparison of the procedures. The results are tabulated below:

<u>TABLE IV</u>			
<u>COMPARISON OF I^{131} PROCEDURES</u>			
<u>Sample (1-23-57)</u>	<u>$\text{ucI}^{131}/\text{g} \times 10^6$</u>		<u>RCAL Recovery</u>
	<u>Spect.</u>	<u>RCAL</u>	
1	41	4.3	11%
2	15	4.4	29%
3	13	3.7	29%

These results verify the preliminary findings reported in December and indicate that the chemical leaching and silver iodide precipitation procedure gives a low value.

Thirty-six vegetation samples, taken during the period of December 27, 1956 to January 16, 1957, were analyzed for $\text{Zr}^{95}\text{-Nb}^{95}$ and $\text{Ru}^{103}\text{-Ru}^{106}$ content by multichannel spectrometry directly on the vegetation sample. The area sampled was bounded by Spokane on the northeast, Walla Walla on the east, Boardman, Oregon on the south, Portland, Oregon on the southwest, and Toppenish on the west. No samples were taken in the northwest quadrant. The average $\text{Zr}^{95}\text{-Nb}^{95}$ content was 2.6×10^{-5} uc/gram and the average $\text{Ru}^{103}\text{-Ru}^{106}$ content was 4.4×10^{-5} uc/gram with no pronounced variation with direction from the plant. These results do not differ markedly from the 2.0×10^{-5} uc/gram $\text{Zr}^{95}\text{-Nb}^{95}$ and 3.4×10^{-5} uc/gram $\text{Ru}^{103}\text{-Ru}^{106}$ obtained on twenty samples taken during the period December 14, 1956 to January 5, 1957 from three on-site sampling

SECRET

SECRET

stations near the 200 West Area. These data are not sufficient to determine the source of these isotopes, but the spectrometer analytical method was proven to be simple, rapid, and of sufficient sensitivity (0.05×10^{-5} uc/g for Zr^{95} - Nb^{95} and 0.3×10^{-5} uc/g for Ru^{103} - Ru^{106}) for routine vegetation studies.

The concentrations of P^{32} , Cr^{51} , Zn^{65} , and Np^{239} were measured by beta absorption counting and multichannel gamma spectrometry on residues from Columbia River water samples taken at twelve stations from Pasco to Vancouver, Washington during the period, January 8 through 14, 1957. Although adequate river flow times are not available and the isotopes are not representative of the same operating period because of the different sampling times, comparison of the relative amounts of each isotope shows that Zn^{65} is lost relatively rapidly to the river bottom and aquatic life, P^{32} and Cr^{51} less rapidly, and Np^{239} suffers very little loss.

The low background multichannel spectrometer was used to determine Zn^{65} and Cs^{137} in tissue and bones from a rat which had been fed for about one year on concentrated (30 to 1) reactor cooling water and sacrificed about three months prior to counting, and on two migratory mallard ducks (one male and one female) which were feeding on the Redox swamp. The values obtained are tabulated below:

TABLE V
 Zn^{65} AND Cs^{137} IN RATS AND DUCKS

<u>Sample</u>	<u>Zn^{65}</u>	<u>Cs^{137}</u>
Rat tissue	7×10^{-3} uc/g	0.56×10^{-3} uc/g
Rat bones	45×10^{-3} uc/g	---
Mallard drake	0.5 uc/duck	0.9 uc/duck
Mallard female duck	0.9 uc/duck	0.04 uc/duck

The appreciable concentrations of Zn^{65} in both tissue and bone indicate the need for further investigation of the Zn^{65} uptake by living forms.

Comparative Co^{58} and Co^{60} analyses were made on reactor effluent water obtained from two cross-headers, one of which contained 16 M-388-clad slugs (about one per cent of the total in the tubes served by the cross-header) and the other contained all conventional slugs. The average values for both types of samples were the same, 1×10^{-7} uc/ml of Co^{58} and 4×10^{-7} of Co^{60} , with no apparent increase due to the increased nickel content of the M-388 cladding. More precise data may be obtained when a sample representing more of the special slugs becomes available.

A new procedure was developed for the determination of nitrate ion in water samples containing as little as 0.1 ppm nitrate ion. The method is based on the absorption of nitrate ion at 204 mμ and absorbance measurements can be made directly on the sample if the concentrations of other ions (particularly carbonate and chromate) are sufficiently low. Direct measurements of nitrate ion concentration in well water samples had a standard deviation of 0.03 ppm and were within 2 to 20 per cent of the values obtained by the conventional polarographic procedure and were rapidly done without chemical treatment.

SECRET

DECLASSIFIED

DECLASSIFIED

C-24

HW-47943

DECLASSIFIED

The interfering contaminants in the P³² procedure for the reactor effluent water isotope monitor were tentatively identified as iodine and tungsten. Sufficient quantities of these contaminants pass through the cation resin and zinc sulfide columns to invalidate the P³² results. The iodine can be successfully removed by oxidation and heating. Elimination of the tungsten activity has not been achieved to date.

The oxidation-reduction indicator, erioglaucine, was purified chromatographically and its radiation sensitivity determined after purification. No change in sensitivity was found for the indicator in solution in the absence of oxygen, but a 30 per cent increase in the initial G-yield was found for aerated solutions of the purified indicator compared to the value before purification.

Environmental and Radiation Chemistry

The polarographic determination of nitrates in ground water was replaced by a colorimetric method (phenyl disulfonic acid). Time for analysis was cut by a factor of three.

Geochemical and Geophysical Research

Maximum southerly dips of about one degree of the Ringold formation and the underlying basalt beneath 200 East Area show that a one-foot rise in the water table level would shift the contact between the water table and the clay beds about 100 feet northward, and accordingly affect the direction of movement of ground waters at the water table level.

Extension of the Ringold stratigraphic studies to the northeast permitted a revision of the probable depth to basalt in that direction in sites to be explored by drilling. Such revisions are possible as the result of the discovery of the parallelism of the Ringold sediments and the basalt even in locations of appreciable relief on the basalt.

Tectonic deformation of the Ringold formation is further indicated by the gradual rise of the surface of that formation north-northeast of the White Bluffs by more than 100 feet in seven miles, and by the presence of Ringold sediments at altitudes of 1100 feet above sea level in Wahluke Slope. Although these features can be explained as the result of other processes, the deformation concept explains them most simply as well as more adequately explaining the features such as earlier described west of the Columbia River.

Laboratory model studies were prepared to evaluate quantitatively the factors affecting the vertical profile of the soil column beneath a disposal site which contribute to the retention of radioisotopes. It is recognized that the "wetted column" may not represent the effective soil volume contributing to the isotope retention since vertical flow rates are not uniform across such a profile. An indeterminate fraction of this wetted volume corresponds to the capillary fringe of the saturated zone and may represent a relatively small contribution to the total waste storage capacity of a crib. These studies are being designed to evaluate the relative magnitude and effectiveness of this unsaturated capillary zone.

DECLASSIFIED

DEL

Drilling on the FY-1957 research and development drilling program by the Geological Survey was an estimated 17 per cent complete. The lack of progress during December and January owing to construction requirements resulted in the research program falling about 13 per cent behind schedule at the end of January.

Soil Chemistry

The calcium carbonate content of soil samples was added to the list of soil characteristics used to identify and characterize soil strata. About one-third of the 400 soil samples being studied have been analyzed. The CaCO_3 content was found to range from 0.2 - 30.0 per cent; the data are expected to assist with the identification of the origin and subsequent history of certain geologic formations important to effluent disposal problems.

Laboratory research on the reaction of yttrium ion with Hanford soils was completed. Yttrium retained on soils was found to be more easily removed by acidic solutions than either cesium or strontium, while alkaline solutions remove both cesium and strontium more easily than yttrium.

The accumulation of such soil characterization data as 15-atmosphere moisture content and clay content continued during the month. Analysis of the data emphasized correlations between samples from the same geologic formation. A few unusually high 15-atmosphere moisture percentages were correlated with the presence of volcanic ash in the sample. The effect is probably caused by the sub-angular nature of the ash particles giving rise to an irregular pore-size distribution. The 15-atmosphere determination may provide a simple method of identifying volcanic ash in certain geologic units, assisting with geologic stratigraphy studies.

The measurement of equilibrium distribution coefficients having a known statistical reliability was started to obtain standard values for the adsorption of Cs^{137} and Sr^{90} by soil. The values will be used as a standard to evaluate the adsorption characteristics of these two radioisotopes in various process waste solutions.

The Gelling of Wastes

Gels were prepared by reacting various amounts of sodium silicate with samples of actual aluminum coating waste supernate containing 0.68 moles per liter of aluminum. The reaction of 5 volumes of coating waste with 2.5 to 3.0 volumes of sodium silicate solution (sp. gr. = 1.19) produced complete gelling of the total liquid volume. After standing for one month, a few drops of liquid formed at the surface of the gel presumably by the process of syneresis, a shrinking action which silica gels undergo on standing. No apparent change occurred in the texture of the gel. These data indicate that the proper waste to sodium silicate ratio can be determined readily for a given batch of waste by a simple laboratory test. This would eliminate the need for the analytical determination of aluminum and silica content in each batch of waste for ground disposal.

The ability of aluminosilicate gel to adsorb additional ions from solution and retain these ions against leaching was investigated. The data were compared with the

SECRET

DECLASSIFIED
WITH DELETIONS

C-26

HW-47943

DEL

results of a similar test with hydrous ferric oxide precipitate. Approximately 30 per cent of the cesium in a solution containing 1×10^{-4} M cesium and 2 M NaNO_3 was removed from solution by the aluminosilicate compared to approximately 3 per cent removed by the ferric oxide. A single water leach of the dried precipitates resulted in the extraction of 60 per cent of the total cesium from the ferric oxide and 4 per cent from the aluminosilicate. These results indicate that a gel formed by the reaction of aluminum coating waste with sodium silicate is capable of adsorbing and retaining considerable quantities of cesium and presumably other radioisotopes in addition to retaining large quantities of water. This property of adsorbing fission products not only increases its usefulness as a waste disposal medium but also suggests the possibility of forming an aluminosilicate precipitate in Redox and Purex wastes to produce a high level "gross fission product" source.

WASHINGTON DESIGNATED PROGRAMS

Project CAD irradiation facilities were unavailable. Some 25 samples were prepared for irradiation. The background interference from contamination was reduced.

V. D. Cooper

Manager
Chemical Research & Development
HANFORD LABORATORIES OPERATION

VR Cooper:bp

DECLASSIFIED
WITH DELETIONS

SECRET

Y-27

HW-47943

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
C. L. Lindekin J. J. Balandia	1/11/	UCRL Livermore, California	Analytical methods and requirements of a radiochemical environmental laboratory discussion.	D. L. Reid R. E. Brown	Yes	329, 300 Area
C. W. Westerbeck W. E. Froeming	1/16-18/	U.S. Air Force Special Weapons Project	Training program.	D. W. Pearce J. F. Honstead D. W. Rhodes	No Yes Yes	329, 300 Area; 222-U, 200-W Area
J. E. Carothers W. N. Roth W. Ramsey	1/17-18/	UCRL Livermore, California	The problems of processing special high irradiated material and associated development studies required were discussed briefly.	O. F. Hill	Yes	2704-E, 200-E Area
D. Barney	1/17-18/	KAPL Schenectady, New York	Discuss technical programs of mutual interest.	W. H. Reas R. B. Richards M. T. Walling R. L. Moore E. E. Voiland V. R. Cooper	Yes	325, 300 Area; 202-A, 200-E Area; 1704-E, 200-E Area.
W.E.F. Smith	1/21/	Savannah River Augusta, Georgia	Consultation on corrosion problems.	W. L. Walker	Yes	326, 300 Area
J. U. Shepardson R. H. Burr K. J. Caplan F. N. Anderson	1/22-24/	Mallinckrodt Chemical St. Louis, Missouri	Information on processing enriched materials	J. G. Bradley R. G. Geier R. W. Wirta	Yes	326, 300 Area; 222-S, 200-W Area.
R. D. Rowe	1/23	General Machinery Spokane, Washington	Inspection of Johnston pump.	J. Dunn	Yes	321, 300 Area

DECLASSIFIED

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
J. Coddington R. P. Schuman	1/24-25/	KAPL Schenectady, New York	Discuss technical programs of mutual interest.	W. H. Reas R. L. Moore R. B. Richards V. R. Cooper M. T. Walling E. E. Voiland	Yes	325, 300 Area; 202-A, 1704-E, 200-E Area
J. J. Shepardson R. H. Burr	1/24/	Mallinckrodt Chemical St. Louis, Missouri	Discuss U isotopic analysis methods.	R. J. Browns	Yes	325, 300 Area.
B. Loring	1/28/	A.E.C. Washington, D.C.	Washington Designated Programs.	R. J. Browns	Yes	325, 300 Area; 105-B, 100-B Area
M. E. Gray	1/28/	Taylor Forge & Pipe Co. Seattle, Washington	Discuss pipe and tubing for use in pump tests.	J. R. Raymond	No	761, 700 Area

VISITS TO OTHER INSTALLATIONS

E. W. Christopherson	1/7-10/	Argonne National Laboratory Lemont, Illinois	Single channel experiment discussion.	F. T. Hagemann	Yes	
M. N. Myers	1/31/	Internal business	Sampling for CAD	B. M. Loring	Yes	
H. E. Hanthorn	1/8/	Oregon State College Corvallis, Oregon	Present paper on "Peaceful Uses of Atomic Energy"	Sigma Xi Society	No	
	1/25/	AIME Spokane Section Spokane, Washington	Present paper on "Peaceful Uses of Atomic Energy"	American Institute of Mining & Metallurgical Engineers	No	

DECLASSIFIED

BIOLOGY OPERATION MONTHLY REPORT - JANUARY 1957

ADMINISTRATION

A. Organization and Personnel

No major or significant items relating to personnel changes or personnel activities occurred during January 1957.

B. Technical Activities

4. Biology and Medicine - 6000 Program

a. Biological Research (reported in the following 7 pages)

C. Off-site Visits and HLO Visitors

a. Off-site Visits

H. A. Kornberg, Jan. 3-4, 1957, visited Medical School, University of Washington, Seattle, Washington, for scientific conference and to discuss research assistance with Professors Neurath and Huff.
No security clearance required.

R. C. Thompson, Jan. 17-18, 1957, Argonne National Laboratory, Lemont, Illinois, to serve on sub-committee on internal emitters for National Academy of Sciences, National Research Council.
Security clearance required.

F. P. Hungate, Jan. 18, 1957, Ellensburg, Washington, to present a talk to the Galena Club on "Uses of Atomic Energy in Agriculture".
No security clearance required.

H. A. Kornberg, Jan. 25, 1957, New York City, to serve as a member on the committee on pathological effects of atomic radiation for National Academy of Sciences, National Research Council.
No security clearance required.

b. Visitors

Carl L. Lindeken, 1/8/57, Health Physics Group, Livermore, California, visited Biology, toured facilities, and discussed current investigations.

Dr. Henry Schmitz and Dr. E. Hines, University of Washington, Seattle, Washington, toured Biology facilities on January 10, escorted by K.L. Englund, local AEC.

Dr. John Wolfe, Jan. 21, 1957, Biology Branch, Division of Biology and Medicine, AEC, Washington, D.C., visited and toured Biology facilities and discussed current programs relating to ecology.

b. Visitors (continued)

Ralph C. Palange, Public Health Center, Cincinnati, Ohio, visited Biology on January 21, 1957, and discussed current investigations with Aquatic Biology personnel.

Messrs. Holdsworth and Morton, Public Relations Office, Schenectady, toured Biology facilities on January 29, 1957, in connection with the forthcoming press tour.

D. Lectures

a. Papers Presented at Meetings

F. P. Hungate, Jan. 18, 1957 - "Uses of Atomic Energy in Agriculture"
Galena Club, Ellensburg, Washington.

b. Seminars

W. C. Hanson, Jan. 22, 1957 - "Bioaccumulation of Radioisotopes through Terrestrial Food Chains"

E. Publications

None

DECLASSIFIED

BIOLOGY OPERATION MONTHLY REPORT - JANUARY 1957

ABSTRACT

Aquatic and terrestrial biological monitoring activities continued without unusual result, except for noting that radioiodine in some rodent thyroids taken from sites near Separations areas were about 25 times higher than they were one year ago.

The deposition of P^{32} in rats fed undiluted reactor effluent is about one-eighth of that which results in rats fed P^{32} as the phosphate (source, Oak Ridge). This lower deposition coefficient is the same as that which was measured when rats were fed reactor effluent concentrated 30 times.

Zn^{65} was found in one rat which had been fed concentrated reactor effluent. Although this is a preliminary result that is yet to be confirmed, it is possible that Zn^{65} is of the same or greater potential hazard than P^{32} in the Columbia River.

Previous work in this laboratory which measured the absorption and deposition of plutonium in drinking water utilized stomach tubes for introducing the plutonium into rats. The legitimacy of the results was confirmed by finding the same deposition coefficient when rats were allowed to ingest plutonium from ordinary drinking water.

When plutonium in strong acid solutions was dropped onto the tongues of rats, a deposition coefficient was observed which was about one-twentieth of that when similar solutions were fed through stomach tubes. There was an appreciable early retention of plutonium in the heads of the rats.

High levels of radioruthenium fed to rats did not cause increased absorption, indicating that radiation damage was not a significant factor in the increased absorption noted earlier in young animals fed radioruthenium.

In plant work we earlier found that the iodide ion markedly increased I^{131} uptake into plants. The chloride ion, however, was found ineffective in increasing uptake. This marked difference in halide effect may have fundamental significance in plant physiology.

Other research studies progressed satisfactorily.

BIOLOGICAL MONITORING

Samples of terrestrial and aquatic organisms are routinely collected and assayed for radioactive contaminants released to the atmosphere, impoundments, and the Columbia River.

DECLASSIFIED

DECLASSIFIED

HW-47943 DEL

Atmospheric Contamination

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

<u>Collection Site</u>	<u>$\mu\text{c } I^{131}/\text{g thyroid}$</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
1 mile SE of Redox	5×10^{-2}	7×10^{-2}	+ 3
West of 200 West Area	3×10^{-2}	6×10^{-2}	+ 5
4 miles SW of Redox	2×10^{-2}	5×10^{-2}	+ 10
Meteorology Tower	1×10^{-2}	2×10^{-2}	+ 3
East of 200 East Area	1×10^{-2}	2×10^{-2}	-
Prosser Barricade	8×10^{-3}	2×10^{-2}	-
100-B Area	4×10^{-3}	1×10^{-2}	-
Wahluke Slope, E	8×10^{-3}	1×10^{-2}	+ 8 *
Route 4S, Mile 14	3×10^{-3}	5×10^{-3}	+ 3 *
Wahluke Slope, NE	3×10^{-3}	5×10^{-3}	+ 4 *
3 miles S of White Bluffs	2×10^{-3}	4×10^{-3}	- *

* The last four trend factors compare values with November rather than December because corresponding collections are made bimonthly.

The current contamination levels are from 5 to 25 times greater than those of January 1956, in the sites near and south of the Redox separations facility.

Fallout debris, presumably of off-Plant origin, was present in rabbit tissues and feces in the following concentrations:

<u>Sample Type</u>	<u>$\mu\text{c FP's/g sample}$</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Bone	4×10^{-5}		-
Liver	1×10^{-5}		-
Feces	4×10^{-5}		-

Swamp Contamination

A generally short food supply caused a migration of waterfowl from the 221-U swamp. Coots and grebes were absent and other species were few in number. The following concentrations of fission products were determined:

<u>Sample Type</u>	<u>$\mu\text{c FP's/g tissue}$</u>		<u>Trend Factor</u>
	<u>Average</u>	<u>Maximum</u>	
Diving ducks			
Bone	5×10^{-4}	7×10^{-4}	- 4
Soft tissue	7×10^{-4}	1×10^{-3}	-
Puddle ducks			
Bone	5×10^{-4}	5×10^{-4}	-
Soft tissue	3×10^{-4}	3×10^{-4}	+ 8

Columbia River Contamination

The contamination levels in representative aquatic forms and in waterfowl for January are shown in the following table. With the exception of plankton, virtually all of the activity is from P^{32} .

<u>Sample Type</u>	<u>Collection Site</u>	<u>μc radioisotopes/g tissue</u>		<u>Trend Factor</u>
		<u>Average</u>	<u>Maximum</u>	
Plankton	Hanford	4×10^{-2}	4×10^{-2}	-
Caddis larvae	"	6×10^{-3}	6×10^{-3}	-
Minnows	"	1×10^{-3}	2×10^{-3}	- 2
Whitefish *	"	2×10^{-4}	3×10^{-4}	- 3
	Priest Rapids	4×10^{-6}	5×10^{-6}	-50
	Ringold	1×10^{-4}	2×10^{-4}	-
Diving ducks*	Hanford	2×10^{-3}	5×10^{-3}	-
Puddle ducks*	"	5×10^{-4}	3×10^{-3}	-
Grebes*	"	3×10^{-4}	5×10^{-4}	- 3
Gulls*	"	1×10^{-4}	3×10^{-4}	- 3
Mergansers*	"	1×10^{-4}	2×10^{-4}	- 2
Hérons*	"	8×10^{-5}	1×10^{-4}	-

* Values are for flesh. Concentrations in bone are ten times higher for fish and three times higher for waterfowl.

The gradual decline in concentration of radioactive materials continued for most river organisms. In past years this seasonal decline has continued through February. The spectacular drop to the background level for whitefish collected at Priest Rapids indicates that no contaminated fish that may have migrated up river from the project were included in the sample (3 fish only). Below the reactors the contamination in whitefish flesh was about double that observed one year ago; in small fish it was about 50% greater. Contamination of waterfowl was about two to five times that of one year ago.

Effects of reactor Effluent on Aquatic Organisms

Survival and growth of fingerling-size whitefish held under laboratory conditions continue to be good in Columbia River water which contains as much as 8 per cent reactor effluent. Chinook salmon eggs were not affected in 4 per cent effluent from the 100-K reactor.

Mortalities of whitefish eggs incubating at temperatures 2 C and 3 C above the average for the Columbia River continue to be significantly greater than for the controls.

Crayfish appear to be quite resistant to chromate. None were killed by 25 ppm Cr(VI) in 14 days. At 38 ppm the mortality was 80 per cent and at 100 ppm all died within 3 to 7 days.

[REDACTED]

River organisms were exposed to a small quantity of effluent collected from a tube which contained a ruptured fuel element. Results are not yet available on the contaminants picked up by the organisms. However, analysis of the effluent indicated that 80 per cent or more of the emitters was associated with particles which settled in less than 24 hours. The soluble or suspended fraction contained about equal amounts of Sr^{89-90} and $\text{Ba}^{140}\text{-La}^{140}$, and a much smaller amount of Cs^{137} .

METABOLISM AND TOXICITY OF RADIOACTIVE MATERIALS

Reactor Effluent

Four rats were killed after approximately 90 days on unconcentrated, 100 per cent, reactor effluent as their sole source of drinking water. The P^{32} content of their skeletons indicated an absorption and deposition of about 1.6 per cent of the P^{32} present in the effluent. This figure agrees with the results obtained from rats fed 30 times concentrated reactor effluent for a year. It is a factor of approximately 8 times lower than the absorption and retention measured in single feeding experiments with P^{32} and a factor of four lower than results obtained with a single feeding of reactor effluent spiked with P^{32} . These results indicate that the low absorption and retention of P^{32} observed in the concentrated reactor effluent experiment was not due to any effects of the concentration process, since the same results are obtained with unconcentrated effluent. The low absorption of P^{32} from reactor effluent may be due to its presence in a different chemical state from that administered in the other experiments or it may be that the extrapolation of the results from single administration experiments to the chronic situation is, for some unknown reason, not permissible. Further experimentation is obviously required to explain these apparently anomalous results and to accurately evaluate the hazard potential of P^{32} in reactor effluent.

Gamma ray spectrographic analysis of the skeleton from a single rat maintained on the concentrated reactor effluent water regimen for 347 days shows that about $6 \times 10^{-4} \mu\text{c}$ of Zn^{65} was present per gram of bone at the conclusion of the feeding period. This is several times the quantity (in μc) of P^{32} present in the bone and on an energy basis would irradiate the bone to approximately the same extent as the P^{32} . In view of its long physical half-life (245 days) and probably long biological half-life (100 days or longer) the Zn^{65} in these animals probably had not reached an equilibrium level. While these data are very limited, they suggest that Zn^{65} may be as potentially hazardous as the P^{32} in reactor effluent.

Plutonium

Rats receiving plutonium in their drinking water for a period of 24 days showed total absorption and deposition in bone and liver of 0.0026 per cent of the total plutonium consumed. This figure is in very close agreement with results obtained from stomach tube feeding experiments and indicates that there is no

DECLASSIFIED

HW-47943

DEL

additional hazard involved from oral intake. These solutions were adjusted to pH 2, or 0.01 N. Plutonium deposited as a relatively concentrated solution on the tongue of rats was absorbed and deposited in liver and bone to the extent of approximately 0.007 per cent of the administered dose. This experiment was performed with both 2 N and 0.1 N nitric acid solutions. The absorption measured was roughly one-twentieth of the absorption when such solutions were administered intragastrically. There was appreciable retention of the administered plutonium in the heads of the animals for the period of one week between administration and sacrifice: 0.4 per cent of the 2 N solution being thus retained and 0.08 per cent of the 0.1 N solution.

Additional rats were intravenously injected with Pu (IV) citrate in continuation of long-term studies of tissue retention, localization, transfer and excretion. Significant excretion in the urine occurs only during the first day following injection when it is approximately equivalent to the amount excreted in the feces. Daily excretion in the feces amounts to from one to three per cent of the daily dose, and continues at this level for about two weeks. Plutonium excreted in the feces is largely insoluble. None is extracted by water; a small amount is removed with lipid fractions.

Preliminary experiments were performed to study the effect of intrapulmonary EDTA in the mobilization of plutonium from the lung. These studies have been limited to the testing of administration procedures and determination of the dosage of the various salts of EDTA which can be tolerated by the rat.

Thirty microcuries of Pu(IV) in sodium citrate were administered intratracheally to three miniature pigs. Intravenous indwelling catheters were placed in the pigs prior to plutonium administration in order to obtain early frequent blood samples during the first day. The purpose of the short-term study was to determine the earliest time when plutonium could be detected in the blood following intratracheal contamination with plutonium. Relation of the plutonium concentration in blood to that in urine will also be determined. These data may be of value in establishing criteria for early treatment of actual contamination cases.

Cesium

The chronic exposure experiment continues with results available through 200 days. Muscle continues to show the highest Cs¹³⁷ concentration with kidney running second. The muscle concentration at 200 days is approximately 11 per cent of the daily intake per gram of muscle.

Ruthenium

Ruthenium fed to week-old rats in amounts varying over a 400-fold range resulted in essentially the same absorption, indicating that radiation damage was not a significant factor in the observed increased absorption in the young animals.

Iodine

Histologic study of the thyroid adenomas previously reported in the 5 μ c/day group was completed. The number of adenomas in each gland varied from two to thirteen, rather than the maximum of three observed grossly. The histologic patterns of the adenomas were follicular, tubular, or cord-like. The tumors showed partial or complete encapsulation, but extension beyond the capsules occasionally occurred. In order to rule out metastases, the present groups of six-year-old ewes scheduled for sacrifice will be retained through 1957.

Radioactive Particles

Plutonium oxide particles suspended in Pluronic has been administered intratracheally as a hydrosol to two dogs (0.1 μ g/gram dog). Feces, urine, and blood samples are being collected daily for plutonium analysis.

A vertical exposure chamber accommodating 72 mice was constructed. Particulate matter can be introduced from aerosol generators or as a dust from a pistol. Preliminary tests included a study of the lung burden versus position in the chamber.

Exposures of mice to radoruthenium oxide and measurements of gross lung clearance rates continued.

Relative Biological Effectiveness

Tests to determine the RBE of S^{35} through viability and genetic studies gave unusually low values. However, some difficulty was experienced with the S^{35} and it appeared that there was a contaminant affecting the dosimeter readings and perhaps also the growth of the organisms. Warburg tests on cultures studied for viability showed that while the cells are non-viable they remain metabolically active.

Tests designed to justify our method of studying genetic mutation show that normal cells can inhibit the expression of back mutation when sufficient numbers of cells are present. With concentrations normally used in our tests, there is no indication that the number of cells is sufficient to invalidate the results previously reported.

Genetic Effects of Metabolized Radioisotopes

Results previously obtained using standard freezing and lyophilizing techniques showed that less than one per cent of the yeast cells survived the treatment. By using protective colloids and drying at room temperature under partial vacuum, viability as high as 50 per cent was obtained. Results are erratic, however, and some growth appears to take place during the process of drying. Additional tests will be made to improve the technique so that better repetition of results can be obtained.

Uptake of Radioactive Substances by Growing Plants

Chloride and iodide ions had different effects on the uptake of I^{131} into barley. Chloride ion concentrations of 400 $\mu\text{g/g}$ soil had little or no effect on I^{131} uptake while iodide increased I^{131} uptake as previously reported. When chloride and iodide were mixed, the effects on I^{131} uptake appeared to be caused almost solely by the iodide.

Homogenates of bean plants previously grown in the presence of I^{131} were tested by paper chromatography to determine the manner in which the I^{131} was bound in the plant. Three radioactive spots were located, one near the locus of tyrosine, one at the iodide position, and the third is as yet unidentified.

Uptake of I^{131} into plants whose roots had previously been killed or removed was greater than the uptake into growing plants.

H. A. Kornberg
Manager RCT
BIOLOGY OPERATION

HA Kornberg:es

OPERATIONS RESEARCH AND SYNTHESIS OPERATION
MONTHLY REPORT
January, 1957

ORGANIZATION AND PERSONNEL

Effective January 1, 1957 the Statistics Operation was split into two functions, Experimental Statistics and Industrial Statistics. Roughly, the latter covers statistical activities for the product departments and the former statistical activities in support of research and development. Concurrent with this change, the position of Manager, Statistics was abolished and L. G. Waters was transferred to the Operations Research function as a Specialist, Operations Research.

J. A. Merrill terminated on 1-11-57 to accept a similar position as a statistician with the Phillips Petroleum Company at the Idaho Chemical Processing Plant.

OPERATIONS RESEARCH ACTIVITIES

Reactor Data

The feasibility and scoping study for the Irradiation Processing Department relative to their proposed reactor data center was concluded. Two reports entitled, "Organizational Aspects of the Irradiation Processing Department Reactor Data Center" and "Alternatives for Mechanization of the Reactor Data Center" were issued to Mr. C. A. Priode, manager of the Production Operation of IPD. An oral report was made to Mr. Priode and his staff, and a final presentation will be made to Messrs. Greninger, Priode, Greager and Lee on February 7.

Economic Studies

The results of a preliminary study of suggested AEC ground rules were formulated into a rough draft report for purposes of discussion.

A preliminary study was made of the applicability of learning curves to HAPO progress in the reduction of unit cost of products. Further work will be required to distinguish operational from constructional learning.

The study of mathematical criteria which would motivate HAPO in accordance with general AEC objectives was continued. In particular, simple economic models are being analyzed to determine those conditions on the value of plutonium and the various types of costs involved which will insure a positive return, and enable the determination of optimum power and exposure levels if they exist.

Personnel Data

Work in this problem area has been approached from the standpoint of determining what decisions and actions are necessary for effective utilization of our human resources and which, in turn, require information or data processing. Specifically, the problem of matching the individuals qualifications, as well as his needs and interests, with plant-wide opportunities so as to optimize individual achievements is being considered. The question of a means to assist in the identification, development, and selection of personnel, as well as the most effective way to initiate such a program, was uppermost in this consideration.

DECLASSIFIED

Investigation of Problem Areas

A preliminary scoping is being made of possible operations research assistance to the HLO in the area of measurements. In addition, a representative of Operations Research & Synthesis Operation is attending meetings of a Regional Monitoring Study group to determine the possibility and extent of operations research assistance to this program.

STATISTICAL AND MATHEMATICAL ACTIVITIES IN SUPPORT OF RESEARCH PROGRAMS.

2000 Program - Metallurgy

Considerable work was done during the month on the diffusion problem dealing with the penetration of alsi into uranium, and vice-versa, in bonded couples. This work was summarizing in nature, since data from all couples have now been collected. A final inspection was made of the methods of estimating maximum penetrations within each couple, with a slight revision of the method for 300°C couples being incorporated. A complete discussion of this problem is contained in a rough draft, soon to be documented, which was sent to D. R. Green. In addition to this aspect of the problem, data from all couples were analyzed collectively in order to obtain estimates of the parameters involved in the equation relating penetration to time and temperature.

Data pertaining to the maximum pit depths in 356 aluminum under different corrosion conditions are contained in Oak Ridge Document ORNL-681. The data were analyzed to see what valid inferences could be elicited, and to point out those instances in which the data were insufficient for such an analysis. The results were reported in an unclassified letter, "Analysis of Maximum Pit Depth Data 356 Aluminum," to C. Groot, dated January 8, 1957.

Mathematical consultation was provided in connection with the solution of certain partial differential equations which arise in the study of elastic and plastic deformation of fuel elements.

2000 Program - Reactor

Investigation of procedures to measure K_{∞} , the coefficient of fast neutron multiplication, was continued this month. A suitable method of estimation was devised and suggested orally to personnel of the Reactor Lattice Physics Operation. A formal report of this work is being prepared.

A new method of estimating nuclear cross-sections from cadmium ratio data was reported to R. A. Bennett in an unclassified letter, "Fiducial Confidence Interval Method of Estimating Nuclear Cross-Sections," dated January 25, 1957. The method, derived from a rigorous appraisal of the measurement errors present in cross-section estimates, replaces an approximate procedure currently in use.

Ninety-five per cent confidence intervals for the elongation and tensile strength of Teflon after exposure to different amounts of radiation were computed for personnel of the Non-metallic Material Development Operation.

DECLASSIFIED

~~RECLASSIFIED~~

E-3

HW-47943

SECRET

Mathematical services provided to the Theoretical Physics Research Operation included methods of manipulating and solving an algebraic equation containing several Bessel functions, and possible methods for obtaining the smallest pseudo-eigenvalue of a linear, homogeneous integral equation whose spectral generator occurs in a non-linear expression.

3000 Program - 234-5 Weapons

Mathematical assistance was given to members of the Plutonium Metallurgy Operation in their effort to design the surfaces of a mold that will possess certain desired hydrodynamical and metallurgical properties, and yet will not violate other limitations which are prescribed by practicability and the principles of nuclear physics.

6000 Program - Biological Research

A program to investigate systematically the likely sources of experimental error in biological experimentation and to make appropriate recommendations to correct these shortcomings is being initiated with the cooperation of interested Biology Operation personnel. During the month, introductory discussions were held with members of the experimental farm staff concerning problems involved with and techniques of measuring radioactive counting rates. Discussions were also held concerning the sample-dilute-count procedure mentioned in the December Monthly Report. Statistical evaluation of the measurement errors in this procedure was continued in January.

Several recent experiments currently being analyzed possess a source of error often overlooked in the design of biological experiments. In these experiments almost fifty per cent of the variability was due to fluctuations in experimenter efficiency. Talks were held with interested persons and procedures were suggested to minimize the experimenter effect on experimental results.

Statistical analysis is being done on a Biology Operation experiment designed to give a "turnover curve" and tissue distribution of insoluble radioactive Ru particles deposited in the lungs of mice.

STATISTICAL AND MATHEMATICAL ACTIVITIES FOR PRODUCT DEPARTMENTS

Chemical Processing Department

An analysis was made of the final product data for October through December, 1956. This analysis is routinely performed in order to determine tolerance statements about the proportion of final product parts meeting specifications. A rough draft was sent to R. E. Smith on January 22, 1957 reporting results of this analysis. In connection with this, a discussion was held with interested personnel on the possibility of performing these analyses on IBM equipment, since the computational labor, if performed more frequently than quarterly as is proposed, becomes somewhat laborious. This problem is currently being investigated.

Data were submitted by personnel of the Radiation Monitoring Operation on the exposure count of men working on furnaces. The total count is defined as the total amount of measured radiation exposure for all steps of an operation. An analysis was performed in which the difference between shifts was investigated. Ninety-five per cent confidence limits were also given for the total amount of exposure.

Fuels Preparation Department

In line with the overall Quality Control Program set up for this department, assistance and direction were given to Manufacturing Operation personnel in the following areas:

1. A lack of statistical control was noted in residual can wall thickness. A conference was held with interested personnel to discuss the investigation of various possible assignable causes and advice was given relative to the setting up of various controlled experiments.

Data from one such controlled experiment to evaluate the effect of slug insertion rate in the canning phase on residual can wall thickness were analyzed, with the results reported verbally to interested personnel. Experimentation is continuing in this direction to determine:

- a) An optimum insertion rate with regard to residual can wall thickness.
- b) Possible effects of insertion rate on other reject categories.
- c) Effect of insertion rate at lower canning bath temperature.
- d) Effects of lowering canning bath temperature on other reject categories.

Cans of different alloy types were used in a controlled experiment to determine their relative effects on residual can wall thickness. The resulting data were analyzed with results reported verbally.

2. Test results of the Penetration Tester were analyzed to determine the reproducibility of results on cans of different alloys. The initial set of data supplied for this analysis was felt to be inadequate. A trend was noted here, however, and on the basis of this, a controlled experiment with paired observations is being made.
3. The effects of slug lot types (K,M,Z), absolute humidity, crews and shifts on non-seat and off-cycle rejects were investigated in an analysis of data covering the period January 1 through June 30, 1956. In analyzing these data a high degree of correlation was found between absolute humidity and off-cycle rejects. The reason for this is not apparent due to the close relationship between time and humidity and it has been recommended that a controlled experiment be conducted, if possible, and if economically wise in view of the small off-cycle reject rate, to evaluate any possible real effects of humidity on off-cycle rejects. This recommendation, together with other results of the analysis, was reported in a letter to D. D. Stone dated January 25, 1957, "The Effects of Humidity on Canning Variables."
4. Assistance was given in the computation of statistical control limits for destructive tests on caps.

DECLASSIFIED

Efforts are presently being made to coordinate all investigative activities to insure the overall quality improvement desired. Emphasis is placed upon the beneficial results to be gained from the wider utilization of statistical control charts in the analysis of data. It is felt that the data necessary for periodic reports might be better presented in control chart form, showing trends, runs, abnormal periods due to assignable causes and the expected future status of critical variables.

Random orientation of grain structure in slugs is believed to yield maximum strength properties. In order to measure the degree of randomness in the slugs, longitudinal and transverse frequencies are recorded, corrected for length, and substituted into three equations in the unknowns a, b, and c. True randomness would be reflected in a, b, and c values which are near 1/3. The 702 electronic computer has been programmed to handle this problem and assistance has been given personnel of the Materials Engineering Operation in carrying out the computations and interpreting the results.

An experiment has been set up to test the ability of the sonobond tester to separate "good" slugs from "bad" slugs as far as rupture rates are concerned. To do this two populations of slugs are separated out. The "good" population of slugs are those that fall into the lower 5% as far as sonobond count is concerned, the "bad" population are those in the upper 5%. The objective of the experiment is then to test whether the "bad" population has a higher slug rupture rate than the "good" population. Assistance has been given to personnel of the Materials Engineering Operation on different statistical aspects of this problem.

Further consultation has been given on the design of an experiment concerning the stability properties of slugs of low hydrogen dignot material when compared to ordinary production material. The main problem was the manner of loading tubes and the number of samples to take. A similar problem was encountered in comparing the stability properties of crystallized versus rolled slugs, and not outgassed versus vacuum outgassed slugs, where recommendations were also made on the manner of tube loading and the number of samples to take.

The k factors for one-sided tolerance factors are not tabled. For this reason various k factors have been computer for different sample sizes at the request of personnel of the Quality Audit Operation.

An attempt is being made to correlate 305 test pile measurements on C-slugs with results of chemical analyses of these slugs, in order that HAP0 may routinely perform 305 test pile readings on selected samples from each C-slug shipment and use results as acceptance criteria. In this connection, several C-slugs, of differing enrichment levels, were measured at the 305 test pile. On the basis of the submitted data, it was possible to estimate test pile variation, both between slugs and between measurements within slugs. The results, useful in estimating required sample sizes, were reported verbally to personnel of the Manufacturing Operation.

Irradiation Processing Department

Consultations were held with personnel of the Research and Engineering Operation in connection with the interpretation of the rupture index for a given tube and pile. This rupture index, which is designed to estimate the rupture proneness

DECLASSIFIED

E-6

HW-47943

of a given tube, and hence a given pile, is useful in determining whether or not pile powers can be raised at the end of a given operating period on the basis of past rupture performance. It is anticipated that more work will be done on this in connection with the general slug rupture problem, complete data for which are presently being collected on the IBM equipment.

OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

In connection with preliminary planning of a fuel element test reactor, one item of importance is the calibration of such a reactor. For example, if fuel elements were tested in the FETR, could quantitative measures of these test results be found which would carry over into a production reactor? One aspect of this problem, the calibration of results of run to rupture tests, was investigated and discussed with personnel in the Advanced Engineering Operation, HLO.

Previous reports have contained a discussion of the study dealing with correlating fission product measurements in the reactor basins. At the request of personnel of this operation, summarizing report on this work was issued to W. N. Koop on December 29, 1956, "Correlation of Fission Products."

Curves are being fitted to HLO salary data submitted by Financial Operation. Standard least squares regression techniques are being used to estimate trend lines for median and upper and lower quartiles of the data.

Further work was done for the Financial Operation on Absenteeism. Tolerance limits for the annual absenteeism rates for various components were calculated. Graphs showing the relationship between limits and the size of components were also constructed.

OFFSITE PROJECTS

Some preliminary discussions were held in preparation for a trip to Washington, D.C. by C. A. Bennett on Operation Pool.

Routine release calculations in connection with Project Bluenose were continued.

OFFSITE VISITS AND HLO VISITORS

C. A. Bennett spent January 28, 1957 in Washington, D. C. obtaining background information on Operation Pool.

J. L. Jaech attended a meeting at the Argonne National Laboratories on January 7, 1957 in connection with the analysis of data from the fifth channel experiment in support of Washington designated project Bluenose.

Three candidates for employment, Dr. Robert L. Basmann, Mr. Harold J. Larson, Mr. Allan A. Weissburg, visited HLO - Operations Research & Synthesis Operation during the month of January.

Carl A. Bennett, Manager
OPERATIONS RESEARCH & SYNTHESIS

CAB:jbk

A. ORGANIZATION AND PERSONNEL1. Organization

No significant change in organization occurred.

2. Force Summary

	<u>12-31-56</u>	<u>1-31-57</u>
Exempt	41	41
Nonexempt	<u>205</u>	<u>205</u>
Total	246	246

B. ACTIVITIES1. Radiation Monitoring

Radiation monitoring service continued to be provided for both Major and Minor Construction as well as Hanford Laboratories and Relations and Utilities Operations. A diver was exposed to an average dose rate of 100 mr/hour while inspecting the inside of the 100-DR outfall line to the river.

The scheduled six-week shutdown work on project CG-558 at 105-DR was started by Minor Construction on January 17. Work on the reactor front face consisted mainly of nozzle and pigtail replacement and was performed at an average body dose rate of 5 mr/hour. Particular care was required to avoid all open tubes which had dose rates up to 1.2 r/hour at 30 inches.

Radiation work in Hanford Laboratories components proceeded normally and with good control. New manipulators were installed in the Mini cell with dose rates up to 200 mr/hour. Dose rates of 4 r/hour at 2 feet were encountered while working between the pile faces of the experimental reactor at 305-B.

Large amounts of telephone and power line equipment and railroad right-of-way equipment were surveyed prior to public sale.

Progress was made on revision of the Civil and Plant Defense plan for the Radiation Protection Operation. The objective is to have one simplified plan which will suffice for all emergencies.

2. Regional Monitoring

Iodine emission was satisfactorily controlled during December with a resultant daily average of 1.1 curies. The maximum total emission during any seven-day period was 18 curies of which 17 curies were released from the Redox plant. Although less than the permissible limit of 1×10^{-5} $\mu\text{c/gm}$ of vegetation, deposition up to 6×10^{-6} $\mu\text{c/gm}$ was measured in off-plant areas within a 100 mile radius of the plant.

The presence of Purex A-8 tank condensate crib wastes in the ground water was confirmed.

Beta activity up to 2.5×10^{-7} $\mu\text{c/ml}$ in several wells indicated that an as yet unidentified waste stream has moved at least four miles southeast of the 200 East Area.

[REDACTED]

Activity levels in drinking water originating from the Columbia River returned to normal levels after several abnormally high values obtained in December. Decay studies of water samples taken at the Pasco Filter Plant revealed apparent half-lives of predominant fractions of 1, 3 and 20 days.

A long-range series of planning meetings was started to review the entire Regional Monitoring program.

Minor amounts of fallout from nuclear bomb tests were detected on vegetation and air samples.

3. Exposure Evaluation and Records

There were no new cases of plutonium deposition confirmed during the month. The total number of cases of measurable deposition remains at 197. There were 36 confirmed cases in 1956. No new cases of fission product deposition were detected with the routine bioassay program.

No radiation incidents involving exposure above permissible limits were reported.

Exposure records of the film badge program were completely converted to electronic data processing techniques as of January 1, 1957. Routine badge reports for this system are being supplied to all concerned HAPO components. The first processing of the new film badge in use at 300 Area was very successful. Identifying numbers on the film were easily read. The 100-B Area was converted to the new film badge on January 31, 1957.

It is noteworthy that as many requests for radiation exposure summaries for former employees were received in 1956 as in the preceding two years. Of the 16 requests received in 1956, 13 were received during the last third of the year. This function will increase as more of the population is engaged in atomic energy work.

4. Calibrations

Mechanical improvements in the source trolley were made in the calibration well which is in service. Plans progressed to place the second well into service.

A procedural change requiring formal releases on all portable instruments returned to the shop resulted in a marked decrease in the number of contaminated instruments being returned to Calibrations.

A physical inventory of radium held by Hanford Laboratories was made in conjunction with Financial representatives. All records and sources were found to be in order.

A purchase requisition was issued for purchase of 5,000 Victoreen pocket chambers on a no substitute basis. These will be added to the general supply in use on the plant.

DECLASSIFIED

DECL

5. Radiological Development

A study relating badge film densities at various wave lengths of transmitted light was initiated. Preliminary investigation indicated that a wave length of 4500 to 5000 A° gives the greatest difference in optical density of an exposed film and a blank film; and hence, use of light of this wave length may effectively increase the observed film sensitivity. Further study in this field is required to determine the magnitude of this increase.

Extensive liaison with a representative of Eastman Kodak Company indicated an active interest in developing improved monitoring film. HAPD needs in this matter were thoroughly reviewed. Arrangements were made to procure test lots of monitoring film for evaluation; Eastman Kodak type 2 and duPont type 555.

Twenty-nine pairs of high zinc standard rubber hood gloves produced by Wilson Rubber Company were received and field testing was initiated. Preliminary results revealed 50% reduction of 17 Kev gamma radiation. The gloves were fabricated by a two-stage process. A standard 22 gauge glove was prepared and the lower 18 inches then dipped in rubber of high zinc content (about 8 times the normal zinc oxide content) for an additional thickness of 8 to 10 mils. Preliminary personnel comments as to comfort and dexterity were very favorable.

Reports from the field of numerous failures of plastic coated gloves were investigated. It was determined that the faulty gloves were purchased recently from a manufacturer on the basis of low bid submitted and our approval. Approval for purchase was granted as a result of the bid sample completing 30 laundering cycles with no indication of unsatisfactory quality. Further, this investigation upheld the opinions that gloves of the final order were of lesser quality and durability than the sample submitted for evaluation. Subsequently, Claims and Records Operation submitted a request to the manufacturer for replacement of the 4000 pairs of gloves remaining in stock.

Work on equipment decontamination methods was confined to liaison with the interested organizations within Hanford Laboratories Operation concerning a pilot test of reactor piping decontamination. Completion of the necessary corrosion tests is expected in the near future; data available to date are favorable. Approval for the test (at 1 ounce per gallon of Turco 4306-B, five minutes shutdown flow) from a radiological standpoint was obtained. Chemical toxicity of the reagent is now under consideration by others.

Calibration of the portable impactor air samplers was completed. The equipment was distributed to the field for experimental collection of data. Arrangements were made with the Radiation Monitoring organizations to obtain data for evaluation. Procurement of Savannah River impactation equipment is in progress by Instruments Research and Development Operation.

Vendor liaison continued on procurement of a suitable running time indicator for portable instruments. One vendor quoted a unit price of \$3.87 on an order of 1000 units including modifications of the commercial equipment. Models will be procured for evaluation. Data available to date indicate that the unit will be applicable.

DECLASSIFIED

Analytical data were obtained and recovery costs estimated for salvage of the silver from metal badges. Liaison is in progress with the San Francisco Mint (through Contracts Administration and AEC-HOO) to determine the recovery steps to be taken and shipment details. Beneficial credits should amount to about \$40,000.

6. Radiological Consultation

The possible application to Hanford of the AEC regulations for licensees (10 CFR-Part 20) was reviewed. Since the regulations use nomenclature and procedures different from Hanford, many of the standard procedures and practices now in use would require change. Many of the operations could be carried out only by special approval from the licensing group. The primary example of an area where such approval would be required is in waste disposal operations. A reply was sent to the Commission indicating the inadvisability of application at Hanford.

Comments were made to Chemical Effluents Technology on the current interpretation of policies for the ground disposal of radioactive wastes in connection with the proposed disposal of solutions containing Co^{60} .

7. Radiological Disaster Studies

A rough draft of the report from the study being made by the Brookhaven National Laboratory on the damage which would result from the nuclear runaway of a power reactor was reviewed. Comments and suggested changes were discussed in a meeting at Washington, D. C. on January 14, 15, 1957.

8. Internal Exposure Studies

A further review of the ratio of blood to urine concentration was made. The change in this ratio with time for intravenously administered plutonium in the human was shown to be statistically significant. A change in the ratio with time since administration was shown to occur in rats following chronic oral or acute i.v. administration of ruthenium and in single feedings of P^{32} . The implications of this change in ratio are under review.

9. Columbia River Studies

Preparations were completed for the Columbia River Advisory Group meeting on February 7, 8, 1957, at Hanford.

10. Significant Reports Issued

A detailed report of radiation monitoring is contained in document HW-48045.

A detailed report of waste disposal monitoring is contained in HW-48135.

DECLASSIFIED

C. OFFSITE VISITS AND HLO VISITORS

Visits to Other Installations

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
JW Healy	1/14-15/57	USAEC Washington, D. C.	Confer on reactor disaster calculations.	Dr. C. Beck	Yes
HV Clukey	1-31-57	National Bureau of Standards	Attend meeting of American Standards Association Z-54 Sectional Committee on Use of Radiation.	WA McAdams AL Baletti JL Dick LC Emerson EA Pinson F Western	No

Visits to Hanford Works

Name	Dates of Visit	Company or Organization Represented and Address	Reason for Visit	HW Personnel Contacted	Access to Restricted Data	Areas and Bldgs. Visited
CL Lindekin JJ Balanda	1/8-11/57	UCRL Livermore, California	Health physics discussion	CK Irwin	No	300:326,327 329
GE Wilcox EG Gordon	1/31/57	University of California Radiation Laboratory	Discuss plastic film badge	RL Junkins LF Kocher	No	300:3706
WD Moss	1/8-10/57	Los Alamos Scientific Laboratory, New Mexico	Discuss bioassay and radiation protection procedures.	AR Keene and Staff	Yes	300 and 700 200-W:202-S 200-E:202-A

D. EMPLOYEE RELATIONS1. Safety

Seven medical treatment injuries occurred for an injury frequency of 1.53.

2. Security

No security violations occurred.

3. Suggestions

Radiation Protection personnel submitted a total of 12 suggestions in January. Three employees were awarded a total of \$25. Seven suggestions were evaluated in January and eight suggestions remain to be evaluated.

4. Training

Five members of the Radiation Protection Operation are participating in the Professional Business Management I Course.

Training assistance was provided by numerous members of the Radiation Protection Operation in the Air Force Special Weapons Program.

Several lectures were presented to students at the Jason Lee school, Fire Protection personnel in the 300 Area, and Project Engineering personnel.

Two members of the RPO are instructing in a School of Nuclear Engineering class on "Radiation Measurement Fundamentals."

5. Relations

One beneficial move occurred.

Preliminary negotiations with the Regional Monitors were held to establish job titles, classifications, jurisdiction and progression schedules.

E. STATISTICSREGIONAL MONITORING

The general findings are summarized in the following:

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Average Activity Density</u> <u>$\mu\text{c}/\text{ml}$</u>	<u>Trend*</u> <u>Factor</u>
<u>Drinking Water and Related Materials</u>			
Benton City Water Co. Well	alpha	1.1×10^{-8}	--
Richland Wells	alpha	$(\leq 5.0) \times 10^{-9}$	-2
100 Areas	beta	$(0.12 \text{ to } 5.0) \times 10^{-6}$	--
200 Areas	beta	$(0.7 \text{ to } 1.5) \times 10^{-7}$	-7
Pasco, Kennewick, McNary Dam	beta	$(\leq 0.05 \text{ to } 2.3) \times 10^{-6}$	--
Backwash Solids -			
Pasco Filter Plant	beta	$7.8 \times 10^{-2} \mu\text{c}/\text{gm}$	+2
Backwash Liquids -			
Pasco Filter Plant	beta	2.7×10^{-6}	--
Anthracite, Sand Filter -			
Pasco Filter Plant	beta	$1.9 \times 10^{-4} \mu\text{c}/\text{gm}$	+2
<u>Other Waters and Related Materials</u>			
200 West Wells	beta	$\leq 1 \times 10^{-7} \text{ to } 1.3 \times 10^{-2}$	--
200 East Wells	beta	$\leq 1 \times 10^{-7} \text{ to } 1.6 \times 10^{-7}$	--
Wells Near 200 Areas	beta	$(\leq 0.1 \text{ to } 4.0) \times 10^{-6}$	+10
107 and 108 Wells	beta	$\leq 1 \times 10^{-7} \text{ to } 9 \times 10^{-4}$	--
Outlying Wells	beta	$\leq 1 \times 10^{-7}$	--
Columbia River - Hanford			
Ferry	beta	3.8×10^{-5}	--
Columbia River - Below			
Reactors	beta	3.4×10^{-5}	--
Columbia River - Paterson			
to McNary	beta	8.9×10^{-7}	--
Columbia River - Shore Mud	beta	$(0.2 \text{ to } 1.7) \times 10^{-4}$	--
Raw Water - Operating Areas	beta	$(\leq 0.005 \text{ to } 2.8) \times 10^{-5}$	--
Reactor Effluent Retention	beta	4,100 to 37,800 $\mu\text{c}/\text{sec}/\text{reactor}$	--
Basins to River		$(2.0 \text{ to } 7.8) \times 10^{-3}$	--
Reactor Effluent Retention	alpha	$\leq 0.04 \mu\text{c}/\text{sec}/\text{reactor}$	--
Basins to River		$\leq 5 \times 10^{-9}$	--

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

DECLASSIFIED

[REDACTED]

<u>Sample Type and Location</u>	<u>Activity Type</u>	<u>Average Activity Density</u> <u>/uc/ml</u>	<u>Trend*</u> <u>Factor</u>
<u>Other Waters and Related Materials (contd)</u>			
I-131 in Farm Wastes to River	I-131	92 /uc/day 1.4×10^{-6}	--
I-131 in Columbia River - Hanford	I-131	1.0×10^{-7}	--
300 Area Pond Inlet	alpha	4.3×10^{-7}	--
<u>Atmospheric Pollution</u>			
Gross Alpha Emitters	alpha	$(\leq 4 \text{ to } 9.1) \times 10^{-15}$	+2
Gross Dose Rate - Separations Areas	beta-gamma	0.8 to 7.0 mrad/day	--
Gross Dose Rate - Residential Areas	beta-gamma	0.6 to 6.4 mrad/day	--
Active Particles - Separations Areas	beta	$(1.5 \text{ to } 3.3) \times 10^{-13}$	--
I-131 Separations Areas	I-131	$(0.6 \text{ to } 7.9) \times 10^{-13}$	+2
I-131 Separations Stacks	I 131	1.1 curies/day	-3
Ruthenium - Separations Stacks	Ru-103-106	$< 0.02 \text{ curie/day}$	--
Active Particles - Wash., Idaho, Ore., Mont.	--	0.01 to 0.07 ptle/m ³	--
Active Particles - Project	--	0.003 to 0.03 ptle/m ³	-4
<u>Vegetation</u>			
Environs of Separations Areas	I-131	$(0.6 \text{ to } 7.6) \times 10^{-5} \text{ /uc/gm}$	+5
Residential Areas	I-131	$(\leq 0.3 \text{ to } 1.5) \times 10^{-5} \text{ /uc/gm}$	+3
Eastern Washington and Oregon	I 131	$(\leq 3 \text{ to } 7) \times 10^{-6} \text{ /uc/gm}$	+2
Non-Volatile Beta Emitters Wash. and Ore.	beta	$(0.18 \text{ to } 5.0) \times 10^{-4} \text{ /uc/gm}$	+2
Alpha Emitters - Separations Areas	alpha	$(\leq 0.07 \text{ to } 1.9) \times 10^{-6} \text{ /uc/gm}$	+2

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

DECLASSIFIED

RADIATION MONITORING

	<u>Hanford Laboratories</u>	<u>Construction Engineering</u>	<u>Others</u>	<u>January Total</u>	<u>1957 To Date</u>
Special Work Permits	1,747	607	214	2,568	2,568
Radiation Surveys	1,203	883	211	2,297	2,297
Air Samples	1,721	114	79	1,914	1,914
Skin Contamination Cases	10	4	0	14	14
*Class II Radiation Incidents	0	0	0	0	0
**Class II Radiation Incidents	0	0	0	0	0

EXPOSURE 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>
January	285,792	10	8	10
1957 to Date	285,792	10	8	10

Beta-Gamma Film Badges

	<u>Badges Processed</u>	<u>Readings 100-300 mrad</u>	<u>Readings 300-500 mrad</u>	<u>Readings Over 500 mrad</u>	<u>Lost Readings</u>	<u>Average Dose Per Film Packet mrad(ow)</u>	<u>mr(s)</u>
January	54,418	667	19	4	58	1.48	2.79
1957 to Date	54,418	667	19	4	58	1.48	2.79

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>
January	2,794	31	12	2
1957 to Date	2,794	31	12	2

Fast Neutron Film Badges

	<u>Badges Processed</u>	<u>Readings Above 50 mrem</u>	<u>Lost Readings</u>
January	847	0	0
1957 to Date	847	0	0

Bioassay

	<u>January</u>	<u>1957 to Date</u>
Plutonium: Samples Assayed	989	989
Results above 2.2×10^{-8} $\mu\text{c/sample}$	25	25
Fission Product: Samples Assayed	1,126	1,126
Results above 3.1×10^{-5} $\mu\text{c FP/sample}$	0	0
Uranium: Samples Assayed	392	392

*Radiation Monitoring Operation Customers

**Total Plant

DECLASSIFIED

DECLASSIFIED

F-10

HW-479431

Uranium Analyses

<u>Sample Description</u>	<u>Following Exposure</u>			<u>Following Period of No Exposure</u>		
	<u>Units of 10⁻⁹ µc U/cc</u>		<u>Number</u>	<u>Units of 10⁻⁹ µc U/cc</u>		<u>Number</u>
	<u>Maximum</u>	<u>Average</u>	<u>Samples</u>	<u>Maximum</u>	<u>Average</u>	<u>Samples</u>
Metal Preparation	6.62	1.45	67	7.25	2.14	56
Technical	8.70	2.02	13	3.47	1.70	15
UO ₃ Plant	8.32	2.08	137	7.38	1.83	81
Special Incidents	0	0	0	--	--	--
Random	1.20	0.57	5	--	--	--

Tritium Analyses

	<u>January</u>	<u>1957 to Date</u>
Samples Assayed	1	1

Thyroid Checks

Checks Taken	101	101
Checks Indicating .01 µc	0	0

Hand Checks

Checks Taken - alpha	52,413	52,413
- beta gamma	49,651	49,651

CALIBRATIONS

Portable Instrument Calibration

	<u>Number of Units Calibrated</u>	
	<u>January</u>	<u>1957 to Date</u>
CP Meter	1,034	1,034
Juno	378	378
GM	1,400	1,400
Other	178	178
Total	2,990	2,990

Personnel Meters

Badge Film	2,490	2,490
Pencils	2,070	2,070
Other	249	249
Total	4,809	4,809

Miscellaneous Special Services

Total Number of Calibrations	8,084	8,084
------------------------------	-------	-------

A. R. Keene, Manager
RADIATION PROTECTION

LABORATORY AUXILIARIES OPERATION
MONTHLY REPORT - JANUARY, 1957

Personnel

	<u>12-31-56</u>	<u>1-31-57</u>
Supervisory	20	20
Other Exempt	16	16
Non-Exempt	<u>201</u>	<u>199</u>
Total	237	235
Personnel on Loan	1	1
Rotational Trainees	0	0

Facilities Engineering Operation

Work is continuing on the preparation of the FY 1959 and Revisions to FY 1958 Plant Acquisition and Construction Budget. Approximately 30 studies are being performed by Construction Engineering Operation. Work is being integrated with that of the Finance Operation.

Project activities are continuing with Construction Engineering Operation performing management services. Our main concern is proper planning of these projects. Those projects that are behind schedule or are overrunning the estimated costs are being reviewed for revisions that will result in regaining planned schedules or costs, and if this is not possible to revise the proposals.

Project activity during the month and project status is included in the schedule attached.

The drafting and design function produced a total of 2242 man hours plus 35.9 man hours of overtime during the month. Approximately 235 drawings of various sizes and categories were developed. Present backlog is about 15 man days of drafting and 10 man days of graphics.

The following is a summary of the Material Requisitioning and Standardization function for the month of January:

Requisitions and Alterations Issued (this month)	-	6
Total Estimated Cost of Requisitions & Alterations (this month)	-	\$2,229
Requisitions Processed (September to date)	-	20
Bid Reviews Completed	-	4

Construction Engineering is processing items for procurement on HLO projects for which they have management responsibilities.

Other work performed by this component included reports and estimated requirements of Stainless Steel, Steel, Bismuth, Copper, Aluminum, Nickel Alloys and Zirconium.

Winter weather conditions have resulted in disrupted service and uncomfortable occupied space in various HLO structures. Steps are being taken to remedy these situations to the extent of correcting operational procedures on installed equipment to the preparation of project proposals for additional heating capacity, particularly in buildings 326, 328 and 3760.

Laboratories Administration Operation

Sixteen additional Organization and Policy Guides were issued. A total of 97 have been issued and 60 are in draft form or ready for duplicating and distribution.

The following contracts were formalized in January:

Special Agreement No. SA-16	Future Farmers of America, Inc.
Special Agreement No. SA-17	The Swedish Hospital
Maintenance and Repair Contract No. MRO-7	North American Philips Co., Inc.
Design, Development and Research	Superior Tube Co.
Contract No. DDR-5 (Supplemental	
Contract No. 1)	

Suggestions were submitted to Transportation and Maintenance Operation on budget for fiscal year 1959 and revisions of budget for fiscal year 1958 on automotive and heavy mobile equipment not included in construction projects.

There was no new assignments on transportation and vehicular equipment.

Organization and Policy Guides were written and/or issued on Assistance to Hanford program and Services for Hanford by Knolls Atomic Power Laboratory.

Radiographic Testing Operation

Testing operations continued at a high level during this month. A total of 983 tests were made. Of this total, 420 were radiographic exposures and 563 were supplementary tests. The supplementary tests included dye penetrant, magnetic particle, ultrasonic, and eddy current tests. Work was done for sixteen different organizational components

Despite below normal temperatures, field work was successfully maintained with only minor interruptions.

Shop fabrication of pressure piping for the 558 Project has been virtually completed. However, field examinations have increased and have been put on a spot check basis. Discovery of borderline and sub-standard welds required this precautionary measure.

The H-4 oxidizer spare being fabricated on-site has almost been completed. Where radiographs were not feasible, dye penetrant tests have been made. Accurate records have been obtained for almost all of the welding on this vessel.

The first true safety work was done this month with the testing of a crane rigging ring. The ring, to carry a load of 20,000 pounds, was cut from boiler plate. X-ray, magnetic particle, and ultrasonic tests were made to discover any discontinuities that might impair the safe functioning of the ring. Failure of a lighter ring gave cause for some concern. Strong ultrasonic indications were found in the two straight portions of the ring and were confirmed by radiographic examination as slag stringers. The ring was scrapped, and the plates from which new rings will be made will be examined thoroughly in the same manner to assure sound material.

Additional experience is being gained in the application of eddy currents for tube testing. Previous indications in titanium tubing were partially confirmed by refined radiographic techniques as being caused by fabrication gall marks. Small diameter aluminum tubing was similarly checked, with eight out of 22 tubes showing deleterious cracks, laps, dents, and wall thickness variations.

Two interesting jobs were encountered in special purpose test slugs for material irradiation. In one case, a uranium slug was successfully penetrated with the 2 mev Van De Graaff to show the displacement of a core assembly. In the other case, the level of the NaK used to fill a zirconium capsule was determined to assure that proper test conditions would be achieved.

So-called KER Spires, the inside canning component for I & E elements, were examined for integrity of the closure. All units examined showed questionable quality and were repaired.

The work on zirconium continues as a major effort. Correlation between rupture tests and discontinuity indications have not yet been completed. Some longitudinal welded tubing was evaluated disclosing serious porosity conditions. The necessary work for adapting the 221-B building for the zirconium program test will be started in February.

Customer	No. of Tests	Feet of Weld	No. of Pieces	Description
<u>Radiographic Tests</u>				
Construction Engineering Operation	79	29	24	Pipe and vessel weld tests; crane rigging ring.
Hanford Laboratories Operation	136	117	80	Titanium & zirconium tubing and misc. items
Chemical Processing Department	48	32	8	Pipe and vessel weld tests.
Irradiation Processing Department	68	80	19	Pipe & vessel weld tests.
Fuels Preparation Department	92	--	32	Aluminum cans.
<u>Eddy Current</u>				
Hanford Laboratories Operation	44	75	22	Seamless aluminum tubing.
<u>Ultrasonic</u>				
Irradiation Processing Department	152	--	33	Pressure vessels and piping thickness measurement. --
Construction Engineering Operation	11	4	2	Crane rigging ring.
<u>Magnetic Particle</u>				
Construction Engineering Operation	20	2	1	Crane rigging ring.
<u>Dye Penetrant</u>				
Construction Engineering Operation	336	285	25	Vessel welds.

Technical Shops Operation

Total productive time for the month was 14,087 hours. The total shop work backlog is 24,019 man hours with 80% scheduled to be completed in 60 days. The remaining 20% consists of major items scheduled over a six month period. Overtime worked during the month was 3.0% (548 hours) of the total available hours.

Distribution of time was as follows:

	<u>Man Hours</u>	<u>% of Total</u>
F.P.D.	2201	16
I.P.D.	2362	17
C.P.D.	625	5
H.L.O.	8484	60
Misc.	335	2

Customer demands for service the first two weeks of the month remained below normal but intensified toward the end of the month to a level which is considered above normal. The machine shop backlog which decreased 25% during the holiday period has returned to the December 15th level. Overtime worked during January totaled 532 hours or 2.96% of the available hours. Since September 1, 1956, the ratio of overtime hours to available hours in the operation amounts to 2.6%.

Safety and security performance was considered satisfactory with no major injuries. The number of medical treatments for minor injuries compared favorably with the standard set for the operation. The quality of the safety and security meetings held during the month was high and the information presented was favorably received by attending personnel.

The grievance filed on 12-20-56 concerning graphite fabrication work which was referred to Step II for settlement has not yet been scheduled by the HAMC for discussion with the General Electric Company. A decision has been reached in not permitting "E" time to be used for time spent attending educational classes at the G.E. Nuclear School of Engineering. Shift personnel desiring to attend will be granted permission, the time away from the job to be on an "EX" basis. Several meetings were held with stewards to iron out minor problems and no grievances were filed against the Operation.

Technical Information Operation

The Technical Information Operation's third annual information meeting was held on January 30 and 31. As in the past, the meetings covered the activities of the Operation as a whole and the accomplishments of each of the Level 5 components. There was an interesting display of the publications and reports issued during the year, and a copy of the work volume statistics for the last five years was given each employee.

Considerable time was spent implementing HAPO OPG 1.5 on the issuance of official correspondence and documents. A suitable approval form has been devised which will be set up as a Stores item. Also to be set up as a Stores' item is a multilith

master for the title page of informal reports and memoranda. The master will have the required disclaimer stamps already printed on it. The Hanford Laboratories OPG on official correspondence and documents will cover the use of these forms.

The annual inventory of Research & Development reports required by the AEC was started January 16. The inventory will reflect the status of R & D reports as of December 31, 1956. Unfortunately the lists supplied by Data Processing for the inventory have a number of discrepancies and omissions, e.g. (1) documents listed as "in file" have been destroyed, and (2) documents appearing on the 1955 list were omitted on the 1956 one. These errors will be corrected as the inventory proceeds. Data Processing now plans to rework the R & D inventory "pass" to facilitate the 1957 inventory.

The inventory of Atomic Weapon Data reports was completed. Results will be included with the R & D inventory report to Security. All copies of AWD reports were accounted for.

Progress on processing the Yellow File documents is slow. One reason for this is that many early GE documents had attachments. The IBM system cannot handle documents with attachments, so these must be detached before the documents can be incorporated into the IBM records. During the month 1,445 copies with attachments were processed.

The AEC program for reclassifying documents containing production data to Top Secret has increased the Files' work load. During the month 659 Secret documents were removed from Files' accountability and transferred to the HAPO TS custodian.

A Flexowriter has been installed in the 300 Area files and the Route Clerks are becoming familiar with its operation. All new documents which have ten or more copies are being routed on the machine.

Little typing time is saved, even on the routing of multiple copy documents. Time is required to prepare the master tape, and the clerk operating the machine must give it her full attention. Essentially, she is able to get the same job done with less effort, but this surplus effort cannot be used on other work.

The savings, if any, will come in the elimination of the keypunch operation. These savings are possible only if the machine is used for file record cards, certificates of destruction, and receipts. Data Processing is studying the tape-to-card conversion.

Work Load Statistics

	<u>December</u>	<u>January</u>
Documents routed and discharged	26,803	33,693
Documents issued	13,412	17,132
Documents destroyed	6,923	6,474
Reports abstracted	175	219
Formal R & D reports issued	27	23
Document classification changes	501	624
Books circulated	1,469	2,149
Periodicals circulated	8,787	12,203
Volumes added to the collection	269	326

Manager,
LABORATORY AUXILIARIES

JL Boyd:po

G-6

MONTHLY PROJECT REPORT

HW-47943

JANUARY 1957

UNCLASSIFIED

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT				STARTING DATE		BENEFICIAL USE DATE	PROJECT COMP. DATE
				AMOUNT	DATE	DESIGN SCHED	CONST. SCHED	ACTUAL	ACTUAL	DATE	CONST.		
General Plant Projects - FY 1956, EC-2-23X-56-L-2		Radiation Protection	\$39,992*	\$40,000	8-29-55	100	100	100	100	5-2-55		11-30-56*	12-29-55
		REMARKS:								7-6-56			3-1-57
G-635	Redox Stack Particulate Sampler	Physical completion notice issued.											
		*Actual.											
G-664	350° C Flow Loop - 314 Bldg.	Reactor & Fuels	\$160,000	\$121,500	5-11-56	100	0	100	2	5-23-56			9-28-56
		REMARKS:								Not Std.			8-1-57
		No acceptable bids were received on a packaged request to bid on this loop. Project Engineering has prepared 22 requisitions for approximately 90% of the total equipment and material required for fabrication of this item and they have been processed for pricing. Under this planning Minor Construction forces would do the fabrication & installation. George Grant, the contractor for the deflonizer installation, will be completed with his work by the middle of February.											
General Plant Projects - FY 1957, EC 2-23-57-N-2		Phys. & Instr.	\$150,000	Dir.AEC-97*	11-28-56*	0	0	0	0	Not Std.		*	12-31-57**
		REMARKS:								Not Std.			
A-658	Shielded Personnel Monitoring Station	*Directive AEC-97 issued 11-28-56 authorized \$150,000 for this project. No work authority has been issued to G. E. to date.											
		**Directive Completion Date.											
G-680	Corrosion Testing Facilities - 314 Bldg.	Reactor & Fuels	\$140,000**	\$29,500*	9-24-56	100	0	100	0	10-3-56		*	1-24-57
		REMARKS:								*			1-20-58
		Design was completed on January 25, 1957. Requisitions are in preparation for procurement of engineered equipment. CEO has been requested to prepare a project proposal revising the completion date and requesting release of construction funds.											
		*Interim authorization only for design and procurement.											
		**Total \$171,000 includes \$31,000 capital equipment transfer.											
A-685	Alterations to Buildings 325 and 326	HLO	\$23,000	\$23,000	9-5-56	100*	0	100*	0	10-1-56			11-19-56
		REMARKS:								Not Std.			8-15-57
		325 Building - Otis Elevator Company performing design & fabrication for 325 elevator. To be completed by June 1957. Work to start about 5-17-57 and to be completed by 7-4-57. 326 Building - Contract 1172 awarded to Patton and Hill for \$8,261. Notice to proceed issued 1-18-57. Contract completion date: 5-17-57.											
		*G.E. portion of design only.											
		UNCLASSIFIED											

UNCLASSIFIED

MONTHLY PROJECT REPORT

HW-47943
JANUARY 1957

HANFORD LABORATORIES OPERATION

PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION		PROJECT PROGRESS IN PER CENT			STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE	
				AMOUNT DATE		DESIGN SCHED ACTUAL	CONSTR. SCHED ACTUAL				DESIGN CONST.	DESIGN CONST.
	Biology Controlled Activity Water System - 100-F Area		\$15,000*	Pending		0	0		To be est.	To be est.		To be est.
		REMARKS:		Pending		0	0		To be est.	To be est.		To be est.
		Project proposal being prepared.										
		* High Spot Estimate.										
	Equipment Not Included in Construction Projects		\$120,000	\$143,000		87	0		5-1-56			4-1-57
		REMARKS:		3-15-56		50	0		6-1-57	8-31-57		9-30-57
CG-620	Melt Plant Modifications - 306 Building *	Revision No. 2 to the project proposal was transmitted to the Commission on Dec. 28, 1956. Installation design has been delayed due to late receipt of the vendors shop drawings. An expeditor has been to the vendor's plant to obtain status of design drawings and a firm shipping date for the equipment.										
	*New Title - Vacuum Furnace		\$135,000	\$135,000		68	0		3-27-56			*
		REMARKS:		3-15-56		75	0		Not Std.	*		9-30-57
CG-660	Modifications and Additions to Metallographic Cell - 327 Bldg.	Design schedule transmitted to HOO-AEC on 1-21-57. Design scheduled for completion by 3-29-57.										
		*Project proposal revision 2 to ask for extension of design and physical completion dates.										
		Reactor & Not	\$22,400*			Not Sch.	Not Sch.		12-6-56			To be est.
		Fuels	Determined	11-13-56		3	0		Not Auth.	*		To be est.
CG-661	Additional Heat Generation Facility - 189-D Bldg.	G. E. design started. CEO has been requested to initiate a project proposal for total funds. Project planning is continuing on equipment design and fabrication in collaboration with manufacturers, notably the G. E. Rectifier Dept.										
		*Interim authorization for design only.										
		Physics &	\$112,000	\$185,000		100	Not Sch.		5-21-56			10-29-56
		Instr.		5-1-56		100	0		Not Std.			6-30-57
CG-672	Monochromatic Neutron Beam Facility - 105-KE Bldg.	REMARKS: The spectrometer bearings and the neutron beam have been received. A revised project proposal is currently undergoing approval in HIO. No acceptable bids were received from 13 manufacturers on the spectrometer. Currently negotiations are proceeding with the Bremerton Navy Yard to fabricate and cast this item.										

UNCLASSIFIED

MONTHLY PROJECT REPORT														JANUARY 1957	
PROJECT NUMBER	TITLE	USING COMPONENT	EST. TOTAL PROJECT COST	AUTHORIZATION INFORMATION			PROJECT PROGRESS IN PER CENT			STARTING DATE	BENEFICIAL USE DATE	PROJECT COMP. DATE			
				AMOUNT	DATE	SCHED	ACTUAL	DESIGN	SCHED				ACTUAL		
CG-681	Hanford Equipment in the ETR	Reactor & Fuels	\$1,200,000	\$80,000*	6-29-56	60	68.3	Not Sch.	0	9-17-56	*	5-29-57			
REMARKS:															
AEC (HOO) review board approved the project proposal for \$600,000 on Jan. 24, 1957 and forwarded it to Washington D. C. AEC for approval.															
*Interim authorization for design only.															
CG-682	High Level Examination and Cut-off Cell - 327 Bldg.	Reactor & Fuels	\$355,000	\$16,500	6-6-56	97	58	0	0	7-18-56	*	2-25-57*			
		REMARKS:													
Scope changed. Project proposal revision 1 requesting \$30,500 total design funds awaiting AEC approval.															
*Interim authorization for design only.															
CA-695	Radio Telemetering Network	Physics & Instr.	\$95,000	\$95,000	1-10-57	N.S.	0	N.S.	0	Not Std.	4-15-57	3-15-57			
		REMARKS:													
Directive AEC-100 authorized the project.															
Work Authority Number CA-695 (1) dated January 23, 1957.															
Project Authorization CA-695 (Issue 1) authorized HLO to proceed with the work described in the Work Authority.															
New Construction - FY 1958															
CG-731	Critical Mass Laboratory	Physics & Instr.	\$2,000,000	None to date	None to date	0	0	Not Sch.	0	1 mo.**	*	*			
		REMARKS:													
AEC(HOO) review board approved this project proposal for \$60,000 on 1-17-57 and forwarded it to Washington D. C. (AEC) for approval.															
**After authorization.															
*To be established.															
None	Metallurgical Development Facility	Reactor & Fuels	\$4,200,000	None to date	None to date	0	0	Not Sch.	0	**	**	**			
		REMARKS:													
Project Proposal prepared by CEO for request of \$57,000* in funds currently being approved by CEO.															
*For scoping and initiation of design only.															
**To be established.															

LABORATORY AUXILIARIES MONTHLY REPORT
JANUARY, 1957

HW-4243

VISITS TO HANFORD WORKS

Name	Dates of Visits	Company or Organization Represented & Address	Reason for Visit	Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
E. M. Skinner) K. M. Spicer)	1-28-57	International Nickel Company, New York	Discuss applications of nickel alloys	HW Benoliel	Yes	3760 Bldg. 300 Area

VISITS TO OTHER INSTALLATIONS

Name	Dates of Visit	Company Visited and Address	Reason for Visit	Personnel Contacted	Access to Restricted Data
C. G. Stevenson	1-22-57	None	Attend meeting of Washington State Library Commission		No

General

On January 31 the staff of the Hanford Laboratories Operation totalled 1175, including 472 exempt and 703 non-exempt employees. Of the total exempt personnel there were 415 with college degrees, including 398 technical degrees as follows:

<u>BS</u>	<u>MS</u>	<u>PhD</u>
201	102	95

In addition there were 38 non-exempt employees with degrees.

Distribution among the nine Level 3 components is shown in Table I.

Personnel Development and Communications

Two Professional Business Management - I courses were inaugurated January 23. This course will continue on a weekly basis until June. Thirty-five members of HLO management are participating including two course instructors.

Rotational Training Program activities reflected little change during the month with 23 Technical Graduates and 22 Technician Trainees on assignment at the end of the period.

Training of AFSWP personnel was two-thirds complete at month's end.

Seven members of Laboratories management attended Management Orientation and eighteen attended Practical Business Writing I and II.

Eight HLO employees were included in the January Area Tour for Women.

The first of a series of weekly Luncheon Information Meetings was held on January 17. Fifteen HLO exempt employees were in attendance.

Eight speeches, technical papers, and signed articles were processed through the Operation during the month.

Salary and Wage Administration

The major effort in this Operation during the month was directed toward the successful completion of the annual salary review.

One new position was established and one position was deleted. There was also a nomenclature change of one position title.

The second proposal on the secretarial grade study is now prepared for submission to the A.E.C. by Relations and Utilities. It is hoped that sufficient data and justification has been provided to permit immediate approval.

The second proposal regarding the title study of engineering and laboratory assistants is currently being reviewed by the HAPD Employee Relations Managers and will be submitted to the A.E.C. for approval shortly.

Personnel Practices

Suggestions - At the January Board Meeting ten suggestions were reviewed and 10 awards totalling \$100.00 were approved. One of these involving

Suggestions - (Continued)

\$5.00 was submitted by a Technical Graduate and was referred to Relations and Utilities for consideration. During the month of January, 35 new suggestions were received. This established a new HLO record and represents 5.0 suggestions submitted per 100 eligible employees.

Benefits - - HLO participation in the Employee Benefit Plans is as follows:

	Jan.	Dec.
Pension Plan	97.5	97.5
Insurance Plan	99.2	99.
Savings and Stock Bonus Plan	58.9	57.3
Savings Plan	8.2	8.1

Pre-retirement files are now current and a breakdown of the number of HLO employees scheduled to retire normally during the next seven years is as follows:

1957	1958	1959	1960	1961	1962	1963
2	2	0	7	3	5	5

To date eight General Electric Fellowship applications have been distributed to Hanford Laboratories Operation employees. Other HAPO departments have distributed one.

Selective Service - Hanford Laboratories Operation currently has 216 employees subject to military service of which 93 are Reservists or National Guard members, 47 are technically trained or engineering personnel for whom deferments have been granted or are being processed and 76 are non-technical non-veterans.

Seven hundred sixty-three Military Status Survey Forms were mailed to male employees of Hanford Laboratories during the month. To date 519 completed forms have been received. The results of this survey will be tabulated and will make possible an exact record of the military status of the Hanford Laboratories personnel.

Placement and Records - As a result of a complete review of HLO personnel, records have been up-dated and corrected to provide accurate information regarding HLO technical and non-technical degrees.

Seven Attendance Recognition awards were issued during the month including one two-year, two three-year, two four-year, one five-year, and one seven-year awards.

Secretarial and stenographic openings decreased during the month and it is anticipated that HLO requirements will be met in this area during the coming month. The outlook is extremely encouraging regarding the filling of other non-exempt openings in HLO. Transfer requests from non-exempt personnel totalled 12 during the month. Reasons for these requests indicated that these fall within the normal trend.

Technical Personnel Placement

Technical Personnel Placement activities are summarized in Table III. The PhD recruiting picture is somewhat more encouraging as a result of an appreciable number of visit acceptances received by Relations

Technical Personnel Placement (continued)

and Utilities during the past month.

Experienced BS/MS recruiting efforts continue to be quite favorable except in the area of mechanical engineering and metallurgy which continue to represent fields of extreme shortage.

The status of exempt transfers are summarized in Table IV. As indicated the transfer activities continue to decrease.

Union Relations

The consent election involving the Field Assistants A and B in the Construction Engineering Operation was held during the month. The vote was 27 to 1 in favor of union affiliation.

Two grievances which have been at arbitration level were settled during the month at Step II. Both were the responsibility of other departments.

One new grievance was submitted within the Hanford Laboratories Operation during the month and was answered satisfactorily at Step I.

Total grievances processed since September now total 15 and include one non-unit grievance. A breakdown of these grievances is included in Table V.

Health and Safety

During the month there were 33 medical treatment injuries with a frequency of 1.53 which is below the expected average. Laboratories personnel worked a total of 214,581 employee hours with no disabling injuries. The medical treatment frequency for December was 1.60.

Two fire alarms were answered during the month neither of which resulted in damage. There were also two incidents of damage resulting from cold weather; (1) a steam line was broken, a compressor cooling water line, a hot water line, and a drain line froze in the train shed of 108-F Building with damage estimated \$550.00; (2) the freezing of coils in the heating unit and damage to interior paint by penetration of snow in the Bio-assaying Laboratory - - estimated damage \$1000.00.

Plans for the thirty-five foot test shaft for Mechanical Equipment Development Operation and plans for installation and consolidation of the test facilities for Corrosion and Coatings Operation and the fresh-air equipment for the Pharmacology Operation were reviewed and approved.

An inspection tour of the fire protection and prevention facilities in the Laboratories buildings of 300 Area was made in company with the A.E.C. Fire Prevention Engineer.

Security

There were 13 security violation incidents during the month bringing the total since reorganization to 40. The month's incidents will be twice the control number for this period and may be compared with a total of 4 for December.

Manager
Employee Relations

T.G. Marshall:vf

UNCLASSIFIED

TABLE III. EMPLOYMENT - TECHNICAL PERSONNEL STATUSI. Employment

Non-Exempt Employment Status Dec. Jan. Non-Exempt Transfer Requests Dec. Jan.

Requisitions

At end of month	52	49
Cancelled	0	2
Received during month	32	21
Filled during month	25	22
Candidates Considered		
Total Applications	54	31
Total Transfer Request		
from other at HAPO	4	10
Total Interviewed	0	7

Transfer Cases

Active cases at end of month	39*	41
Cancelled	17**	3
New during month	5	12
Transfers effected	4	7
Planned Transfers		
Effective during month	2	4

* 4 Transfer Requests to San Jose not previously counted.

** Corrected for last month.

II. Technical Personnel PlacementPhD Recruiting

	Cases Con- sidered	VISITS TO RICHLAND				OFFERS			On The Roll
		Extended	Visited	To Visit	Open Invite.	* Extended	* Accepted	* Open	
Engineering:									
Chemical	50	24	1	12	8	1	0	1	0
Electrical	13	5	0	1	4	1	0	1	0
Mechanical	14	5	1	0	4	2	1	1	0
Metallurgical	35	20	3	4	11	3	1	0	0
Civil	2	0	0	0	0	0	0	0	0
Science:									
Chemistry	176	68	3	22	34	3	1	0	1
Physics	194	80	5	22	45	8	3	3	2
Math-Stat.	34	8	0	1	5	0	0	0	0
DVM	2	1	1	0	0	1	1	0	1
Other	30	10	4	2	3	4	3	1	0
TOTAL	550	221	18	64	114	23	10	7	4

*Includes 12 carry overs with 5 acceptances not on the roll as of 9/1/56 and 6 open offers at that time.

BS/MS Experienced Recruiting

	Cases Con- sidered	VISITS TO RICHLAND				OFFERS			On The Roll
		Extended	Visited	Inv.	Rejected	Extended	Accepted	Rejected	
Engineering:									
Architectural	2	2	1*	0	0	0	0	0	0
Ceramic	3	3	3	0	3	1	0	0	1
Chemical	9	5	1	1	0	0	0	0	0
Electrical	11	8	2	2	1	1	0	1	1
Industrial	3	1	1	0	1	1	0	1	1
Mechanical	12	10	3	4	3	1	1	1	1
Metallurgical	7	5	2	1	1	1	0	0	0
Nuclear	1	1	0	1	0	0	0	0	0
Other	2	0	0	0	0	0	0	0	0
Science:									
Chemistry	17	5	1	3	1	0	1	0	0
Math-Stat.	3	2	2	0	2	2	0	0	2
Physics	8	5	3	1	2	1	1	0	0
Other	10**	1	1*	0	0	0	0	0	0
TOTAL	88	48	20	13	14	8	3	6	

*Includes one case - no offer made

**Includes 9 cases - no HLO interest

IV. Exempt Transfer Cases

	<u>Jan.</u>	<u>Dec.</u>
Active cases at end of month	19	23
Total cases since 9/1/56	50	48
(Includes those initiated prior to 9/1/56)		
Initiated by employee	35	34
Initiated by management*	15	14
New cases during month	2	3
Initiated by employee	1	3
Initiated by management*	1	0
Cases closed during month	6	4
Transfers effected:		
Within HLO	1	0
Within HAPO	1	0
Other GE	2	1
Requests Withdrawn	0	3
Terminated	2	0

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

V. Union RelationsGrievances Processed -- September 1, 1956 to date.

Total processed 15 (includes 1 non-unit grievance)

Step I

Pending Step I Answer	0
Answered Satisfactorily*	7

Step II

Pending Step II Discussion	1
Pending Step II Answer	1
Answered	
Satisfactorily**	6
Unsatisfactorily	
Applied for arbitration	0

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

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

VISITS TO HANFORD WORKS

Name	Dates of visit	Company or organization represented & address	Reason for Visit	H.W. Personnel Contacted	Access to Restricted Data	Areas and Buildings Visited
William Scholz	1/14/57	General Electric Co. New York, New York	Consultations on Communications	T. G. Marshall W. A. Burns R. G. Wark D. C. Fleckenstein	No	3760
E. D. Rebucci	1/17/57	General Electric Co. New York, New York	Consultations on Manpower Inventory	T. G. Marshall W. A. Burns R. G. Wark D. C. Fleckenstein R. H. Scott T. W. Galbraith H. A. Paulsen R. S. Himmelright J. P. Crewdson R. D. Tillson	No	3760

VISITS TO OTHER INSTALLATIONS

D. C. Fleckenstein	1/9-10/57	General Electric Co. Schenectady, N. Y.	Seminar - Laboratory Professional Personnel	Dr. Glen Giddings R. Seeman	No No	Research Lab. General Engineering Lab.
	1/11/57	General Electric Co. Schenectady, N.Y.	Discussions re Personnel Development & Training activities	John Leslie	No	KAPL

UNCLASSIFIED

H-7

HW 47943

TABLE I. HLO-FORCE REPORT AND PERSONNEL STATUS CHANGES

Date January 31, 1957FORCE REPORT

	At close of Month		At beginning of Month		Additions		Separations		Sep. Rate			
	Exempt	Non-Exempt	Total	Exempt	Non-Exempt	Total	Exempt	Non-Exempt	M	F		
Chemical Res. and Development	126	94	220	128	95	223	0	1	2	2	1.399	-
Reactor & Fuels Research & Dev.	139	87	226	139	86	225	2*	3	2	2*	1.562	-
Physics & Instr. Research & Dev.	59	25	84	58	25	83	1	0	0	0	-	-
Biology	32	41	73	32	42	74	0	1	0	2	2.222	3.571
Operations Res.	10	3	13	11	3	14	0	0	1	0	10.00	-
Radiation Proteo.	41	205	246	41	205	246	0	5	0	5	1.574	1.680
Laboratory Aux.	36	201	237	35	200	235	1	8	0	7	2.222	1.960
Financial	15	34	49	15	32	47	0	2	0	0	-	-
Employee Relations	13	12	25	13	12	25	0	2	0	2	-	16.666
General	$\frac{1}{472}$	$\frac{1}{703}$	$\frac{2}{1175}$	$\frac{1}{473}$	$\frac{1}{701}$	$\frac{2}{1174}$	$\frac{0}{4}$	$\frac{0}{22}$	$\frac{0}{5}$	$\frac{0}{20}$	$\frac{1.562}{1.696}$	$\frac{1.696}{1.696}$
TOTAL												
Total excluding Internal Transfers	472	703	1175	473	701	1174	4	17	5	14		

* 1 Reassignment from Non-exempt payroll

Composite Separation Rate ----- 1.610
 Separation Rate (based on HLO personnel separating from G.B.) ----- 1.012
 Controllable Separation Rate ----- 340

UNCLASSIFIED

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

Date January 31, 1957

Component	PROMOTIONS		EXEMPT TRANSFERS (2)					NON-EXEMPT TRANSFERS	
	Exempt	Non-Exempt to Exempt	Non-Exempt	From Other HAO	To HAO	From Other G.E.	To Other HAO	To HAO	From HAO
Chemical	1	0	0	0	0	0	1(3)	0	0
Reactor & Fuels	5	1	2	1	0	0	0	2	1
Physics & Instr.	0	0	1	0	0	0	0	0	0
Biology	1	0	2	0	0	0	0	1	0
Operations Res. & Syn.	2	0	0	0	0	0	0	0	0
Radiation Protection	0	0	4	0	0	0	0	0	1
Laboratory Aux.	0	0	5	1	0	0	0	1	3
Financial	0	0	0	0	0	0	0	0	0
Employee Relations	0	0	2	0	0	0	0	0	0
Total	9	1	16	2	0	0	1	4	5

- (1) Data through 1/31/57
 (2) Transfers within HAO not included
 (3) F. L. Mourich to R & U
 (4) G. B. Barton to APED

FINANCIAL OPERATION MONTHLY REPORT
JANUARY, 1957

Compiled by Members of the
FINANCIAL OPERATION
HANFORD LABORATORIES OPERATION

Activities

General Accounting Operation

An overtime control procedure, effective January 1, 1957, was established by the Manager - Hanford Laboratories. The procedure provides for the submission by each Level 3 component, at the beginning of each calendar quarter, of an analysis of overtime for the preceding quarter and a forecast for the current quarter. Control limits for the current quarter will be established by the Manager - Hanford Laboratories.

Effective January 1, 1957 accruals for Continuity of Service and deductions from employees' pay for payroll taxes and group insurance are retained on HLO books until disbursed. Previously they were transferred to Relations and Utilities Operation.

Effective in January the dollar values of transfers of SS Materials are recorded in the month in which they occur, rather than in the following month.

A special report was issued, entitled "Annual Industrial Fire Program and Experience." The report indicated replacement values of HLO property at December 31, 1956 of \$4,611,000 in excess of cost.

Decision was made to take new physical inventories of uninstalled catalogued equipment, rather than to reconcile with the book records a physical inventory taken in June, 1956 and prior. The reconciliation of the former inventory with the book records was deferred because of work involved in decentralization of the plant records. Physical inventories will begin in March, 1957.

Appropriation requests aggregating \$264,108 received approval during the month.

FY 1957 funds allocated to HLO for Equipment Not Included in Construction Projects were increased from \$1,702,000 to \$1,930,000 in a letter dated January 31, 1957 from W. E. Johnson.

Level 3 components were requested to submit estimates of equipment needs for the Budget for FY 1959 and Revision of Budget for FY 1958.

Cost Accounting

Level 3 components were requested to submit estimates of personnel, overtime, unusual costs and inventory requirements for the Budget for FY 1959 and Revision of Budget for FY 1958. A time schedule was established for the preparation and submission of budget estimates.

Detailed analyses of operating costs and liquidations through December 31, 1956 were submitted to Level 3 managers, for their use in planning for the remainder of the fiscal year.

Personnel Accounting Operation

A revised procedure was adopted in January for the processing of employees' health claims under the General Electric Insurance Plan. The procedure will speed the settlement of claims, improve efficiency in processing claims and provide additional data to employees.

Withholding tax statements (W-2 forms) were provided to all employees on January 14, 1957.

Personnel Accounting Operation moved from the 700 Area to the 3702 Building in the 300 Area on January 12, 1957.

Auditing

A report was issued on the audit of Control of Capital Assets.

Traveling auditors from Accounting Services began the audit of HAPO during the latter part of January. The Specialist - Auditing will assist the traveling auditors, on a loaned basis, for several weeks beginning January 28, 1957.

Payroll Statistics

<u>Changes during month</u>	<u>Total</u>	<u>Exempt</u>	<u>Non-Exempt</u>
Employees on payroll at beginning of month	1 174	473	701
Additions and transfers in	20	3	17
Removals and transfers out	(19)	(5)	(14)
Transfer from weekly to monthly payroll	-0-	1	(1)

Employees on payroll at end of month	<u>1 175</u>	<u>472</u>	<u>703</u>
--------------------------------------	--------------	------------	------------

<u>Gross payroll paid during month</u>	<u>January</u>	<u>December</u>
Exempt	\$333 128	\$331 102
Non-exempt	265 556	276 124
	<u>\$598 684</u>	<u>\$607 226</u>

Overtime payments during month

Exempt	\$ 4 043	\$ 976
Non-exempt	8 162	11 975
	<u>\$12 205</u>	<u>\$12 951</u>

Insurance claims paid

	<u>January</u>		<u>December</u>	
	<u>Number</u>	<u>Amount</u>	<u>Number</u>	<u>Amount</u>
Employee				
Life	-0-		-0-	
Weekly sickness and accidents	19	\$2 408	16	\$1 355
Comprehensive medical	62	8 174	48	5 094
Dependents				
Comprehensive medical	83	5 558	68	5 331
	<u>164</u>	<u>\$16 140</u>	<u>132</u>	<u>\$11 780</u>

Good Neighbor FundJanuaryDecember

Number participating
Percent participating

826
70.3%

814
69.3%

Other StatisticsCash advances and travel expenses

Advances outstanding at beginning		\$10 793		\$12 472
Advances issued - by checks	34	6 044	40	6 552
- by cash	41	6 821	19	3 317
- air travel order		7 040		7 108
		<u>\$30 698</u>		<u>\$29 449</u>
Less:				
Expense vouchers processed				
Travel expense accounts	50	\$12 874	46	\$11 804
Other (movement of household goods, conference expense etc.)	14	263	20	2 045
Refunds of advances	42	5 538	51	4 444
Billing to and from HAPO Components-Net		485		363
		<u>\$19 160</u>		<u>\$18 656</u>
Advances outstanding at close	32	<u>\$11 538</u>	33	<u>\$10 793</u>
Ages of advances outstanding				
15 days or less	26	\$ 8 126	19	\$ 4 978
16 - 30 days	6	3 412	11	4 086
More than 30 days		-0-	3	1 729
		<u>\$11 538</u>		<u>\$10 793</u>

Project proposals and appropriation requests

	<u>Project proposals</u>	<u>Appropriation requests</u>
On hand beginning of month	1	--
Received	--	34
Total	<u>1</u>	<u>34</u>
Recommended for approval	1	26
Returned for rewrite	--	5
Cancelled	--	3
Total	<u>1</u>	<u>34</u>
On hand at close of month	--	--

J. P. Holmes
JP Holmes:bb
2-11-57

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.

<u>INVENTOR</u>	<u>TITLE OF INVENTION OR DISCOVERY</u>
G. E. Driver	Phase Sensitive Rectifiers
G. E. Driver	Direct Current Resolvers
G. D. Linsey	Dual Filter Alpha Air Monitor
W. G. Spear	A Scintillation Beta-Gamma Exposure-Rate Detector
W. G. Spear	A Transistorized Loudspeaker Circuit
W. G. Spear	A Transistorized Pulse Amplifier
J. Dunn	Hermetically Sealed, Shaftless, Bearingless, Submersible Motor-Pump
J. Dunn	High Capacity - Low Head Axial Flow Pump
J. Dunn	Process Solution Lubricated Sleeve Bearings and Methods of Retention in Rotating Equipment
V. P. Kelly	A Vane-Type Rotary Solids-Feeder Valve for High-Temperature, Corrosive Service
O. F. Hill	The PUNEX Process - A Process for the Extraction of Plutonium, Uranium and Neptunium
T. R. Cartmell	An Electronic Capacitance Type Remote Liquid Level and Interface Gauge and Controller
W. L. Wyman	Fuel Element Support System in Reactor Process Tubes

H. M. Parker

END

**DATE
FILMED**
8/21/92